MUSEUM OF NEW MEXICO

OFFICE OF ARCHAEOLOGICAL STUDIES

ARCHAEOLOGICAL INVESTIGATIONS IN THE SOUTHERN MESILLA BOLSON: DATA RECOVERY AT THE SANTA TERESA PORT-OF-ENTRY FACILITY

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ADMINISTRATIVE SUMMARY

From May 31 to August 2 and September 6 to September 30, 1994, the Office of Archaeological Studies, Museum of New Mexico, conducted archaeological data recovery investigations at two sites at the Santa Teresa Port-of-Entry facility in southern Doña Ana County, New Mexico. This project was conducted at the request of the State of New Mexico General Services Department. Both sites were on land owned by the state of New Mexico.

Data recovery investigations were aimed at recovering information relevant to local prehistory. The Santa Teresa site (LA 86780) was a multioccupational Archaic camp with occupations dated to the Middle and Late Archaic periods. The Mockingbird site (LA 86774) was also multioccupational and contained both Early and Late Formative period components. All components from both sites appear to represent occupations by small groups of foragers in the late summer or early fall. Our investigations are considered to have exhausted the potential of both sites to provide information on local prehistory.

MNM Project No. 41.580 (Santa Teresa)
State of New Mexico Excavation Permit No. SE-96 (expired April 5, 1995)

ACKNOWLEDGMENTS

Only because of the efforts of many people was this project successfully completed. I would like to express my utmost appreciation to all of those who labored to complete this study. Thank you everyone for putting up with extreme heat, surviving car wrecks, and completing the often tedious analysis of the materials we recovered. Senior field assistants were Laurel Wallace and Deborah Johnson. Field assistants were Joy Beasley, Heather Bixler, Marcy Snow, and John Zachman. Thanks, guys, for putting up with the longest streak of 100+ degree days in El Paso history with only a moderate amount of complaining. Alan Phelps of El Paso was our lone volunteer during this project. He not only willingly shared his knowledge of the area's archaeology with us, he also shoveled through some of the hottest days on record. As if working with us during the day wasn't enough, he and his family even had us out to their house for a feast. Thanks for all your help, Alan.

Numerous people on the OAS staff participated in laboratory analysis and report preparation. John Zachman prepared data files for mapping, and he and Joy Beasley plotted rough drafts of site maps. Ceramic analysis and interpretation was done by Dean Wilson. Mollie Toll supervised the macrobotanical analysis and was assisted in the interpretation of these materials by Pamela McBride. Deborah Johnson sorted and identified flotation samples, and Laurel Wallace analyzed the charcoal samples. Deborah also analyzed the ground stone assemblage. Studies of burned rock were completed by Marcy Snow and Joy Beasley. Susan Moga examined the few pieces of bone we managed to recover, and interpretation of these materials was done by Linda Mick-O'Hara. Illustrations were produced by Ann Noble. Nancy Warren photographed the artifacts, and Tom Ireland was technical editor.

Several consultants conducted specialized studies during both the field and laboratory phases of investigation. Geophysical studies at the sites were conducted by David Hyndman of Sunbelt Geophysics. Paul Drakos of Glorieta Geoscience, Inc., prepared a geomorphological study of the sites. Radiocarbon analyses were completed by Beta Analytic, Inc. Analysis of pollen samples was undertaken by Richard Holloway of Castetter Laboratory for Ethnobotanical Studies.

This project also benefited from the expertise of several other archaeologists, both within and outside the OAS, who were generous with their time and expertise. Richard Chapman of the Office of Contract Archeology at the University of New Mexico provided reports and advice based upon his experience in the region. Regge Wiseman of the OAS reviewed and critiqued several chapters of the report. While we didn't always agree on details, his insight into the archaeology of this region was particularly valuable. Finally, samples of lithic artifacts were examined and visually sourced by Tim Church of the Cultural Resource Branch of the Directorate of the Environment at Fort Bliss. Between this and several phone discussions, Tim provided information that strengthened our analysis of chipped stone materials immeasurably.

My special thanks go to the New Mexico General Services Department, who provided funding for this project. We would also like to express our appreciation to the staff at the temporary port-of-entry facility for allowing us to use their air-conditioned rest rooms and providing a shady place to park our vehicles and eat lunch.

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PART 1: INTRODUCTION AND BACKGROUND

INTRODUCTION

James L. Moore

At the request of the State of New Mexico General Services Department (GSD), the Office of Archaeological Studies, Museum of New Mexico (OAS), conducted data recovery investigations at two sites at the Santa Teresa Port-of-Entry facility in southern Doña Ana County, New Mexico (Figs. 1-1 and A-1 [see Appendix A]). The Mockingbird site (LA 86774) and the Santa Teresa site (LA 86780) were both entirely within the limits of a planned border-crossing facility and required treatment before construction of the permanent facility could begin. These sites were recorded by Batcho & Kauffman Associates in 1990 (Stuart 1990) and were tested by the OAS in 1992 (Moore 1992). At that time it was determined that they had the potential to provide information on the prehistory of south-central New Mexico, and data recovery efforts were initiated. The results of those investigations are presented here.

Fieldwork was conducted from May 31 to August 2, and September 6 to September 30, 1994. Field investigations was directed by James L. Moore, and Yvonne R. Oakes was principal investigator. Laboratory analyses were supervised by James L. Moore (chipped stone and ground stone artifacts), C. Dean Wilson (pottery), Mollie S. Toll (macrobotanical specimens), and Linda Mick-O'Hara (faunal remains). Both sites were on land owned by the state of New Mexico and were excavated under State of New Mexico Excavation Permit No. SE-96 (expired April 5, 1995).

The Santa Teresa site (LA 86780) contained components dating to the Middle and Late Archaic periods. While no structural remains were found at this site, it contained the remains of several short-term residential camps occupied by microbands. A small Middle Archaic occupation was represented by two adjacent hearths and a small scatter of associated artifacts. The main use of this site occurred during the Late Archaic, and evidence for between three and six occupations from this period was found. The most extensive use was represented by a cluster of seven hearths and numerous chipped stone, ground stone, and burned rock artifacts. Two other clusters of hearths (three apiece) seem to represent discrete occupational areas and were spatially and probably temporally distinct from the main area of occupation. Other potential occupational areas were represented by undated features or clusters of artifacts.

As many as three periods of occupation were identified for the Mockingbird site (LA 86774). Evidence for perhaps two Early Formative period occupations included a cluster of three hearths and associated artifacts, and an activity area that contained a moderate number of artifacts but no features. While there were no good absolute dates from these areas, it is likely that separate uses during the Early and Late Mesilla phase are represented. The main occupation of the site occurred during the Late Formative period, either late in the Doña Ana phase or early in the El Paso phase. This component contained a shallow ephemeral pit structure with an internal heating pit and three extramural hearths. Numerous chipped stone, ceramic, ground stone, and burned rock artifacts and a few fragments of bone were associated with these features. The distribution of artifacts was patterned, suggesting that various

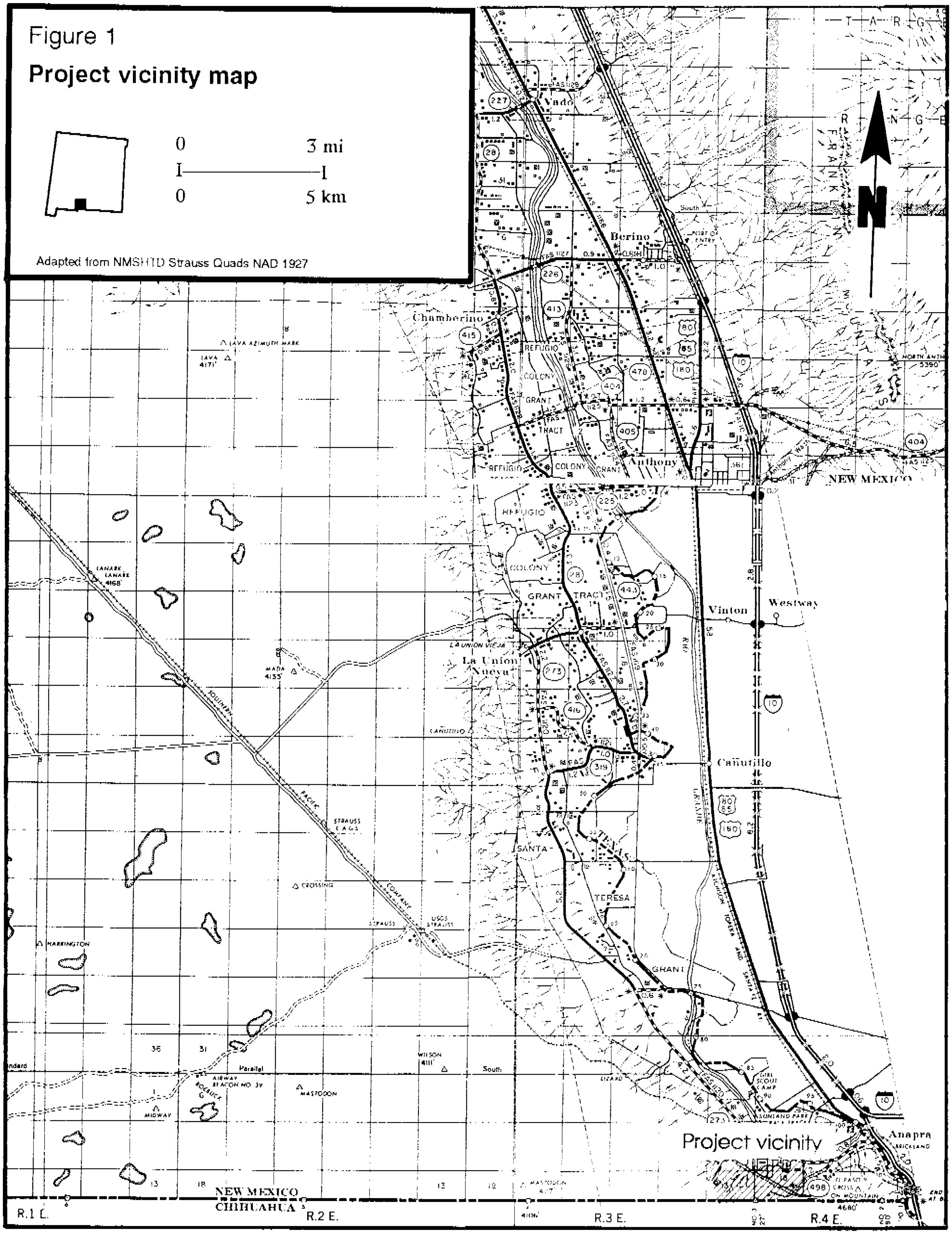
Figure 1
Project vicinity map
0
3 mi
0
5 km
Adapted from NMSHTD Strauss Quads NAD 1927
Vado
Berino
Chamberino
Anthony
NEW MEXICO
Vinton
Westway
La Union
Nueva
Cañutillo
TEXAS
Anapra
Project vicinity
NEW MEXICO
CHIHUAHUA
R.1 E.
R.2 E.
R.3 E.
R.4 E.

categories of materials were generated by a series of spatially discrete but slightly overlapping activities. A second Late Formative period use may be evidenced by the presence of comparatively large numbers of artifacts in the pit structure, which suggest its use as a discard area after it burned.

Ethnobotanical information suggests that all components from both sites reflect a late summer to early fall occupation. This is particularly important in applying the various settlement and subsistence models that have been developed for the region. Even though evidence of noncultural disturbance was common and LA 86780 was badly disturbed by mechanical equipment, the patterning of cultural materials was still sufficiently intact to allow us to make some sense out of the distributions of various artifact categories. We were also able to compare assemblages from different parts of both sites and derive conclusions about how they were related.

These sites were situated next to one another on a large parabolic dune. By comparing site data with the results of a geomorphological study, we were able to determine that features and associated assemblages from several periods of occupation clustered at a variety of depths in the dune. Almost continual sand accretion was indicated, making these sites nearly unique in the region. Where periods of sand accretion and erosion throughout the Holocene have compressed many discrete occupations into a single or very few cultural layers at most sites in the desert basins of south-central New Mexico, the various occupations at the Santa Teresa sites were not collapsed, but remained vertically and horizontally distinct. This allowed us to discriminate between periods of occupation based on elevation as well as artifact content, even when absolute dates were not available or were unreliable.

This report is structured in several parts. Part 1 contains background information on local environment and culture history, a consideration of various models of settlement and subsistence, a discussion of our research design, and a summary of field and analytic methods. Site descriptions and discussions of geophysical and geomorphological studies are included in Part 2. Part 3 contains discussions of cultural materials recovered during excavation. Interpretations of these remains are provided in Part 4.

Based on our findings during the excavation, analysis, and interpretation of materials from LA 86774 and LA 86780, we felt that the potential of these sites to provide information on the prehistory of south-central New Mexico was exhausted. No further investigations are suggested.

HISTORY OF ARCHAEOLOGICAL STUDIES IN THE SANTA TERESA AREA

James L. Moore

The area surrounding Santa Teresa has been the focus of intense archaeological investigations since the mid 1980s. The first detailed study of this area was conducted in September 1984 (Ravesloot 1988a:1). At that time the land encompassing the study area was administered by the USDI Bureau of Land Management (BLM) but was scheduled to be exchanged for private lands in the San Juan Basin as part of the Navajo-Hopi Relocation Project. As Ravesloot (1988a:4) notes, the BLM is required by the Historic Preservation Act of 1966 and subsequent legislation to address cultural resources on public lands that are being disposed of. Thus, investigations were initiated at Santa Teresa to clear the way for the land exchange. The first step in this process entailed preparation of a comprehensive plan that would guide the identification, evaluation, and treatment of cultural properties within the study area (Ravesloot 1988a:4). Such a plan was prepared by personnel from the Arizona State Museum and the Desert Research Institute (Ravesloot 1988a).

In conjunction with preparation of the comprehensive plan of study, a sample survey of ten parcels of land encompassing a total of 2,283 ha was undertaken and reported by Ravesloot (1988a). Fieldwork was conducted in two phases. The first included identification and instrument mapping of major geomorphological zones and a sample survey of 3 percent of each zone that was identified. A density-dependent, or nonsite, approach was used during this phase in which all cultural materials within each 100 sq m transect unit were mapped and collected. These materials were also recorded in the traditional manner, with divisions into sites, isolated manifestations, and isolated occurrences. The second phase of study was a more traditional pedestrian survey of 50 percent of each geomorphological zone. A total of 68 sites, 198 low density but discrete artifact clusters (termed isolated manifestations), and hundreds of isolated occurrences were recorded (Ravesloot 1988a:4).

The next phase of study was also a density-dependent, or distributional, survey of three parcels containing a total of 6,310 ha, which was completed in 1985 and is reported by Camilli et al. (1988). The entire project area was examined by a Phase I survey, which concentrated on collecting artifact and feature density data. As a result of this examination, 393.8 ha that contained the highest densities of cultural resources were set aside for application of land patent restrictions to conserve and protect those resources for the future. The survey areas were then sampled at a more intensive level (Phase II), examining the surface distribution of archaeological resources using a 5 m transect spacing. A total of 448 ha were examined by the Phase II study, recording 40,350 surface artifacts and 155 features. In addition to intensive surface coverage, the Phase II program tested 88 features to establish their subsurface extent and excavated 28. This survey was nontraditional in that no sites were defined. As a consequence, it is difficult to mesh its results with those that use more traditional methods.

To satisfy the BLM's responsibility for these lands prior to the exchange, 18 additional features were selected for excavation. This work was completed by the Office of Contract

Archeology and is reported by O'Leary (1987). In the process of locating these features, 28 additional unrecorded features were found. Of this total of 46 features, 40 were excavated. A more detailed examination of the patent restriction lands was also conducted by the Office of Contract Archeology and is reported by Elyea (1989). This study consisted of a detailed survey of 45 percent of the patent restriction land, or 175 ha, and resulted in the recording of 54 sites and 628 isolated occurrences.

Following the land exchange, plans were formulated to develop this area along the international border with Mexico. These plans included construction of a port-of-entry facility, an industrial park, and a beltway road. In association with these plans, approximately 130 ha were reexamined by Batcho & Kauffman Associates and reported by Stuart (1990). Parts of this area were previously examined by Ravesloot's (1988a) and Camilli et al.'s (1988) surveys. However, additional survey was required by the Historic Preservation Division (HPD) because it felt that the earlier studies did not provide enough information to permit accurate evaluation of the potential effects of construction on cultural resources in the area. As Stuart (1990:4) notes: "The New Mexico SHPO [State Historic Preservation Office] believes that the 'non-site' surveys were less than intensive and most of the data obtained were of limited utility. . . . Because Ravesloot's survey was not a 100 percent inventory and the 1985 BLM study was inadequate, the New Mexico SHPO advised that areas with potential impacts by Federal involvement should be re-surveyed." Thus, a 100 percent surface survey of the area was completed, locating 26 sites and 144 isolated occurrences (Stuart 1990). It was during this survey that LA 86774 and LA 86780 were first recorded. This is quite understandable in the case of LA 86780, because it was in an area of deep eolian sand and was buried until recently. Sometime between the initial surveys and Stuart's (1990) resurvey, a large part of this dune was cleared using a brush rake, removing between 1 and 2 m of sand and uncovering cultural deposits. LA 86774 probably showed up as a series of isolated artifacts during earlier studies, since it was also in a zone of deep eolian sand adjacent to LA 86780 and represented on the surface by a sparse scatter of artifacts.

In 1992 the OAS was contacted by the governor's office, HPD, and GSD and asked to conduct test excavations at LA 86774 and LA 86780, which were the only sites recorded by Stuart (1990) in a 40.5 ha block scheduled to be donated by a private owner for construction of the port-of-entry facility. Of particular interest was an 18.3 m wide strip along the international border, the ownership of which had been retained by the BLM. A temporary road was to be built along this strip to connect the Republic of Mexico port-of-entry facility (which was nearing completion at the time) with a temporary U.S. facility (also nearing completion at the time). During testing it was determined that both sites contained potentially important subsurface deposits or features that warranted further study (Moore 1992). Fortunately, there were no subsurface deposits within the area slated for construction of the temporary road, and surface materials were limited to two or three artifacts in that zone. Consequently, no further work was recommended for the strip of BLM land along the border, but more intensive studies were suggested for LA 86774 and LA 86780, and a data recovery plan was prepared (Moore 1992).

In early 1994, the OAS was contacted by GSD and informed that the state of New

Mexico had acquired the 40.5 ha block of land on which the port-of-entry facility was to be built. Archaeological investigations had to be completed before the parcel could be turned over to the federal government for construction of the permanent facility, so our data recovery plan was implemented, and excavation was conducted during the summer and early fall of 1994. Details of the project are discussed in the introduction to this report, and in the following chapters we discuss the results of our excavations.

ENVIRONMENTAL OVERVIEW

James L. Moore

Physiography and Geology

South-central New Mexico and adjacent parts of Texas and Mexico are in the Mexican Highlands section of the Basin and Range province. Most mountains in this region were formed by uplift and trend from north to south. The East and West Potrillo Mountains, formed by volcanism, are exceptions. The San Andres-Organ-Franklin chain, which flanks the east side of the Rio Grande Valley and the Doña Ana and Caballo Mountains to the north of the project area, have intrusive granitic to porphyritic cores formed during Precambrian and Tertiary times (King et al. 1971).

The Potrillo volcanic field covers more than 900 sq km in south-central New Mexico (Hawley and Kottlowski 1969). It was formed during Quaternary times and can be divided into three sections (Hawley and Kottlowski 1969; Hoffer 1969). The West Potrillo Mountains occupy the west section and comprise more than 80 percent of the field, containing at least 85 cinder cones. The central section covers 190 sq km and contains a series of maars including Kilbourne Hole, Hunt's Hole, Potrillo Maar, and various cones and basalt flows. Kilbourne Hole is the largest of these features. It measures 3 km in diameter by 85 m deep and is 40 km northwest of El Paso. The Black Mountain-Santo Tomas chain occupies the east section of the field and covers 39 sq km.

The project area is in the Mesilla Bolson, one of a series of downwarped basins that formed along the continental rift now occupied by the Rio Grande (Chapin and Seager 1975). Three episodes of deformation contributed to development of the Rio Grande depression (Chapin and Seager 1975:299). The first was during the late Paleozoic, as the ancestral Rocky Mountains were formed, and the second was during the Laramide uplifts of late Cretaceous to middle Eocene times. These events created a north-trending tectonic belt. Chapin and Seager (1975:299) note, "The Rio Grande rift is essentially a "pull-apart" structure caused by tensional fragmentation of western North America. Obviously, a plate subjected to strong tensional forces will begin to fragment along major existing zones of weakness and the developing "rifts" will reflect the geometry of the earlier structure." Thus, the early deformations weakened the continental plate, causing it to split along the Rio Grande depression. Downwarped basins formed as the plate pulled apart. The basins in south-central New Mexico were internally drained until early to mid-Quaternary times (Hawley and Kottlowski 1969).

The geologic history of the Rio Grande Valley is summarized by Hawley and Kottlowski (1969). Major basins in south-central New Mexico include the Palomas and Jornada del Muerto, and the Mesilla and Hueco Bolsons. Materials eroded from surrounding highlands began filling these basins during Tertiary times and continued until the mid-

Quaternary. These sources were supplemented by the ancestral upper Rio Grande during the later stages of basin filling. The Rio Grande extended from Colorado to northern Chihuahua by Kansan times, entering the Hueco Bolson through a gap between the Franklin and Organ Mountains during the early Quaternary. It was apparently diverted from the Hueco Bolson to the Mesilla Bolson during the mid Pleistocene. Until its integration with the lower part of the system, the upper Rio Grande fed a series of lakes in west Texas, Chihuahua, and south-central New Mexico. Several mechanisms for integration of the two river systems have been proposed, including headward erosion and capture by the lower stream, spillover of the upper system, and tectonic uplift and subsidence. Whatever the cause, entrenchment of the river seems to have halted deposition in the basins soon after the systems were integrated.

Soils

Information on soils is summarized from Bulloch and Neher (1980:34). Pajarito-Pintura complex soils occur at both sites. This complex is found on nearly level to gently sloping terrain at an elevation of 1,220 to 1,370 m. It contains six soils but is dominated by Pajarito and Pintura soils, which comprise 45 and 35 percent of the complex, respectively. Areas of Harrisburg, Wink, Simona, and Onite soils are minor components and make up the remaining 20 percent. Only major soils are discussed.

The Pajarito soil formed between dunes in mixed alluvium that was worked by wind. This soil is deep and well-drained, with moderately rapid permeability. The typical surface layer is a 36 cm thick unit of light brown loamy fine sand. Under this is a reddish-yellow fine sandy loam subsoil, also 36 cm thick. Beneath the subsoil and extending to a depth of 2 m is a layer of brown loamy fine sand. While suitable for irrigation, this soil is primarily used for livestock grazing.

The Pintura soil formed in eolian deposits on dunes; it is deep and somewhat excessively drained, with rapid permeability. The typical surface layer is a 25 cm thick unit of light brown loamy fine sand. Under this is a light brown fine sand which extends to a depth of 2 m. Available water capacity is very low, surface runoff is slow, and there is a very high hazard from blowing soil. This soil is poorly suited to irrigated crops because of its low water-holding capacity.

Geomorphology

As noted earlier, the Mesilla Bolson is a downwarped basin along the Rio Grande rift, filled with consolidated and unconsolidated sediments of the Santa Fe group. These materials were eroded from surrounding uplands and near the end of the fill sequence were also deposited by the ancestral Upper Rio Grande (Hawley and Kottlowski 1969; Hawley et al. 1969). The Fort Hancock formation contains materials deposited in the sealed basin, while the overlying Camp Rice formation contains fluvial materials deposited by the Upper Rio Grande as well as sediments from adjacent uplands (Hawley et al. 1969:55). The basin floor, which now holds the deeply entrenched Rio Grande, is known as La Mesa or West Mesa. Much of this surface is now covered by a thin veneer of eolian sand (Hawley et al. 1969:58). The project area flanks the west edge of the Rio Grande Valley.

Davis and Nials (1988) studied the geomorphology of the project area during an inventory of BLM land for the Navajo-Hopi relocation project. Three major zones were defined: "Zone 1 is characterized by coppice dunes stabilized by . . . mesquite which are usually lying upon a deflated surface armored by pebbles. Zone 2 is characterized by flat-lying surficial sand with little relief; and Zone 3 is characterized by parabolic dunes with or without intervening blowouts, dominated by yucca" (Davis and Nials 1988:11). Zones 1 and 3 cover most of their study area, and Zone 2 comprises only a small part of the west-central section (Fig. 3-1). These zones were divided into subzones, listed in Table 3-1.

Table 3-1. Geomorphological subzones in the Santa Teresa area (Davis and Nials 1987:12)

Zone	Description	Subzone	Description
1	mesquite stabilized coppice dunes	A	Pleistocene deposit floored blowouts
		B	partial sand sheetcover
		C	relict large-scale deflation basins
		D	escarpment edge coppice dunes
2	surface sand with low relief	-	inactive sand sheet zone
3	parabolic dunes	A	linear blowout
		B	low-relief dunes
		C	high relief dunes
		D	yucca coppice dunes
		E	mesquite-yucca-anchored coppice dunes

LA 86744 and LA 86780 are in Zone 3C, defined as an area of high-relief parabolic dunes (Davis and Nials 1988:19). The prehistoric topography is believed to have been similar to today's, though modern sand covers more than 80 percent of the area. Zone 3C is characterized by unstable dunes and circular blowouts draped over relict deflation basins which are 10 to 15 m lower than surrounding areas and may date to the Pleistocene (Davis and Nials 1988:19). Archaeological visibility in Zone 3 was very poor except at the edge of blowouts. The unstable dunes are probably modern and cover the terrain as it existed around 500 years ago (Davis and Nials 1988:20).

These zones were partially redefined during survey for the Santa Teresa Port-of-Entry facility (Fig. 3-2). Redefinition was based on examination of vegetation patterns, surface soils,

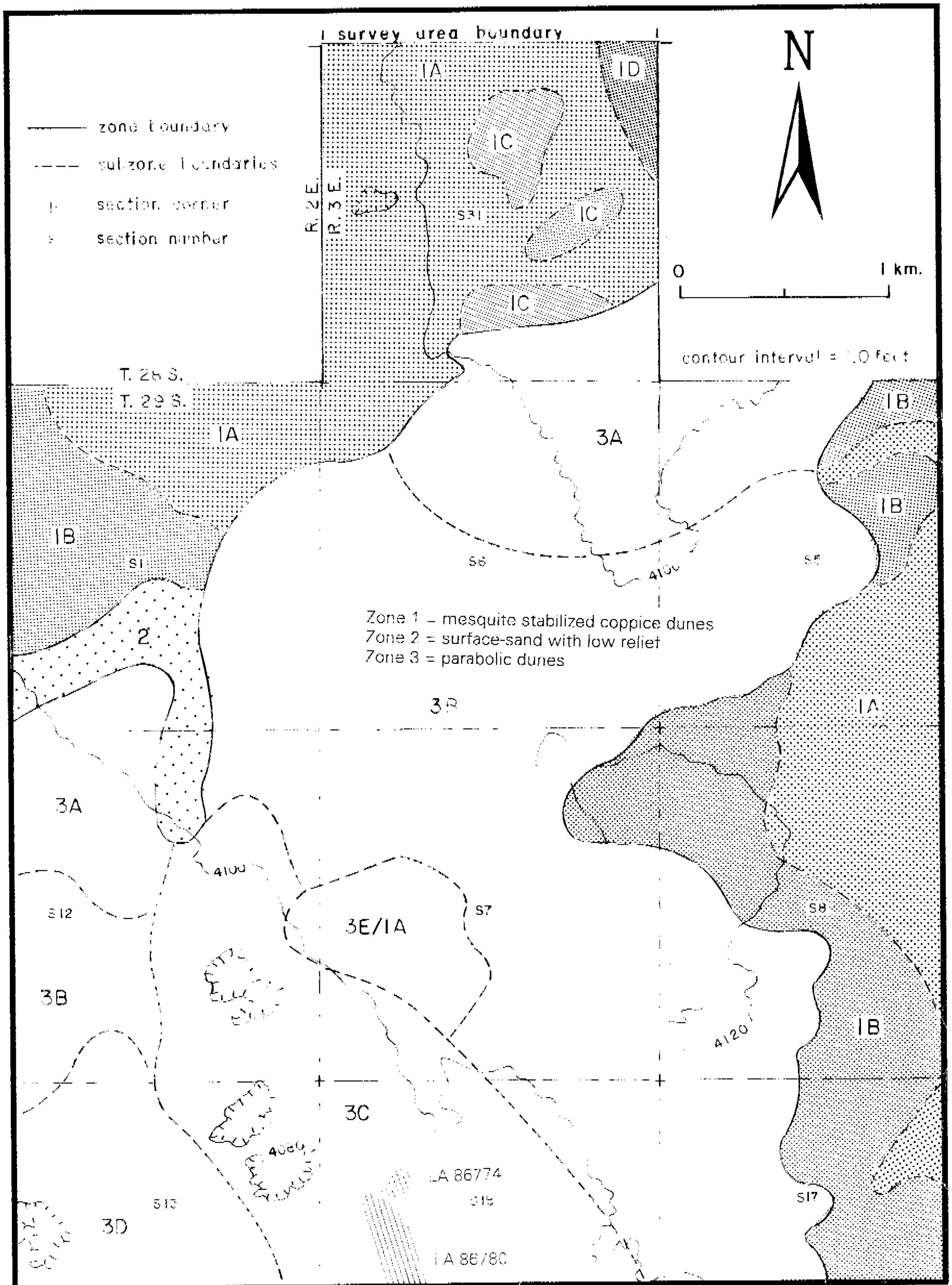

Figure 3-1. Davis and Nials's (1988:12) stratification of the project area showing site locations in relation to geomorphologic zones.

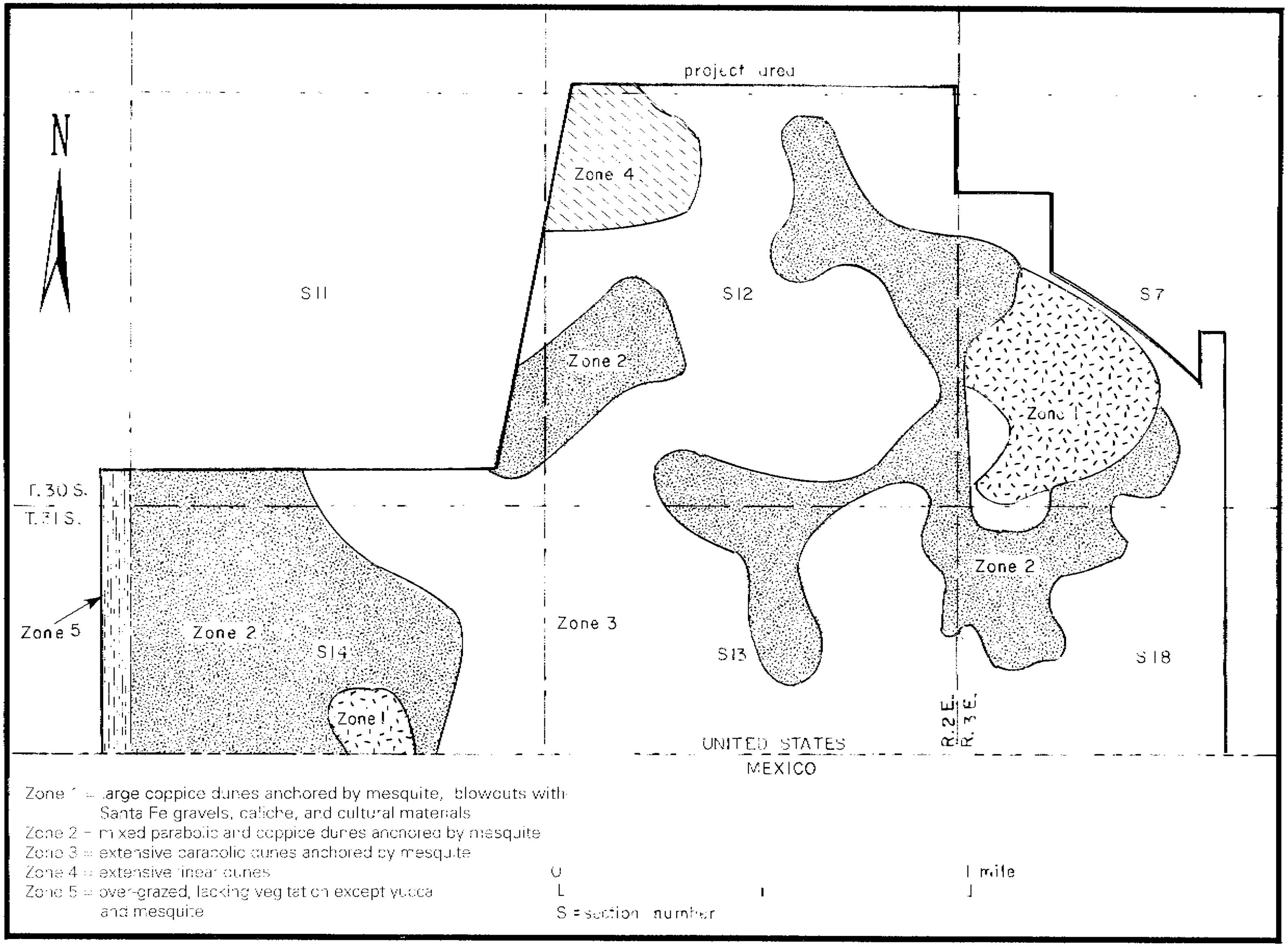

Figure 3-2. Stuart's (1990:6) redefinition of environmental zones in the study area.

and aerial photographs, and five zones were defined (Stuart 1990a:5-9):

> Zone 1. Large coppice dunes anchored by mesquite with blowouts containing scatters of Santa Fe gravels, caliche nodules, and cultural materials. Two areas of Zone 1 were defined on ridge tops; this zone could not be correlated with any of Davis and Nials's (1988) zones.
>
> Zone 2. Mixed parabolic and coppice dunes, dominated by the former. Contains isolated and small concentrations of mesquite anchored coppice dunes. Corresponds to portions of Davis and Nials's (1988) Zones 3B, 3C, and 3D.
>
> Zone 3. Extensive parabolic dunes; corresponds to portions of Davis and Nials's (1988) Zones 3B and 3C.
>
> Zone 4. Extensive linear dunes; corresponds to Davis and Nials's (1988) Zone 3A.
>
> Zone 5. Overgrazed zone which lacks vegetation other than mesquite and yucca. Not correlated with any of Davis and Nials's (1988) zones.

LA 86744 was in Zone 2, and LA 86780 was in Zone 3. Stuart (1990a:43) notes that LA 86780 was the *only* site found in Zone 3, and its discovery was attributed to mechanical disturbance, which exposed cultural materials.

Camilli et al. (1988) examined three parcels adjacent to Davis and Nials's (1988) project area. Davis and Nials's (1988) zones were reinterpreted and extended to those parcels. Though they criticize Davis and Nials (1988) because of the scale used and their conclusions concerning archaeological significance, they are in general agreement with that study. Camilli et al.'s (1988) study was larger in scale and concentrated on delineation of Davis and Nials's (1988) Zones 1 and 3. Zone 2 was eliminated when it was shown to be the result of downwind sediment dispersal from a single blowout (Camilli et al. 1988:2-12). They considered the subzones developed during the earlier study to be too detailed at a systems organizational level and overgeneralized at an episodic site occupational level (Camilli et al. 1988:2-12). Thus, subzones were not delineated.

It was concluded that Zone 1 resulted from erosion or deflation, while Zone 3 was formed by deposition or accretion:

> Photointerpretation, particularly of those portions of these zones appearing south of the international border, reveals that the parabolic dunes comprising Zone 3 are derived from the transport of sediments by southwesterly winds which occur during the spring when soil moisture is low and thus sand mobility is highest. The sediments which actually make up the dunes of Zone 3 may be derived from bolsons to the southwest. Zone 3 is,

then, an accretional zone where transported sediments are building a more or less continuous sand sheet, probably with little sediment removal at least at the present time.

> Zone 1, on the other hand, consists of relatively small accumulations in coppices, separated by larger and cleaner interdunal areas and thus is the site of two complementary processes--accumulation *and* removal. (Camilli et al. 1988:2-14)

While Zone 3 comprised about half the area examined by Davis and Nials (1988), it made up only 15 percent of the area studied by Camilli et al. (1988). Thus, mesquite-anchored coppice dunes are the dominant local landform, and parabolic dunes form a smaller component. In terms of archaeological visibility and integrity, they determined that the distribution of artifacts in Zone 1 may preserve the original horizontal patterning, but deflation has destroyed vertical proveniencing. The integrity of cultural materials in Zone 3 may be high, but archaeological visibility is much lower. Thus, even small amounts of cultural materials in that zone may accurately reflect shallow archaeological deposits (Camilli et al. 1988:2-15).

Following this survey, forty features were excavated to satisfy the BLM's responsibilities for a land exchange (O'Leary 1987). A geomorphological study accompanied this work, focusing on coppice dune structure (Basabilvaso and Earl 1987). Three major units were defined: an uppermost layer of active eolian sand (DS II), a slightly indurated sandy unit (DS I), and a lowermost massively carbonate indurated clay-silt-sand unit (Qal_{cr}) (Basabilvaso and Earl 1987:17-20). The lowest unit is the Camp Rice formation of mid-Pleistocene age, which is also the highest terrace of the Rio Grande. This surface is 300,000 years old and has been stable (except for eolian activity) since first deposited (Basabilvaso and Earl 1987:24, 27). Long-term stability has led to development of a massive Stage IV caliche layer atop this surface. DS I represents eolian materials deposited between 2,850 and 15,000 years ago (Basabilvaso and Earl 1987:20, 24). Most cultural materials were found at the top of this unit and provide the upper depositional date. DS II is a modern deposit, less than 100 years old (Basabilvaso and Earl 1987:24). DS I could have formed as in as short a period as 100 years, as could DS II (Basabilvaso and Earl 1987:24). A period of over 2,000 years of relative surface stability and soil formation separates the deposition of these units.

By combining these studies, an interesting picture of local geomorphology begins to emerge. Most researchers have built upon the base provided by Davis and Nials (1988). Basabilvaso and Earl's (1987) study is an exception but provides important supplementary information. According to Davis and Nials (1988), both sites are in a zone of high-relief parabolic dunes draped across relict deflation basins that may date to the Pleistocene. The current dunal instability is a modern event. While Stuart (1990) also places LA 86780 in a zone of parabolic dunes, LA 86744 was in a zone of mixed parabolic and coppice dunes. This placement probably reflects modern conditions, with coppice dune formation occurring atop the more stable parabolic dunes. Reinterpretation of Davis and Nials's (1988) environmental zones by Camilli et al. (1988) suggests that the parabolic dunes represent a zone of sand accretion and potentially contain good vertical and horizontal integrity. Basabilvaso and Earl

(1987) suggest that 2,000 years of relative stability followed deposition of their DS I unit and preceded deposition of the modern DS II unit. These studies suggest that the parabolic dunes containing our sites were stable for a great amount of time before erosion began about a hundred years ago. This area has a high potential for containing intact cultural features and deposits, which could be of much greater extent than indicated by their surface expression.

Vegetation

The project area contains two communities--one dominated by mesquite and the other by yucca. A third community dominated by creosote occurs elsewhere on West Mesa but is not found in the project area. The mesquite community is associated with active coppice dunes. Mesquite, four-wing saltbush, and yucca act as anchors for coppice sand accumulation, and snakeweed, zinnia, and globe mallow also occur on the dunes (Camilli et al. 1988:2-7). Deflation basins often contain stands of indigo, Mormon tea, and chamisa blanca (Camilli et al. 1988:2-7). The yucca community occurs on currently aggrading parabolic dunes. Besides soaptree yucca this community contains four-wing saltbush, Mormon tea, mesquite, snakeweed, sagebrush, zinnea, globe mallow, hogpotato, senna, sunflower, unicorn plant, and prickly pear. Sacaton grass and goatshead are common, and some grama grass is present (Camilli et al. 1988:2-7). Creosote dominates the third community; other common plants include mescat acacia, ocotillo, winterfat, and fluffgrass (Camilli et al. 1988:2-7).

LA 86744 is in a zone that contains a mixture of the mesquite and yucca communities. There is little vegetation on LA 86780 due to mechanical removal of the upper 1 to 2 m of sand, but the adjacent landscape is dominated by the yucca community. The vegetation on these sites is much as described above. Common plants that do not occur in those lists are sand dropseed and spectacle pod. Bulloch and Neher (1980:34) note that Pajarito soils potentially support sand dropseed, black grama, mesa dropseed, threeawn grass, and seasonal forbs. The potential plant community for Pintura soils includes mesa dropseed, giant dropseed, bush muhly, sand sagebrush, four-wing saltbush, broom dahlia, and seasonal forbs (Bulloch and Neher 1980:34).

Most authors agree that the modern vegetation does not accurately reflect that of the past. Territorial survey records indicate that the mesas of southern New Mexico were dominated by grasslands until at least the 1880s (Dick-Peddie 1975; York and Dick-Peddie 1969). What is now Chihuahuan desert with occasional pockets of grama grass was once a mosaic of grassland-desert scrub (Dick-Peddie 1975:81). This change is generally blamed on large-scale cattle ranching. The former grasslands were dominated by black grama, blue grama, and side-oats grama. Other common plants included soaptree yucca, tobosa grass, bushmuhly, mesquite, four-winged saltbush, creosote, Mormon tea, sacahuista, prickly pear, and cholla (Dick-Peddie 1975:83).

Camilli et al. (1988:2-13) indicate that some authors have questioned the idea that the modern vegetation appeared at the same time as the recent sand sheet. Noting that those authors feel there have been a number of oscillations between grassland and desert scrub in the last 4,000 to 5,000 years they conclude: "Fluctuations like the one evidenced by increasing eolian erosion and the invasion of mesquite and other desert scrub over the last 100 years have probably occurred throughout most of the Holocene in the study area. If this is the case, then the archaeological materials there have all been subjected to a number of episodes of covering and uncovering" (Camilli et al. 1988:2-13). Unfortunately, these are straw-man arguments, because both Dick-Peddie (1975) and York and Dick-Peddie (1969) are explicitly concerned with vegetation changes over only the last hundred or so years. In particular, their argument links modern ranching with deterioration of the grasslands that dominated southern New Mexico before the area was settled by immigrants from the United States. As they state: "The mesas of southern New Mexico were covered by grass in the middle of the last century" (York and Dick-Peddie 1969:165). The delicate nature of these grasslands was also noted: "It is apparent that the replacement of grassland by desertscrub could be accomplished with very little modification of the environment" (Dick-Peddie 1975:81). Thus, the vegetation of this area is fragile and could be affected by variations in rainfall as well as intense human occupation.

Fauna

Numerous animal species are available and were probably hunted prehistorically. Small game dominates the list of species. The most common large mammals available on the basin floor are pronghorn and mule deer. Medium and small mammals include black-tailed jackrabbit, desert cottontail, badger, coyote, kangaroo rat, skunk, and a variety of mice and rats (Moore and Bailey 1980; O'Laughlin 1980; Stuart 1990; Whalen 1977). Various species of birds also occur including roadrunner, scaled quail, mourning dove, turkey vulture, raven, and several species of hawk (Moore and Bailey 1980; Stuart 1990). Many snake and lizard species also occur, including whiptail lizards, prairie rattlesnakes, western diamondback, and bull snake (Moore and Bailey 1980).

O'Laughlin (1980:20-22) defines three hunting patterns for the region: highland, lowland, and riverine. The highland pattern involved use of mountain zones and was characterized by the hunting of deer and cottontails. While deer occur in all zones, they are most common in the mountains, which contain sufficient browse for larger populations (O'Laughlin 1980:22). Because deer usually aggregate into herds only during the winter, they would have been mainly exploited in that season (O'Laughlin 1980:22). Cottontails were probably hunted year-round.

The lowland pattern exploited the bajada and basin floor zones. Mostly jackrabbits and some cottontails and pronghorns were available in these zones (O'Laughlin 1980:22). However, other small mammals and lizards were probably also consumed. Deer may have been available occasionally but were not as common as in the mountains. The riverine pattern probably exploited the largest number of species, few of which occur in the project area. They include cottontail, jackrabbit, fish, spiny soft-shell turtle, and migratory water fowl

(O'Laughlin 1980:22). Deer may have also been available occasionally, and beaver and muskrats were probably also hunted.

Climate

New Mexico is one of three areas in the United States that receives over 40 percent of its annual precipitation during the summer months (Tuan et al. 1973). Precipitation rates fluctuate greatly around the mean, and dry years are more frequent than wet years (Tuan et al. 1983). Though these oscillations are less severe than those occurring in humid regions, they are of greater significance because of the overall aridity of the region. With less precipitation to begin with, any reduction can seriously affect the biotic environment.

Summer rainfall in the Southwest follows a true monsoon pattern (Martin 1963). Moisture-laden winds flowing north from the Gulf of Mexico are the main source of summer moisture, and their movement is controlled by a high pressure system situated over the Atlantic Ocean. The amount of summer rainfall in the Southwest depends on the position of this system. When it is in a northward position, moist tropical air flows into the area, and the summer is wet. When it is positioned southward, the summer can be dry, a condition that may be caused by abnormally cold years in the north temperate latitudes (Martin 1963). Research in the San Juan Basin suggests that this pattern began during the early Holocene (Betancourt et al. 1983:215; Gillespie 1985:36).

Winter precipitation is derived from air masses originating in the extratropical regions of the Pacific Ocean or in Canada. While summer storms are generally short and intense, winter precipitation usually falls as snow, which melts slowly and soaks into the soil rather than running off as does most summer rain. Though all precipitation is beneficial to local biota, winter precipitation is more effective because it soaks into the ground and recharges soil moisture reserves.

The project area receives little annual precipitation and has a relatively high mean temperature--it averages 203 mm of precipitation per year, and the mean temperature is 15.6 degrees C (Bulloch and Neher 1980:34). There is an average of 210 frost-free days annually (Bulloch and Neher 1980:34), usually beginning around March 30 and ending around November 10 (Tuan et al. 1973). Southern New Mexico has an annual evaporation rate of 2,400 mm and up to one-third of yearly precipitation may fall outside the growing season, conditions that create an extremely demanding environment (York and Dick-Peddie 1969:157). Rainfall records from north of the project area show that the wettest period of the year is between July and September, and the driest is between January and May (Gabin and Lesperance 1977:113). Average rainfall by month is illustrated in Figure 3-3 for the nearby Lanark and Lanark A stations.

Using modern figures, the project area is unsuitable for growing corn without supplementary water. Allessi and Power (1965:612) indicate that corn requires a minimum of

152 mm of water for germination, growth, and fruiting during the growing season. Since the long growing season would allow farmers leeway in crop scheduling, by planting in June and harvesting in September they could have taken advantage of the maximum amount of moisture available during the growing season. The Lanark station received an average of 144 mm of rain during these months (between 1899 and 1912), while the Lanark A station averaged only 91.4 mm of rain for the same months (between 1912 and 1923). When these figures are combined, the growing season averaged 125.1 mm of rain between 1899 and 1923. This produces a deficit of 27 mm of rain below the *minimum* required for a successful corn crop. This deficit would have to be made up by moisture stored during the winter and spring, and those seasons are the driest parts of the year. Thus, it is likely that little farming was practiced in this area except during years of exceptionally high rainfall.

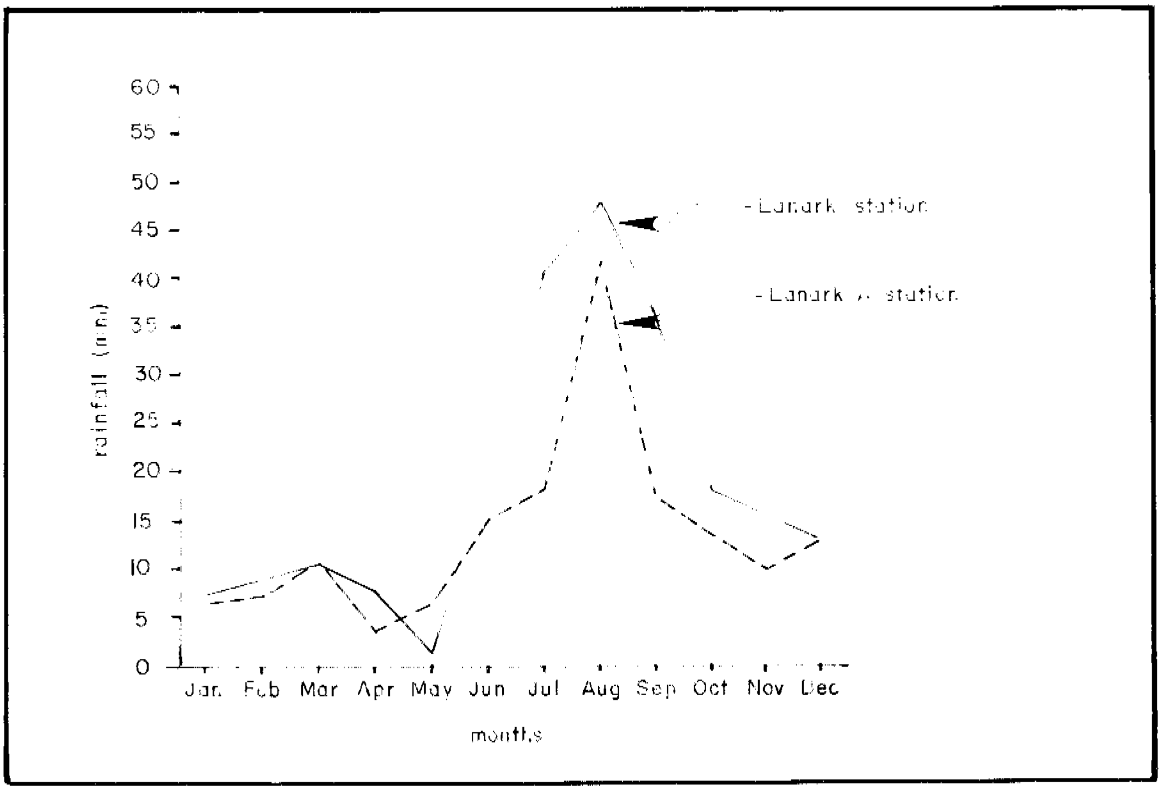

Figure 3-3. Average rainfall by month for the project area (from Gabin and Lesperance 1977:113-114).

Camilli et al. (1988:2-7 to 2-9) present a paleoclimatic reconstruction based on geologic, palynologic, faunal, and macrofloral data from southern Arizona and New Mexico, and west Texas. That discussion is summarized here. Three major shifts seem to have occurred during the Holocene. As the Pleistocene ended (ca. 11,000 B.P.), the dense mesic forests of the Late Wisconsin period were replaced by juniper/oak woodlands and grasslands. Until 8000 B.P. the climate was characterized by a winter dominant precipitation pattern. Desert grasslands predominated in the area until 4000 B.P., and desert shrub species appeared after 5000 B.P.

While the middle Holocene Altithermal (ca. 8000 to 4000 B.P.) was originally characterized as a hot, dry period of widespread erosion (Antevs 1955), that interpretation has been challenged (Martin 1963). Alternatively, a summer monsoonal rainfall pattern is thought to have developed during this time, creating moist conditions coupled with a period of warm weather. Precipitation levels decreased after 4000 B.P., and the late Holocene was characterized by alternating periods of erosion and increased precipitation. Desert shrub/grassland is thought to have dominated during this period.

CULTURE HISTORY OF THE SOUTHERN JORNADA REGION

James L. Moore

The first synthesis of archaeological data was completed for south-central New Mexico in 1948. Through survey, excavation, and reevaluation of previous work in the region, Lehmer (1948) defined the Jornada Branch of the Mogollon in a region extending from north of Carrizozo to south of Villa Ahumada, Chihuahua, and from 120 km west of to 240 km east of El Paso. This was not only the first comprehensive study of the region, it was virtually the only such study until large-scale cultural resource studies began in the 1970s.

Large areas of federally controlled land in south-central New Mexico have been surveyed since this time, and some of the sites recorded by these studies have been tested or excavated. The most extensive investigations have been conducted on land administered by the Department of Defense in south-central New Mexico and adjacent parts of Texas. Thus, over the last twenty years, much information has become available, and literally tens of thousands of new sites have been recorded in this area. This has provided us with a considerable amount of new data concerning the entire span of human occupation in the region.

Thus, the culture history of the Jornada region is undergoing continual revision, and this synthesis is based upon the current state of that knowledge. Further refinement will doubtless lead to changes in the scheme presented here, but hopefully the general outline will prove accurate. In addition to information and ideas developed by other researchers, this discussion contains critiques and alternate interpretations. These are meant to invite further discussion and consideration of cultural development in the region and are certainly not definitive solutions to the many questions that remain unanswered or have been inadequately addressed.

The Jornada area is large, and most agree there are differences between adaptations in the northern and southern parts. This study focuses on the southern Jornada region, an area that encompasses the broad basins and small intervening mountain ranges of south-central New Mexico and northern Chihuahua. Following other studies of the region, culture history is divided into four broad periods: Paleoindian, Archaic, Formative, and Protohistoric. The Paleoindian and Protohistoric periods are not well known for the area and are discussed in a general manner. Settlement and subsistence are cursorily addressed for the Archaic and Formative periods, because they are considered in greater detail in the next chapter.

Paleoindian Period (10,000 to 6000 B.C.)

The earliest occupation of the Southwest was during the Paleoindian period, which contains three broad temporal divisions: Clovis (10,000 to 9000 B.C.), Folsom (9000 to 8500 B.C.), and Plano (8500 to 6000 or 5500 B.C.). The assigned dates are by no means exact and fluctuate by several hundred years between researchers (Agogino 1968; Irwin-Williams 1965, 1973; Irwin-Williams and Haynes 1970; Neuman 1967). While Clovis and Folsom represent distinct cultures, the Plano encompasses a number of individual traditions.

These divisions are based on variations in projectile points and tool kits that may reflect differences in lifestyle. At one time all Paleoindians were classified as big-game hunters. Many now consider the Clovis people to have been more generalized hunter-gatherers, while Folsom and some later groups turned increasingly toward the specialized hunting of migratory game, particularly bison (Stuart and Gauthier 1981). Other Plano groups may have been hunter-gatherers whose lifestyle resembled that of the Archaic. However, it is likely that even these groups placed more emphasis on large-game hunting and less on collecting plant foods that required extensive processing.

Some archaeologists view the break between Paleoindian and Archaic periods as an actual dislocation of populations. This view entails the migration of Late Paleoindian peoples onto the Plains in response to the movement of bison out of the desert Southwest (Irwin-Williams and Haynes 1970). While some groups, particularly those that specialized in big game hunting, probably did follow the retreating bison, it is unlikely that everyone left and a new group of people moved in to fill the vacuum. Instead, later inhabitants were probably descended from Paleoindians that exploited a more general array of resources. Thus, this period ends with the demise of specialized big-game hunting and the movement of most of those specialists out of the Southwest. The population that remained was adapted to a broader resource base and was less affected by the major environmental changes that signal the end of the Pleistocene.

Although Paleoindian remains are rare in the Jornada region, they do occur and indicate that south-central New Mexico and far west Texas were occupied by humans by at least 10,000 B.C. However, there are some who feel that the occupation of this region can be pushed back to a much earlier date. From data collected during excavations at Pendejo Cave in the Organ Mountains, MacNeish et al. (1993) propose three distinct pre-Clovis complexes dating back to ca. 55,000 B.P. As Riley (1995:37) notes, these early dates have been met with some skepticism. While some consider such evidence of pre-Clovis occupations to be real, others are critical of the concept. Lacking a firm resolution to this controversy, we simply note that possible pre-Clovis remains have been found in the region, but that many question their validity.

Clovis materials are rare in this region. Sechrist (1994:47) indicates that only three Clovis sites or localities have been found, including the Mockingbird Gap site, the Rhodes Canyon locality, and the North Mesa site. Other Clovis remains generally consist of isolated points found in southern New Mexico and the Casas Grandes Basin of northern Chihuahua (DiPeso 1974a; Krone 1976).

Evidence of a Folsom occupation is more common. Seaman and Doleman (1988:15) found two Folsom points and many possible Paleoindian beaked scrapers during a survey in the Jornada del Muerto. The only evidence of Paleoindian occupation found by Whalen

(1978:14) during surveys in the Hueco Bolson were two isolated Folsom point fragments. Other isolated Folsom points have been found east of El Paso in the Hueco Bolson (Brook 1968a) and north of El Paso in Otero and Doña Ana Counties (Davis 1975; Krone 1975). A few probable Folsom sites are also known. Ravesloot's (1988a, 1988b) survey of the Santa Teresa area located a single site containing a Folsom component. Quimby and Brook (1967) found a site containing a Folsom point and a possibly associated hearth along the New Mexico-Texas border. Russell (1968) recorded three Folsom campsites around a dry Pleistocene lake near Orogrande.

Plano materials also occur in the region. During a survey near Santa Teresa, Elyea (1989:18) found a Cody Culture projectile point and a spurred endscraper. These artifacts occurred on different sites and were in association with no other Paleoindian materials, suggesting they were curated by prehistoric peoples. Hart (1994:39) recorded a Late Paleoindian site in the southern Tularosa Basin that contained an Agate Basin point fragment. A probable Cody Culture site was found during the Border Star 85 survey in the southern Tularosa Basin (Elyea 1988). Brook (1968b) located an isolated Scottsbluff point in a graded roadbed just north of El Paso. Russell (1968) recorded a large Plainview site on the edge of a dry Pleistocene lake near Orogrande and notes that later Paleoindian points were found on two of the three Folsom sites he recorded in that area.

A few studies have found rather large numbers of Paleoindian sites. Carmichael (1986a:107) recorded 50 Paleoindian components in the southern Tularosa Basin. Relative dates were established for 29 components, including 14 Folsom and 15 Plano. Nearly all seemed to be short-term camps and contained similar tool assemblages (Carmichael 1983:151). Anschuetz et al. (1990:87) found four Paleoindian components during another survey in the southern Tularosa Basin. Other than a Plainview point on one component, the only temporally diagnostic artifacts reported were an unidentified point and beaked scrapers.

Unfortunately, the rarity of Paleoindian sites in the region precludes any detailed discussion of settlement or subsistence patterns. Whether this rarity is real or related to patterns of soil deposition or later occupation is still unresolved. However, it is interesting that most recorded sites from this period are parts of multicomponent locales or occur in badly eroded areas. This suggests that most Paleoindian remains may be covered by soils deposited after their occupation or are mixed with the remains of later peoples who either mined their sites for useable materials or chose to occupy the same location.

Archaic Period (6000 B.C. to A.D. 200)

A new tradition based on the use of a broad range of plant and animal foods emerged at the end of the Paleoindian period. This was the Archaic, which is also called the Preceramic because a lack of pottery is sometimes used to separate these remains from those of later periods. Four Southwestern Archaic traditions have been defined--western, southern, northern, and southeastern (Irwin-Williams 1979). The western Archaic is the Pinto-Amargosa of southern California and western Arizona. The southern tradition is the Cochise, extending from northern Chihuahua to southeastern Arizona and south-central New Mexico (MacNeish and Nelken-Turner 1983). The Oshara tradition is in the north and includes southern Colorado and northern New Mexico. The Chihuahua tradition is in the southeast, and extends from Chihuahua into south-central New Mexico (MacNeish and Beckett 1987).

Irwin-Williams (1979:38) considers the principle feature of these broadly related traditions to be a low-level but large-scale communication system, reflected by the rapid spread and sharing of subsistence and stylistic elements over large areas. Moore (1980) agrees with this, suggesting that the separate traditions may simply be variations within a single widespread communication system. On the basis of assemblage similarities, Irwin-Williams (1979) concludes that the Oshara and Pinto-Amargosa complexes form the ends of a population continuum, possibly reflecting a common cultural derivation. The Cochise is considered relatively distinct, while the Chihuahua tradition seems more closely related to the Cochise than the Oshara (MacNeish and Beckett 1987). However, while the Cochise and Chihuahua traditions contain diagnostic artifacts that are different from those of other traditions, many are identical to tools from other areas. Thus, while Chiricahua and San Pedro points are relatively distinct from styles in other traditions, types that are diagnostic of the Oshara tradition (Jay, Bajada, and San Jose points) also occur in the Cochise and Chihuahua areas. This suggests there is a closer relationship between these traditions than some have thought.

Archaic Phases

Only the Chihuahua tradition is discussed in detail, since our sites were within that region. The Chihuahua tradition is described by MacNeish and Beckett (1987, 1994) and MacNeish (1993). These summaries provide a framework for Archaic development in the region and draw upon information from previous work as well as their own studies. However, their results are preliminary, and some aspects of their scheme are unclear or questionable. Much of this discussion is adapted from their model, but information on some aspects of the Archaic is amplified and expanded using data from other areas. This scheme is not yet widely adopted, but it provides a good base for discussing the local Archaic adaptation.

The Gardner Springs phase (6000 $\pm$ 500 to 4300 $\pm$ 300 B.C.) represents the earliest Archaic occupation and was initially termed a complex rather than phase because little information concerning it was available (MacNeish and Beckett 1987:31). However, further investigations have apparently provided enough data to consider it a phase, since that is how a more recent study by MacNeish (1993) refers to this period.

MacNeish (1993:391) feels that the Gardner Springs population migrated into the area from the west. However, elsewhere he suggests that it could have evolved out of the local Paleoindian population (MacNeish 1992:3), and this possibility is probably more likely. He further notes that the end of the Pleistocene brought on considerable environmental change in this area, involving a shift from grassland to desert (MacNeish 1993:401). This is thought to have presented a dilemma to those Paleoindians who remained in the region, necessitating a switch from a subsistence system that was primarily dependent on hunting to one based on foraging or collecting.

Most sites from this phase are small, and a pattern of seasonal scheduling may be indicated, though in another study MacNeish (1993:401) seems to feel this pattern did not begin until later. The Gardner Springs population probably exploited a wide range of floral and faunal resources. The associated chipped stone assemblage contains a number of tools including projectile points, flake and core choppers, denticulates, scraper planes, and scrapers. The ground stone assemblage contains basin milling stones, anvil mortars, slab mullers, and pebble hammers or pestles.

It should be noted that a distinction is made between milling stones and mullers, and metates and manos based on the grinding motion used. Milling stones were used with a round-and-round motion, combined with rocking back-and-forth, and mullers are the handstones used with them (MacNeish and Beckett 1987). Metates were used in a back-and-forth rocking motion, roughly parallel to their long axis, while manos are the handstones used with them (MacNeish and Beckett 1987:21).

The Keystone phase (4300 ± 300 to 2600 ± 200 B.C.) is considered to be a period of efficient foragers. MacNeish (1993) feels there was a further deterioration of the climate during this period and rainfall became less reliable. Dependence on plant foods may have increased, but this is tentative. Again, most Keystone phase sites are small, and there are some indications that the use of resources was seasonally scheduled, focusing on the processing and consumption of seeds. The associated artifact assemblage includes small half-moon bifacial side blades, large pointed unifaces, scraper planes, and projectile points. Milling stones and mullers continued to be used, and were joined by manos and metates.

Significant changes occurred during the Fresnal phase (2600 ± 200 to 900 ± 150 B.C.), which is somewhat better defined than earlier phases, both from survey and excavational data. In particular, there is definite evidence for the use of domesticated plants during this phase, and as a consequence there seems to have been significant changes in the settlement system. Of equal importance is evidence suggesting that surplus foods were stored in pits. MacNeish (1993:401) feels that the seasonally scheduled movement of earlier phases gave way to a system based out of macroband camps with logistical forays into other resource zones. The associated assemblage includes scraper planes (fewer varieties than earlier), gouges, choppers, projectile points, and bone beads. Though milling stones and mullers continue to occur in the ground stone assemblage, they are now outnumbered by manos and metates.

The Hueco phase (900 ± 150 B.C. to A.D. 200 ± 100) was first described by Lehmer in 1948. Beckett (1979:224) challenged this definition, noting the likelihood that perishable materials used to define it were actually from the later Jornada Mogollon occupation. In fact, Beckett (1979:225) suggested that "Hueco phase" be dropped from the local sequence, arguing that if this name was retained it should only be applied to the Late Preceramic horizon. Following this suggestion, while early studies refer to the entire Archaic as the Hueco phase, MacNeish and Beckett (1987) redefined it as the last part of the Archaic period.

MacNeish (1993:403) suggests that the population grew rather rapidly during this phase. More sites are recorded that date to this phase than any earlier period. Base camps were larger, suggesting they were either occupied for longer periods of time or by larger groups. Distinctive scrapers and small disk choppers occur in addition to projectile points. Wedge manos and trough metates dominate the ground stone assemblage from this phase, which also includes bedrock mortars. There is also evidence that baskets and sandals were being woven by this time. Importantly, the number and types of storage features appear to increase during this phase.

Diagnostic Artifacts. In general, only projectile points are considered temporally diagnostic for the Archaic period. Styles that are commonly associated with the Gardner Springs phase include Bat Cave, Abaloso, Jay, and Bajada. The two latter types are also diagnostic of separate phases in the Oshara tradition (Irwin-Williams 1973). Bat Cave points are usually considered indicative of a Cochise occupation, while Abaloso points are more common in Archaic traditions further to the east.

A different array of projectile points is associated with the Keystone phase, including Pelona, Amargosa, Todsen, Almagre, Langtry, Shumla, Trinity, and Bat Cave styles. The Pelona style crosses tradition boundaries, and is also found in Oshara and Cochise assemblages. The Bat Cave style is commonly associated with the Cochise, the Amargosa is diagnostic of the Pinto-Amargosa, and the Langtry, Shumla, Almagre, and Trinity types are common further to the east and southeast.

Projectile point styles commonly associated with the Fresnal phase include Chiricahua, Nogales, Augustín, Todsen, La Cueva, San José, Fresnal, Maljamar, and possibly Pedernales. Only the Fresnal and Maljamar types are diagnostic of the Chihuahua tradition; the rest also occur in other areas. In particular, the Chiricahua point is diagnostic of the Cochise tradition, while the San Jose point is diagnostic of the Oshara. Augustín points are common in both of these traditions, and styles like Pedernales are diagnostic of Archaic traditions further to the east.

Projectile point styles associated with the Hueco phase include San Pedro, Hatch, Hueco, and Fresnal. Again, some of these styles also commonly occur in other areas. In particular, San Pedro points are diagnostic of the Cochise tradition. Hueco points are defined as a distinct style, yet illustrations suggest similarities to both San Pedro and En Medio styles of the southern and northern Archaic traditions, as well as styles further east in Texas.

The array of projectile points from the Chihuahua area reflects a mixture of diagnostics from several traditions. Not only is this region stylistically connected to the general Southwestern Archaic communication system, it also appears to have ties to Archaic traditions further to the east and southeast in Texas. This should come as no surprise, since it is likely that Archaic groups interacted with all other peoples whose territories bounded theirs.

House Forms and Feature Types. Data on structures and features are available from a number of excavations. Roney and Simons (1988) excavated five Late Archaic pit structures in the Santa Teresa area. Using MacNeish and Beckett's scheme, all should date to the Fresnal or Hueco phases. These structures were circular (4) or oval (1) and were dish-shaped in profile except for one, which was flat-bottomed. All were under 3 m in diameter, and three were less than 2 m in diameter. None were deeper than 30 cm. Interior features included postholes, a basin hearth in one structure, and an informal hearth on the floor of a second. Three similar pit structures were also excavated in the Santa Teresa area by O'Leary (1987). They were circular (2) or oval (1) in shape, less than 3 m in diameter, and no deeper than 25 cm. In profile they were dish-shaped and contained no internal features. All 3 were radiocarbon dated to the Hueco phase.

A structure similar in form and profile to those from Santa Teresa was excavated on White Sands Missile Range (Swift and Harper 1991). It was shallow (18 cm deep) and less than 2 m in diameter, with no internal features other than a possible posthole (Swift and Harper 1991:115). This structure was interpreted as a temporary brush hut dating to the middle or Late Archaic (Swift and Harper 1991:128). Gerow (1994) excavated two clusters of features at a site near Chaparral that appear to be Archaic in date, though some contamination from a later occupation was noted. Two pit structures were examined, each associated with a different cluster of features. They were roughly circular. One was dish-shaped, while the second was incompletely excavated. Both structures were less than 3 m in diameter and 30 cm deep. One floor was use-compacted, though there was no formal structure to it, and an informal hearth was found on its surface.

O'Laughlin (1980) excavated 12 pit structures at the Keystone Dam site and found at least 11 more in auger tests. In general, they were small (ca. 3 m diameter), shallow (ca. 10 to 20 cm deep), and circular, with nearly level or dish-shaped floors. Most, if not all, contained informal hearths. Evidence for a clay or adobe coating on the outside of superstructures was found in at least 12 cases (O'Laughlin 1980:144). This, the only site known that contains a large number of Archaic structures, is interpreted as a winter village. Several clusters of huts in groups of two to five were identified, suggesting the presence of multiple nuclear families. Rather than indicating a single large macroband occupation broken into a series of smaller groups living in discrete clusters, the site was probably occupied on several occasions by smaller groups of two to five families.

In general, Archaic pit structures were shallow, with basin-shaped or flat-bottomed, scooped-out, unplastered floors. Posts usually occur in irregular patterns and were placed around and within floor areas, often found in both positions in the same structure. Interior hearths are often absent and when present are usually informal concentrations of ash and charcoal on floor surfaces, though at least one shallow basin hearth has been found. Posts formed the base of the superstructure, which was covered with a variety of materials including grass stems, yucca stalks, and reeds. Mesquite branches were most commonly used for posts, though other woods were undoubtedly also used when available. A thin layer of clay or adobe may have been applied to the exterior surface, but evidence for this has been found at only one site.

Only a few types of extramural features are documented for Archaic sites in the region. Most of the exterior features encountered are hearths, both with and without fire-cracked rock in association (Gerow 1994; Hard 1983b; O'Laughlin 1980; O'Leary 1987; Roney and Simons 1988). At least one large charcoal stain has been found at an Archaic site (Oakes 1981) and may represent a deteriorated structure. Between one and four extramural pits were probably used for storage at the Keystone Dam site, and two were reused for trash disposal at a later time (O'Laughlin 1980).

Ideology and Ceremonialism. Little information concerning Archaic religious beliefs is available. Panels of abstract rock art in the region may have been created by Archaic peoples (Schaafsma 1992), but while this art is probably related to ideology, its nature precludes any interpretation of meaning at this time. However, variation between this style of rock art and later forms suggests that there were great differences between the ideological systems of local hunter-gatherers and farmers.

Ties to Other Regions. Again, little information is available concerning Archaic ties to other areas. However, as we noted earlier, certain projectile point styles suggest that this region participated in more than one large-scale communication system. Thus, at some level, this area was tied into a vast region in which the widespread occurrence of some artifact styles is probably indicative of information flow.

Subsistence. The few subsistence data that are available suggest the use of a broad range of plant and animal foods during the Archaic period. Deer and antelope bones are apparently common in Gardner Springs deposits, implying heavy dependence on large-game hunting. The presence of only milling stones and mullers suggests that wild seeds were processed and consumed. Domesticates may have been used as early as the Keystone phase, as indicated by the presence of three cucurbit seeds in a level dating ca. 3434 B.C. at Todsen Shelter. The addition of manos and metates to the grinding assemblage during this phase implies adoption of new techniques for wild seed processing. However, it might also indirectly suggest that corn was being used.

Domesticates were certainly being grown during the Fresnal phase, and there is good evidence for the storage of surplus food in pits. At least two varieties of corn were grown in addition to squash. The fact that manos and metates outnumber milling stones and mullers in sites from this phase may suggest the growing importance of corn in the diet, or it could simply mean that both domestic and wild seeds were being processed in the same way. Most of the meat consumed by this time seems to have come from small game, particularly rabbits.

The range of domesticated plants being grown again increased during the Hueco phase and included at least four varieties of corn, cucurbits, and possibly beans and amaranth. Mostly small game seems to have been hunted, with little evidence for reliance on large animals. The number and types of storage features appear to increase during this phase, suggesting careful planning and storage of surpluses for consumption during the winter rather than any degree of true sedentism.

The use of several wild plant species has been documented, particularly in Late Archaic contexts. Camilli et al. (1988) found evidence for Late Archaic use of vetch seeds and flower stalks or pods of a plant from the Liliaceae family. Other economic plants found in Archaic contexts during that study include purslane and amaranth seeds, and a probable yucca pod. Gerow (1994) recovered evidence for the use of chenopodium and purslane from a site near Chaparral. Mesquite seems to have been the main source of fuel wood, but there is also evidence for the use of other shrubs like saltbush (Camilli et al. 1988; Hard 1983b).

Bohrer (1981a) reports a variety of wild and domestic plants from Archaic levels at Fresnal Shelter. Domestic plants were represented by small quantities of corn and beans. The list of edible wild plants is much more extensive and includes amaranth, dropseed grass, panic grass, saltbush, buffalo gourd, Turk's head cactus, juniper berries, four o'clock root, prickly pear, New Mexico feathergrass, mesquite, yucca fruit, squawbush, piñon nuts, chenopodium, acorns, and agave.

A wider variety of woods and economic plants was identified at the Keystone Dam site than elsewhere. Mesquite, certainly used as fuel wood, was recovered from two extramural thermal features. A variety of other woods were identified in samples from structures and probably represent construction materials, though use as fuels cannot be ruled out. They include desert willow, Apache plume, creosote, wolfberry, reed, cottonwood, and possible tornillo (O'Laughlin 1980:82). Burned grass stems and yucca stalks were also identified, as were fragments of Turk's cap cactus. The array of charred seeds included saltbush, cheno-am, tansy mustard, Turk's cap, various grasses, creosote, prickly pear, purslane, smartweed, mesquite or tornillo, possible acacia, dock, bulrush, and a plant from the poppy family (O'Laughlin 1980:88).

Interestingly, some evidence suggests a specialized Archaic hunting pattern in the highlands. At Fresnal Shelter in the Sacramento Mountains, Wimberly and Eidenbach (1981) found evidence of large game hunting and butchering. Most of the identified bone was mule deer, though some antelope, bighorn sheep, and bison bones were also found. The butchering pattern suggested that meat packages that included major long bones and attached muscle were removed and transported elsewhere, while portions that contained less meat were processed and consumed on-site (Wimberly and Eidenbach 1981:27). This has major implications for low altitude sites, especially since radiocarbon dates suggest that the shelter was used throughout the Archaic period. If this pattern was common, there may be little evidence for consumption of large game in lowland sites. When such evidence occurs, only long bones may be present. Thus, the predominance of small mammal remains in lowland Archaic sites does not preclude the consumption of meat from large mammals obtained in the highlands.

Evidence of Archaic Occupation in the Study Area

During initial survey of the Santa Teresa area, Ravesloot (1988a:79) recorded 15 Archaic sites and 4 isolated occurrences. This may suggest relatively heavy Archaic use of the area, but he cautions that all but one of the Preceramic components were identified by the presence of a single Archaic point. Thus, if Archaic points were collected and reused during later periods, the actual temporal distribution of sites may be obscured. However, several Preceramic obsidian hydration dates and one radiocarbon date were obtained, indicating that there definitely was an Archaic presence in the study area.

Of the 1,796 artifact clusters defined during Camilli et al.'s (1988) distributional study at Santa Teresa, only 9 were identified as Archaic. However, five shallow round pit structures and three hearths excavated in association with the survey yielded Archaic dates. Radiocarbon dates for three of the structures are 2490 to 2310 B.C., 1150 ± 270 B.C., and 1920 ± 250 B.C.; the other two were simply dated to the first millennium B.C. (Roney and Simons 1988:9-40). Dates for two exterior hearths suggest their use was related to one of the pit structures dated to the first millennium B.C. (Roney and Simons 1988:9-40). Another extramural pit or hearth yielded a date of 220 ± 180 B.C. (Roney and Simons 1988:9-13).

O'Leary (1987) excavated several Archaic features in the follow-up to Camilli et al.'s (1988) study. Three pit structures were radiocarbon dated to 590 ± 110 B.C., 600 ± 60 to 360 ± 70 B.C., and 900 ± 100 B.C. Other dated features included an ash stain containing fire-cracked rock (840 ± 120 to 720 ± 90 B.C.), a charcoal stain containing fire-cracked rock (820 ± 90 B.C.), and two ash stains or hearths (390 ± 330 B.C. and 740 ± 150 B.C.).

Elyea's (1989:18) survey in the Santa Teresa area located 22 sites that contained bifaces or evidence of biface reduction considered indicative of Archaic occupations. Only six of these sites were single component; the rest also contained El Paso phase materials. Elyea (1989:18) feels that the areal extent of most of these sites suggests they represent locales that were repeatedly occupied by Archaic groups. During survey for the Santa Teresa Port-of-Entry, Stuart (1990:38) recorded no definite Archaic remains. Moore and Bailey (1980) found no preceramic sites during their survey for the Santa Teresa Airport; however, two Late Archaic projectile points were recorded as isolated occurrences.

Formative Period (A.D. 200 or 500 to 1450 or 1500)

The Jornada Mogollon occupation is often collectively labeled the Formative period (O'Laughlin 1980; Ravesloot 1988a; Stuart 1990). Lehmer (1948) defined three phases for this period, which originally spanned the years between A.D. 900 and 1400. This framework remained essentially unchanged until the 1970s, when large-scale studies were begun in the Hueco Bolson of southwest Texas (Whalen 1977, 1978). Through these and other studies in the region, the temporal framework and settlement and subsistence model developed by Lehmer have been modified and refined.

Mesilla Phase (A.D. 200 or 500 to 1100)

Lehmer (1948) considered the Mesilla phase to be an outgrowth of the Archaic and dated it between A.D. 900 and 1100. It was characterized as the "first pottery-making, village-dwelling horizon in south-central New Mexico" (Lehmer 1948:78). Farming was assumed to be of primary importance, despite the lack of cultigens in the sites he investigated (Lehmer 1948:76). These assumptions have been questioned by other researchers.

Dating the Phase. Whalen (1977, 1978) initially pushed the beginning of the Mesilla phase back to ca. A.D. 400, renamed it the Pithouse period, and proposed a generalized settlement-subsistence system. Other beginning dates have been proposed by various researchers, illustrating a continuing uncertainty about when it started. While some (O'Laughlin 1980; Whalen 1980a, 1981a) have placed its beginning around 0 B.C./A.D., others feel it began ca. A.D. 200 (Batcho et al. 1985; Ravesloot 1988a). O'Laughlin (1985:54) notes that the best evidence for early ceramics in the Hueco Bolson comes from a site that has been radiocarbon dated to the sixth or seventh centuries A.D.; earlier dates are single samples from limited activity sites. This suggests that an A.D. 200 or earlier date for the beginning of the phase is questionable, and that it probably began between A.D. 200 and 500. In a recent study, Whalen (1994a:23) simply suggests that the Mesilla phase began in the early centuries A.D., effectively sidestepping the issue. In contrast, most authors still agree with Lehmer's ending date of A.D. 1100.

Since this phase represents a rather long, unbroken time period, it is often difficult to deal with, particularly since research suggests there were significant differences in settlement and subsistence between the early and late parts of the phase. Thus, most researchers now break the Mesilla phase into early and late periods, mostly based on the array of ceramic types present.

Mesilla Phase Pottery. While undecorated El Paso Brown wares predominate throughout the phase, early sites contain intrusives such as Alma Plain and San Francisco Red, while Mimbres white wares occur in later assemblages. The appearance of the latter provides a good demarcation point, and the late Mesilla phase is considered to have begun ca. A.D. 750 (Hard 1983a:41; Hard 1986:266; Whalen 1993:481).

The extremely long span of time in which El Paso Brown was manufactured has led many analysts to search for temporally sensitive variation in vessel form, manufacturing techniques, and stylistic attributes. For example, in one of his early studies, Whalen (1980b:31-32) suggested that early El Paso Brown vessels tended to have pinched rims, coarse temper, and a coarse, bumpy surface finish. Late El Paso Brown was thought to have been dominated by rims that were inverted and tapered or direct, with finer temper and a smoother surface finish (Whalen 1980b:31-32). Some of these ideas have been verified and amplified by further research. A regional comparison showed that ceramic densities increase on Mesilla phase sites over time, so there tends to be more pottery on sites from late in the phase than on early sites (Whalen 1994a:75). Two long-term trends in vessel tempering were also identified. Through time, vessels tend to contain more temper, and temper tends to be more finely ground (Whalen 1994a:79). While vessel forms were dominated by neckless and short-necked jars throughout the life of this type, changes in vessel shape, volume, and orifice diameters indicate that storage in large containers became increasingly important in the late Mesilla phase

(Whalen 1994a:86, 89). These conclusions are echoed by those of Seaman and Mills (1988a, 1988b).

Another significant variation identified by Whalen's (1994a:83) study was a change in firing temperatures around A.D. 700. After that date vessels seem to have been fired at higher temperatures or for longer periods, producing differences in surface hardness and core characteristics that are distinguishable from early Mesilla pottery. However, Whalen (1994a:83) does not believe this represents a radical reorganization of ceramic technology. Rather, something as simple as the use of more wood and less grass during firing may have been involved.

Unfortunately, the use of rim form for dating has been less successful. This type of analysis uses a rim sherd index, or RSI. The history, application, and methods used in this analytic technique are summarized by Whalen (1993) and are not discussed in detail here. In general, this technique was used in an attempt to seriate rims on El Paso Brown vessels using measurements of thickness at standardized locations. Whalen (1993:484) argues that while there is some differentiation in rim form over time, it is of little use in seriating assemblages. His original observation that pinched rims were more common in the early Mesilla while flattened rims were more frequent in the late Mesilla did hold true. However, detailed analysis of an assemblage containing early and late Mesilla components indicates that both forms occur in appreciable percentages in both periods, and that the use of small samples of rims from the surface could result in incorrect temporal assignments.

While these studies have pointed out differences in El Paso Brown pottery produced during the early and late parts of the phase, little of this information is applicable to individual sites, especially those found during survey. However, certain trends may be of behavioral significance. Changes in the amount and size of temper in the late Mesilla phase suggests an attempt to produce pottery more resistant to thermal shock (Whalen 1994a:11). This implies that vessels were required to withstand longer periods of heating, which could indicate changes in food processing technology. Changes in firing techniques may have resulted in harder and more durable vessels. This may have been required by changing patterns of pottery use or could reflect variation in the types of materials used in firing, possibly as a consequence of environmental change. Finally, the larger average size of vessels in the late Mesilla phase may indicate an increase in their use for storage (Seaman and Mills 1988a, 1988b; Whalen 1994a). All of these changes suggest there were important behavioral differences between the early and late parts of the Mesilla phase.

House Forms and Feature Types. Pithouses were the only form of structure used throughout the Mesilla phase. Some differences have been noted between structures in different environmental zones, but there seems to have been little variation in form between the early and late parts of the period. Whalen (1994a:46) found that the largest, deepest, and most heavily roofed structures are in the Rio Grande Valley, while those in the desert basins are smaller, shallower, and less heavily roofed. In general, pit structures from this region are smaller than their contemporaries elsewhere in the Southwest and tend to contain few internal features. Heavily used extramural activity areas are often found in association.

The most detailed information on Mesilla phase structures is from Whalen's (1994a) excavations at Turquoise Ridge, a winter village occupied during both the early and late parts of the phase. While it is likely that the late Mesilla population was larger and remained at the village for longer periods, the only apparent difference between early and late structures was their depth (Whalen 1994a:47). Late structures were somewhat deeper, though it is uncertain whether this was caused by deeper initial excavation or more wear during longer occupations (Whalen 1994a:47). The latter is probably more likely. Some structures were occupied long enough to require remodeling or were used more than once. House abandonments were apparently planned, and abandoned structures were used for trash disposal (Whalen 1994a:50).

Internal features include postholes, hearths, storage pits, warming pits, and pits of unknown function. Postholes occur both on and around the edge of floors, often in combination. Hearths include formal basins excavated into floors and informal deposits of ash and charcoal or areas of oxidation on floor surfaces. Both large and small storage pits sometimes occur inside structures. Warming pits are found but are rare. They consist of pits of irregular form that show no signs of burning but contain burned or heated rock.

Numerous types of extramural features also occur at Mesilla phase sites. While storage features appear to be common at winter villages like Turquoise Ridge (Whalen 1994a), they are rare at sites occupied during other seasons. Middens are usually shallow and diffuse, with imprecise boundaries (Whalen 1994a:61). While they occur at winter villages, middens are rarely found at more ephemeral sites. Burials are occasionally encountered, but are rare and usually unaccompanied by grave goods. Thermal features are usually the most common type and take several forms. The most common are simple hearths, small fire-cracked rock features with and without associated fire pits, and large fire-cracked rock features with or without associated fire pits. In general, the varieties of fire-cracked rock features probably reflect different degrees of erosion. Those with fire pits usually seem less eroded, while those without them are generally badly eroded. Fire-cracked rock features are thought to have been used for baking or roasting leaf succulents like sotol and lechuguilla (O'Laughlin 1979:72). Small roasting features may be related to household use, while larger features were probably used communally (Whalen 1994a).

Ideology and Ceremonialism. Little information is available concerning Mesilla phase ceremonialism. Larger than normal pithouses that may reflect a ritual use have been found at only three sites, including Turquoise Ridge (Whalen 1994a), Los Tules (Lehmer 1948), and the Rincon site (Hammack 1962). These sites were all occupied late in the phase, leading Whalen (1994a) to conclude that this type of structure originated after A.D. 750. The appearance of such features suggests there was an accompanying change in social organization. Traditionally, communal structures in the Southwest are associated with ritual societies whose membership crosscuts a community and binds it together. Thus, the appearance of communal structures in the late Mesilla phase suggests that the loose social organization characteristic of the Archaic and early Mesilla occupations was giving way to a more cohesive pattern of group identity and membership. However, there is no evidence for any ceremonial organization larger than individual villages.

Late in the phase there is also a significant change in rock art style that may reflect participation in a widespread ideological system with its roots in Mesoamerica. Jornada style rock art seems to appear around A.D. 1000, and Schaafsma (1992) suggests that it began in the Mimbres area and spread to the Jornada. Common motifs include masks and faces, which occur as both carvings and paintings (Schaafsma 1992:67). As Schaafsma (1972:122) notes, "The advent of the Jornada rock art style in the Desert Mogollon area seems to have been more than an isolated event. This stylistic complex appears to be the visual manifestation of an underlying ceremonial development which involved masked impersonations of particular spiritual beings as well as a ritual concern for other life forms, as indicated by the numerous depictions of mammals, reptiles, birds, and insects. As the art represents a significant break with the past, so, too, must the associated ritual have represented a cleavage with the earlier tradition." This new ritual system may have been adopted very late in the Mesilla phase and is probably closely linked to many subsequent changes in Jornada Mogollon society. While it is possible that the possible ceremonial structures discussed above are another manifestation of this change, the appearance of these features is not well dated, and definite links to the new ritual system are lacking. Thus, no real connection can currently be drawn between these developments.

Ties to Other Regions. Certain types of artifacts are indicative of ties to other regions, but what form those ties took cannot be determined with any great certainty. Most of the imported pottery at Mesilla sites is from the Mimbres area to the west. Mimbres pottery occurs on both early and late Mesilla sites, suggesting that the Jornada region was tied in to the regional exchange system that centered on the Mimbres area, particularly during the late part of the phase.

Marine shell represents another relatively common import, and includes *Olivella* sp. beads and fragments of *Glycimeris* sp. bracelets. The former have ben found at Los Tules, the Brazito South site, and Turquoise Ridge (Lehmer 1948; O'Laughlin 1985; Whalen 1994a). Finds of *Glycimeris* sp. shell are more commonly reported and include Los Tules, the Roth site, the Country Club site, Brazito South, the Northgate site, and Turquoise Ridge (Lehmer 1948; O'Laughlin 1977a, 1985; O'Laughlin and Greiser 1973; Whalen 1994a). Other types of marine shell are rare and include fragments of *Haliotus* sp. from Brazito South and *Pyrene* sp. from Turquoise Ridge (O'Laughlin 1985: Whalen 1994a). Turquoise also occurs in Mesilla contexts and is best reported from Turquoise Ridge (Whalen 1994a), where 11 fragments were found. One piece of turquoise was also found at Los Tules (Lehmer 1948). However, without chemical analysis it is impossible to determine whether this material was obtained from local sources, such as those in the Orogrande area, or was imported.

Subsistence. The Mesilla people consumed both wild and domestic foods, presumably continuing the Archaic pattern of exploiting a broad spectrum of resources. In general, domesticates are rarer than wild foods. Corn and beans have been recovered from Mesilla sites, but cucurbits have not been identified. However, since cucurbits occur at Archaic sites, they were probably used but are poorly preserved. In the most detailed study yet conducted, Whalen (1994a) found a differential distribution of corn remains in samples from early and late Mesilla contexts at Turquoise Ridge. Corn occurred in 7.3 percent of early samples and 27 percent of late samples, suggesting increased use after A.D. 750. One bean was also found in early deposits at this site.

A wide spectrum of wild plants occurs at both early and late Mesilla sites, representing use as food, fuel, and construction materials. Wild plant foods are mostly represented by seeds including purslane, chenopodium, amaranth, sunflower, acorn, mesquite, tornillo, mallow, yucca, sumac, bugseed, mustard, and various cacti and grasses (Camilli et al. 1988; Dean 1994; Ford 1977; Hard 1983b; O'Laughlin 1979, 1981, 1985; Wetterstrom 1978; Whalen 1980b, 1994a). Some evidence for the use of leaf succulents also exists. Scott (1985) found agave fibers in a large roasting pit, and Camilli et al. (1988) recovered yucca leaves from a late Mesilla pit structure; both examples probably represent foods.

Fuels were mostly composed of shrubs, mesquite in particular (Camilli et al. 1988; Hard 1983b; Minnis and Toll 1991; O'Laughlin 1979), though there is limited evidence for the use of small trees like oak and juniper (Kirkpatrick et al. 1994; Minnis and Toll 1991). Other fuels include saltbush, Mormon tea, creosote, desert hackberry, and desert willow (Brethauer 1979; O'Laughlin 1979). Several species were also used in construction. It is usually assumed that mesquite branches were the main elements in pithouse superstructures, though there is little direct evidence of this. Materials used to cover superstructures include grass stems and yucca stalks (Gerow 1994; Hard 1983b; Roney and Simons 1988).

Evidence for the range of animals used for food is somewhat more limited. Rabbits, both cottontails and jackrabbits, are the most commonly identified faunal remains (Brethauer 1979; M. Brown 1994; Foster 1988; Hard 1983b; O'Laughlin 1977a, 1979, 1981, 1985; Whalen 1980b, 1994a). Other types of animals for which evidence of consumption exists include box turtle, spiny soft-shell turtle, quail, owl, muskrat, artiodactyls including deer and possibly antelope, fresh water mollusks, and various rodents and birds (O'Laughlin 1977a, 1979, 1981, 1985; Whalen 1994a).

Doña Ana Phase (ca. A.D. 1100 to 1200)

While the Doña Ana phase was initially described by Lehmer (1948), it continues to be the most tenuously defined and least known period of occupation. Lehmer (1948) considered this phase to be transitional between the Mesilla and El Paso phases and dated it from A.D. 1100 to 1200. No attempt was made to distinguish Doña Ana components in Whalen's (1977, 1978) early studies in the Hueco Bolson because of difficulties involved in distinguishing those remains from survey data alone. Thus, Doña Ana components were combined with the later El Paso phase into his Pithouse period. Whalen (1980a) has also referred to the Doña Ana phase as the Transitional period, again combining it with the El Paso phase.

Lehmer (1948:88) used pottery recovered during excavations at La Cueva, which lacked structural remains, to date the Doña Ana phase. The initial definition of this phase was mostly based on guesswork using remains excavated in 15 cm levels from the talus in front of a cave in which the fill was described as "hideously disturbed" (Lehmer 1948:35-37). No wonder there has been so much confusion and speculation about this phase! Whalen, who has conducted the most extensive studies in the region, has virtually ignored this phase because of difficulties involved in identifying it from surface remains alone. Nevertheless, Carmichael has proposed a locally extensive Doña Ana occupation in the Tularosa Basin. Unfortunately, his arguments are based on survey data, and some have criticized his logic.

In several publications, Carmichael (1983, 1984, 1985a, 1985b, 1986b) presents a series of attributes he considers diagnostic of a Doña Ana occupation and integrates these findings into a model of nonlinear culture change for the region. First is a mixture of pottery, combining types from the Mesilla and El Paso phases. Initially, sites were only assigned to the Doña Ana phase when this ceramic association occurred in discrete features thought to represent eroded middens (Carmichael 1986a:72). However, once the association was considered valid it was extended to all sites at which it occurred, whether it was found in discrete features or not. The latter class of sites comprised over two-thirds of his sample. Though no definite structural remains were found, they were inferred by the presence of features interpreted as eroded trash-filled borrow pits (Carmichael 1986a:72). The associated adobe pueblos are thought to have eroded away, leaving behind little visible evidence of their existence.

From these data, Carmichael inferred a locally extensive but short-term occupation during the Doña Ana phase for the southern Tularosa Basin. Many large habitation sites were identified in environmental situations similar to, but slightly different from, those occupied during the El Paso phase. This suggested a climax of population and complexity at an earlier date than was previously thought, and led to construction of a model of nonlinear cultural development entailing oscillations in the relative intensity of local occupations (Carmichael 1985b). Simply put, Carmichael feels there were peaks in occupation size and intensity during both the Doña Ana and El Paso phases. In his study area, the larger peak is thought to have been during the earlier phase.

While this is an interesting model and certainly deserves consideration, many assumptions on which it is based have been criticized. Anschuetz (1990:24) notes that the framework on which Carmichael's definition of the Doña Ana phase is built is based on excavations at La Cueva and Indian Wells Village (Lehmer 1948; Marshall 1973)--sites that are disturbed or incompletely described. The ceramic association used to define the phase may be more indicative of mixed Mesilla and El Paso occupations (Anschuetz 1990:24). While Carmichael originally considered this possibility, he later disregarded it. His logic in concluding that trash deposits represent the remains of eroded trash-filled borrow pits rather than surface middens is also criticized.

Anschuetz and Seaman (1987:5) conclude there is no definitive or consistent way to define Doña Ana remains during survey. One of the main problems they point out is the lack of pottery types exclusive to this phase, leading to serious difficulties in discriminating remains from this period from those of earlier or later occupations. Thus, they feel that survey data should not be used to define Doña Ana occupations.

During a survey on Fort Bliss, Mauldin (1993) recognized and addressed these difficulties. Sites containing pottery types that Carmichael would consider diagnostic of a Doña Ana occupation were defined as multicomponent in this study (Mauldin 1993:24). However, one such site was subjected to a more rigorous examination to test Carmichael's assumptions. While this did not include excavation, it did entail detailed mapping and recording of surface feature and artifact type and distribution. Even though several middens on the site contained pottery types diagnostic of both the Mesilla and El Paso phases, he concluded, "The spatial patterning of components . . . suggests that the apparent Doña Ana assemblage actually may represent the overlap of the Mesilla and El Paso phase occupations" (Mauldin 1993:41).

Mauldin's (1993) results suggest that Carmichael may indeed be in error, and that his sites simply represent a mixture of overlapping Mesilla and El Paso occupations in an area that was eminently suitable for use during both time periods. So, where does this leave the Doña Ana phase? Should it be abandoned, or merely reconsidered yet again? Fortunately, a few other sites dating to this phase have been excavated and provide some data (Bilbo 1972; Kegley 1982, 1980; Scarborough 1986). Thus, a basic outline of the Doña Ana phase can be sketched.

Dating the Phase. Mauldin (1993:41) suggests that this phase should be dated between A.D. 1100 and 1150 and may have spanned an even shorter period. This is based on Kegley's (1980) work at the Hueco Tanks site and Scarborough's (1986) excavations at Meyers Pithouse Village, which suggest that the overlap between Mimbres Black-on-white and Chupadero Black-on-white (which originally defined the phase) lasted only 50 years or less. In fact, Mimbres Black-on-white is absent from Meyers Pithouse Village, which has been securely dated to the late Doña Ana phase by radiocarbon and archaeomagnetic samples (Mauldin 1993:41). If the traditional date of A.D. 1100 to 1200 continues in use, it is possible that what Lehmer and then Carmichael considered a characteristic ceramic assemblage may only occur at sites occupied early in the phase. Later sites may contain assemblages very similar if not identical to those of the early El Paso phase. This will make it difficult to distinguish these sites by pottery alone.

Doña Ana Phase Pottery. Traditionally, this phase was defined by the occurrence of El Paso Brown, El Paso Polychrome, Chupadero Black-on-white, St. Johns Polychrome, Three Rivers Red-on-terracotta, and Mimbres Classic Black-on-white (Lehmer 1948:37). Marshall (1973:53) added El Paso Bichrome to the list. Carmichael (1986a:72) indicates that Playas Red Incised also occurs on Doña Ana phase sites and notes that the variety of El Paso Brown on his sites was late and had thickened rims. An unidentified black smudged ware was found in a probable Doña Ana phase pithouse near El Paso (Bilbo 1972:75).

Mauldin (1993:41) notes that the Hueco Tanks site (Kegley 1982) contained a ceramic assemblage similar to that defined by Lehmer. However, Mimbres Black-on-white comprised only a very small percentage of imported wares, while 90 percent was Chupadero Black-on-white. The latter type also comprises most of the nonlocal pottery from Meyers Pithouse Village (Mauldin 1993:41). Other intrusive ceramic types at that site include Three Rivers Red-on-terracotta, Playas Red, and undifferentiated Chihuahuan wares (Mauldin 1993:41). Again, no Mimbres Black-on-white was found in this assemblage, which contained over

13,000 sherds (Mauldin 1993:41). Interestingly, locally manufactured brown ware vessels appear to have been smaller during the Doña Ana phase than they were in the Mesilla and El Paso phases (Seaman and Mills 1988a, 1988b).

House Forms and Feature Types. Information concerning these topics is limited. Marshall (1973:53) indicates that Indian Wells Village contained a mixture of pithouses and surface structures. Round pithouses were common, but square pithouses also occurred. Surface structures were jacal or coursed adobe, and rooms often contained hearths. He feels that surface rooms are common late in the period, with small pit rooms being used for storage (Marshall 1973:53). Unfortunately, this site is incompletely described, and little detail is available. Even more unfortunate is that it was assigned to the Doña Ana phase because it contained a mixture of surface and pit rooms, even though the ceramic assemblage is similar to that of the El Paso phase (Marshall 1973:13). Since large pit storage features similar to those described for this site were found at an El Paso phase fieldhouse in the Mesilla Bolson (Batcho et al. 1985), the association of surface and subsurface rooms may not be a good indicator of Doña Ana occupation.

At Meyers Pithouse Village, Scarborough (1986) found no surface structures, only four rectangular pithouses. One was substantially larger than the others and may have been a communal structure or work area (Scarborough 1986:283). Other internal features include irregularly placed postholes and well-defined hearths in at least three structures. Extramural hearths were also found, and storage pits occurred both within and outside pithouses.

Six pithouses were excavated at the Hueco Tanks site, all similar in construction style (Kegley 1982). These pithouses were rectangular, ranged between 2.3 and 5.5 m long by 2.3 to 4.5 m wide and 0.24 to 0.95 m deep. Floors were plastered with adobe and contained two postholes oriented on a north-to-south axis and a formal hearth, usually collared. An adobe step was sometimes adjacent to the south wall and may have been related to a wall or roof entrance in that area. Walls appear to have been plastered but were usually so deteriorated that this could not be determined for certain. Little evidence of roof construction remained, but in at least one case the roof appears to have been covered with a layer of adobe.

A probable pithouse from this phase was excavated at the Castner Annex Range Dam site (Bilbo 1972). It was shallow (10 cm deep) and rectangular, with both interior and exterior postholes (Bilbo 1972:75). Building materials had collapsed into the structure when it was partially burned and showed that walls were made of jacal and slanted inward and that roof vigas were covered with a similar material (Bilbo 1972:75). A formal hearth may have existed, but the condition of the structure made this difficult to verify.

The premise that Doña Ana phase sites contain combinations of surface and pit rooms must be reevaluated. Surface rooms dating to this phase were absent at both Meyers Pithouse Village and the Hueco Tanks site. While they were present at Indian Wells Village, the lack of a detailed report and the essentially El Paso phase ceramic assemblage render its comparability suspect, especially since features similar to the pit storage rooms have been found at an El Paso phase site. It is possible that pithouses continued to be the main residential structures in this phase, with movement to primary residence in above ground structures only occurring near its end or early in the next phase.

Ideology and Ceremonialism. It is likely that the late Mesilla ceremonial pattern continued into this phase. This is suggested by the probable communal structure at Meyers Pithouse Village (Scarborough 1986), which resembles similar structures from late Mesilla phase sites. Thus, it is likely that the region was still participating in a widespread ideological system with roots in Mesoamerica, but there is no evidence of a ceremonial organization larger than individual villages.

Ties to Other Regions. Using the traditional date for this phase, some significant changes in extraregional ties begin to appear. These are mostly suggested by pottery imports. Mimbres pottery disappears from ceramic assemblages by around A.D. 1150 (Mauldin 1993), and this corresponds rather closely to the date assigned to the collapse of the Mimbres system (Stuart and Gauthier 1981). Subsequent pottery imports were dominated by types from the north (Chupadero Black-on-white, Three Rivers Red-on-terracotta, and St. Johns Polychrome) or the south (Playas Red and undifferentiated Chihuahuan wares).

Turquoise was found at Meyers Pithouse Village (Scarborough 1986:283), though it is uncertain whether it was from sources in the Jornada region or elsewhere. Turquoise and a *Glycimeris* sp. shell bracelet fragment were found at the Castner Annex Range Dam site and may have been from Doña Ana phase deposits (Bilbo 1972). A small fragment of cloth was recovered from the pithouse at this site (Bilbo 1972:75); though it is not described in detail, it may be a fragment of imported cotton cloth. *Olivella* sp. shell beads were recovered from the Hueco Tanks site (Kegley 1982).

Subsistence. It is presumed that the range of plant and animal foods consumed during the Doña Ana phase was similar to that of the late Mesilla. The most extensive published data on subsistence items is from Meyers Pithouse Village, where excavation recovered at least one bean, several kernels of corn, and a large amount of rabbit bone (Scarborough 1986). A mountain goat or sheep vertebra was found in a thermal feature at the Castner Annex Range Dam site (Bilbo 1972). Thus, while there is evidence that cultivation of domesticates and wild game hunting continued during this phase, little else can be said.

El Paso Phase (A.D. 1150 or 1200 to 1450 or 1500)

Lehmer noted few differences between the El Paso and Doña Ana phases. Rather, he felt that the "difference between the two phases is primarily one of time and of formalization of already existing patterns" (Lehmer 1948:82). Residence was generally in adobe pueblos, with roomblocks grouped around plazas or in rows oriented east to west. Pithouses were thought to have been phased out by this time.

Dating the Phase. Lehmer (1948) found it difficult to assign a date to end of the Doña Ana phase and the beginning of the El Paso phase. He considered the occurrence of Mimbres pottery in the former and its absence in the latter to be significant and from this suggested that the transition between phases occurred between A.D. 1150 and 1250 (Lehmer 1948:87-88). The end of the phase was linked to dates for the early Rio Grande glazewares that were occasionally found in local assemblages and suggested that the El Paso phase ended sometime between A.D. 1375 and 1400.

Since they were first proposed, these dates have come under scrutiny and are questioned by many researchers. Traditionally, the El Paso phase has been considered to extend from around A.D. 1200 to 1400. As Mauldin (1993:41) notes, if the presence of both Mimbres Black-on-white and Chupadero Black-on-white defines the Doña Ana phase, evidence from the few well-dated sites suggest the phase ended around A.D. 1150. However, if the construction of adobe roomblocks is also used as a defining characteristic, the El Paso phase probably didn't begin until around A.D. 1200, as tradition suggests. Even with nearly 50 years of additional research, we are little better off on this point than Lehmer was.

However, recent research has added a considerable amount of information concerning the end of this phase. Cordell and Earls (1984) have reevaluated dates of manufacture for Glaze A in the Piro district and conclude that it was produced or continued in use until at least A.D. 1500 in that area. This is a hundred years later than the traditional end date for this type (Habicht-Mauche 1993). If most of the Glaze A in the Jornada region was obtained from the Piro district, Cordell and Earls (1984:96-97) suggest that a later ending date for this phase must be considered.

Archaeomagnetic dates for several El Paso phase villages, including the Hot Well, Orogrande, Robledo Mountain, Sherman Hog Ranch, and Sabina Mountain sites, all fall within the traditional date range for the phase, clustering between the 1230s and 1360s (Brook 1970, 1975). However, a radiocarbon date from Pickup Pueblo is much later than expected. This date centers at A.D. 1530 $\pm$ 110 (Gerald 1988), yielding a second standard deviation range of A.D. 1310 to 1750. While the early part of this range falls into the traditional El Paso phase, it is equally likely that a later date is indicated. Beckett and Corbett (1992:44-45) cite several late dates from El Paso phase sites, which in addition to the redating of key ceramic types imply that the phase lasted past A.D. 1400.

Beckett and Corbett (1992) suggest that the El Paso people abandoned their villages and returned to a hunting and gathering subsistence base supplemented by some horticulture sometime between A.D. 1350 and 1450. Considering the redating of key ceramic types and some of the late dates for the area, it is possible that this phase lasted until around A.D. 1500. However, the early Spanish entradas encountered no sedentary farmers living in adobe pueblos in the Jornada region, and they received no information from groups farther to the south that pueblo dwellers existed in that region. Thus, there appears to have been enough separation between the end of adobe village occupancy and dependence on farming in the region and the appearance of the Spaniards in the mid to late sixteenth century for the memory of that type of adaptation to have faded.

Thus, some evidence suggests that the El Paso phase can be considered to have begun as early as A.D. 1150, though other characteristics are more indicative of the traditional date of A.D. 1200. A growing body of evidence indicates that this phase lasted longer than has been traditionally assumed, possibly into the 1500s. Since Spanish explorers encountered no signs of pueblo-dwelling farmers in the region, the phase definitely ended before the mid 1500s.

El Paso Phase Pottery. The beginning of the El Paso phase has often been assumed to coincide with the almost exclusive use of polychromes and the virtual abandonment of plain wares. However, Seaman and Mills (1988a:181) suggest that use of El Paso Brown continued into the early El Paso phase and was not replaced by decorated wares as rapidly as many believe. Thus, one cannot assume that an assemblage which contains both El Paso Brown and El Paso Polychrome dates to the late Mesilla or Doña Ana phases, as has often been the case in the past.

El Paso Polychrome sherds, both from decorated and undecorated portions of vessels, usually comprise a very high percentage of El Paso phase ceramic assemblages. For example, this type makes up 94 percent of the assemblage from La Cabrana Pueblo, 95 percent from Pickup Pueblo, 90 to 95 percent from the Sgt. Doyle site, 95 percent from the Condron Field site, 94.4 percent from the Bradfield site, 83.3 percent from the Alamogordo sites, and 90 percent from Twelve Room House (Bradley 1983; Gerald 1988; Green 1969; Hammack 1961; Lehmer 1948; Moore 1947). Trace amounts of El Paso Brown were found at the McGregor and Sgt. Doyle sites (Brook 1966a; Green 1969). A few textured El Paso Brown sherds were also noted at the Alamogordo sites (Lehmer 1948).

Imported wares from a variety of regions occur in small percentages in assemblages from this phase. Chupadero Black-on-white is often the most common imported ware present. Small amounts of Mimbres Black-on-white occur at a few sites and probably represent an earlier occupation or heirloom pieces (Brook 1966a; Hunter 1988; Lehmer 1948). Other types made in the Mogollon region are Lincoln Black-on-red and Three Rivers Red-on-terracotta. Pottery from the White Mountain and Zuñi areas include St. Johns Polychrome and Heshotauthla Polychrome (Bradley 1983; Brook 1966a; Gerald 1988; Green 1969; Hammack 1961; Hunter 1988; Lehmer 1948). Rio Grande wares of the Glaze A period occasionally occur and include Agua Fria Glaze-on-red and Arenal Glaze Polychrome (Green 1969; Lehmer 1948). Galisteo Black-on-white has also been reported from a few sites (Brook 1966a; Green 1969).

Wares imported from northern Mexico include Ramos Polychrome, Ramos Black, Playas Red Incised and Corrugated, Casas Grandes Incised, Carretas Polychrome, Villa Ahumada Polychrome, Madera Black-on-red, Babicora Polychrome, and unidentified Chihuahuan brown wares (Bradley 1983; Brook 1967; Foster and Bradley 1984; Green 1969; Hammack 1961; Hunter 1988; Kirkpatrick et al. 1994; Lehmer 1948). However, it should be noted that Wiseman (1981) has identified local copies of Playas Incised produced in the Sierra Blanca region. Thus, this type cannot always be assumed an import. Types generally associated with the Salado Culture include Tucson Polychrome and Gila Polychrome (Bradley 1983; Green 1969; Hammack 1961; Kirkpatrick et al. 1994; Lehmer 1948).

Unidentified smudged wares are sometimes recovered and include a polished brown ware from Pickup Pueblo (Gerald 1988) and corrugated wares from La Cabrana Pueblo, the Sgt. Doyle site, the Condron Field site, the Alamogordo sites, and Twelve Room House (Foster and Bradley 1984; Green 1969; Hammack 1961; Lehmer 1948; Moore 1947). Unidentified black and brown incised wares are reported from the McGregor site (Brook 1966a), and a red punctate ware was found at the Tony Colon I site (Hunter 1988).

Thus, while imported wares usually comprise less than 10 percent of El Paso phase assemblages, they occur at many sites, particularly those containing adobe structures. Various pottery types were imported from regions to the north, west, southwest, and south and represent a number of different groups including the Rio Grande Pueblos, Zuñi, northern Jornada Mogollon, western Mogollon, Salado, and Casas Grandes of northern Mexico.

House Forms and Feature Types. Lehmer (1948:80) claimed that El Paso houses were always adobe-walled surface structures and defined two basic forms--linear roomblocks and rooms grouped around plazas. While his first assertion is not upheld by more recent data, the second is basically confirmed. Unfortunately, incomplete descriptions make it difficult to determine the structure of many sites. For example, Hot Well Pueblo contains 150 to 200 rooms, 47 of which have been excavated (Bentley 1993:1). Unfortunately, the number of roomblocks is not mentioned. Brook (1975:19) implies that all but two rooms are contiguous; however, an excavational plan presented earlier (Brook 1966b) suggests that the village contains a series of discrete linear units. Thus, the organization of this village is uncertain, but the latter is more likely. The only large, plaza-oriented pueblos described in detail are from the Alamogordo area. House 2 at Alamogordo Site 1 was arranged in a C-shape around a plaza and contained between 75 and 100 rooms (Lehmer 1948). Alamogordo Site 2 contained about 60 rooms in a rough rectangle enclosing a plaza (Lehmer 1948).

In addition to Hot Well Pueblo and House 2 at Alamogordo Site 1, Hubbard (1992) indicates that Escondida and Indian Tank Pueblos contain more than 100 rooms apiece, and Cottonwood Springs Pueblo has over 200. Of these large villages, only Indian Tank is thought to contain more than one story (Hubbard 1992). Foster (1993:11) notes that pueblos containing eight to ten single story-rooms are more common than these large villages. Smaller villages were usually built as linear roomblocks, though a few L-shaped structures also occur. They are generally one to two rooms wide, and multiple roomblocks often occur at the same site. Descriptions are available for several of these small linear sites and can probably be considered representative. La Cabrana Pueblo contains nine rooms, eight in a double roomblock with a single large room at the northeast end (Bradley 1983; Foster and Bradley 1984). Pickup Pueblo contained six linear rooms (Gerald 1988). A total of 17 rooms in several blocks of 1 to 4 rooms was defined at the Sgt. Doyle site (Green 1969). Most were a single room wide, but one was two rooms wide, and another was L-shaped. The Condron Field site contained seven rooms in blocks of three and four, each a single room wide (Hammack 1961). A total of 16 rooms arranged in a block 1 to 2 rooms wide was found at the Bradfield site (Lehmer 1948). House 1 at Alamogordo Site 1 contained 15 rooms in a linear block one to two rooms wide, with an isolated block of two rooms (Lehmer 1948). Twelve Room House was built along similar lines, containing 12 rooms in a block that was 1 to 2 rooms wide in most places, and

3 rooms wide in one area (Moore 1947). Finally, Anapra Pueblo contained eight linear rooms (Scarborough 1985).

Villages seem to have grown by accretion rather than being built as planned communities. Pueblo walls are usually described as coursed or puddled adobe; they were commonly set in foundation trenches and often extend below floor levels. Wall heights are impossible to determine, since erosion has usually reduced them to mere stubs. In some cases walls are so badly eroded that only the subfloor extensions remain. Floors are sometimes described as slightly subsurface, and steps commonly occur, usually just within the presumed locations of doors. Floors are normally made of adobe, and interior surfaces of both walls and floors are usually plastered. One exception to this was La Cabrana Pueblo, where the floors were simply compacted soil (Foster and Bradley 1984). A few examples of multiple plaster layers on floors and walls have been noted, indicating that some structures were refurbished (Brook 1966a; Hammack 1961; Lehmer 1948).

Normally, little evidence of roof construction is either preserved or described in reports. However, good evidence of roof construction techniques is available from La Cabrana Pueblo (Foster and Bradley 1984). The roof of that village consisted of wooden vigas overlain by mesquite and tornillo limb latillas. This framework was covered with layers of grass and reeds, which were coated with a layer of adobe in at least some rooms.

Besides the refurbishing of wall and floor surfaces, there is evidence of more extensive remodeling at some pueblos. Part of one room at the Bradfield site was partitioned into a long narrow bin or room (Lehmer 1948). A room at Twelve Room House was similarly remodeled (Moore 1947). There, a large room was partitioned into three long narrow bins or rooms in addition to the original room, which was severely reduced in size. Remodelings like these could have been done to create secure storage spaces for important objects or supplies, and may be an indication of seasonal residence rather than year-round use. This was almost certainly the case at Twelve Room House, where a cache of ritual objects was discovered in one of the bins/narrow rooms.

Nearly every El Paso phase village contains at least one room that is much larger than other rooms at the site (Hammack 1961; Marshall 1973). Caches of ritual materials are often found beneath the floors of these rooms, and they seem to have served a communal function similar to Anasazi kivas. At Twelve Room House, Moore (1947:99) notes that the largest room did not show much evidence of use. The hearth was not fired to the extent of similar features in other rooms, and the floor was rough and unpolished. However, another room that was remodeled into four compartments was as large or larger than this chamber before it was subdivided. It is possible that the communal room was replaced, and the old one was used for the storage of ritual materials.

Postholes and hearths are the most common features in El Paso phase pueblos. Pits for roof support posts are often, but not always, found inside rooms. Support posts were set into walls in at least one case (Brook 1979:27). Intramural hearths are normally plastered and often collared and are usually circular in shape, though rectangular examples occur. Storage pits were often built within rooms. Their walls are sometimes plastered, and in some cases they were abandoned, filled, and covered by the floor. Other pits with undefined purposes sometimes occur, as do caches. A possible above-ground storage cist was identified in one room at the Sgt. Doyle site (Green 1969).

Few types of extramural features are recorded for pueblos because most excavation has concentrated on rooms. Extramural hearths containing fire-cracked rock were noted at the Sgt. Doyle site (Green 1969). Middens have been recorded at several sites, as have trash-filled borrow pits. Extramural storage pits also occur at a few villages, and small plazas or work areas have been defined at several sites. Perhaps the most interesting features are those associated with water conservation and control. At least nine reservoirs are recorded for the area, and all are either associated with El Paso villages or contain materials indicative of use during that phase (Bentley 1993; Hubbard 1987; Leach et al. 1993). Hubbard (1992) has located a possible canal, which he dates ca. A.D. 900 to 1000 on the basis of nearby sites. However, this date is probably too early, and if this feature is real it was probably built during the El Paso phase.

Some variation has been noted between villages along the Rio Grande and in basin interiors. In particular, there are important variations in village size, construction techniques, and degree of refurbishing. Foster and Bradley (1984:199) note that riverine sites tend to lack internal floor features, while basin villages often contain a variety of them. Riverine pueblos usually lack internal support posts and do not exhibit evidence of extensive refurbishing. This may reflect variation in the duration of occupation, with little major refurbishing required at riverine villages because of constant attention to maintenance needs (Foster and Bradley 1984:211). The largest villages tend to occur in basins rather than along the river.

While adobe villages are considered the main residences of the El Paso population, short-term habitation or task-specific sites also occur. While most seem to be open camps containing ephemeral shelters at best, there are a few examples of more substantial structures. Batcho et al. (1985:54-55) excavated an El Paso phase pithouse at the Santa Teresa Airport. This structure was square, measured 2 by 2 m, and was at least 40 cm deep. Sherds from a large El Paso Polychrome jar were on the floor, providing a firm date for the structure. At least five large extramural pits were probably used for storage. This site is thought to be a fieldhouse.

Carmichael (1985a, 1986c) excavated numerous pit structures dating to the Pueblo period (Doña Ana and El Paso phases) at Site 37 at Keystone Dam. Between 16 and 23 pit structures were located, generally small and circular with sloping walls, irregular floors, informal internal hearths, and postholes around their peripheries as well as on floor surfaces. Several structures overlap, suggesting that numerous occupational episodes were represented. The structures seem to have been unburned ephemeral brush shelters (Miller et al. 1985:182). Extramural features included large and small hearths containing fire-cracked rock. Carmichael (1986b) feels that these remains represent multiple short-term hunting and gathering occupations. However, it is also possible that they were farming structures.

Other researchers also suggest the existence of farming structures or fieldhouses in this region. Hubbard (1992) feels that many ceramic scatters and smaller pueblos may represent fieldhouses. During a survey in the southern San Andres Mountains, Browning (1991:31) identified numerous single-room structures represented by upright slab foundations that are thought to have been fieldhouses. These structures are often surrounded by activity areas containing extramural hearths and middens, and are probably contemporaneous with large El Paso phase villages in the area.

Ideology and Ceremonialism. The ideological and ritual system that originated during the late Mesilla phase became more pronounced and elaborate during this phase. The rock art style depicting masks, human faces, and animal forms continued in use, and the two former elements figured predominantly in the art of the Rio Grande Valley and Tularosa Basin (Schaafsma 1972, 1992). Foster (1993:12) feels that the abundant and complex rock art is evidence for increased ceremonialism. This ritual system was probably much different from that of Archaic and early Mesilla times and seems to have been particularly concerned with farming and rainmaking. That its adoption coincided with agricultural intensification and an increase and diversification of external contacts is of great importance and is treated in more detail in the next chapter.

Foster (1993) feels that Jornada society became more complex during the El Paso phase, with greater population concentrations and densities resulting in its reorganization. The largest villages were built during this phase and were probably at least partly integrated by ritual societies whose activities were centered in the large communal rooms, which Thompson (1988:61) suggests were focal points for activities related to group needs. Further evidence for the increased importance and elaboration of ritual was found at Hot Well Pueblo. There, analysis of features in one room suggests that it functioned as an astronomical observatory (Brook 1979:38). Another room contained a polychrome wall mural (Brook 1975:19). Though this mural was destroyed before it could be examined, a similar mural was found in a site near Roswell, dating to the fourteenth century (R. Wiseman, pers. comm., 1995). Though this region may not be closely related to our study area, a similar ritual system seems to have been functioning. This mural depicts a polychrome horned or plumed serpent and was painted on the wall of a large semisubterranean room that seems to have had a communal function.

Thus, the increased importance of ceremonialism is suggested by the presence of communal rooms in most sites, evidence for the importance of astronomical observations, and the occurrence of wall murals with a probable ritual association. The discovery of ritual caches and objects of religious importance buried beneath the floors of El Paso phase sites is further evidence of this process.

Ritual caches are documented for several sites and known anecdotally for others. Thompson (1988:61) notes that they are usually found beneath the floors of large communal rooms and often contain combinations of ornaments, pigments, and ceramic vessels. Brook (1975:19) notes that there were jewelry caches under the floors of two rooms at Hot Well Pueblo. Hammack (1961) found a cache in the center of the largest room at the Condron Field site, which contained 99 shell beads in a pit covered with a removable adobe plug and filled with sand that was not native to the area. Lehmer (1948) documents a cache from one of the Alamogordo sites that contained five polished turquoise blanks, several olivella shells, and a quartz crystal buried in a small jar under a room floor.

More extensive caches are reported from a few sites. A subfloor cache at La Cabrana Pueblo contained limonite and kaolin pigments, a large projectile point, three turquoise pendants, and smoothing stones (Bradley 1983:48). Numerous fossils were recovered from the floor of an adjacent room in association with pieces of shaped and unshaped calcite, gypsum crystals, shell beads and a pendant, turquoise, pyrite, carved stone shells, a copper ore pendant, a piece of pyrite embedded in a basalt nodule, many olivella shell beads, a fragment of a *Conus* sp. shell, and pieces of kaolin, hematite, malachite, limonite, and copper ore (Bradley 1983:72, 74). There was also a necklace containing an etched fluorite pendant and olivella shell beads, crinoids, turquoise, and sandstone concretions.

Perhaps the most extensive cache was found at Twelve Room House (Moore 1947). Room 2 at that site was partitioned into several bins or smaller rooms, in one of which was found a collection of materials that had apparently been stored and never recovered. It included 3 large jars, 2 "jug form" vessels, 3 El Paso Polychrome bowls with terraced rims, a polished black ware bowl, a small trough metate with yellow ocher on its surface, 2 round stone balls, a round stone object, 6 pieces of yellow ocher, 2 pieces of travertine, 62 olivella shell beads, 34 shell disk beads, 4 turquoise beads, 15 *Alectrion* sp. beads, 1 tubular shell bead, 1 small charred corn cob, a section of hollow reed containing a soft light green material, a basket fragment, and many burned gourds. The shell beads were stored in one or two of the broken jars. The material in the section of reed was similar to a lump of iron potassium found cached under three large sherds in a shallow pit in the southeast corner of Room 12. Hammack (1961) recovered a similar El Paso Polychrome bowl with stepped rim at the Condron Field site.

Several unique or very rare objects of probable religious function have also been found in sites of this phase. Lehmer (1948:53) reports seeing several stone and clay animal effigies in private collections from the Alamogordo area, which were reputedly found in El Paso phase sites. Four stone effigies were found at the Alamogordo sites. Three resembled bears and one a mountain sheep (Lehmer 1948). In addition, an elaborate white stone cloud terrace which was set into a cylindrical base was buried beneath the floor of one room (Lehmer 1948:70). Traces of green, brown, black, and blue paint were all that remained of its decoration. Lehmer (1948) notes that it was similar to another specimen seen in a private collection in Las Cruces.

Thus, an elaboration of the ritual system is visible in the array of objects and materials left behind, usually hidden in caches. They include objects depicting animal forms and cloud terraces, as well as ceramic vessels, particularly bowls with cloud terrace rims. Various pigments, numerous species of marine shell, turquoise, and perhaps projectile points also seem to have had a ritual significance. These types of objects and caches have not been found in earlier sites and may have assumed a special significance during this phase.

Ties to Other Regions. There is much evidence for extraregional contact during this phase, and pottery is one of the best indicators of its areal extent. Though imported types usually comprise only 5 to 10 percent of ceramic assemblages, they consistently indicate some level of interaction with distant regions. In particular, there seems to have been a great deal of interaction with other Mogollon peoples. Types like Lincoln Black-on-red and Three Rivers Red-on-terracotta suggest ties with the northern Jornada area. Contact with the White Mountain Red Ware-producing area of east-central Arizona and west-central New Mexico is suggested by finds of St. Johns Polychrome and Heshotauthla Polychrome. Small amounts of Mimbres Black-on-white also occur but are probably indicative of earlier occupations or heirloom pieces rather than contact with that area, since the Mimbres system collapsed before this phase began. Smudged or polished corrugated wares are reported from many sites but are never common, and their source remains unidentified. Wiseman (pers. comm., 1995) has examined a smudged corrugated sherd from Hot Well Pueblo that may be from the Reserve area. However, he notes that similar types were also manufactured along the east front of the Black Range and further north.

Pottery types from the Anasazi area include Glaze A and Galisteo Black-on-white, though these types are reported from only a few sites. Chupadero Black-on-white from central New Mexico is more common and sometimes occurs in fairly large percentages. Some contact with the Salado peoples to the west and southwest are suggested by finds of Tucson Polychrome and Gila Polychrome, but these types are rarely common. Conversely, the array of Mexican pottery types suggests a considerable amount of contact with northern Chihuahua. Numerous polychromes and textured ceramics were imported from that region and are fairly common at sites of this phase, particularly the large adobe-walled villages.

Considering the rarity of most Anasazi pottery, it is likely that there were no direct contacts with the far northern segments of that group. However, the common occurrence of Chupadero Black-on-white suggests a rather high degree of contact with intermediate groups in central New Mexico. Considerable contact also seems to have been maintained with other Mogollon groups, particularly those in the northern Jornada area and with the peoples of northern Chihuahua.

Turquoise is often found at El Paso phase sites, though much of it may have been mined in the Jornada area. Bentley (1993) suggests that at least some of the turquoise from Hot Well Pueblo was mined in the Jarilla Mountains. Similarly, some of the turquoise at La Cabrana Pueblo was from the Jarillas, though other specimens were from undetermined sources. Turquoise fragments or ornaments are reported from other sites but are not sourced (Brook 1966a; Green 1969; Hammack 1961; Hunter 1988; Kirkpatrick et al. 1994; Lehmer 1948; Moore 1947). Thus, it is difficult to determine whether most of the turquoise from this area was imported or mined locally. Preliminary evidence suggests that both possibilities are likely. Finds of copper bells are reported for the region but are rare (Lehmer 1948).

Marine shell, primarily from the Gulf of California, occurs with regularity in El Paso assemblages and suggests the existence of an extensive exchange network. *Olivella* sp. shells were often processed into beads, but unworked specimens also occur. Fragments of *Glycimeris* sp. shell bracelets have been recovered from many sites, though they are never common. *Conus* sp. shells were often used for tinklers and probably dangled from clothing or jewelry.

Other types of shell include a mother-of-pearl pendant from La Cabrana Pueblo and a possible abalone shell fragment from the Tony Colon I site (Foster and Bradley 1984; Hunter 1988). Lehmer (1948) reports beads made from marine worm casings and pendants cut from bivalve shells at the Alamogordo sites. Unfortunately, he does not mention whether the bivalves were marine or freshwater. *Alectrion* sp. beads were found at Twelve Room House (Moore 1947). Finally, Southward (1979) reports freshwater mussel shells in an assemblage from Three Rivers, as well as specimens of *Vermitus* spp. and *Spondylus princeps*. The freshwater mussel was either obtained from the Rio Grande (100 km away) or the Rio Pecos (160 km away).

Goods from a large region were moving into the southern Jornada area during the El Paso phase. While there was a degree of contact with other areas during earlier phases, there appears to have been an intensification of exchange ties with distant areas during this period that is represented by a proliferation in the amounts and types of exotic goods at many sites. In particular, there seems to have been quite a bit of contact with northern Mexico and central New Mexico. The latter includes the northern Jornada area and part of the Salinas district, especially the areas producing Lincoln Black-on-red, Three Rivers Red-on-terracotta, and Chupadero Black-on-white. While direct contact is possible for these areas, indirect contact is probably responsible for the occurrence of raw and processed marine shells, some turquoise, and pottery from the northern Anasazi region.

Subsistence. Though wild plant foods continued to be consumed in this phase, the variety and amounts of domesticates found in sites suggest that they had increased in dietary importance. This is partly suggested by large finds of corn. For example, Scarborough (1985) recovered corn cached in storage pits at Anapra Pueblo, and Brook (1966b:4) notes that a village excavated in 1939 about 64 km north of Hot Well Pueblo yielded 200 bushels of charred corn.

The array of cultigens included corn, several species of beans, and probably several species of cucurbits. Corn parts found during excavation include kernels, cupules, and cobs, (Brook 1966b, 1966b; Bradley 1983; Scarborough 1985; Southward 1979; Wetterstrom 1978). In addition to common beans, tepary and lima beans are reported from a few sites (Bradley 1983; Ford 1977). Cucurbit remains are rare and are often not identified to species. However, Ford (1977) identified warty squash at an El Paso phase site in the Hueco Bolson, and gourds are mentioned as possible cultigens (Bentley 1993).

Many wild plants were used for food, fuel, building materials, and other purposes. Mesquite and tornillo were probably very important supplements to the diet. Beans, pods, seed coats, and stems from these plants have been recovered from many sites of this phase (Bentley 1993; Brook 1966b; Bradley 1983; Ford 1977; Scarborough 1985; Southward 1979). Chenopodium and amaranth were also important food sources, and there was some use of grass seeds, though they are not commonly reported. Other wild plants that were consumed include large petal onion, mariola, acorn, at least two species of yucca, spurge, two species of acacia, purslane, buffalo gourd, a member of the pink family, bugseed, Mexican buckeye, and several species of cactus including prickly pear, Turk's cap, cholla, and pitaya (Bentley 1993; Brook 1966b; Bradley 1983; Ford 1977; Kirkpatrick et al. 1994; Southward 1979).

Woody plants were used for fuel and construction. Types of fuel woods reported for El Paso sites include mesquite, saltbush, and oak (Kirkpatrick et al. 1994; Southward 1979). Mesquite and tornillo limbs were also used in construction, as were ponderosa pine, juniper, reeds, and grass stems (Bentley 1993; Bradley 1983; Foster et al. 1981; Southward 1979). Some plants may have been used for different purposes. Sand Mormon tea stems were found at Hot Well Pueblo (Bentley 1993) and may have been used as a medicine. Hoary pea was found at La Cabrana Pueblo. This plant is used to stupefy fish by the Tarahumara and may have served a similar purpose at La Cabrana (Bradley 1983:109).

Many animal species were eaten, though rabbits seem to have remained the dominant source of animal protein. This is true even of La Cabrana Pueblo, where large amounts of fish were consumed (Bradley 1983; Foster et al. 1981). It is possible that turkeys were kept in El Paso villages, but direct evidence for this is not good. Turkey bone was recovered at La Cabrana Pueblo, but an overlying historic component also contained turkey remains. Thus, the turkey bone found in prehistoric deposits could have originated in historic levels (Foster and Bradley 1984). Fortunately, egg shells have been found at some sites and are probably turkey (Brook 1966b; Green 1969). Other mammals used for food include antelope, mule deer, kangaroo rat, white-throated woodrat, and possibly long-tailed weasel (Brook 1966b; Bradley 1983).

Fish remains are reported only from La Cabrana Pueblo, but they comprise a large percentage of the faunal assemblage from that site and probably represent an important, but often unrecognized, food source. This is particularly true of the riverine villages. Over 5,000 fish bones and scales were found in trash deposits at La Cabrana, including members of the catfish, gar, and sucker families. As noted above, the recovery of hoary pea from that site suggests that stupefying poisons were used in fishing.

Evidence of Formative Period Occupation in the Study Area

Formative period remains have been documented by most of the projects that have examined the Santa Teresa area. Ravesloot (1988a) recorded 42 Formative period components, assigning 32 to the Mesilla phase and 10 to the El Paso phase. Eleven other components contained a mixture of pottery suggesting they were occupied during more than one phase.

While Camilli et al. (1988) did not record sites, their study contains data on artifact clusters that provide some insight into the Formative period occupation. Artifact clusters from this period include 20 that contain Mesilla phase pottery, 134 that contain Doña Ana/El Paso phase pottery, 287 that contain undatable Formative period ceramics, and 34 lithic assemblages that contain diagnostic projectile points. Several pit structures and features were also investigated this study. Radiocarbon dates suggest that three of the excavated pit structures were built during the early Mesilla and two were built during the late Mesilla. Two excavated pits were probably used during the Mesilla phase, while a third had a late Mesilla date and was associated with one of the late Mesilla phase pithouses.

Of the 40 features investigated by O'Leary (1987) in the Santa Teresa area, one pit structure was not precisely dated but was associated with other features dating between the Late Archaic period and late Mesilla phase and may reflect a Mesilla phase occupation. Only one feature, a simple hearth, was definitely dated to the early Mesilla phase. Another hearth that contained fire-cracked rock was given a general Mesilla phase date. Three roasting pits were used during the Late Archaic period or early Mesilla phase. Four hearths, one of which contained fire-cracked rock, dated to the late Mesilla phase, while two hearths that contained fire-cracked rock dated to either the late Mesilla or El Paso phases. Only one feature, a simple hearth, was definitely dated to the El Paso phase.

In her survey near Santa Teresa, Elyea (1989) recorded 1 early Mesilla phase site, 3 late Mesilla phase sites, and 36 El Paso phase sites. Of the latter, 12 contained definite or suspected adobe structures, 6 had small middens and may represent seasonal field structures, and 18 had few or no features and probably were ephemeral field facilities or special-use locales (Elyea 1989:18). Seven other sites contained no diagnostic ceramics and were assigned a general Formative period date. Of the 26 sites recorded by Stuart (1990) during his survey at Santa Teresa, all but 2 contained pottery and were assigned at least a general Formative period date. Diagnostic ceramics were found at only 8 sites, including 3 Mesilla phase, 2 Doña Ana phase, 2 El Paso phase, and 1 mixed Mesilla-Doña Ana phase.

Two projects have examined cultural resources at the Santa Teresa Airport a few kilometers north of the project area. Moore and Bailey (1980) recorded 1 Mesilla phase component, 7 El Paso phase components, and 13 Formative period components that contained only nondiagnostic brown wares. The only structure defined was a probable pithouse at an El Paso phase site. Batcho et al. (1985) later tested 11 of these sites, as well as 2 others found during testing. Five hearths were investigated at NMSU 1380 (OCA:FA:15 and 16), but only one produced enough material for a radiocarbon date. That feature dated ca. A.D. 1600, which is much later than was suspected from surface remains. Other sites that contained dateable features were all from the El Paso phase. A hearth at NMSU 1384 (OCA:FA:13) dated to the fourteenth century. Two storage pits were found at NMSU 1386 (OCA:FA:20) and dated between A.D. 1320 and 1410. Perhaps the most significant discovery was at NMSU 1393 (OCA:FA:24), where a square pit structure, a large pit, and six smaller pits were found. While no dateable materials were recovered from the structure, pottery from the floor suggested an El Paso phase date.

A short distance east of the project area, Zamora (1992) excavated a small pit structure near Sunland Park. While the surface ceramic assemblage suggested an El Paso phase occupation, charcoal from the structure dated to A.D. 465 $\pm$ 60, suggesting a Mesilla phase occupation. Thus, it is likely that this site was used during more than one phase.

Protohistoric Period (A.D. 1450 or 1500 to 1600)

Many assume that the southern Jornada area was abandoned at the end of the El Paso phase. Unfortunately, most evidence for this abandonment is negative. While no sites from this area are assigned a Protohistoric date, Spanish documents show that it was occupied in the sixteenth century, and the reevaluation of ceramic dates and a few late absolute dates suggest a continual occupation from the El Paso phase into the Protohistoric period, though residence in adobe-walled villages did not continue. Upham (1984, 1988) feels that a realignment of subsistence strategies occurred, rather than replacement of the indigenous population. He suggests that the Jornada people adapted to changing environmental conditions (probably both physical and social) by switching to a more generalized settlement and subsistence system. Thus, the Protohistoric economic and settlement systems are thought to have been similar to those of the Archaic or Early Formative periods.

The study area was occupied by the Manso during Protohistoric times (Beckett 1984; Beckett and Corbett 1992). This name is not of native origin but was given to them by the Spaniards (Ayer 1916). At times they were also referred to as *Gorretas* or *Pasagueles* (Hammond and Rey 1953:661). The former name was given them because the way they wore their hair reminded the Spaniards of a small cap (Ayers 1916:13). The Mansos were not the only descendants of the Jornada Mogollon in this region. Beckett (1994:163) notes that the Jano and Jocome spoke similar dialects of the Sonoran branch of the Uto-Aztecan language family. Other groups like the Suma and Jumano were latecomers to the region and probably spoke languages that were related to one another but not to those of the other groups that inhabited the region (Beckett 1994). Riley (1987:297) suspects that the inhabitants of the La Junta area at the junction of the Rio Grande and Rio Conchos also spoke Uto-Aztecan dialects. Thus, since it is likely that several closely related groups lived along the Rio Conchos and Rio Grande as far north as the El Paso area, information on these groups may help flesh out the little we known about the Protohistoric Manso.

Spanish descriptions of the Manso are rather sketchy but provide some indications of their life style and customs. The first encounter between these groups may have occurred during the journey of Cabeza de Vaca and his companions along the Rio Grande. Just south of modern El Paso, they apparently encountered a people who Covey (1990) feels were either Mansos or Jumanos:

> He reported finding permanent houses where the people ate beans and melons [squash] and that he had seen corn. Overjoyed at this news, we gave boundless thanks to our lord.
>
> Castillo further told us that the Negro was on his way with the whole population of the town to await us on the trail not far off. Up we got and, in a league and a half, met the Negro and the townsfolk coming to greet us. They piled up for us beans, many squashes, gourds for carrying water, cowhide blankets, etc. (Covey 1990:114)

These people lived along a river that passed between mountains, an area that Covey (1990:114) places just below El Paso. Covey (1990:115) also notes that these people were not as sedentary as they seemed to Cabeza de Vaca. As Cabeza de Vaca passed through this area he noted a large population but saw no corn being grown (Covey 1990:116). This was apparently because of drought, and they told him they obtained the little corn they had from the west (Covey 1990:116). However, it is possible that Cabeza de Vaca was describing people near or in the La Junta area, where farming villages still existed. Indeed, when questioned by members of the Chamuscado-Rodríguez expedition in 1581, the people of that area stated that Spaniards had once passed through (Hammond and Rey 1966:77). Thus, it is difficult to determine whether Cabeza de Vaca was describing Mansos or inhabitants of the La Junta area.

A somewhat better description is provided by Diego Pérez de Luxán, who chronicled the Espejo expedition of 1582 to 1583. Both Hammond and Rey (1966) and Beckett and Corbett (1992) feel that the group he called Tanpachoas were Manso:

> During the six or seven days that we rested there in order to refresh our horses, they brought us a large quantity of mesquite, corn, and fish, for they fish much in the pools with small dragnets. They are people of the same blood and type as the Otomoacos, and of the same dress, except that the men tie their privy parts with a small ribbon. (Hammond and Rey 1966:169)

The Otomoacos along the Rio Conchos were described in more detail:

> These people go practically naked, with their privy parts exposed. They cover themselves with well-tanned skins of the cíbola (bison). These hides they tan and beat with stones until they are soft. The bows are Turkish, all reinforced and very strong, and the strings are made from the sinews of the buffalo. For these people ordinarily go after meat and skins where the buffalo range, which is about thirty leagues from this province. The women wear tanned deerskin bodices of some sort, resembling scapularies, for covering their breasts, and other tanned deerskins as skirts, using as cloaks tanned skins of the cattle. The indians wear [part of] their hair long and tied up on their heads. The men have their hair cut very short, up to the middle of their heads, and from there they leave it two fingers long and curl it with minimum paint in such a way that it resembles a small cap. They leave on the crown a long lock of hair to which they fasten feathers of white and dark birds such as geese, cranes, and sparrow-hawks. They cultivate corn, beans, and calabashes. (Hammond and Rey 1966:160-161)

Oñate's expedition encountered the Manso in 1598, describing them as having "long hair cut to resemble little Milan caps, headgear made to hold down the hair and covered with blood or paint" (Hammond and Rey 1953:315). During the Valverde investigation of 1601, Captain Juan de Ortega stated he had seen Mansos catching several species of fish and that they ate neither chiles or beans (Hammond and Rey 1953:661). The names of the fish he saw were *bagres, agujas,* and *coteas*. The first were catfish, the second probably gar, and the third could not be translated.

A very similar description of the Manso is provided by Fray Alonso de Benavides:

> This is also a people which has no houses, but only huts of branches [*ranchos de ramas*]. Nor do they sow, nor do the [men] wear any clothing in particular, but all [go] naked. And the women only cover themselves from the waist down with two deer-skins, one in front and the other behind. . . . And between a few of them they eat a cow raw, leaving nothing of the paunch--since they do not even pause to clean it of its filth but swallow it as it is, grabbing it with the mouth and cutting it off with knives of flint, and swallowing it without chewing. . . . And likewise they are accustomed to regale us with what they have--which is fish and mice. It is a people very comely, well-featured and robust. (Ayer 1916:13-14)

In his revised memorial of 1634, Benavides added to this description, noting, "They take pride in bedaubing themselves with powder of different colors which makes them look very ferocious" (Hodge et al. 1945:53). He also indicates that they ate quite a bit of fish.

While none of these descriptions are detailed, they provide a fair amount of information about the Manso. In turn, this may shed light on earlier phases (see the next chapter). From these descriptions it appears that males wore little clothing and that their hair was decorated with paint and features or covered with painted caps. Women wore deerskin skirts and perhaps bodices. Both sexes apparently wore bison robes when it was cold. In addition to painting their hair or caps, Manso males also probably painted their faces and bodies. In this they would have been following a widespread tradition in the region. For example, groups along the Rio Conchos were described as painting stripes on their arms, faces, and bodies (Hammond and Rey 1966:70, 73).

Benavides provides a brief description of Manso houses, which seem similar to the huts occupied by Mesilla phase and Archaic period peoples. However, further south in the La Junta area, Luxán saw pithouses: "The ranchería resembled a pueblo, as it was composed of flat-roofed houses, half under and half above the ground" (Hammond and Rey 1966:162). Thus, more substantial houses were still being used in parts of the southern Jornada region.

Subsistence information is similarly scanty, though some statements are very interesting. In general, the people of this region are described as farmers raising corn, beans, and squash. However, there also appears to have been a great deal of dependence on collected foods, particularly mesquite and agave. Early descriptions of Manso dress suggest they hunted deer and bison in addition to the rodents and fish that are specifically mentioned. If Covey (1990) is correct, agriculture may still have been very important in the 1530s, and fairly substantial houses may have been occupied. Forty to fifty years later, when several Spanish expeditions passed through the area, the Manso are described as subsisting on mesquite, corn, and fish. A statement made in 1601 suggests that neither chile nor beans were grown and that the Manso were observed fishing. In 1630 Benavides mentions the consumption of fish and mice, and implies that they hunted other animals, but no mention is made of farming or the collection of wild plant foods. By this time there appears to have been some attempts at missionary work in the area (Hughs 1914:304).

The first mission was established in the El Paso area in 1659, and it is likely that Spanish settlers moved in and established the pueblo of El Paso at that time (Hughs 1914). Alonso de Posada stated in 1686 that the Manso were not farming and were few in number (Thomas 1982:23). The Manso population was gathered into missions in the El Paso-Ciudad Juarez area over a number of years. Peace with all Manso bands was achieved by 1698, and the last Spanish Colonial record of an independent Manso population was dated 1711 (Beckett and Corbett 1992). By the 1760s there were too few Manso left to maintain a separate tribal organization, and they were essentially extinct as a tribe (Beckett and Corbett 1992).

If Cabeza de Vaca actually visited and described the Manso, it is apparent that significant changes took place between the 1530s and 1580s. Since there is no mention of pueblos, the population appears to have returned to a more generalized lifestyle by this time. However, there were still apparently a lot of people living in the region, so there does not seem to have been a large population collapse at the end of the El Paso phase. Another mechanism may be responsible for the abandonment of intensive agriculture. Settlements seem to have become even less permanent after Cabeza de Vaca's visit, and residential structures were not as substantial. Less and less farming may have been done, until by the 1680s they no longer farmed at all. This process is much easier to explain. Direct contact with the Spanish and indirect contact through intervening populations undoubtedly introduced diseases to which the Manso had no natural immunity. This probably caused a considerable reduction of the population, making full-time hunting and gathering a viable economic option. In other words, the population was once again small enough that they could subsist on wild resources without having to supplement them with domesticates.

Conclusions

This lengthy discussion of culture history has been presented as a base for later chapters. Since many of our concerns are with changing patterns of settlement and subsistence in the southern Jornada area, it was necessary to present a detailed discussion of several pertinent topics. The following chapter, in particular, will build upon the information presented here, examining different views of local adaptations and attempting to synthesize them into a testable model. This will allow us to refine the research design developed from test excavations (Moore 1992) and apply it to information recovered during excavations at the Santa Teresa site and the Mockingbird site.

CHANGING SCALES OF MOBILITY IN THE SOUTHERN JORNADA MOGOLLON REGION

James L. Moore

Various models have been used to explain settlement and subsistence patterns for the southern Jornada region. Some are detailed, while others are rather sketchy. Several of these models are examined and critiqued in this chapter. Settlement systems are considered to have been structured as microbands or macrobands in this discussion. Microbands are the basic building blocks of social organization, containing nuclear families and perhaps a few unmarried or elderly relatives. Macrobands contain more than one microband and may be related by blood or cultural ties.

Modeling Pit Structure Type

The ability to distinguish cold-season from warm-season sites is necessary, since most models suggest significant seasonal variation in group size and residence patterns. Hard (1983a:48) defines two house types for the late Mesilla phase: huts and pithouses. Huts are less than 3 m in diameter, have scooped-out floors that are less than 30 cm deep, are circular, and have sloping walls. Pithouses are over 3 m diameter, are deeper than 30 cm, have vertical walls, and are circular or rectangular. Unfortunately, this model classifies all excavated Archaic and early Mesilla phase structures as huts, no matter how they were used or how long they were occupied. Clearly, there are problems with extending it to periods for which it was not designed. A more fruitful approach would be to look for differences indicative of occupational type rather than strict variations in size and shape.

Season of use can be an important factor in structural variation. According to most models for the region, cold-season sites were occupied by macrobands for long periods of time, while warm-season sites were occupied by microbands for short periods of time. While all excavated Archaic structures can be classified as huts, variation in construction techniques and associated features suggest seasonal differences. The same attributes can be extended to later periods. Cold-season hut superstructures at Keystone Dam were sometimes plastered, perhaps for waterproofing or insulation (O'Laughlin 1980). Informal hearths occur in most and perhaps all of these structures, and there is evidence for storage facilities. Archaic structures elsewhere in the region seem to represent warm-season use. Their superstructures were not plastered, and storage features and internal hearths are rare.

Similar differences occur in early Mesilla phase structures. While houses at probable cold-season camps are sometimes larger than 3 m in diameter, they are usually less than 30 cm deep and lack the vertical walls indicative of pithouses in Hard's (1983a) model. Warm-season structures are often smaller in diameter, but are similar in depth and shape. However, there are important differences in associated features. Structures in probable cold-season camps often contain formal or informal hearths. Storage features also occur, both within and outside structures. Burials are sometimes found at these sites, while they are almost always absent at warm-season sites. Artifact assemblages are usually larger and more varied at cold-season sites.

Only two cold-season villages are well reported: the Keystone Dam site and Turquoise Ridge (O'Laughlin 1980; Whalen 1994a). The former is Archaic, while the latter contains early and late Mesilla phase components. There is evidence for repeated occupations at both sites. The Keystone Dam site represents multiple uses of a favored locale by macrobands of two to five households (O'Laughlin 1980). New houses were apparently built each time the site was occupied. At Turquoise Ridge there is evidence of remodeling and repair of old structures, as well as construction of new houses. Unfortunately, many probable warm-season sites were also reoccupied, though structures were rarely reused.

A flexible definition of cold-season versus warm-season houses should take form, associated features, and site structure into account. Thus, warm-season structures should be comparatively ephemeral. They should lack internal hearths, though this will not always be the case. Superstructures should be flimsy and unplastered, and formal storage features should be absent. There should be no evidence of remodeling or reoccupation. In contrast, cold-season houses should contain hearths and have comparatively substantial superstructures that may be plastered. Formal storage features should occur in structures or extramural areas. Finally, these houses may exhibit evidence of reuse or remodeling.

Archaic Period Settlement and Subsistence

MacNeish and Beckett (1987, 1994) provide a general model of Archaic settlement and subsistence in their discussions of the Chihuahua tradition. However, there are problems with their scheme, especially in how it sets the stage for the Early Formative period. In particular, their model is mostly derived from survey data rather than excavation. Hence, it is difficult to determine whether a large site represents a macroband gathering or a locale that was repeatedly occupied by microbands over a long period of time (see Moore [1980] and Vierra [1985] for discussions of this problem). It is also nearly impossible to determine whether a small site represents a microband camp or a task-specific locale. These problems pertain not only to Archaic sites but present a continuing dilemma throughout the prehistory of this region.

MacNeish and Beckett's Model: Evaluation and Criticisms

Except when specified, this discussion is based on MacNeish and Beckett (1987, 1994) and MacNeish (1993). The Gardner Springs phase (6000 $\pm$ 500 to 4300 $\pm$ 300 B.C.) settlement system is thought to have included macrobands, microbands, and possibly task groups, with band size varying seasonally. People were grouped in macrobands inhabiting camps in desert basin or playa zones during the winter. In the spring they are thought to have moved into riverine or lower bajada zones as microbands or task groups. The focus of exploitation shifted to the upper alluvial fans and riverine zone during the summer, again either as microbands or task groups. Some macrobands may have formed during this season, dispersing into microbands in the fall to exploit resources in the basin and riverine zones, with some task group use of the mountains.

This pattern is based on only 21 components and seems a bit detailed for so small a sample. It is more likely that these people were usually grouped into microbands that foraged between different ecological zones depending on the availability of food and water. There may have been seasonal macroband gatherings corresponding to periods of food surplus, but there is no indication that they lasted very long. There is also little evidence for storage features during this phase, suggesting that the population remained mobile year round, moving whenever food was depleted in an area.

The Keystone phase (4300 ± 300 to 2600 ± 200 B.C.) settlement system is thought to have been similar to that of the Gardner Springs phase, though the population may have been larger. In addition to macroband camps in the basin zone, there is evidence for similar sites in riverine settings that may have contained pit structures. However, MacNeish (1993:394) notes that most components from this phase are small and probably represent microband or logistical camps. Five sites may be large enough to have functioned as macroband camps, though he also feels that they could represent repeatedly occupied microband camps.

The presence of three cucurbit seeds in Keystone phase levels at Todson Shelter suggests that cultigens were grown by this early date. However, lacking corroborating data from other sites, this must be considered tentative. Similarly, a pit structure at the Keystone Dam site was dated to this phase, suggesting the use of small macroband camps. Unfortunately, only one structure dated this early, and reliance on radiocarbon samples always entails the risk of erroneous dates from old wood. Had this structure (House 2) dated to the middle or early part of the phase, its assignment to the Keystone phase would be more solid. Unfortunately, it dated toward the end of the phase and has a very large error factor (2790 ± 310 B.C.; O'Laughlin 1980:48). Even more unfortunate is the lack of dates from adjacent and probably associated pit structures and features that could be used to either corroborate or refute this date. Considering the large error factor and the probability of old wood use, it is equally likely that House 2 at the Keystone Dam site was used during the early part of the succeeding phase and by itself is not good evidence for the use of winter macroband camps during the Keystone phase.

It is likely that the settlement system for this phase mirrored that suggested for the Gardner Springs phase. Groups were probably structured as microbands during most of the year, moving whenever local foods were depleted. Winter macroband camps may have been occupied in favorable zones, though this is uncertain, as discussed above. There is limited evidence for horticulture, which could have supplied seasonal surpluses and made macroband site occupation possible. However, this possibility is also tenuous.

The Fresnal phase (2600 ± 200 to 900 ± 150 B.C.) settlement system was initially thought to consist of macroband camps along the Rio Grande during part of the year, with microbands using other ecological zones during the rest of the year. MacNeish (1993:396, 401) now feels that this population was relatively sedentary. He suggests that macrobands were based out of camps along the river or near playas, exploiting other zones by logistical forays during certain seasons.

While O'Laughlin's (1980) work at the Keystone Dam site showed that macroband camps certainly existed in the Rio Grande Valley during this phase, there is no evidence for sedentary residential sites. Macroband camps were probably used seasonally and could be inhabited for extended periods because of predictable surpluses. It is unlikely that this "sedentism" lasted longer than a season, and perhaps only part of a season, with the population foraging as microbands in other resource zones during the rest of the year. Cultigens probably represent the predictable food surpluses that made settlement in macroband camps feasible, and the existence of food surpluses is suggested by storage pits at the Keystone Dam site. While cultigens probably represent the predictable surplus that made long-term camp occupancy possible, we are in no way inferring that they were the only foods consumed or even stored for use during this season. Wild plant seeds were undoubtedly also stored for consumption in winter villages, but their availability (both spatial and quantitative) may have been less predictable than that of the cultigens.

Hueco phase (900 ± 150 B.C. to A.D. 200 ± 100) macroband camps are thought to have been occupied for most of the year, if not year round. This was accompanied by seasonal forays by microbands or task groups into other resource zones. Macroband camps are assumed to have been in the Rio Grande Valley, though some may have existed in desert basins. It is suggested that some macroband camps could be considered hamlets or pithouse villages and may represent the first evidence for a pattern representative of the early Mesilla phase. The use of logistical camps may have increased, though the difficulty involved in determining whether a small site represents a logistical or short-term microband camp is noted.

This model has the Late Archaic population living in permanent or nearly permanent villages along the Rio Grande or in desert basins, exploiting other resource zones by logistical forays. This is the culmination of a long-term trend toward increasing sedentism that fits well with the assumed development of fully agricultural villages during the early Mesilla phase. Unfortunately, this scheme is not well supported by data. There is no good evidence for this degree of sedentism during the Archaic or even the early Mesilla phase (Hard 1986; Mauldin 1993; Carmichael 1985b; Whalen 1994a). It is more likely that a pattern of short-term seasonal sedentism followed by dissolution into microbands during the rest of the year continued through this phase.

A General Model of Archaic Settlement and Subsistence

In the preceding discussion we suggested alternatives to MacNeish and Beckett's (1987, 1994) model of Archaic settlement and subsistence. In particular, we were critical of the function of macroband camps in the proposed settlement system and the level of mobility that they suggest. These criticisms are important because many feel that an Archaic lifestyle was retained during the Early Formative period, particularly in regards to residential mobility. If, as MacNeish and Beckett suggest, the Late Archaic population was essentially sedentary, the level of Early Formative residential mobility would constitute a return to an earlier Archaic pattern. However, if there is little evidence for Late Archaic residential stability, the Early Formative pattern represents only a slight change.

One of the biggest problems with this model is that it is mostly based on survey data. This can amplify difficulties involved in interpreting the meaning of cultural remains, since many features may have eroded away or are buried, and it is hard to fully analyze artifacts in the field. Thus, it is often difficult to distinguish macroband camps from those that were repeatedly used by microbands. It is also difficult to distinguish logistical sites from those used for foraging. While MacNeish and Beckett provide a useful and admittedly preliminary overview of the Archaic, many of their basic assumptions are questionable.

Macroband camps are an important part of this model, yet only one has been identified: the Keystone Dam site (O'Laughlin 1980). Other macroband camps are assigned this function solely on the basis of size, and this assumption can be dangerous. In contrast, Carmichael (1983) interprets large Archaic scatters in the Tularosa Basin as evidence of repeated microband visits to favored locales. He also argues against interpreting these sites as loci of long-term habitation, noting that they lack significant cultural deposits and thus must be short-term camps (Carmichael 1986c:120). Whalen (1994b:627) feels the Archaic population spent much of the year dispersed across the landscape in microbands. Winter camps were probably occupied by small macrobands for longer periods of time and were located to take advantage of permanent water sources during the dry winter.

O'Laughlin (1980:24-25) agrees that site locations imply that movement was scheduled to take advantage of resource availability, but he does not see any degree of sedentism. In comparison with MacNeish and Beckett, he downplays the size and significance of macroband camps. This is important, because he presents the only detailed examination of such a site for the area. As he suggests:

> These sites reflect a general tendency for the movement of social groups to correspond to the seasonal availability and spatial distribution of economically useful plant and animal resources. Some locales are repeatedly occupied due partially to the distribution of natural resources but more importantly to conditions that make the site more amenable to habitation. Variability in site size also suggests that small social groups may gather at favored locales for short periods of time to carry out cooperative activities, to reaffirm group solidarity, to exchange information, and to build economic, social, and kin networks. Residential mobility and the lack of permanent storage facilities suggest low population densities and the sufficiency of natural resources for subsistence needs. (O'Laughlin 1980:24-25)

Houses at the Keystone Dam site were small, shallow, of flimsy construction, and hardly large enough for a nuclear family (O'Laughlin 1980:234). They clustered in groups of two to five houses (O'Laughlin 1980:234). However, rather than a single occupation by a large macroband structured as clusters of smaller social groups, the site was probably occupied on several occasions by small macrobands. O'Laughlin (1980:234) suggests that this type of site may have been used throughout the year. However, instead of functioning as sedentary residences, he feels they were visited infrequently during much of the year to cache supplies of food. Only during the winter does he envision a residential use.

O'Laughlin's (1980) and Whalen's (1994b) ideas are in conflict with those of MacNeish and Beckett (1987, 1994). They feel that the Archaic population remained residentially mobile. Macroband camps were the focus of occupation during a single season at most and during the rest of the year were used to store food for the winter when resource availability was low. Archaic settlement and subsistence systems were probably similar to those modeled elsewhere in New Mexico (Irwin-Williams 1973, 1979; Moore 1980; Vierra 1980; Wills 1988). In general, these models envision a considerable amount of residential mobility in response to the distribution of food resources, both spatially and temporally. People traveled to where food was predicted or known to be available, and some degree of scheduling may have been employed to allow efficient exploitation of a wide range of resources.

Camps were probably occupied by microbands for a few days or weeks at a time during most of the year. This pattern may have changed during the winter, when food resources were seriously reduced. From at least the Fresnal phase (late Middle Archaic period), macroband camps seem to have been occupied during the winter and represent a period of short-term sedentism. If O'Laughlin is correct, winter camp locations were selected well in advance of that season, and preparations for the period of low resource availability were made. This probably entailed the construction and stocking of storage features at winter villages with surpluses.

Houses at the Keystone Dam site have already been described. While those structures could be considered ephemeral, pit structures investigated in other environmental zones are even more so. These structures probably represent warm-season occupations and are always small, seldom contain hearths, and rarely have associated storage features. Postholes are usually the only internal features, and they are often poorly preserved. Assemblages are nearly always small, and no middens have been reported, suggesting short-term occupations. No other clusters of pit structures like those at Keystone Dam have been found. In short, there is currently no evidence for the occupation of seasonal macroband sites anywhere but along the Rio Grande.

A wide variety of plant and animal foods were consumed by the Archaic population. It is possible that as the period progressed, reliance on small mammals increased while the use of large mammals decreased. However, Wimberly and Eidenbach's (1981) analysis of faunal remains from Fresnal Shelter suggests that hunting at highland camps may have focused on large game, with high meat-mass packages being transported away. Corresponding with this was evidence for the consumption of low meat-mass packages and discard of associated skeletal elements at the site. Since most bone tools from the region are made from large mammal bone, many elements that were transported in high meat-mass packages were probably turned into tools when the meat was gone. Large mammal remains may be badly underrepresented at lowland sites if this represents a common strategy, and patterns of meat consumption may be skewed.

Wild plants were important foods at all times. However, while many different plants were consumed, two categories were very important. First were those that produce storable seeds, such as grasses, cheno-ams, portulaca, and mesquite. Not only can these seeds be eaten when ripe, they can also be stored for use during leaner seasons. The second category are leaf succulents like agave, yucca, and sotol. The leaves, hearts, or stalks of these plants can be eaten, and some parts are available year round, though they are better food sources in certain seasons than in others (Hard 1983a). Thus, not only are some plant foods available year round, some can be also stored for later consumption.

Storable plant foods may have provided the surpluses that permitted early use of cold-season camps. Macrobands could have gathered in areas where these foods were available and remained until they were exhausted. This would have allowed the close social interaction with other people that was undoubtedly critical to their continued existence. When environmental conditions provided plentiful foods, the collection of seeds from a large area and transport to a central location for short-term storage may have allowed macrobands to remain in place for much of the winter.

Cultigens were a late addition to the subsistence system and represent a seasonally predictable and reliable surplus. The population undoubtedly maintained a high degree of residential mobility even after cultigens were adopted, but the surplus that they represent may have allowed more lengthy occupations of winter camps. Conversely, increasing population density may have required the addition of such surpluses because of competition for wild resources. With more people scattered across the landscape, it may have been difficult to amass the surpluses needed to last through the winter. Thus, the addition of cultigens may have been necessitated by demographic pressure. However, there is no good evidence for winter macroband camps before cultigens were adopted, and long-term residence in base camps may have been impossible without the reliable and predictable surplus that they represent.

Water was also a critical resource, particularly in desert basins lacking perennial streams other than the Rio Grande. Carmichael (1983) notes that many large Archaic camps in the Tularosa Basin are situated near playas and represent repeated visits to favored locations. He also notes that the few known long-term habitation sites are near permanent water sources. This illustrates the importance of water to site location. A zone along the river could be exploited as long as the Rio Grande was within convenient walking distance, perhaps no more than 3 or 4 km. However, the desert basins could only be used when water was locally available. Thus, their use was probably mostly restricted to the late summer rainy season. Winter is the driest time of year, which explains why macroband villages were probably confined to the riverine zone.

Thus, we suggest a pattern of high residential mobility throughout the Archaic, in contrast to the model of increasing sedentism proposed by MacNeish and Beckett (1987, 1994). By at least the Late Archaic, the lowest level of mobility was probably during the winter, when camps containing perhaps two to five microbands were occupied. The population probably subsisted on foods that were stored in anticipation of need during that season. It is likely that they also hunted, fished, and visited other food caches to supplement stores at the winter camp. Residence was in small microband camps occupied for short periods of time during the rest of the year.

Early Formative Period Settlement and Subsistence

The Mesilla phase (A.D. 200 or 500 to 1100) comprises the Early Formative period and can be broken into early and late parts. Many feel that a basically Archaic adaptation continued to be used during this period (Carmichael 1981, 1983; Sechrist 1994; Whalen 1980b, 1986). While this may be partly true, there were also important differences between Archaic and Early Formative adaptations. Unfortunately, it is often difficult to distinguish early from late Mesilla phase sites. Where absolute dates are lacking, the presence of Mimbres Black-on-white is usually used to separate late from early Mesilla components. When only El Paso Brown Ware sherds are present, it is impossible to confidently assign an occupational period.

Ceramic vessel rim shape was thought to indicate temporal change in many early studies. However, Whalen (1993) now doubts the ability of this characteristic to provide accurate temporal assignments, especially when only surface materials are available. Thus, many studies are unable to differentiate between early and late Mesilla components and lump them together.

Comparisons between Archaic and Early Formative Settlement Patterns

While the early Mesilla phase settlement and subsistence system was similar to that of the Archaic, some important differences have been noted. During a survey in the southern Tularosa Basin, Anschuetz et al. (1990:90) found no patterning in the distribution of Archaic sites, while Mesilla phase sites clustered in areas containing potential farm land. Mauldin (1993) noted a similar pattern in his survey near the same area, in which the Mesilla phase occupation tending to focus on alluvial fans. Whalen (1994b) feels that the Mesilla settlement system was larger and more complex than that of the Archaic, though food collection continued to be an integral part of the subsistence system.

Using nearest neighbor analysis to examine site distribution, Carmichael (1986a:126) found that Archaic sites in the southern Tularosa Basin display the largest degree of dispersion. The nearest neighbor statistic for Mesilla sites was almost identical, suggesting that the Archaic model of generalized foraging was also applicable to that phase (Carmichael 1986a:126). Still, some potentially important differences were noted. In particular, there was evidence for increasing occupational intensity over time, and the greatest percentage of increase occurred between the Archaic period and Mesilla phase (Carmichael 1986a:106).

Whalen (1986:75) notes that Archaic camps are distributed similarly to those of the early to middle Mesilla phase in the Hueco Bolson, and this may reflect a similar adaptation. The main difference between these adaptations seems to be an increased importance of winter base camps in the Mesilla phase (Whalen 1994a, 1994b). Winter base camp occupations were increasingly heavy and lengthy by at least A.D. 500 and were sustained by large-scale food storage (Whalen 1994a:141). But apart from this, he sees few differences between Early Formative and Late Archaic settlement systems.

However closely Archaic and Early Formative settlement systems resemble one another, there are differences in assemblages from these periods that suggest changes in the scale of mobility. Chipped stone reduction strategies can be used to assess mobility patterns. Two basic strategies are found in the Southwest: curated and expedient. The former entailed the manufacture of bifaces that served as both unspecialized tools and cores, while the latter focused on removal of flakes from cores for use as informal tools (Kelly 1985, 1988). Curated strategies are usually associated with a high degree of residential mobility, while expedient strategies are typically associated with sedentism. 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). Neither of these exceptions applies to the study area.

Curated strategies allowed production of the maximum length of useable edge per biface. By maximizing the return from cores it was possible to reduce the volume of raw material required for informal tool production. This helped lower the amount of weight transported between camps. Neither material waste or transport cost were important considerations in expedient strategies, where flakes were simply struck from cores when needed. Thus, knowledge of the type of reduction strategy used by a group can help in estimating whether they were residentially mobile or sedentary.

The types of materials used by a group may be useful in distinguishing between these strategies. High-quality cryptocrystalline rocks are well suited to the manufacture of formal tools because they can be flaked in a predictable fashion, while grainier materials are less suitable because they are not as easily or predictably flaked (Whittaker 1994). Since Southwestern curated strategies focused on production of certain formal tools, one would expect them to use high-quality materials. Material quality was less important in expedient strategies, where the production of sharp edges was usually all that mattered. Thus, material quality should vary between curated and expedient strategies, the former preferring high-quality materials, and the latter using a mixture of high- and poor-quality materials.

Some differences have been noted between Archaic and Mesilla reduction and material selection strategies, though evidence for this is often inconsistent. Carmichael (1986a:185) sees a clear distinction in material selection patterns, with poorer-quality materials being used during the Mesilla phase. In this, Mesilla assemblages are more similar to those of later sedentary periods than they are the highly mobile Archaic. Elyea (1989:18) separated Archaic assemblages from those of later periods by the presence of bifaces or biface reduction debris. She notes that Archaic assemblages contain thinner flakes and larger quantities of high-quality materials than do those of the Formative period. Ravesloot (1988a:153) examined tool distributions on sites in the Santa Teresa area. He found a higher than expected frequency of formal tools on Archaic sites, while values were near the expected for Mesilla sites. In contrast, El Paso phase sites contained fewer formal tools than expected but more informal tools. Thus, there seems to be a decrease in the use of formal flaked tools through time. Whalen (1994a:94) summarizes the findings of the many studies of chipped stone technology in the region. There seems to have been a simplification of technology between the Archaic and Early Formative periods. The latter focused on expedient tool production. Bifaces were still made, but were less common than during the Archaic.

These differences probably reflect variation in mobility patterns. The Archaic strategy focused on reduction of high-quality materials to produce bifaces. The Mesilla strategy was more expedient and, while high-quality materials continued to be used, large quantities of low grade materials were also reduced. This suggests a reduction in mobility or development of new ways to fulfill tool kit needs. Major changes in the tool kit included the adoption of ceramic technology and replacement of darts and atlatls by bows and arrows. Unfortunately, these changes do not account for variations in reduction strategy, and some change in residential mobility is probably indicated. While the Mesilla population remained residentially mobile, it was probably scaled differently than the Archaic.

Hard's Model of Late Mesilla Phase Settlement and Subsistence

Hard (1983a:41-51) has proposed a model of late Mesilla settlement and subsistence. While both the early and late parts of this phase were probably dominated by hunting and gathering, with agriculture playing a secondary role, he suggests there was a higher degree of sedentism, more dependence on farming, and a larger population in the late part of the phase. Five environmental zones are defined: mountains, a riverine zone along the Rio Grande, a mountain periphery zone comprised of alluvial fans and pediments at the base of mountain ranges, desert basins, and playas in the desert basins. Use of these zones was scheduled around resource availability, particularly water and plant foods.

Hard proposes two types of residential sites in the late Mesilla phase: summer foraging camps and winter collecting camps. Structure types should vary with season of use, with pithouses occurring at cold-season camps and huts at warm-season camps. While evidence for repeated annual occupations is expected at cold-season camps, a similar pattern should not be found at warm-season camps. Cold-season camps should occur in the mountain periphery and riverine zones, where reliable supplies of water and firewood are available. Summer camps should mainly be in the desert basins, where firewood and water are much scarcer.

Fields were probably situated along the river or at the base of alluvial fans, locations that were presumably near cold-season villages. Hard feels that riverine fields were planted in the spring, while those on alluvial fans could not be planted until the late summer rains began. This is questionable, particularly in regards to corn growth patterns. While soil moisture is important for corn germination, it is especially critical during the period of silking and tasseling and the 50 days between that stage and crop maturation (Denmead and Shaw 1962; Shaw and Thoms 1951). The predictable late summer rains were critical to crop maturation and yield. Planting was probably timed so the late growth period coincided with the monsoon season, as is suggested for the Taos area (Moore 1994). Thus, fields on alluvial fans were probably planted in the spring whenever soil moisture was sufficient for seed germination and may not have been used in dry years.

Spring was the period of greatest resource stress. Water was available only in the river, mountain springs, and deepest playas. Food stores were probably low by this time, and few wild plant foods were available. The deer population is dispersed during this season, and the rabbit population has begun to grow, particularly in the desert basins. Unfortunately, little water is available in that zone. Spring residences should be in the same environmental zones as cold-season camps, and the latter may have been occupied into the spring. Leaf succulents were the main food resource available and may have been exploited in the mountain periphery zone by logistical or foraging camps. Residential movement was probably more common in spring than winter but was restricted to zones where water was available. Rabbits and agave were probably the main subsistence items. Fields were either abandoned or tended by a few individuals who remained nearby while the rest of the group moved on.

Rainfall accelerates plant growth during the summer, seeds ripen on many species of edible plants, rabbit populations peak, and water becomes available in playas. Summer camps should be located where there were sufficient supplies of food, water, and firewood. In normal years, the vast inner basins would be open to use during this season. During dry years only parts of the basins may have been useable. Foraging camps were probably established near sources of water and were moved as food resources became depleted, probably on the order of every few days or weeks.

The rainy season ends in the fall near the end of October, and the structure and locations of resources begin to change. Shallow playas dry up, limiting water supplies in desert basins. Seed production slows, while acorns and piñon become available in the mountains. Deer enter the rut and are easier to hunt, and cultigens begin to ripen. Since more resources are available in the mountains than in the basins, acquisition strategies and camp locations should shift between summer and winter patterns.

By winter, only leaf succulents are available for consumption, but ethnographic groups prefer not to consume them at this time of year because their sugar content is low. Deer and rabbits were still available and probably hunted from logistical camps. The population mainly subsisted on stored foods during this season, including cultigens. Sites were located in the mountain periphery and riverine zones because dependable supplies of water and firewood were both available nearby.

As Hard (1983a:47) summarizes, "Groups during the Late Mesilla phase would subsist on some cultigens and substantial amounts of wild plant and animal products. The seasonal changes in location of the base camps and in land use strategy would be in response to the seasonal congruence or lack of congruence of plant products, animals, fuel, and water."

More cultigens should be consumed in cold-season camps and would require a slightly different tool kit: mainly vessels suitable for extended simmering or boiling. Ground stone tools at cold-season camps should have larger grinding surfaces, possibly reflecting the use of trough metates and two-hand manos. Tools with smaller grinding areas are expected at warm-season sites, reflecting wild seed processing.

Whalen's Model of Late Mesilla Phase Settlement and Subsistence

Whalen (1994a, 1994b) also presents a settlement and subsistence model for this phase. While not as detailed as Hard's, it includes some of his ideas and takes both the early and late parts of the phase into account. Whalen believes that the early Mesilla people maintained a basically Archaic settlement and subsistence system, with one major difference: a more intensive use of cold-season camps. This pattern was sustained by large-scale food storage. While there is some evidence for food storage at Archaic cold-season camps, it was at a much lower scale. Storage facilities at cold-season camps were probably filled with cultigens and wild foods gathered at warm-season camps. The rest of the settlement system probably resembled that of the Archaic and included small camps and resource extractive locales (Whalen 1994a:142).

This pattern apparently continued into the late Mesilla phase with little change, though there is evidence for increased storage capacity at cold-season camps. Subsistence throughout the period relied on wild resources supplemented by domesticates. However, there is some evidence for an increase in the use of cultigens during the late Mesilla phase (Whalen 1994a:119; Whalen 1994b:634). Other changes suggest a slight reorganization of society late in the phase that included larger groups using cold-season camps and construction of communal structures.

Variation between early and late Mesilla phase pottery also suggests that important changes occurred. Sherds are more common at late Mesilla sites, suggesting an increase in the use of pottery vessels for certain tasks. Technological changes resulted in more durable pottery and may be related to changes in food preparation techniques. Foods processed in pottery vessels may have been heated for longer periods or more intensively than before. This required an increase in vessel use-life, resistance to heat shock, and improved heating characteristics. Changes in vessel form and capacity suggest that storage in large ceramic containers may have also increased in importance.

The population seems to have remained highly mobile during this phase. Settlement focused on the environmental zones that provided the most resources. The best areas for farming were at basin edges where they meet mountain piedmonts, while basin interiors were optimal for hunting and gathering. Most prehistoric sites are located in these zones. The mountains were used as special resource procurement areas, while mountain piedmonts were the least productive environmental zone.

A General Settlement and Subsistence Model for the Mesilla Phase

These models make several important points. First, the Mesilla phase population is believed to have been residentially mobile, with a settlement system resembling that of the Archaic. The subsistence system was based on collection of wild plant foods and hunting, supplemented by farming. The mobility strategy seems to have shifted back and forth between foraging and collecting, depending on season. Finally, there were important differences between early and late parts of the phase, involving both the level of dependence on cultigens and how society was structured.

Hard's (1983a) model is detailed yet virtually untested. On the other hand, Whalen's (1994a) model is less detailed, but it is supported by some excavation data. By combining these models, taking points made in the preceding paragraph into consideration and incorporating other observations pertinent to this time period, it is possible to construct a more general model.

While the Mesilla phase population remained residentially mobile, it is likely that their mobility was scaled differently from that of the Archaic. Several aspects of the Mesilla phase lifestyle are indicative of this, including a tendency for sites to cluster in areas containing potential farmland, a focus on expedient chipped stone reduction, and an increase in the scale of storage at cold-season camps. While other variables could certainly be used to differentiate between Archaic and Mesilla phase occupations, these should be sufficient to illustrate differences in the scale of mobility.

Though the Mesilla population remained residentially mobile, evidence suggests that the scale of mobility was lower than during the Archaic. As Vierra (1992:71) notes, the use of storage as a subsistence strategy can reduce mobility by tethering a group to those stored foods. While Vierra's study focused on hunter-gatherers that consumed no cultigens, his observations are useful in this discussion. When storage became an important part of the subsistence system, residential mobility was necessarily reduced. The need to transport surplus foods to cold-season camps and a corresponding need to protect those goods meant that groups probably did not move as far or as often as they had in the past.

The use of domesticates probably represents an attempt to diversify the subsistence base and perhaps add stability. While this trend began during the Late Archaic, it became a critical need by the beginning of the Mesilla phase. Domesticates represent a dependable and predictable seasonal surplus that can supplement stores of wild plant foods and allow groups to reside in one location for longer periods. The need to do this suggests that stored wild plant foods supplemented by the few foods available during the cold season were no longer sufficient to support the population through the lean winter months. Changes in cooking technology may also indicate the growing importance of domesticates in the diet. Starchy foods, like corn, often need to be cooked longer or at higher temperatures, and increasing the consumption of such foods may have required use of ceramic vessels.

One aspect of subsistence that neither model takes into account is the use of aquatic resources. This is probably because they are focused on desert basins rather than the Rio Grande Valley. O'Laughlin has conducted excavations at Mesilla phase sites along the Rio Grande and reports the use of a limited number of aquatic species. Examples of spiny soft shell turtle were recovered from the Sandy Bone and Roth sites, and muskrat was also found at the former, while possible freshwater mollusk was recovered from the latter (O'Laughlin 1977a, 1981). However, the absence of fish is puzzling. Fish bone was common at the El Paso phase La Cabrana site (Bradley 1983; Foster and Bradley 1984), and there are numerous accounts of fish consumption by the historic Manso (Ayer 1916:13-14; Hammond and Rey 1953:661, 1966:169; Hodge et al. 1945:53), who are believed to be descended from the southern Jornada people. It would be logical to assume that fish were eaten throughout the prehistoric sequence, especially since there is evidence for use of other aquatic resources. Unfortunately, no sites earlier than the El Paso phase have to this date yielded fish bone, so this remains conjectural.

So, while the Mesilla population maintained a relatively high degree of residential mobility, their movement was structured differently from that of the Archaic. A heavy dependence on stored foods probably tethered the population to cold-season sites, restricting the distance and frequency of residential moves. Some evidence suggests a diversification of the subsistence base during this phase, with cultigens assuming increased importance. Aquatic resources may also have been more important than current data suggests. Changes in chipped stone technology suggest a reduction in mobility. Evidence for more intensive site occupancy and a clustering of sites in zones containing potential farm land suggests that the pattern of movement became more regular or that some camps were occupied for longer periods. Thus, there are clear differences in the scale of mobility between Archaic and Mesilla occupations that suggest the latter was somewhat less mobile.

We do not want to give the impression that Mesilla phase people were sedentary farmers. Quite the contrary, this adaptation was mainly predicated on hunting and gathering; cultigens simply seem to represent a supplement to the diet. However, they were a very important supplement. Foods like corn and beans are well suited to long-term storage and probably allowed the population to remain in cold-season camps for much longer than was possible when they were subsisting on wild foods alone. However, as noted above, reduction in mobility was a probable consequence of this strategy.

In general, Hard's (1983a) model seems applicable to the entire Mesilla phase, though there were differences in the amount of farming practiced and length of stay in cold-season camps between early and late parts of the phase. Cold-season structures were somewhat more substantial, tend to contain heating features, and were sometimes remodeled. The riverine zone was probably the best location for cold-season camps, but it was apparently not possible to support everyone in that zone. This led to the establishment of winter camps in other areas where water and firewood were available. These camps may have been occupied into late spring or early summer, with stored foods being supplemented by leaf succulents obtained by logistical task groups. Conversely, villages may have broken into microbands to forage for leaf succulents, early greens, and meat when food stores were exhausted.

Fields were probably planted in late April or May to schedule the late stage of corn growth to coincide with the arrival of the summer monsoons. Warm-season movement was in microbands, and evidence suggests a regularity to the pattern of movement, with the same general areas being reoccupied. Fields may have been left untended, as was common among the Western Apaches (Hard 1983a:44). It is also possible that a few individuals remained near fields to protect them from damage.

Heavy reliance on stored foods during the cold season suggests that locations of winter camps were planned in advance, whether that meant a return to a former camp or selection of a new one. Groups were probably tethered to these locations by a need for periodic visits to transport foods for storage. These visits could have served a dual purpose if fields were left untended: foods could be stored and fields could be tended. Either the entire band or just a few individuals could have participated in these visits. Warm-season camps moved around the landscape as resources were depleted. A variety of zones were exploited, and this aspect of the settlement system is modeled in detail by Hard (1983a).

As Whalen (1994a) suggests, there are important differences between the early and late Mesilla phase. There seems to have been a further intensification of the role played by domesticates in the subsistence system during the late part of the phase. In addition to this were apparent changes in the ideological system that led to a formalization of social integration mechanisms. Ties to other regions also appear to have intensified.

Obviously there were fluctuations from year to year that this model cannot account for. In years when climatic conditions were ideal for farming, much more land was probably planted, providing larger stores of cultigens. Conversely, in dry years there may have been no planting at all, and the population derived most or all of its sustenance from wild foods. While these factors can rarely be considered in a general model, they must be kept in mind. Too often, sites that do not fit models are considered anomalous and dropped from consideration or explained away. It may be more useful to think of them in terms of microfluctuations in settlement and subsistence systems in which atypical sites are actually evidence of flexibility in adapting to short-term difficulties.

Religion, Trade, and Regional Centers

Shifting patterns of regional interaction are evident in the history of the southern Jornada region. Some consider widespread interaction to be evidence of social networks allowing access to resources in different areas (Anschuetz 1984; Rautman 1993). Others feel that much exchange was aimed at acquiring luxury goods that were not locally available (Crown 1991; Mathien 1984). Still others feel that certain classes of necessary goods were moved to regional centers (DiPeso 1974b: H. Toll 1984).

While we lack sufficient data to consider this point in detail, exchange probably fulfilled all three of these functions. Short-range exchange could have provided access to resources controlled by neighbors. Thus, basin-oriented groups could have gained access to riverine resources through ritualized exchange and vice versa. Long-range trade probably fulfilled a completely different set of needs. Many goods from distant regions seem to have been acquired as luxury items or for ritual use, while goods from the Jornada region may have been moved to regional centers for consumption. Whatever their function, the presence of exotic materials shows that the study area was linked to large-scale exchange systems, though the direction and intensity of those connections changed over time.

There were also major changes in ideology and ceremonialism over time. When this is compared and contrasted with regional systems of exchange and influence, an interesting pattern of culture change emerges. It is likely that the southern Jornada region was not always as isolated and on the fringe of regional developments, as is commonly thought.

Early Regional Patterns of Exchange and Influence: The Mimbres Factor

Throughout the Mesilla phase, the study area seems to have had its greatest degree of outside contact with the western Mogollon region, particularly the Mimbres area. While contact with the northern Jornada area was also common, the Mimbres contact is considered more significant in this context because it seems to have served as the center of a regional interaction sphere through much of this phase.

Considerable interaction had developed between the Mimbres and Hohokam regions by A.D. 750, involving the adoption of certain artifact types and ceramic styles and motifs by the former from the latter (LeBlanc 1989:184). Large amounts of shell ornaments also seem to have moved into the Mimbres area from the Hohokam (LeBlanc 1989). Hohokam influence began to decline by A.D. 900 and had little effect on further developments in the Mimbres area (LeBlanc 1989). Major changes occurred in Mimbres society between A.D. 1000 and 1150, leading to the development of large villages containing above-ground roomblocks and partitioned ritual space. However, there is no evidence for organization at a macrovillage level or the assignment of hereditary status to groups of related people (LeBlanc 1989).

The Mimbres system collapsed by A.D. 1150, perhaps because of an inability to cope with environmental adversity at this level of social integration. The cause of its collapse is not important to this discussion, but the timing is. The Chaco system that integrated much of northwestern New Mexico also collapsed at nearly the same time, and perhaps for similar reasons. Both systems were large-scale organizational networks, and their collapse at nearly the same time must have created a huge vacuum in regional exchange networks. Other systems soon stepped in to fill the void. In the north, the Chaco system was replaced by an organizational network centered on the upper San Juan district, while in the south the Mimbres was replaced by the Casas Grandes system.

While some trends in the Mimbres area are echoed in the southern Jornada region, they caused no extensive changes. This is probably because the Mimbres were unable to exert direct influence over others due to a lack of central control. While they probably controlled the movement of certain goods to the north and east, they lacked the ability to spread their organizational system over a large region. This is similar to the early Chaco sphere of influence. Before A.D. 1050 there was little central control over that network, which was linked by the exchange of certain goods (Judge 1989). However, after A.D. 1050 the entire system seems to have been closely integrated, perhaps by ritual centers first located at Chaco Canyon and later in the San Juan/La Plata River Valleys (Judge 1989). Thus, the late Chaco system was able to actively expand its influence over a large area, while the Mimbres system had no such capability.

Even so, the Mimbres sphere of influence was quite extensive. Mimbres Black-on-white pottery is often found in small amounts on late Mesilla phase sites. Phillips (1989:182) notes that Mimbres pottery occurs on Perros Bravos phase sites in the Casas Grandes area, which he dates between A.D. 1075 and 1150. Thus, Mimbres pottery occurs on sites in south-central New Mexico and adjacent parts of west Texas, as well as in northern Chihuahua.

However extensive this exchange network was, the Mimbres system exerted little influence over developments in the southern Jornada region. While changes are apparent in the southern Jornada area after A.D. 750, most are probably related to local demography rather than outside influence. Changes in the religious system may be an exception to this. Whalen (1994a) notes that communal structures only occur at Mesilla sites dating after A.D. 750 and suggests they indicate the development of corporate entities capable of making group-level decisions (Whalen 1994b:634). While this may simply be related to a need for tighter social integration in cold-season camps that were occupied for longer periods of time, the impetus for the specific mechanism that was adopted may have come from the Mimbres area, which had a long history of group integration centered on communal structures (LeBlanc 1989). Thus, economic ties may have led to the adoption of certain social mechanisms based on a Mimbres model. While the southern Jornada area was part of the Mimbres interaction sphere, that larger region was not integrated into a single social or economic entity. Ties seem to have been weak and based solely on the exchange of goods. Any influence on the development of local social systems was indirect and unintentional, a simple outgrowth of a close economic relationship. This situation changed drastically after A.D. 1150.

Late Regional Patterns of Exchange and Influence: The Casas Grandes Factor

Two processes had considerable effect on the development of late southern Jornada society: the spread of a new set of religious beliefs and the rise of Casas Grandes. Rather than representing independent events, it is likely that they are closely related. Paquimé is the only large Casas Grandes town that has been extensively excavated (DiPeso 1974a, 1974b). This town was part of an organizational system quite different from anything known earlier or later in the prehistoric Southwest. Though DiPeso considered it the center of a large, tightly integrated region, it actually seems to have been only one of many populous towns.

Paquimé contained evidence of monumental ritual architecture, craft specialization, and a hierarchical social system based on warfare (DiPeso 1974b; Phillips 1989; Ravesloot 1988c). DiPeso (1974b) felt it was founded by immigrants from Mesoamerica. Others disagree and link developments in northern Chihuahua to indirect influence from Mesoamerica (Phillips 1989:393). The major period of construction and power at Paquimé, and presumably other Casas Grandes towns, was the Medio period (DiPeso 1974b). This period, recently redated, lasted from A.D. 1150 to 1450 (Phillips 1989; Ravesloot 1988c). Phillips (1989:383) and LeBlanc (1989:201) link development of the Casas Grandes sphere of influence to collapse of the Mimbres system. However, it was patterned quite differently. LeBlanc (1989) feels it was organized at a chiefdom level and was expansionistic, incorporating groups that had previously been autonomous. Trade is thought to have been highly organized rather than "down the line," as was probably characteristic of earlier systems (LeBlanc 1989:195).

Thus, Casas Grandes was an expansionistic entity that seems to have exerted direct control over a large area. The apparent importance of warfare among the elite may have provided the means to exert this control. While the southern Jornada area was almost certainly outside the zone of direct control, it was definitely within the Casas Grandes sphere of influence and closely affected by developments in that region.

Religion may have been one of the ways in which the southern Jornada was affected by Casas Grandes. Schaafsma (1995) notes that the late prehistoric rock art of Casas Grandes (Paquimé style) resembles that of the Jornada and Mimbres regions (Jornada style). Though these styles are given different names, they are quite similar (Schaafsma 1995:54). Indeed, they vary more in the frequency of certain motifs than in their presence or absence (Schaafsma 1995:58). This style represents a major break with past traditions (Schaafsma 1992:60), and its eventual spread to the Pueblo area is linked to "the appearance of socioreligious institutions capable of successfully integrating the multilineage villages which were forming at that time" (Schaafsma and Schaafsma 1974:544).

Schaafsma (1992, 1995) feels that the Jornada style may have originated in the Mimbres area around A.D. 1000, based on the similarity of some motifs to designs on Mimbres Black-on-white pottery. Since the development of this style seems to represent the adoption of a new ideological system, one would expect to see corresponding changes in other aspects of social organization at that time. While there is some evidence that this might have occurred, it was not rapid. The switch from residence in pithouses to above-ground pueblos occurred around A.D. 1000. Lekson (1992) links this to a decrease in mobility and suggests that it may have occurred over a few generations rather than overnight.

LeBlanc (1989) has summarized changes in Mimbres ritual architecture between A.D. 1000 and 1150. Great kivas fell out of use during this period, roomblocks were arranged to form plazas which may have replaced the great kivas, small rooms were used for ceremonial purposes, and unusually large rooms with an apparent communal function appear late in the period (LeBlanc 1989:187). The latter are similar to rooms in El Paso phase villages, suggesting the development of a similar religious system. Even if the new iconography visible in rock art and pottery was introduced as early as A.D. 1000, it took a long time for the accompanying religious system to take hold. Thus, much of this religious complex may not have been introduced until later, perhaps as late as A.D. 1100. This would coincide with the period of greatest spread of the system and may indicate the need for a more effective organizational system. Conversely, it could also be evidence of an inherent systemic weakness.

Did this religious system first develop in the Mimbres area and spread to the Jornada, or is it evidence of influence from Casas Grandes? The fact that its iconography includes symbols reminiscent of Mesoamerican religions seems especially significant. The use of certain symbols indicative of the Mesoamerican Tlaloc and Quetzalcoatl cults argues for a southern derivation for this set of beliefs and suggests that a new religious system with Mesoamerican roots expanded into the southern Mogollon region sometime in the early to mid-twelfth century. Its appearance may be evidence of the growing influence of Casas Grandes and a corresponding weakening of the Mimbres system.

While these ideas are conjectural, they suggest that several otherwise separate trends may in fact be related. Small changes in the southern Jornada seem to accompany expansion of the Mimbres system. However, while there may have been relatively close exchange ties between these regions, there is little evidence for direct Mimbres influence on the southern Jornada. Tentatively, only in the development of communal structures in winter villages might there be evidence of this process.

Changes in the Mimbres religious system between A.D. 1000 and 1150 may reflect the growing influence of Casas Grandes. Certainly, the latter quickly stepped in to fill the void left by the demise of the Mimbres system. Rather than a weak trade-based interaction sphere, the Casas Grandes system was organized in an entirely different way. It seems to have exerted direct control over a large area and indirect control over a much larger region. Major changes in southern Jornada organizational, ceremonial, and subsistence systems coincided with the spread of Casas Grandes, while the end of the El Paso phase coincides with its collapse. Like other researchers (LeBlanc 1989; Phillips 1989; Schaafsma 1979), we link Late Formative period changes to the development of the Casas Grandes system. While this area was not under direct control of the Casas Grandes towns, it was in a peripheral zone that was obviously linked to them by economic and ideological ties.

Thus, changes in the southern Jornada region can be linked to shifting spheres of regional interaction. The weak Mimbres system exerted little influence over cultural developments in the Jornada region. Ties between these areas seem to have been economic in nature, and there is little evidence for more extensive influence. The strong Casas Grandes system wielded tremendous influence over cultural developments in the southern Jornada region and may have inspired major changes in social organization, subsistence system, and residential and architectural patterns. These influences can be seen at both the inception of the interaction sphere and its demise.

As suggested above, Late Formative period developments can not be understood without considering the effect of the Casas Grandes sphere of influence. As the Mimbres system began to wane and the Casas Grandes towns to expand, major changes occurred over a large area, including the southern Jornada region.

The Doña Ana Phase

Only a few minor changes are apparent in the Doña Ana phase. Unfortunately, few sites can be unambiguously assigned to this period, especially when only surface data are available. Currently, excavated features at only three sites are confidently dated to the Doña Ana phase (Bilbo 1972; Kegley 1982; Scarborough 1986).

Mauldin (1993:41) suggests that Mimbres wares disappeared from the region by A.D. 1150, and Chupadero Black-on-white is firmly established as a trade ware by that date. No Mimbres pottery was found at Meyers Pithouse Village, and trade wares were dominated by Chupadero Black-on-white (Mauldin 1993; Scarborough 1986). Also present were small amounts of pottery from northern Chihuahua, including Playas Red Incised. This site is well dated to the last half of the Doña Ana phase (A.D. 1150 to 1200), and these data suggest that the trade and exchange system was in flux during this period. With the collapse of the Mimbres system, the southern Jornada seem to have been developing exchange ties with several regions. Close ties with other Mogollon populations are evident in the importation of St. Johns Polychrome and Three Rivers Red-on-terracotta and represent a continuation of earlier exchange patterns. However, pottery from central New Mexico (Chupadero Black-on-white) dominates the array of trade wares and suggests close exchange ties with that region. In addition to the intensification of northern ties, for the first time there is evidence of links with northern Chihuahua.

By the beginning of this period there is a change in house form. All excavated Doña Ana phase pithouses are rectangular; most contain formal hearths and have plastered floors. Storage features occur inside structures and in extramural areas. These houses seem to have been built with more permanence of occupation in mind than those of the Mesilla phase. At this time it is impossible to determine whether this represents a trend begun in the late Mesilla or a new development.

The few data available from this period suggest several possibilities. First, that combinations of pithouses and surface rooms in Doña Ana phase villages was an assumption of Lehmer (1948) for which there are currently no corroborating data. Second, the trend toward increased lengths of cold-season village occupations continued and perhaps intensified, leading to construction of more substantial houses. Third, collapse of the Mimbres system required replacement of that economic facet, leading to closer ties with central New Mexico and northern Chihuahua. Finally, no major changes in settlement and subsistence are indicated that can be traced to external influences. Perhaps viewing this phase as transitional between Early and Late Formative periods is more accurate than assuming a close affiliation with the El Paso phase.

Mauldin's Model of Late Formative Settlement and Subsistence

Mauldin (1986) presents a model of Late Formative period settlement and subsistence for Fort Bliss, which is probably applicable to the southern Jornada region in general. The period of interest for his model extends from A.D. 1150 to 1400, or the late Doña Ana through the El Paso phase. It is predicated on the existence of permanent villages, which were the focus of occupation during most of the year. Logistical forays for wild foods probably originated from villages in most seasons. Much of the population probably moved to foraging camps during the summer, leaving behind only those needed to tend the fields.

This pattern is thought to have been necessitated by the structure of the economy and available wild resources. By late summer. at least, food stores from the previous year were probably low or exhausted. Areas around villages could be used for foraging through part of the year but would not have provided sufficient resources for year-round use (Mauldin 1986:259). Thus, complete or partial abandonment of villages for part of the year may have been compelled by limitations of the subsistence base, even when supplemented by cultigens.

Winter and spring subsistence was based on foods collected and stored during other seasons, supplemented by foraging around villages. Preparation of fields along the Rio Grande and on alluvial fans may have been the most important task completed in early summer. Part of the population could disperse across the landscape when this task was completed, though their movement was limited by the availability of water. The onset of the monsoon season in late summer would allow most of the population to forage in other environmental zones, particularly the desert basins.

People probably returned to their villages for the fall harvest. Some foraging undoubtedly occurred as well, but it is thought to have been of secondary importance because of limited plant growth during this time of year. Task groups may have been sent out to procure deer and leaf succulents, and, given the scheduling conflict between these resources and the harvest, a logistical organization is presumed (Mauldin 1986:260).

Mauldin (1986:262) describes the expected patterning of sites as follows:

> Primary villages on mountain slopes and at the river will have some residents throughout the year. Frequent reoccupation, larger populations, a formalized site layout with substantial structures, clearly defined trash disposal areas, and activity areas should characterize these sites. Secondary habitation sites should be characterized by less reoccupation, smaller groups, and occupation only during the late summer. Those secondary habitation sites in the central basin, where greater year-to-year variability in the resource base is

predicted, will have a lower intensity of use relative to the secondary mountain periphery sites. Structures might be less formalized, if present at all, and well-defined activity and trash disposal areas are not expected.

> Corn preparation would be a major activity at primary residential locations, but would be infrequent or absent at secondary sites, where wild seed collection and small game hunting should predominate. The ceramic and groundstone assemblages at primary villages should be well-suited for corn processing. Groundstone should have larger grinding surfaces, and ceramics should be plentiful. Groundstone at secondary sites should have smaller grinding surfaces, and fewer ceramics should be present.
>
> As raw material sources are within foraging radius of primary villages, early reduction and large artifact size should characterize the assemblage. Lithics should be plentiful at these locations. The ceramics-to-lithics ratio, given the expected importance of corn processing, should favor ceramics. Secondary residential sites along the mountain slopes would also have easy access to lithic sources, and should have evidence of early reduction and plentiful lithics. Secondary sites in the central basin, however, would not have easy access to material sources, and therefore should be characterized only by late reduction. Lithics should not be plentiful on these sites. Given the lack of access to lithic materials, mountain periphery secondary sites should be dominated by lithics. Central basin sites should be dominated by ceramics, and groundstone should be relatively infrequent.

This model is quite specific in suggested site location and structure, and Mauldin (1986:268) notes that preliminary testing with data from secondary habitation sites in the mountain and central basin zones suggests its validity.

Characteristics of the El Paso Phase

From Mauldin's (1986) model and our discussion of regional culture history, it is obvious that the El Paso phase represents a time of great change. Farming supplemented hunted and collected foods before this period, but during this phase it seems to have been the focus of the subsistence system. The population remained fairly mobile, but the amount of movement was again scaled down. The first suggestion of this shift may have occurred during the Doña Ana phase, but data from that period are simply too few to address this possibility. El Paso villages are adobe pueblos, and some are quite large, containing 200 rooms or more. However, most were much smaller, containing less than 20 rooms. Villages grew by accretion and were not planned constructions. Evidence of remodeling and repair suggest that most were occupied for long periods.

Some variation between riverine and basin villages have been noted, particularly in size, construction techniques, and remodeling. Foster and Bradley (1984:211) suggest that the lack of extensive remodeling at riverine villages means that maintenance was constantly attended to at those sites. Thus, villages along the river may have been continuously occupied rather than partly or wholly abandoned during part of the year. Riverine villages are usually smaller than those on the margins of desert basins. Where multiple linear roomblocks are often present in the latter, most riverine villages seem to contain a single linear roomblock. But do these isolated room blocks represent all or simply part of a community? The organization of communities in this region may be related to the distribution of arable land. Farm land on basin margins is mostly concentrated in alluvial fans. Communities probably clustered near these resources to more efficiently exploit them. In contrast, farmland along the river is distributed in a linear pattern. Communities in this zone were probably strung out to more efficiently exploit this pattern. The number of corporate groups comprising individual communities may have been similar in both zones. They were simply nucleated in areas where arable land was concentrated and dispersed where arable land was distributed linearly.

El Paso phase communities probably contained several corporate groups integrated through religious beliefs and ceremony. As noted in the culture history overview, the ritual system was more pronounced and elaborate during this phase. Caches of ritual objects are relatively common, while they are lacking at earlier sites. Symbolism suggests that the belief system focused on farming and rainmaking. In turn, this demonstrates the growing importance of farming. This trend is also visible in the amount of cultigens recovered from El Paso villages versus earlier sites.

The Casas Grandes Factor, Part II

There was a major restructuring of society on several levels during the El Paso phase. Architectural styles were considerably different, with residence shifting from pithouses to adobe pueblos. The scale of mobility suddenly dropped, and villages became the focus of residence during most of the year. Community size seems to have increased, and most villages probably contained multiple corporate groups. This was accompanied by development of a more pronounced and elaborate ritual system based on a Mesoamerican model. Changes in community structure and religion were probably related, the latter either allowing or resulting from a closer integration of diverse corporate groups. Farming also became more important and probably contributed to many of these trends.

Ties with the Casas Grandes area were increasing as these changes occurred. Mexican pottery often dominates the array of imported pottery on El Paso phase sites. Exotic wares from the north and west also occur, and Chupadero Black-on-white is another common import. Wares from elsewhere in the Mogollon region, the central Rio Grande, and the Salado area occur but are rare. Conversely, El Paso Polychrome vessels were the most common import at Paquimé, where they are likened to tin cans (DiPeso 1974b:624). This type is also common at many other Casas Grandes sites.

Obviously, the southern Jornada region was economically linked to the Casas Grandes towns. Exports to the Jornada region probably included raw shell, shell ornaments, copper objects, pottery, and possibly cloth. Indeed, shell ornaments are more common during the El Paso phase than at any other time. What the Jornadans were sending in return is unclear. While it is possible that food, in particular corn, may have been moving to the center of the interaction sphere, this is uncertain and very speculative. DiPeso (1974b:629) suggests that turquoise was an important import into Casas Grandes. While the sources he lists are in the Mimbres area, turquoise was also available in the Jarilla Mountains in the southern Jornada region, and there is evidence for the processing of this commodity at El Paso villages (Bentley 1993). Turquoise from more distant sources is also found in the southern Jornada region. Thus, this material was probably an important commodity that was procured locally or obtained from other groups to the north for exchange with Casas Grandes.

Though the data base is too small to be absolutely certain, it seems obvious that Late Formative period society was heavily influenced by northern Chihuahua. The timing of major changes in southern Jornada adaptive systems with the demise of the Mimbres exchange network and expansion of the Casas Grandes sphere of influence cannot be coincidental. While the study area was not in the zone of direct (and perhaps coercive) control of the Casas Grandes towns, it was certainly an integral part of that system. We suggest that the economic relationship between those areas was rather closely integrated. Soon after the Casas Grandes system began to expand, the structure of southern Jornada society experienced major changes. Soon after the system collapsed the southern Jornada returned to their former lifestyle, abandoning their adobe pueblos and focus on farming. By the time Cabeza de Vaca traveled through the region, they were living much as they had during the late Mesilla phase.

A Revised Model of Late Formative Period Settlement and Subsistence

Mauldin's (1986) model fails to take into account data generated by other studies which suggest that the settlement and subsistence system was more complex than he indicates. Like Hard's (1983a) discussion of the Mesilla phase, this model suggests that every year was much like the last, when in reality there was probably quite a bit of fluctuation.

Mobility remained part of the Late Formative settlement and subsistence system but was reduced in scale from the Mesilla phase. According to Mauldin's (1986) model, the population resided in villages most of the year. Foraging from villages probably occurred on a daily basis, or logistical task groups were sent out to collect specific resources. During much of the summer the population became residentially mobile, exploiting a variety of environmental zones. It is implied that zones with dependable supplies of water were used during the early summer, particularly along the mountain slopes and river. Only when the late summer rains arrived was there sufficient water to allow exploitation of the central basins.

This model lacks flexibility and is unable to account for fluctuations in weather patterns that could cause short-term changes. It also does not account for variation in the distribution of important resources. Unfortunately, this is one of the limitations of a general model. While we can offer a few corollaries, it is impossible to take every potential factor or combination of factors into account. Thus, we can only add a few comments based on our interpretation of the data base that may help strengthen Mauldin's model.

Mauldin (1986) only considers two types of sites: villages (adobe pueblos) and temporary camps. However, he suggests that camps were used for both foraging and collecting. Consumers are moved to resources in a foraging system, while resources are moved to consumers in a collector system (Binford 1980). Thus, foraging and collecting camps should be different in several respects, if these functions were kept separate. Foraging camps should reflect a wide range of maintenance, production, and processing activities without heavy investment in structures or storage features. If present, structures should be ephemeral and indicative of short-term use. Collecting camps should reflect temporary occupancy by a group engaged in specialized activities. Storage features should be absent (unless the site was used as a cache), and any structures should be ephemeral. Camps used both for foraging and logistical collection of foods for storage at the village may be impossible to distinguish from those used solely for foraging.

This probably accounts for much variation in camp type during normal years and those in which precipitation was low and there was a high dependence on foraging. However, it is likely that farming was expanded into normally unsuitable zones during periods of above-average rainfall. When this occurred, fieldhouses or farmsteads were probably established to take advantage of that window of opportunity. Where water was available or could be obtained within a reasonable distance, this type of site may have been common in nearly all years. Where water was only periodically available, there may have been years or decades between agricultural uses. Thus, at least three types of secondary residences are suggested: foraging camps, collecting camps, and farming camps.

We must also account for differences in residential patterns between basin edge and riverine villages. Why do villages along the river seem to have been permanently occupied while those on basin edges were either completely or partly abandoned on a regular basis? The distribution of certain resources may be responsible for this variation. Basin-edge villages lack direct access to aquatic resources, which were available at riverine villages except in dry years, when the Rio Grande may have stopped flowing. Fish could have made year-round occupation of riverine villages possible, as suggested by the use of several species at La Cabrana. In order to exploit these resources, the occupants of basin edge villages would have to move into camps along the river or trade with established riverine villages. In either case, it was undoubtedly necessary to maintain reciprocal relationships with riverine communities to allow access to these resources.

To summarize, we accept most of Mauldin's model but differ on a few points. The amount of dependence on hunting and gathering versus farming probably varied with rainfall because some years were more amenable to extensive agriculture than others. Expected differences between foraging and collecting camps were identified, and it was suggested that farming camps were also an integral part of the settlement system. Rapid and radical changes do not occur in southern Jornada adaptive systems until the Casas Grandes towns began expanding in the late twelfth century. Residence shifted from pithouses to adobe pueblos by A.D. 1200, the religious system was altered by adoption of Mesoamerican traits, and there was a decrease in the scale of residential mobility. After the collapse of Casas Grandes the settlement and subsistence system seems to have returned to an earlier form, which involved much higher levels of mobility and dependence on wild foods.

Summary and Conclusions

The southern Jornada Mogollon are often seen as peripheral to the Southwest, lagging behind developments elsewhere. In some ways this is true. For much of their history, the southern Jornada were able to live much as their Archaic ancestors had, retaining a heavy dependence on hunting and gathering and placing less emphasis on farming than in other Southwestern areas. This was mostly due to the structure of their environment. However, rather than viewing environment as a limiting factor, it may be more instructive to consider its potential for producing wild foods. Highly storable resources like mesquite, tornillo, and certain annuals may have allowed the population to avoid intensifying their food production system until a comparatively late date. When food production was finally intensified, it may have been in response to external stimulus rather than local needs. Certainly, when that stimulus was removed, the system reverted to a simplified model that was much less reliant on food production.

Over time we can see a shifting scale of residential mobility. The Archaic population was highly mobile, continuously moving in response to resource needs until the Late Archaic, when cold-season villages began developing. This represents an initial reduction in the scale of mobility, with people living in small macroband camps for at least part of the cold season. A further reduction in mobility occurred in the early Mesilla phase and is represented by greater use of stored foods at cold-season camps, suggesting longer periods of occupancy. Indeed, evidence of structure repair and remodeling tends to corroborate this possibility. Cultigens increased in importance during this phase and represent a dependable storable surplus that was probably critical to subsistence in cold-season villages. Changing settlement patterns are also suggestive of this process, in which sites concentrate around areas containing arable land.

While these changes may seem minor, they had considerable impact on the settlement system. Early Mesilla cold-season camps seem to have been occupied for longer periods of time than those of the Archaic. While the population continued to move in response to resource availability through most of the year, they were probably tethered to cold-season camps by the need to stock them and tend nearby fields. A further reduction in mobility occurred in the late Mesilla, when the length of time cold-season camps were occupied again increased, as did dependence on stored foods. The first evidence of communal structures appears during this period and suggests the development of mechanisms for integrating the small microbands that were the building blocks of society. For the first time, the southern Jornada seems to have been part of a formal exchange system that controlled the movement of certain types of goods over a large area. Ties to the Mimbres system may have caused minor changes in settlement and subsistence, but this is uncertain.

Between A.D. 1000 and 1150 a new ideographic system appeared throughout the

Mimbres, southern Jornada, and northern Chihuahua region. This seems to represent the adoption of a new set of religious beliefs based on concepts originating in Mesoamerica and may be evidence for the growing influence of the Casas Grandes towns. Radical changes are visible in southern Jornada society by A.D. 1200. Unfortunately, the Doña Ana phase may be the key to understanding this process, and we have few data from that period. However, the few data we have suggest that southern Jornada society continued to develop along the same trajectory, though ties with areas to the north and south intensified, and the scale of mobility may have again decreased. Doña Ana houses are more substantial than those of the late Mesilla phase, with plastered floors and a new dominant shape. Whether this is evidence of outside influence or simply the continuation of a local process is unknown. Continued population growth could have required a higher degree of dependence on farming and a consequent reduction in residential mobility. This sets the stage for the El Paso phase, but in no way explains it.

Substantial changes are evident in the El Paso phase. While these changes were along the same trajectory as earlier regional developments, they represent a sudden surge toward a more sedentary lifestyle dependent to a large degree on farming. This surge may be the result of influence originating in the Casas Grandes towns. While outside the zone of direct control, the southern Jornada region seems to have been an integral part of the Casas Grandes sphere of influence. Thus, the surge toward what many would consider a more puebloan lifestyle may have been fueled by the needs of Casas Grandes. This possibility may be supported by the sudden abandonment of adobe pueblos and return to a more nomadic lifestyle after the collapse of Casas Grandes.

The long-term trend in this region was toward decreased residential mobility, though never was the population completely sedentary. The closest they ever approached that point was during the El Paso phase, and this development could have been due to the influence of Casas Grandes. Left on their own, the southern Jornada peoples may have remained hunter-gatherers with only a minor reliance on agriculture.

THE SANTA TERESA PROJECT RESEARCH ORIENTATION

James L. Moore

A detailed research design was developed for this study from data recovered during testing (Moore 1992). Unfortunately, some conclusions made during that stage of investigation were incorrect. We are also now working with a more detailed model of cultural adaptations for the region. Thus, it is necessary to modify the original research design to take these factors into account.

During survey it was thought that both the Santa Teresa site (LA 86780) and Mockingbird site (LA 86774) were occupied during the Formative period (Stuart 1990). Testing provided few additional data concerning dates of occupation for these sites. However, the structure of the Santa Teresa site assemblage suggested an Archaic rather than Formative period occupation. While use during the Early Formative period was thought likely for the Mockingbird site, the possibility of a Protohistoric Manso occupation was also considered.

Radiocarbon and ceramic dates obtained during excavation indicate we were correct in our assumed date for the Santa Teresa site, but our assessment of the period of occupation for the Mockingbird site was somewhat off. Pottery at that site suggests a Late Formative period occupation, though Mesilla phase components are probably also present. While the main tenets of the research design for the Santa Teresa site can be addressed with little modification, our orientation for the Mockingbird site must be restructured to take these dates into account.

The Nature of Cultural Remains in the Mesilla Bolson

The nature of archaeological remains in a region is affected by both cultural and natural processes. Models describing the effects of these processes on cultural remains are discussed in this section, as well as how they are expected to apply to our sites. This will provide a better understanding of how the structure of cultural remains may have been affected by geologic processes.

Geomorphology and Site Formation Processes

Rather than being distributed as discrete sites and isolated occurrences across the basin floors of south-central New Mexico, cultural materials often occur as *palimpsests*, which are defined as "assemblages that, due either to having been deposited on the same surface or to erosional collapsing, are a blend of many separate occupations" (Doleman and Chapman 1991:12). Doleman and Chapman (1991:12) felt that conventional site and isolated occurrence concepts could not be applied to cultural remains in their study area in the Tularosa Basin because they obscured the actual spatial patterning of archaeological remains. Many studies in the region have proceeded under this assumption. Researchers have assumed that cultural remains are continuously distributed across the landscape rather than concentrated into discrete sites separated by scatters of isolated artifacts representing the locations of resource-extractive tasks (Camilli et al. 1988; Doleman 1992; Seaman et al. 1988). Thus, because of recent dune formation and erosion, only part of the archaeological record is probably visible at any one time.

These concepts have been formalized into models for the Tularosa Basin that should also be applicable to the Mesilla Bolson. The Holocene Litter Model (Doleman 1992:73) "proposes that the extant archeological record on the basin floor consists of a more or less random and continuous distribution of cultural remains, which is the product of highly dispersed foraging/extractive activities." This model has two variations. The first considers the distribution of artifacts to be nearly uniform and related to purely extractive activities (Doleman 1992:75). Large-scale variation based on landform-related productive diversity was expected to accompany this pattern. The second variation adds "small camps and processing areas located primarily to minimize the energy expended in transporting unprocessed raw materials or to support extended foraging trips" (Doleman 1992:75). In this variation, smaller-scale patterning was expected.

The second model proposed by Doleman (1992:73) is the Geological Disturbance Model, which "proposes that the original archeological distribution has been masked and disturbed to varying degrees by eolian processes both during and subsequent to prehistoric times. These geomorphic processes have both buried and exposed archeological materials and biased sample of the total archeological record. The geomorphic processes of the Geological Disturbance Model are expected to have both collapsed and smeared portions of the original archeological distributions." Nearly all cultural materials (except Paleoindian) are contained within a single geomorphic unit in the Tularosa Basin, dating ca. 7300 to 100 B.P. (Blair et al. 1990: Doleman and Stauber 1992; Doleman and Swift 1991). Surface artifacts have been exposed by erosion and subjected to varying amounts of vertical and horizontal displacement (Doleman 1992:75).

Cultural and geological processes are described by these models and are not mutually exclusive: both have undoubtedly affected the distribution of cultural remains. The Holocene Litter Model describes the way in which cultural materials were deposited on the basin floor, while the Geological Disturbance Model depicts the ways in which that distribution has been affected by natural processes. Thus, both must be considered in a discussion of site formation processes.

Dolman's models were tested with data from the southern Tularosa Basin, and several conclusions were generated. Small-scale patterning in the archaeological record confirmed the second variation of the Holocene Litter Model, in which small camps and activity areas are discernable. Thus, rather than a random and continuous scatter of cultural remains across the basin floor, the distribution of artifacts was patterned and in at least one case strongly associated with features.

The distribution of artifacts was also influenced by natural processes, as suggested by the Geological Disturbance Model (Doleman 1992). The development of deflation basins affected horizontal artifact distributions by concentrating materials during the early stages of blowout formation. This process is termed the *funnel effect*. The development of deflation basins also caused vertical sorting, in which larger artifacts remained at or moved to the surface, while smaller artifacts stayed buried. Thus, surface densities tend to seriously underrepresent the number of buried artifacts. The distribution of cultural materials through the main artifact-bearing stratum suggests they were subjected to both eolian and soil formation processes. However, while this unit has suffered numerous geologic disturbances, evidence for intact spatial patterning of cultural materials was found in eroded areas.

These models have important implications for our sites. First, it is likely that both surface and subsurface artifacts have been displaced from their original locations. Surface artifacts in blowouts may have been displaced vertically and horizontally due to the funnel effect. However, subsurface artifacts may not have suffered the same degree of displacement. Other studies suggest that, while buried artifacts may move vertically, horizontal displacement may be minimal (Moore n.d.; Schutt 1992). Geomorphic processes apparently caused materials to be vertically sized in Schutt's (1992) study in the Tularosa Basin, but spatial analysis was able to determine whether artifact clusters represented cultural activity loci or artifacts grouped by natural processes.

These studies suggest that we may be able to compress the vertical distribution of artifacts to assess the original horizontal structure of assemblages. This may allow us to define activity areas and assess their relationship to features and structures. One way of doing this is to track identifiable lithic materials that may indicate separate reduction episodes and examine their distribution. It may also be possible to isolate sherds from specific vessels and perform the same analysis. In this way, we should be able to determine how the geomorphic processes defined by Doleman (1992) might apply to our sites, and the degree to which site structure has been affected.

Models and Test Implications

Data recovered from these sites will be used to examine two general models. The first is related to the nature of cultural deposits and assumes that, like other basins in south-central New Mexico, the distribution of cultural remains is a palimpsest. That is, numerous overlapping occupations have deposited an almost continuous scatter of artifacts and features. However, local geomorphology suggests that cultural materials in the study area are not compressed by erosion, as they are elsewhere. Thus, the clustering of features and deposits at a series of depths across these sites may reflect multiple uses of the area.

The second model concerns the nature of local settlement and subsistence patterns over time. As discussed in the last chapter, hunting and gathering remained important through all time periods. However, farming seems to have increased in importance through time, assuming a much larger role in the Late Formative economy before once again declining in importance during the Protohistoric period. Accompanying this trend was the increasingly important role assumed by cold-season villages. Beginning by at least the Late Archaic, villages were occupied by macrobands for part or all of the cold season. The occupation of these villages intensified during the early Mesilla phase and again in the late Mesilla phase. This trend probably continued into the Doña Ana phase, and characteristics of the El Paso phase suggest a sudden escalation of the process.

While cold-season villages were more and more intensively occupied through time, small temporary microband camps continued to be used in other seasons, particularly the late summer. Farming became more important as cold-season village occupations grew longer. However, the population continued to break into microbands, foraging through other resource zones during part of the year. A collector strategy may also have been followed at times, in which distant resources were exploited by logistical task groups who transported resources back to the cold-season camp. However, it is unlikely that this strategy was used while people were scattered across the landscape in microbands. Logistical groups were probably sent out from cold-season camps to collect foods that would augment stored supplies.

This pattern changed during the El Paso phase. Cold-season villages appear to have assumed an even greater importance. In fact, it is possible that villages along the Rio Grande were occupied on a year-round basis. Villages in other zones may have been periodically abandoned by part or all of their occupants, especially in the late summer, when desert basin resources became available with the onset of the rainy season. Other resource zones may have been exploited by logistical groups during other seasons, and farming camps were probably also used during the growing season, particularly when climatic conditions were favorable.

Based on assumptions concerning geomorphology and regional culture history, a series of research questions are generated that can hopefully be addressed with information from the Santa Teresa and Mockingbird sites. In turn, assessment of the fit between our data and the predicted patterns will allow us to appraise the accuracy of the models. Background information pertaining to these research questions was presented earlier in this and the preceding two chapters.

Dating the Sites

While general dates have been presented for the sites, the structure of cultural remains in this region indicates that they could contain evidence of multiple occupations. Such a possibility was suggested by the results of testing and must be addressed with the more detailed information retrieved during data recovery. Thus, the spatial patterning of features and cultural deposits will be examined to determine whether there are clusters at different levels that may reflect this phenomenon. When absolute dates are available, they will be applied to this patterning to determine whether clusters are indicative of multiple occupations or an undulating dune surface. When absolute dates are not available or conflict with artifact dates, it may be possible to use stratigraphic positioning to estimate occupational dates.

How Is Site Structure Related to Geomorphic Processes?

While the distribution of cultural features and deposits might reflect an undulating landscape at the time of occupation, it more likely indicates repeated uses over time. The grouping of features at various depths can be likened to an uncompressed palimpsest. True palimpsests occur along the Chaco River. There, complex sites containing thousands of artifacts and numerous features occur as large continuous scatters along major arroyos (Reher 1977). These sites were originally thought to represent large macroband camps, but more recent research concludes that a series of adjacent or overlapping camps were established in that area (Moore 1980). Deflation has mixed materials from various occupations, resulting in a continuous scatter of artifacts and features. Thus, an archaeological palimpsest is a confused scatter of cultural materials derived from numerous overlapping uses and activities. Unraveling such a record is often difficult or impossible.

Geomorphically, the Santa Teresa and Mockingbird sites are in an area that may represent an almost continuous accumulation of sand during the late Holocene. While some periods of deflation may be represented, this area does not appear to have suffered the continuous process of dune and blowout formation that characterizes most basin floors in the region. Clusters of cultural features and deposits at various depths suggest repeated occupations at widely varying times. By combining an examination of site structure and dates from features, it will hopefully be possible to determine what this clustering means. Was it caused by an undulating landscape, or could it be due to multiple occupations of the same general area over a long period of dune formation?

Are There Differences between Archaic and Formative Chipped Stone Assemblages?

The Santa Teresa site was occupied during the Late Archaic period, while the Mockingbird site dates to the Early and Late Formative periods. While each of these periods was characterized by residential mobility, differences in scales of mobility have been noted and should be reflected in assemblages. Many researchers have isolated differences between chipped stone assemblages used by mobile and sedentary groups (Chapman 1977; Hicks 1986; Irwin-Williams 1973; Kelly 1988; Kerley and Hogan 1983; Laumbach 1980; Moore 1993; Rozen 1981). These differences are modeled by Kelly (1988). In general, the reduction strategy used by southwestern hunter-gatherers was oriented toward the manufacture and curation of general purpose bifaces, while that of sedentary groups was based on the expedient production of flake tools.

While Kelly (1988) associates curated strategies with mobility, Bamforth (1986) argues they are more closely related to the availability of desired materials. Studies near San Ildefonso (Moore 1993) suggest that both are correct. Archaic assemblages in that study displayed a differential reduction of local and exotic materials. While most local materials were expediently reduced, exotic materials were primarily reduced as large bifaces. It was concluded that Archaic populations reduced exotic materials efficiently because they were desirable and in limited supply. Local materials were expediently reduced because they were easily obtained and plentiful, and conservation was unnecessary.

Suitable raw materials for lithic reduction are rare in the Mesilla Bolson and are mostly associated with volcanic features or deep erosional cuts. Small pebbles can be found, but they are rarely large enough for careful reduction. Other than at their sources in adjacent mountain ranges, suitable raw materials are only common in gravels along the Rio Grande. While they are available 8 to 9 km from the project area in the Rio Grande Valley, lithic materials are not evenly distributed throughout the region, as is necessary to Bamforth's (1986) argument. Thus, some curation of materials, particularly those of the highest quality, would be expected among mobile hunter-gatherers.

If Archaic and Mesilla phase peoples were both mobile foragers, as some have suggested, a curated reduction strategy should have been used during both periods. However, if there were differences in the scale of mobility between these periods there may be corresponding variation in reduction strategies. In this case, a curated strategy should be evident in Archaic remains, while Mesilla assemblages should focus on use of an expedient strategy. Though the El Paso phase exhibits a degree of residential mobility, it was at a reduced scale when compared with earlier settlement systems. Thus, an expedient reduction strategy is expected for this period. In addition to variation in reduction strategies, there should also be differences in the quality of materials selected for use. High-quality, fine-grained materials should be associated with curated strategies, while materials used in expedient strategies may be coarser and of lower quality.

What Type of Occupation Is Represented by These Remains?

According to our settlement-subsistence model, use of the basin floor during the Archaic and Early Formative periods should be limited to briefly occupied microband camps near temporary water sources. These camps can be characterized as short-term residential sites used for a few days to several months. The number of structures present and the amount and range of associated debris depends on the size of the occupying group and the length of stay. During the Late Formative period the basin floor is thought to have been the location of specialized collecting and processing camps in addition to foraging and farming camps. The former were used for short periods by logistical task groups and should reflect a limited range of activities. Foraging camps should be similar to those from earlier periods, and farming camps may be hard to distinguish from them.

Testing the Models

The test implications listed below should help determine the function and nature of these sites. But it should be remembered that they represent only a small part of the settlement and subsistence systems to which they belonged. They also occupy a minuscule part of the Mesilla Bolson. Thus, it will not be possible to fully test the models with information from our sites. However, when combined with the results of other studies, our data may be sufficient for a preliminary assessment of the models.

Dates of Occupation. If the Mockingbird site was occupied during more than one period, the following characteristics are expected:

1. Dates from deeper deposits in the south part of the site should be earlier than those from shallower deposits in the north section.

2. Features in the south part of the site should date before A.D. 500, and features in the northeast part of the site should date after A.D. 500.

3. Only lithic artifacts should occur in subsurface contexts in the south part of the site. If pottery is recovered, it should be restricted to the upper 10 to 20 cm. Subsurface pottery should mostly be restricted to the northeast part of the site.

4. If projectile points are recovered, large dart points should be found in the south part of the site, and small arrow points should occur with pottery in the north part.

5. Any structural remains should be ephemeral and consist of round pit structures.

6. The ceramic assemblage should be dominated by El Paso Brown wares. Intrusive types should be rare.

7. More evidence of grinding activities should be associated with Preceramic deposits, if present.

If the Santa Teresa site was occupied during the Archaic period, the following characteristics are expected:

1. Features should date before A.D. 200 to 500.

2. Few sherds will be found and should be restricted to the surface; the assemblage will contain mostly chipped and ground stone artifacts.

3. The only projectile points present should be large dart points; no arrow points should be found.

4. Any structural remains should be ephemeral, and should consist of round pit structures.

5. There should be considerable evidence of grinding activities.

Interrelationship of Cultural and Geomorphic Site Formation Processes. If these sites occupied an undulating land surface, the following characteristics are expected:

1. Dates from features at each site will cluster, suggesting they were used at approximately the same time.

2. Dates from the Santa Teresa site should be earlier than those from the Mockingbird site, reflecting the greater depth of deposits at that location.

3. Since both sites seem to represent multioccupational locales, a wide range of dates may be recovered. If so, dates should not cluster according to depth. Dates suggesting that an array of features are related to one occupational episode may occur at a variety of depths.

If these sites represent an uncompressed palimpsest, the following characteristics are expected:

1. Dates from features at both sites will not cluster within a narrow time frame; a relatively wide range of dates should be recovered.

2. Dates from features should cluster according to depth.

3. Since both sites seem to represent multioccupational locales, a wide range of dates may be recovered. Dates from features with similar depths at both sites should cluster.

Archaic and Formative Chipped Stone Assemblages. If there were equivalent levels of mobility during the Archaic and Early Formative periods, the following characteristics are expected:

1. Assemblages from both periods should reflect reduction strategies aimed at maximizing the amount of useable edge removed from a core.

2. There may be differences in the way common or local materials were reduced versus rare or exotic materials. Rare and desirable materials, especially those that are glassy or very fine-grained, should be reduced in a way that maximizes the number of flakes removed. Common materials, especially those available locally, should be reduced in an expedient manner, though some maximization might occur.

3. While the maximization of materials might encompass the systematic removal of flakes from a prepared core, it will more likely be expressed as the manufacture and use of large general purpose bifaces.

4. Since suitable materials are not available in the study area, there should be little if any evidence of large general purpose biface manufacture at these sites. Evidence for the use of this type of tool should be restricted to flakes struck for use or resharpening, and spent or broken general purpose bifaces that were discarded.

5. The same approximate range of raw materials should be reflected in both Archaic

and Early Formative period assemblages.

6. A wide range of formal and informal tools should occur in assemblages from both time periods.

If different levels of mobility are reflected by Archaic and Early Formative deposits, the latter should resemble those from the Late Formative period. Thus, Early and Late Formative reduction strategies should be similar, while Archaic strategies will be quite different. The following characteristics are expected:

1. A curated reduction strategy should be evident in Archaic chipped stone assemblages. An expedient strategy should be visible in Formative assemblages.

2. Evidence for the use of large general purpose bifaces should occur in Archaic assemblages. For reasons specified above, it should be restricted to flakes removed from large bifaces and discarded tools.

3. Only bifaces with specialized purposes should occur in Formative assemblages.

4. A different range of lithic raw materials should occur in Archaic and Formative period assemblages.

5. Archaic assemblages should contain a wide range of formal and informal tool types. Formative assemblages should contain fewer and a smaller range of formal tools and should be dominated by informal tools.

Site Occupation Type. If these sites functioned as foraging camps, the following characteristics are expected:

1. Evidence of repeated short-term occupations should be found. Attributes that should not occur include long-term storage features, structures suitable for cold-season use, human burials, evidence for macroband occupation, formal midden deposits, and signs of task-specific use. Attributes that may occur include ephemeral structures, evidence for microband occupation, sheet trash deposits, and a wide range of manufacturing/maintenance and food procurement/processing activities.

2. Structures should be shallow (less than 30 cm deep) and reflect warm-season use. Both formal interior heating features and weather-proofing should be absent. There should be no formal structure to floors. Only compacted sand floors should occur.

3. There should be evidence for a wide range of floral and faunal foods in the diet. No cultigens should occur. Only the remains of local foods should be found. Foods available in distant ecozones should be absent.

4. Clusters of associated features and artifact assemblages should be redundant. They

should reflect the same season of use and performance of the same range of activities through time.

If the sites were used by logistical task groups, the following characteristics are expected:

1. Evidence of repeated short-term occupations should be found. Attributes that should not occur include long-term storage features, structures suitable for cold-season use, human burials, evidence for macroband occupation, and formal midden deposits. Attributes that may occur include ephemeral structures, evidence for occupation by a small group, sheet trash deposits, and a narrow range of food procurement/processing activities.

2. Structures should not occur, but if they do, they should be shallow (less than 30 cm deep) and ephemeral. Both formal interior heating features and weather-proofing should be absent. There should be no formal structure to floors.

3. There should be evidence for a narrow range of floral and faunal foods. No cultigens should occur. Only the local foods should be found. Foods available in distant ecozones should be absent.

4. Clusters of associated features and artifact assemblages should be redundant. They should reflect the same season of use and performance of the same range of activities through time.

If use as a farming camp is reflected, the following characteristics are expected:

1. Evidence of a relatively long period of occupation should be found. Storage facilities may be present, and there may be specific trash disposal or activity areas. Human burials, evidence for macroband occupation, and signs of task-specific use should be absent. Other attributes that may occur include evidence for occupation by a single family, sheet trash, and a wide range of manufacturing/maintenance and food procurement/processing activities.

2. Structures should be shallow (less than 30 cm deep) and reflect warm-season use. Interior heating features may occur, but weather-proofing should be absent. There should be no formal structure to floors. Only compacted sand floors should occur.

3. There should be evidence for a wide range of floral and faunal foods in the diet, and cultigens may occur. The remains of foods available in distant ecozones may be found.

4. Structures may evidence signs of reuse. Conversely, if specific areas and structures were not reused, there may be evidence of redundant groups of related features representing repeated use over time.

It may be difficult to distinguish between these patterns of use, particularly if tools were removed for recycling by later peoples. However, enough data should be available to assess the remains and determine whether one or more patterns of use are reflected and to suggest what they are.

Discussion

Though the above discussion is rather specific, a caution is in order. Most of our models and test implications were developed from studies in the Anasazi region. The use of large general purpose bifaces is a case in point. While a relatively uniform pattern of lithic resource acquisition and reduction might be expected across the Southwest, this may not be the case. The curation of large general purpose bifaces might not be applicable to all parts of the region, and other patterns of acquisition and reduction could easily occur. Thus, while many aspects of our research design provide a base for examining and interpreting the remains from these sites, we do not expect all of our predictions to hold up. If proven incorrect, it will be necessary to determine whether those predictions were intrinsically wrong or if local conditions resulted in the development of different approaches to problems than those we expected.

FIELD AND ANALYTIC METHODS

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This chapter describes the field and analytic methods used by OAS personnel to recover data from the Santa Teresa and Mockingbird sites. Methods used by consultants to complete field and laboratory studies are discussed in the chapters describing the results of those studies. The specialized studies include remote sensing investigations by Sunbelt Geophysical, analysis of pollen samples by Castetter Laboratory for Ethnobotanical Studies, and descriptions of site geomorphology by Glorieta Geoscience, Inc.

Field Methods

The same general methods were used to examine both sites. However, there were site-specific differences in the techniques used, including the reasons certain areas were selected for excavation, how the zones around features were examined, and how remote sensing techniques and mechanical trenching were applied. Specific investigative methods are described in the site reports, while the more general techniques applicable to both sites are discussed here.

All vertical and horizontal measurements originated at a main datum established on a high point between the sites during testing (Moore 1992). The same datum was used for both sites because of their close proximity and to provide comparability of vertical and horizontal measurements as required by certain aspects of the research design. A system of 1 by 1 m grids was superimposed across both sites. The grid system originated at the main datum, which was arbitrarily labeled the intersection of the 500N and 500E grid lines. The elevation of the ground surface at the main datum was arbitrarily set at 10 m below datum.

After establishing the main datum, sites were mapped by transit and stadia rod or 50 m tape. A series of base lines was established across each site, with subdatums placed at varying intervals along them to serve as reference points. Most mapping activities and grid line placement originated at the subdatums. The locations of all visible cultural features, excavation units, surface artifacts that were collected individually, and topographic features were recorded for plotting on a site plan. Both sites were contour mapped to provide an accurate depiction of their structure in relation to the immediate physical environment. Surface artifacts were collected in 1 by 1 m grids or by point provenience. All features and structures that were either noted on the surface or encountered during excavation were described, photographed, and mapped.

Hand tools were used for most excavation, though some areas were mechanically trenched to determine whether buried cultural features or deposits were present. Horizontal excavation units were 1 by 1 m grids except in features and mechanically dug trenches. Exploratory grids were excavated in arbitrary 10 cm levels until soil strata were defined or cultural materials were no longer present. When features or structures were encountered they became the horizontal units of excavation, and grid lines were no longer used as boundaries. Unfortunately, except in features and structures, the homogeneity of natural soils at both sites prevented definition of stratigraphic boundaries in most cases. After defining the vertical limits of the artifact distribution, most grids were excavated as single levels. Excavation ended when sterile deposits were encountered or the vertical limits of the artifact distribution was reached.

Soil from hand-dug grids and features was screened through ¼ inch mesh hardware cloth. Artifacts recovered in screens were bagged, assigned a field specimen number, and transported to the laboratory for analysis. Forms describing soil matrix and listing ending depths and field specimen numbers were completed for all excavation units. Flotation and radiocarbon samples were collected from all cultural strata and features, while pollen samples were only taken in structures.

Profiles showing the relationship of cultural and noncultural strata were drawn for excavation areas, structures, and features. Small features like hearths were bisected, one half excavated as a single arbitrary unit and the other by natural strata when more than one depositional unit was present. When fieldwork was finished, all mechanically dug trenches and deeper excavation areas were backfilled. Cultural materials recovered during these investigations are curated at the Laboratory of Anthropology, Museum of New Mexico. Field and analysis records are on file at the Archaeological Records Management System of the Historic Preservation Division.

Chipped Stone Artifacts

Chipped stone artifacts were recovered from both sites. Each artifact was examined using a binocular microscope to aid in defining morphology and material type, examine platforms, and determine whether it was used as a tool. The level of magnification varied between 15X and 80X, with higher magnification for wear-pattern analysis and identification of platform modifications. Utilized and modified edge angles were measured with a goniometer; other dimensions were measured with a sliding caliper. Analytic results were entered into a computerized data base using the Statistical Package for the Social Sciences Data Entry program. Data summaries are included in individual site reports and a separate chapter devoted to synthesis.

Analysis was completed using our standardized methodology (OAS 1994a) and designed to examine material selection, reduction technology, tool use, and site taphonomy. These topics provide information concerning ties to other regions, mobility, site function, and the reliability of specific attributes. While material selection studies cannot reveal *how* materials were obtained, they can usually provide some indication of *where* they were procured. In particular, by examining the type of cortex present on artifacts it is possible to determine whether materials were obtained at the source or from secondary deposits. By studying the reduction strategy employed at a site it is possible to assess the level of residential mobility. Whereas a high degree of residential mobility is usually accompanied by the use of a curated strategy, sedentary peoples more commonly use an expedient strategy. The types of tools present on a site can be used to help assign a function, particularly on artifact scatters lacking features. Tools can also be used to help assess the range of activities that occurred at a site. Finally, the condition of an assemblage can be used to judge the reliability of certain attributes. This entails analysis of artifact breakage and edge damage patterns and can provide information concerning the source of damage. Thus, as the percentage of artifacts broken after removal and the incidence of edges damaged by noncultural means (erosion or trampling) increase, the reliability of attributes such as artifact size, flake portions, and evidence of use decreases.

Attributes Examined during the Study

Table 7-1 lists the attributes examined during this study and indicates which relate to each class of chipped stone artifact. Four classes were recognized: flakes, angular debris, cores, and formal tools. Flakes are debitage exhibiting one or more of the following characteristics: definable dorsal and ventral surfaces, a bulb of percussion, and a striking platform. Angular debris are debitage that lack these characteristics. Cores are artifacts that exhibit two or more negative scars originating from one or more surfaces. Formal tools are artifacts that were intentionally altered to produce specific shapes or edge angles. Alterations took the form of unifacial or bifacial retouch, and artifacts were considered intentionally shaped when retouch scars extended across two-thirds or more of a surface, or their original shapes or edge angles were significantly modified.

Attributes recorded for all artifacts include material type and quality, artifact morphology and function, amount of surface covered by cortex, portion, evidence of thermal alteration, edge damage, and dimensions. Material type was coded by gross category unless specific types could be distinguished. When this was possible, those types were assigned individual codes. Texture was measured subjectively to examine flakeability. Most materials were divided into fine, medium, and coarse categories depending on grain size, and such measures were applied within material types but not across them. Obsidian was classified as glassy by default, and this category was applied to no other material. The presence or absence of visible flaws that would affect material flakeability was also noted.

Two attributes were used to provide information about artifact form and function. The first was morphology, which categorized artifacts by general form. The second was function, which categorized tools by inferred use. Cortex was recorded in increments of 10 percent, and cortex type was defined when possible. All artifacts were coded as whole or fragmentary; when broken, the portion was noted if it could be identified. Two types of alteration were noted: thermal and edge damage. When present, the type and location of thermal alteration were recorded. This information was used to determine whether or not the artifact was purposely altered. Edge damage, both cultural and noncultural, was recorded and described when present. Edge angles were measured on all artifacts demonstrating cultural edge damage and on all formal tools. Edges lacking evidence of cultural damage were not measured.

Dimensions were measured on each artifact. On angular debris and cores, length was defined as the artifact's largest measurement, width was the longest dimension perpendicular to the length, and thickness was perpendicular to the width and usually the smallest measurement. On flakes and formal tools, length was the distance between the platform (or proximal end) and termination (or distal end), width was the distance between the edges paralleling the length, and thickness was the distance between dorsal and ventral surfaces.

Table 7-1. Correlation of attributes analyzed with chipped stone artifact categories

Attribute	Flakes	Angular Debris	Cores	Formal Tools
Material type	x	x	x	x
Material quality	x	x	x	x
Artifact morphology	x	x	x	x
Artifact function	x	x	x	x
Cortex	x	x	x	x
Cortex type	x	x	x	x
Portion	x	x	x	x
Platform type	x			
Platform lipping	x			
Dorsal scarring	x			
Distal termination type	x			
Thermal alteration	x	x	x	x
Wear patterns	x	x	x	
Modified edge angles	x	x	x	x
Dimensions	x	x	x	x
Core number	x	x	x	x

Four attributes were examined on flakes only: platform type, platform lipping, dorsal scarring, and distal termination. Platform type is an indicator of reduction technology and stage. Any modification of platforms was noted, as were missing and collapsed platforms. Platform lipping usually indicates soft hammer reduction (Crabtree 1972) and is often an indication of the later reduction stages. Analysis of dorsal scarring entailed noting whether scars originating at the distal end of a flake were present. These are opposing scars, which are often evidence of removal from a biface. The type of distal termination was noted to help determine whether it was a successful removal or ended prematurely and to provide data on manufacturing versus postremoval breakage.

Flakes were further divided into removals from cores and bifaces using a polythetic set of variables (Table 7-2). A polythetic framework is one in which fulfilling a majority of propositions 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 need be satisfied. This array of conditions models an idealized biface flake and includes information on platform morphology, flake shape, and earlier removals. The polythetic set used here was adapted from Acklen et al. (1983). In keeping with that model, when a flake fulfilled 70 percent of the listed conditions it was considered 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. At the same time it is low enough to permit most flakes that were removed from a biface but that do not satisfy the entire set of conditions to be properly identified. While not all flakes removed from bifaces are identified by the polythetic set, those that are can be considered definite evidence of biface reduction. Flakes that fulfilled less than 70 percent of the conditions were classified as core flakes. Instead of rigid definitions, the polythetic set provided a flexible means of categorizing flakes and helped account for some of the variability seen in experiments.

Table 7-2. Polythetic set for distinguishing manufacturing flakes from core flakes

Whole Flakes

1. Platform:
    a. has more than one facet
    b. is modified (retouched and abraded)
2. Platform is lipped.
3. Platform angle is less than 45 degrees.
4. Dorsal scar orientation is:
    a. parallel
    b. multidirectional
    c. opposing
5. Dorsal topography is regular.
6. Edge outline is even, or flake has a waisted appearance.
7. Flake is less than 5 mm thick.
8. Flake has a relatively even thickness from proximal to distal end.
9. Bulb of percussion is weak (diffuse).
10. There is a pronounced ventral curvature.

Broken Flakes or Flakes with Collapsed Platforms

1. Dorsal scar orientation is:
   a. parallel
   b. multidirectional
   c. opposing
2. Dorsal topography is regular.
3. Edge outline is even.
4. Flake is less than 5 mm thick.
5. Flake has a relatively even thickness from proximal to distal end.
6. Bulb of percussion is weak.
7. There is a pronounced ventral curvature.

Artifact Is a Manufacturing Flake When:

1. If whole it fulfills seven of ten attributes.
2. If broken or platform is collapsed it fulfills five of seven attributes.

Ground Stone Artifacts

Ground stone artifact analysis was completed using our standardized methodology (OAS 1994b) and designed to examine material selection, manufacturing technology, tool use, and reuse. Artifacts were examined macroscopically, and dimensions were measured with a sliding caliper or metal tape. Analytic results were entered into a computerized data base using the Statistical Package for the Social Sciences Data Entry program and are discussed in individual site reports and a separate chapter devoted to synthesis.

Besides providing information on activities occurring at a site, this analysis measures assemblage costs and values. When these measures are compared it is possible to look at differences between what went into a site and what left it, length and type of occupation, processes of site abandonment, and differences in material wealth between site residents. Considering the types of sites investigated, the latter cannot be examined, but most of the other questions can. For example, ground stone tools which retain an intrinsic value that outweighs difficulty of transport will be removed in an orderly site abandonment. In a hasty or unplanned abandonment, ground stone tools that retain value and are easily transported may be left behind. A long-term sedentary occupation should leave behind an array of broken and exhausted ground stone tools demonstrating a wide range of production inputs. A fieldhouse or farmstead, on the other hand, should contain few whole ground stone tools, and those that remain should retain little if any value. Ground stone tools on hunter-gatherer sites should exhibit little formal modification. Broken tools and heavy tools that are more easily cached than transported should be present. Small ground stone tools that could be transported easily should only be represented by broken fragments, unless contained in caches.

Modifications to ground stone tools were studied to provide information on the potential recycling of tools for other purposes. Any evidence of multiple uses was recorded, as were all signs of thermal use. This is an important aspect of our study, since many researchers have suggested that ground stone tools were reused as hearth stones, particularly at desert basin sites (Camilli et al. 1988; Duncan and Doleman 1991; Hard 1983; Leach 1994; O'Laughlin 1979; O'Laughlin and Greiser 1973; Whalen 1994). Thus, the presence of ground stone tools on sites may be completely unrelated to their primary function. This analysis was used to determine whether grinding tools were used at our sites or were simply evidence of recycling for other purposes.

Attributes Examined during the Study

Several attributes were recorded for each ground stone artifact. Other attributes were recorded for a few specialized tool types only. Those recorded for all ground stone artifacts included material type, material texture and quality, function, portion, preform morphology, production input, plan view outline form, ground surface texture and sharpening, shaping, number of uses, wear patterns, evidence of heating, presence of residues, and dimensions. The only specialized attributes recorded were mano cross-section form and ground surface cross section.

By examining function(s) it is possible to define the range of activities in which ground stone tools were used. Because these tools are usually large and durable, they may experience a number of different uses during their lifetime, even after being broken. Several attributes were designed to provide information on the life history of ground stone tools, including dimensions, evidence of heating, portion, ground surface sharpening, wear patterns, alterations, and the presence of adhesions. These measures can help identify postmanufacturing changes in artifact shape and function, and describe the value of an assemblage by identifying how worn or used it is. Such attributes as material type, material texture and quality, production input, preform morphology, plan view outline form, and ground stone texture provide information on assemblage cost. In combination they furnish data on raw material choice and cost, and the cost of producing various tools. Mano cross-section form and ground surface cross section are specialized measures aimed at describing aspects of form for manos and metates. As these tools wear they undergo regular changes in morphology that can be used as relative measures of age.

Thermally Altered Rock

Thermally altered rock was analyzed independently unless other forms of alteration were also present. Those cases include chipped or ground stone artifacts that were purposefully altered by heat or reused in thermal features and are discussed in those categories. Thus, only burned and fire-cracked rock not included in other assemblages were examined by this analysis. A series of attributes was recorded to provide comparability with other analyses as well as information unique to this class of artifact.

A number of attributes overlap those recorded for chipped and ground stone artifacts, and were coded in the same way. They include material type and quality, artifact morphology and function, and amount and type of dorsal cortex. Size was recorded by weight in this artifact category. Finally, the shape of breaks on heat-fractured rocks were noted in an attempt to determine how breakage occurred. Experiments by Duncan and Doleman (1991) suggest that breakage patterns vary according to the speed of cooling: rapid cooling produces different patterns than slow cooling. These differences may indicate use for stone boiling versus roasting. Thus, our analysis was structured to distinguish between these patterns and attempt to assign a function to thermally fractured rock. Analytic results were entered into a computerized data base using the Statistical Package for the Social Sciences Data Entry program and are discussed in individual site reports and analysis chapters.

Ceramic Artifacts

The recording of descriptive attributes, typological categories, associated contexts, and quantitative data provide the basis for ceramic characterizations relevant to examinations of various issues and trends. Sherds were linked to a particular provenience through the recording of the associated site and field specimen (FS) number. Sherds that exhibited similar morphological characteristics were separated into groups. Each group was given a lot number, which was recorded on a data line along with other codes describing those sherds. Lots were placed in separate bags along with a slip of paper recording site, FS, and lot numbers. Quantitative data recorded for each line included count and weight. Analytic results were entered into a computerized data base using the Statistical Package for the Social Sciences Data Entry program and are discussed in individual site reports and a separate chapter devoted to synthesis.

Descriptive Attributes

The recording of descriptive attributes reflecting resource use, technology, manufacture, decoration, vessel form, and postfiring modification of vessels allows for the documentation of variation reflecting diverse trends or patterns. Attributes recorded for all sherds include temper, pigment, surface manipulation, rim profile, wall thickness, paste profile, rim shape, vessel form, modification and wear, and rim radius.

Temper. Temper categories were identified by examining freshly broken sherd surfaces through a binocular microscope. *Temper* as used here refers to aplastic particles intentionally added to clay to avoid cracking in newly formed vessels during the drying process, as well as aplastic fragments naturally occurring in the clay that would have served the same purpose. Temper categories were initially differentiated based on distinctive combinations of color, shape, fracture, and sheen of observed particles. Criteria used to identify various temper categories were selected to differentiate various clay or temper source areas.

All brown ware sherds examined exhibited very similar temper consisting of relatively large white angular fragments of quartz and feldspar. The source of this temper appears to be a crushed granite for which the source nearest the Santa Teresa area is the Franklin Mountains, about 24 km to the east. Based on variation noted during petrographic analysis, Hill (this volume) recognized two major compositional groups within this temper category. One group contained alkali feldspar with a fresh appearance, while a smaller number of sherds were tempered with a granite displaying a greater degree of alteration.

The only other variety recognized during this study consisted of fine volcanic temper with possible sherd fragments. Crushed sherd temper is recognized by angular to subangular particles that are usually more finely crushed than rock particles. These particles are dull in luster and usually white or gray in color. Smaller reflective rock particles, representing the original temper present in the crushed sherd fragments, may be included inside or outside these sherd particles.

Pigment Type. The presence and type of paint pigment were identified based on surface characteristics. Only two categories of paint pigment were recognized during this study. One category consisted of a faded black organic pigment which was soaked into rather than on the surface and did not exhibit surface relief. Surface irregularities were visible through organic painted decorations. The other category consisted of a gray to black organic pigment along with decorations in a red pigment.

Surface Manipulation. Surface manipulation refers to treatments resulting from the presence or type of coiled construction and surface polishing or slipping. Various manipulations may have functional or temporal significance. Surface manipulation attributes were recorded for both interior and exterior sherd surfaces. Manipulation categories recorded include missing, plain smoothed, plain polished, plain smoothed with striations, polished with striations, smoothed and somewhat lustrous, thin white unpolished slip, and plain corrugated polished. The "missing" category refers to cases where the type of surface treatment could not be determined because of heavy surface wear or spalling. Plain smoothed surfaces refer to surfaces where coil junctures were completely smoothed but not subsequently polished. This category appears to be equivalent to Whalen's (1994a:81) coarse finish category. Plain polished surfaces are those which were intentionally polished after smoothing. Polishing implies intentional smoothing with a polishing stone to produce a compact and lustrous surface. This category appears to be similar to Whalen's (1994a) fine finished category. Smoothed and somewhat lustrous refers to intermediate treatments that are either highly smoothed or lightly polished and is similar to Whalen's (1994a) medium finished category. Striated refers to the presence of a series of long thin parallel grooves apparently resulting from brushing with a tool during vessel finishing. Thin unpolished white slip refers to the presence of a distinct thin white clay layer on the vessel surface. Plain corrugated polished refers to the presence of unindented polished coils.

Wall Thickness. Since previous studies indicate that changes in wall thickness of Jornada Brown Ware vessels have possible temporal implications, thickness was recorded to 0.1 mm for all sherds analyzed. This measurement was made on an area of the sherd that appeared to be most typical of the overall thickness.

Paste Profile. The color combinations of a sherd cross section reflect clay iron content and the firing conditions to which a vessel was exposed. Reddish or buff profiles indicate final oxidation atmospheres. Black or dark gray profiles result from reduction atmospheres. White or light gray colors may indicate neutral or low oxidation atmospheres. Color categories recorded for sherd cross sections included not recorded, brownish or red throughout, brownish or reddish exterior with dark gray or black core, dark gray or black throughout, and white to light gray.

Vessel Form. Vessel form categories are often assigned to a particular sherd based on rim shapes or the presence and location of polish and painted decorations. While it is often possible to identify the basic form (bowl versus jar) of body sherds from many southwestern regions based on the presence and location of polishing, such distinctions may not be as easy for Jornada Brown Ware types. For example, in contrast to sherds belonging to many Southwest pottery traditions, Jornada Brown Ware bowl sherds are often polished or smoothed on either side. Such observations have resulted in a reluctance to assign brown ware sherds to specific vessel form categories. Still, the location of surface polishing may convey some relevant information, though caution must be employed in the resulting interpretations. Therefore, while body sherds were not assigned to specific vessel form categories during this study, they were placed in a series of categories reflecting the presence and location of surface polish. Categories recorded for body sherds included indeterminate (one or both sides missing), both sides unpolished, both sides polished, interior side polished, exterior side polished, and corrugated with polished interior. The only nonrim sherds assigned to more distinct form categories were jar neck sherds, identified by the presence of distinct curves. *Jar rim sherd* refers to items exhibiting rims with distinct shapes associated with necked jars that could have been used for cooking or storage. *Bowl rim* refers to sherds exhibiting an inward rim curvature indicative of bowls. *Seed jar rim* refers to sherds derived from spherical vessels that do not exhibit distinct necks but have rounded openings near the top.

Rim Profile. *Rim profile* refers to the basic rim shape resulting from differences in rim thickness or tapering near the rim. Basic categories described by Whalen (1993:43) as rim forms A through F were employed during this study.

Modification and Wear. Evidence of postfiring modification and wear resulting from repair of vessels, reuse of broken sherds, or natural processes were recorded. Such evidence provides functional information related to the repair and modification of vessels as well as postdepositional processes that resulted in the shaping of sherds. These categories were only assigned to sherds exhibiting very distinct evidence of modification or wear.

The most common modification category noted consisted of small regularly shaped forms. These items tend to be rounded or regular and exhibit wear along the entire sherd edge. Microscopic examination of worn edges associated with this form showed that they lack the directional grooves or marks found in most intentionally shaped sherds. Surfaces of these modified sherds also tend to be heavily worn, and it is likely that they were naturally shaped by sand and wind. A few smaller sherds with single beveled edges appear to be broken items from the previously described category. *Repair drill hole* refers to the presence of purposely drilled holes presumably used in the mending of vessels through the lacing together of drilled sherds. *Medium circular sherd with partial hole in center* refers to a large rounded shaped item with an uncompleted drill hole in its center. An unfinished spindle whorl that probably served as a balance for spinning or drilling may be indicated. *Medium to large shaped items* refer to intentionally shaped sherds that were probably used as pukis or plates.

Refired Paste Color. Clips from 35 sherds were fired to controlled oxidation conditions at a temperature of 950 degree C to standardize ceramic pastes. This provides for a common comparison of pastes based on the influence of mineral impurities (particularly iron) on paste color and may be used to identify sherds that could have originated from the source (Shepard 1965). The color of each sample was recorded using a Munsell Soil Chart.

Type Categories. Ceramic types represent convenient groupings incorporating information concerning combinations of spatially and temporally distinct traits. Ceramic items are assigned to typological categories based on a series of decisions. First, an item is placed in a distinct ceramic tradition based on temper, paste, and technological traits. Next, it is assigned to a particular ware group based on technological and surface attributes. Finally, an item is placed in a particular type category based on temporally sensitive surface textures or design styles.

As is the case for other sites in the general area, the overwhelming majority of sherds recovered during the Santa Teresa Project exhibit characteristics that resulted in their assignment to Jornada Mogollon brown ware types. As defined here, Jornada Mogollon brown wares include a number of regional variants produced in different parts of the Jornada area. Examples of types associated with different regions and distinguished by minor differences in temper or manipulation include Jornada Brown and El Paso Brown. Sherds exhibiting traits representative of the Jornada Mogollon dominate ceramic assemblages from a large part of southern New Mexico, western Texas, and northern Mexico. Undecorated pottery from sites along the Rio Grande near the Texas-New Mexico border and the Tularosa Basin are usually assigned to El Paso Brown Ware but may differ from other Jornada Mogollon brown ware sherds solely by the presence of a coarse angular temper of local origin (Anyon 1985; Hard 1983b; Jennings 1940; Lehmer 1948; Whalen 1994a). It is often not possible to distinguish El Paso Brown Ware sherds from other Jornada Mogollon brown ware types without careful characterization of the associated temper. Thus, the various El Paso Brown Ware types are best considered a regional variant or tradition of Jornada Mogollon brown ware (Whalen 1994a).

Distinct characteristics shared by different Jornada regional variants include the presence of smoothed to polished surfaces and the usual absence of distinct surface textures

(Jelinik 1967; Jennings 1940; Lehmer 1948). Surface colors tend to be gray or brown to reddish, and cross sections range from brown to black and may exhibit various combinations of exterior and core colors. Pastes also tend to be well fired but are relatively soft and friable compared to pottery types belonging to other southwestern ceramic traditions.

The overwhelming majority of sherds from sites investigated during the Santa Teresa Project exhibited ranges of temper and paste properties described for the El Paso variant of Jornada Mogollon brown ware. During this study, sherds exhibiting pastes and tempers definitive of the El Paso Brown Ware variant were further divided into a series of types based on the presence of painted decoration or surface texture. Because the introduction of painted pottery represents one of the few temporally diagnostic changes in ceramics produced in this area, the development of criteria allowing for the potential distinction of sherds derived from painted versus unpainted vessels is particularly important. El Paso Brown Ware types identified during this analysis include El Paso Brown Body, El Paso Brown Rim, White Slipped Brown Ware, Mimbres Style Corrugated, and El Paso Polychrome.

El Paso Brown Rim is identical to ceramics previously classified as El Paso Plain Brown (Mills 1988) and refers to smoothed and unpainted rim sherds exhibiting El Paso Brown Ware pastes. Unpainted rim sherds were assigned to a different type from body sherds because temporally diagnostic El Paso Polychrome vessels are often undecorated in their lower portions. Thus, the likelihood that an unpainted brown ware sherd originated from an earlier unpainted vessel is much more likely for rim than for body sherds. Unpainted El Paso Brown Ware vessels appear to dominate assemblages in this area for a very long period, from possibly as early as A.D. 300 until about A.D. 1100, when they were replaced by El Paso Polychrome. Although there is little evidence of complete unpainted El Paso Brown vessels at sites dated after A.D. 1200, very low frequencies of El Paso Brown Rim sherds may still be present at El Paso phase sites.

El Paso Brown Body is similar to the category defined by others as Unspecified El Paso Brown (Anyon 1985; Hard 1983b; Mills 1988) and includes sherds where attributes such as paint and rim, which are most commonly used to distinguish El Paso Brown from El Paso Polychrome vessels, are absent. Plain body sherds are assigned to a more generalized category than rim sherds, since it is usually not possible to distinguish body sherds from the lower unpainted portions of El Paso Polychrome vessels from those originating from El Paso Plain Brown vessels.

During this study, *El Paso Polychrome* was assigned to all El Paso Brown Ware sherds exhibiting painted decorations. In some schemes, sherds thought to be from vessels exhibiting painted decoration in pigments of only one color are classified as El Paso Bichrome, while those with decorations in both black and red are classified as El Paso Polychrome (Mills 1988). It is likely, however, that many smaller sherds previously classified as El Paso Bichrome may simply represent parts of El Paso Polychrome vessels where evidence of the other pigment happens to be absent. All painted brown ware sherds identified during this study were assigned to El Paso Polychrome, although information on pigment color combinations was recorded separately. Of the seven sherds classified as El Paso Polychrome, two were decorated in red and black paint, while five were decorated in black paint alone. El Paso Polychrome is characterized by large geometric motifs executed in red and black paint (Stallings 1931). Since decoration on jars is often limited to the rim or neck areas, unpainted body sherds from El Paso Polychromes may be classified as El Paso Brown Body.

Mimbres Style Corrugated refers to sherds from a single vessel exhibiting pastes and temper noted for El Paso Brown Wares but with polished shallow banded corrugated textures similar to those noted for Mimbres Corrugated. Given the similarity of the temper and paste to El Paso Brown Wares, it is possible that these sherds represent a textured variety of this type. It is also possible that they represent a corrugated vessel produced somewhere in the Mimbres region, where similar-looking raw materials were utilized. Petrographic analysis of one corrugated sherd indicates it was tempered with a granite porphyry similar to those noted in other El Paso Brown Wares examined during this study (Hill, this volume). Additional analysis involving comparison with Mimbres Corrugated sherds from the Mimbres Valley is necessary to reliably determine whether these sherds are from vessels produced in the El Paso area or the Mimbres Valley.

Slipped Brown refers to sherds exhibiting pastes and tempers noted on other El Paso Brown Ware sherds, which also feature the remains of white slips. These slips are very worn and may only be visible on some parts of the vessels. As was the case with the corrugated sherds, this type could represent the occasional local use of a slip on local pottery, or Mimbres White Ware vessels with similar paste and temper.

Unpainted Polished White Ware represents the only pottery identified during this study that was definitely not locally produced. Sherds assigned to this type contrast dramatically with local pottery both by the use of light low-iron paste and the possible presence of sherd along with fine volcanic temper. The absence of painted designs makes it impossible to assign these sherds to a particular type. It is possible that they represent a light paste variety of Mimbres White wares, or they could have originated somewhere in the Anasazi country to the north.

Flotation and Macrofloral Samples

The 37 soil samples collected during excavation were processed at the OAS by the simplified "bucket" version of flotation (see Bohrer and Adams 1977). Samples ranged in size from 1 to 15 l. Each sample was immersed in a bucket of water and a 30 to 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 fabric was lifted out and laid flat on coarse mesh screen trays until the recovered material dried. Each sample was sorted using a series of nested geological screens (4, 2, 1, 0.5 mm mesh) and then reviewed under a binocular microscope at 7X to 45X.

In the Santa Teresa study we wished to combine detailed examination of key proveniences with more general information from the maximum possible number of additional site locations. We accomplished this by full-sorting 24 flotation samples and scanning an additional 13 samples. Full-sort samples were examined in their entirety except when large size and redundant results made subsampling suitable. All botanical remains were counted, removed, and stored in labeled vials by taxon. Raw flotation data are reported as an estimated number of seeds per liter of soil. This figure is most useful for comparing proveniences within the site and making comparisons with other sites because it takes into account sample volumes other than the standard one liter, as well as subsampling. In scanning, flotation samples are first separated by screening into major particle-size categories that correspond generally with taxonomic divisions. Scanning involves full-sorting of material larger than 2 mm and most material larger than 1 mm. Corn kernels and cob fragments (relatively common in flotation samples) and bean and squash remains (relatively rare in flotation samples) are almost entirely restricted to these two screen sizes, so that scanning provides a reliable view of the presence or absence of cultivated taxa. Wild taxa recovered in these larger screen sizes include mesquite seeds and pods, yucca, cholla, and prickly pear seeds, and large-seeded grass and weed taxa such as ricegrass and beeweed. Most annual weed seeds are caught in the 0.5 mm screen, which is usually partially examined in the scanning procedure. Scanning accurately picks up the presence of higher-frequency weed taxa such as chenopods, pigweed, purslane, and tansy mustard. Among particles smaller than 0.5 mm (not examined in a scan sample), botanical remains are often completely absent or else consist of fragments of seed types encountered in larger screens. Rarely, low frequencies of small seed types, such as tansymustard or dropseed, will occur in the smallest screens without also occurring in the larger screens. For the time invested, scanning provides relatively reliable presence/absence flotation data as well as general information about relative quantities of specific taxa. Indicators of postdepositional disturbance (modern roots and other vegetative parts, insect exoskeleton fragments, rodent and insect scats) are also noted.

Wood charcoal was extremely fragmented, and only nine samples had wood charcoal specimens large enough to attempt any identification. All wood charcoal caught in the 4 mm and 2 mm screens from the nine samples was identified when possible. Each piece was snapped to expose a fresh transverse section and identified at 45X. Prior to submission, charcoal samples for radiocarbon dating were examined in the same fashion. 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.

Faunal Analysis

All faunal remains recovered during the excavation phase of the Santa Teresa Project were returned to the OAS for processing and analysis. Due to the heavy fragmentation and weathering of faunal materials, minimal cleaning was undertaken before analysis. During identification, more complete surfaces were dry brushed so that muscle attachments, other identifiable surface features, and processing marks would be visible if present.

The remains were then identified to the most specific level possible using the comparative faunal materials housed at the OAS and the Museum of Southwest Biology at the University of New Mexico in Albuquerque. Identifications were also aided by using guides to the taxonomic and element identification of mammals and birds (Gilbert 1990; Gilbert et al. 1985; Olsen 1964, 1968). Guides were only used for preliminary identification, and all specimens were specifically compared to osteological specimens for final classification.

Attributes recorded for all specimens included taxonomic level, element, portion, completeness, laterality, age, and developmental stage. Fragments of bone associated with a single element were refitted where possible, and articular units of a single animal were coded as conjoinable where appropriate. In addition, each specimen was assessed for any environmental, animal, or thermal alteration. Finally, any butchering marks (cuts, impacts, etc.) (Fisher 1995; Olsen and Shipman 1988) were noted along with any apparent modification for tool manufacture or use (Kidder 1932; Semenov 1964). Analytic results were entered into a computerized data base using the Statistical Package for the Social Sciences Data Entry program and are discussed in individual site reports and a separate chapter devoted to synthesis.

Petrographic Analysis

Ceramic artifact and clay samples were analyzed using a Nikon Optiphot-2 petrographic microscope. The sizes of natural inclusions and tempering agents were described in terms of the Wentworth Scale, a standard method for characterizing particle sizes. These sizes were derived from measuring a series of grains using a graduated reticle built into one of the microscope's optics. The percentages of inclusions in untempered ceramics were estimated using comparative charts (Matthew et al. 1991; Terry and Chilingar 1955).

Analysis was conducted by first going through the total ceramic collection and generating a brief description of each sherd. A second phase created classification groups based on the similarity of paste and temper between sherds. This process also allowed for examination of variability within each group. Additional comments concerning the composition of individual sherds were made at this time. The four samples of clays were obtained from excavations conducted at 41EP3625. The clays were derived from the fill of an abandoned Rio Grande channel near Ysleta, Texas. Prior to thin-sectioning, clay samples were fired to 900 degrees C to stabilize them.

PART 2: FIELD INVESTIGATIONS

THE MOCKINGBIRD SITE (LA 86774)

James L. Moore

Even though this area was examined during earlier surveys (Camilli et al. 1988; Ravesloot 1988a), the Mockingbird site (LA 86774) was not recorded until Stuart (1990) conducted a detailed study of the port-of-entry location in 1990. While the site is now covered by coppice dunes, these features are resting atop a parabolic dune that also contains the Santa Teresa site (LA 86780). The coppice dunes are a modern feature of the landscape, while the parabolic dune is much older and has probably been continuously forming for more than 4,000 years. Surface artifacts reached that location through bioturbation, moving from a cultural level up to a meter below the modern surface. This is a different situation from what usually prevails in the region. Sites in this part of the state are usually deflated, a process that has uncovered and concentrated artifacts on the surface. Elsewhere, the few widely scattered artifacts and lack of surface features at the Mockingbird site would be interpreted as evidence for a rather unimportant work or processing area with little potential for containing intact features. The depositional regime is what makes the difference in this case and provides an unusual look at a type of site that has rarely been investigated in this region.

Initial Definition of the Site during Survey

The Mockingbird site was first recorded as a scatter of 20 chipped stone and ceramic artifacts and designated in the field as BK233 (Stuart 1990). As first defined, it covered 1,352 sq m and was situated directly north of a small playa in a zone of mixed parabolic and coppice dunes. It was thought to have functioned as a small resource processing and procurement locale (Stuart 1990). Artifacts were concentrated in two loci, and no evidence of surface features was found. Undifferentiated brown ware sherds were the only diagnostic artifacts noted, suggesting the site was occupied sometime during the Formative period (ca. A.D. 200 to 1450).

Evaluation of the Site by Testing

The site was subsequently tested to determine whether it contained potentially important subsurface cultural remains or features (Moore 1992). It was found to be much more extensive than thought during survey, containing 200+ artifacts in a 1.28 ha area. Surface artifacts were scattered through a series of shallow deflation basins between mesquite-anchored hummocks, suggesting they were exposed by eolian processes. Four artifact clusters were noted; each was in a deflation basin, but not every deflation basin contained an artifact cluster. While chipped stone and ceramic artifacts comprised the bulk of cultural materials, a few fragments of ground stone and burned rock were also noted, suggesting a rather substantial occupation.

Two methods were used to investigate this site during testing: hand-excavated test grids and mechanically dug trenches. Numerous artifacts were recovered from three of seven test grids, and a charcoal stain was encountered in one test grid in addition to artifacts. Auger holes were bored into the bottoms of test grids to determine whether deeper cultural deposits were present. None were found, and cultural materials seemed confined to a zone extending to a depth of 0.50 to 0.60 m below the surface.

Seven longer and deeper trenches were dug by mechanical means within the boundaries of the scatter, and two were excavated outside its limits. Three possible ash stains were noted in a trench dug between this site and LA 86780, but no definite cultural deposits were found. The only trench in which definite cultural remains occurred contained a 2.0 m long by 0.20 to 0.30 m thick charcoal and ash stain thought to be a pit structure. The presence of at least two buried cultural features and numerous subsurface artifacts suggested that this site could yield potentially important information concerning local prehistory, and a data recovery plan was prepared (Moore 1992).

Summary of Data Recovery Efforts

Site boundaries were again revised during data recovery, and it was found to cover 1.91 ha, measuring 178 by 107 m (Fig. 8-1). Substantially more artifacts were recovered than our original estimates suggested would be present, including chipped stone, ground stone, ceramic and bone artifacts, fragments of fire-cracked rock, and botanical specimens. The assemblage is described by artifact category in a later section of this chapter.

Several methods were used to define subsurface features and cultural strata. Two features and at least one other area containing subsurface cultural deposits were found during testing. A magnetometer survey of the site was completed before excavation began, identifying a series of magnetic anomalies that represented potential features. Since both of the features found during testing were also defined by the magnetometer, it was felt that this procedure was able to identify burned features and structures on the site. The initial placement of hand-dug excavational grids was biased toward areas shown to contain features or cultural deposits during testing and those in which magnetic anomalies occurred. As these areas were explored by series of adjacent grids, other features and cultural deposits were found and excavated. A total of 243 grids was excavated by hand, removing nearly 120 cu m of soil.

Mechanically excavated trenches were the third method used to search for subsurface remains. In addition to the 8 trenches that were mechanically-excavated during testing, 12 were dug during this phase of work, resulting in the definition of several potential features. These trenches were spaced to examine parts of the site that were not excavated by hand and determine whether small or weak magnetic anomalies represented cultural features. About 98 cu m of soil were mechanically removed during testing and 118 during data recovery.

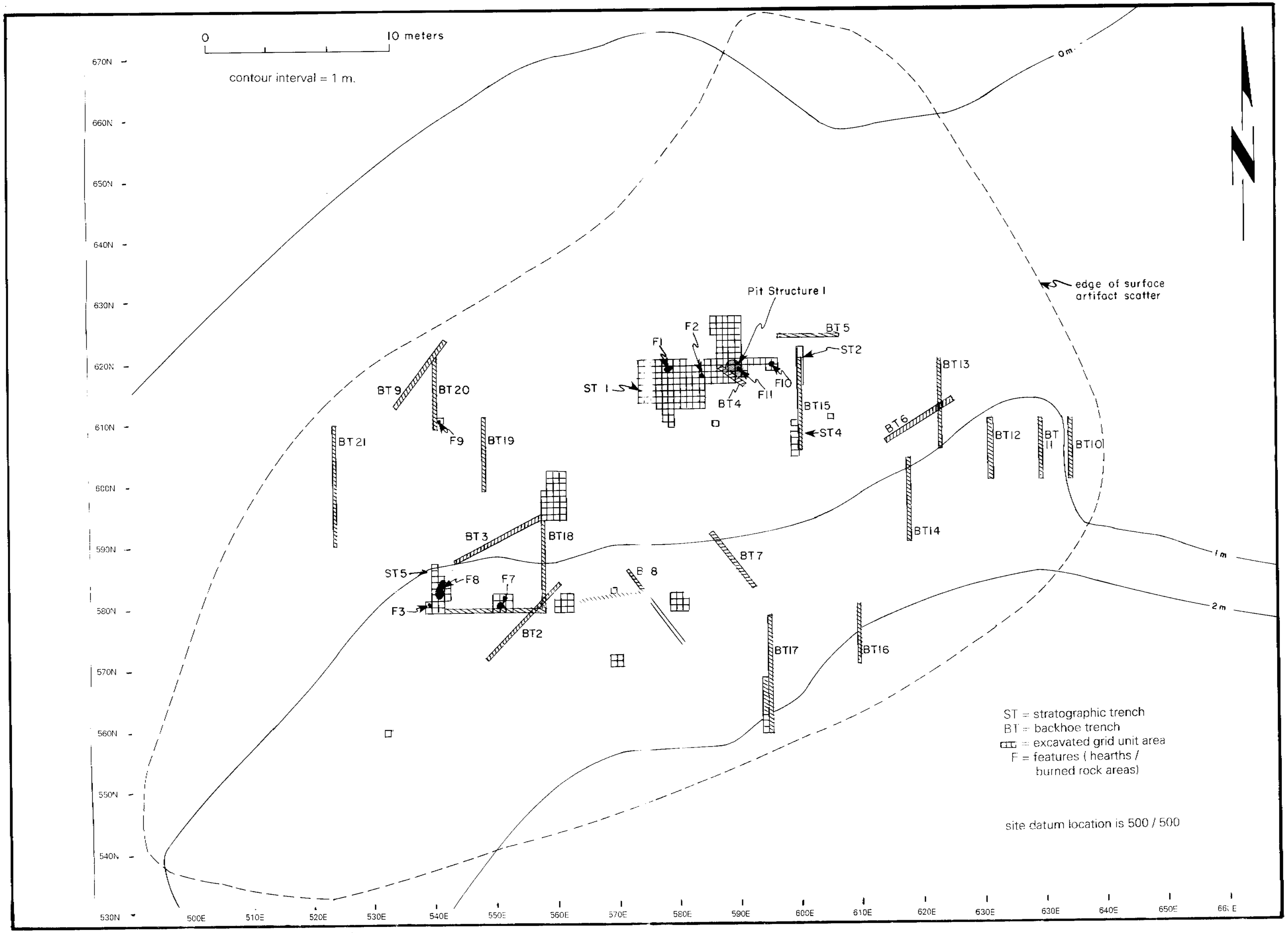

Figure 8-1. Plan of the Mockingbird site, LA 86774.

Excavation Methods

All proveniencing was tied to the main datum, located between LA 86774 and LA 86780. Two methods were used to collect surface materials. Artifacts were collected in 1 by 1 m grids in areas containing moderate to dense surface scatters. Where artifacts were more widely scattered they were collected by point provenience. Following our return to the laboratory, their locations were plotted on site plans, and they were assigned grid designations to make their proveniencing consistent with the rest of the assemblage.

Excavation areas were selected using the criteria discussed above. Data recovery efforts concentrated on two main areas of the site, and only a few grids were excavated outside those zones, either during testing or to investigate potential features found in mechanically dug trenches. While the excavation areas represent the imposition of arbitrary limits, evidence suggests they represent different occupational clusters. Thus, these arbitrary divisions also seem to represent groups of features and artifacts that can be empirically separated. Because of this, our investigations in each of these areas is discussed separately. Following that, grids and mechanically dug trenches outside the main areas of excavation are discussed and described.

General Site Stratigraphy

Geomorphic studies suggested there were two main strata at this site (see "Geomorphology of the Santa Teresa Sites"). The upper 0.15 to 0.45 m of fill consisted of recently deposited dune sand. This was Unit Q4b, which exhibited no soil development and was probably less than 100 years old. Below this was a massive sand unit (Q4a), which exhibited a similar lack of soil development. This stratum was considerably older than Q4b and correlated with similar sands at the Santa Teresa site. Considering the date of that site and the fact that Q4a continues to an undetermined depth below the cultural strata, a considerable time depth is indicated.

Archaeologically, strata were distinguished in a different manner. This was partly because the geomorphic study was not completed until fieldwork was nearly finished. Also, natural strata could not be differentiated during excavation unless they were significantly discolored by cultural inclusions. Only when profiles were allowed to dry for several days to weeks were any differences evident, and they were too subtle to identify while digging. Other than features, only two types of strata were distinguished during excavation: those that were stained from cultural activities, and those that were not. Strata were assigned numbers as encountered; thus, their numbers are unrelated to the sequence in which they occur.

Stratum 1, combining units Q4a and Q4b, was the main unit of fill. A slight break was distinguishable in this stratum in some areas, consisting of differences in sand color, compaction, and inclusions. The upper 0.05 to 0.20 m was a loose, dry, fine-grained eolian sand that was light yellowish brown. It often contained a considerable amount of organic matter including twigs, leaves, mesquite beans, and scat. This zone corresponds to Unit Q4b. Below this the sand was slightly darker and more compact, and it contained less organic matter. This zone corresponds to the upper part of Unit Q4a. While some cross-bedding was visible in the upper zone, none was seen in the lower zone. Pebbles were found throughout this unit but were usually smaller than 2 to 3 cm in diameter and comprised no more than 1 percent of the fill.

Distinct staining was found in two areas (EA-2, Subareas 3 and 4), and indistinct staining was identified after excavation in a third (EA-1, Subarea 1). Staining seems to have resulted from the inclusion of small amounts of organic materials in the massive sand layer. However, except for the staining, these zones were texturally identical to unstained parts of Q4a. Thus, cultural strata represent brief episodes in the long depositional history of sand in this area that can be distinguished only by their organic and artifact content.

Excavation Areas

Two excavation areas were defined, based on the proximity of grids. While other zones were investigated by mechanically excavated trenches or grids, they were not assigned to specific excavation areas. Even though excavation areas were defined arbitrarily, they may represent real clusters of artifacts and features. Analysis of the spatial distribution of features, artifacts, and lithic materials are presented in a later chapter. For the remainder of this discussion we consider the excavation areas to potentially represent different occupational episodes.

Excavation Area 1

Excavation Area 1 (EA-1) contained 158 grids in four subareas, and three mechanically dug trenches (Fig. 8-2). Subarea 1 was examined because two subsurface features were found there during testing: a pit structure and a hearth. Excavation was expanded outward from the features and continued until the numbers of artifacts dropped off, suggesting that the limits of extramural work areas had been reached. Excavation was not extended to the south because of time limitations and the presence of a large coppice dune. Subareas 2 and 4 were excavated during testing, and Subarea 3 was dug to examine stains found in the profile of BT-15. Three trenches were mechanically dug in this area (BT-4, BT-5, and BT-15). Only BT-15 was excavated during data recovery; the others were dug during testing.

Subarea 1. A total of 151 grids were dug in Subarea 1 (Fig. 8-2), which can be divided into four zones: a central zone containing a pit structure and west, north, and east extensions. Testing had located a probable pit structure and a charcoal stain west of the structure, thought to represent a hearth. The former was found in a mechanically dug trench, and the latter in a test trench. Both features were also defined by the magnetometer survey. Three additional

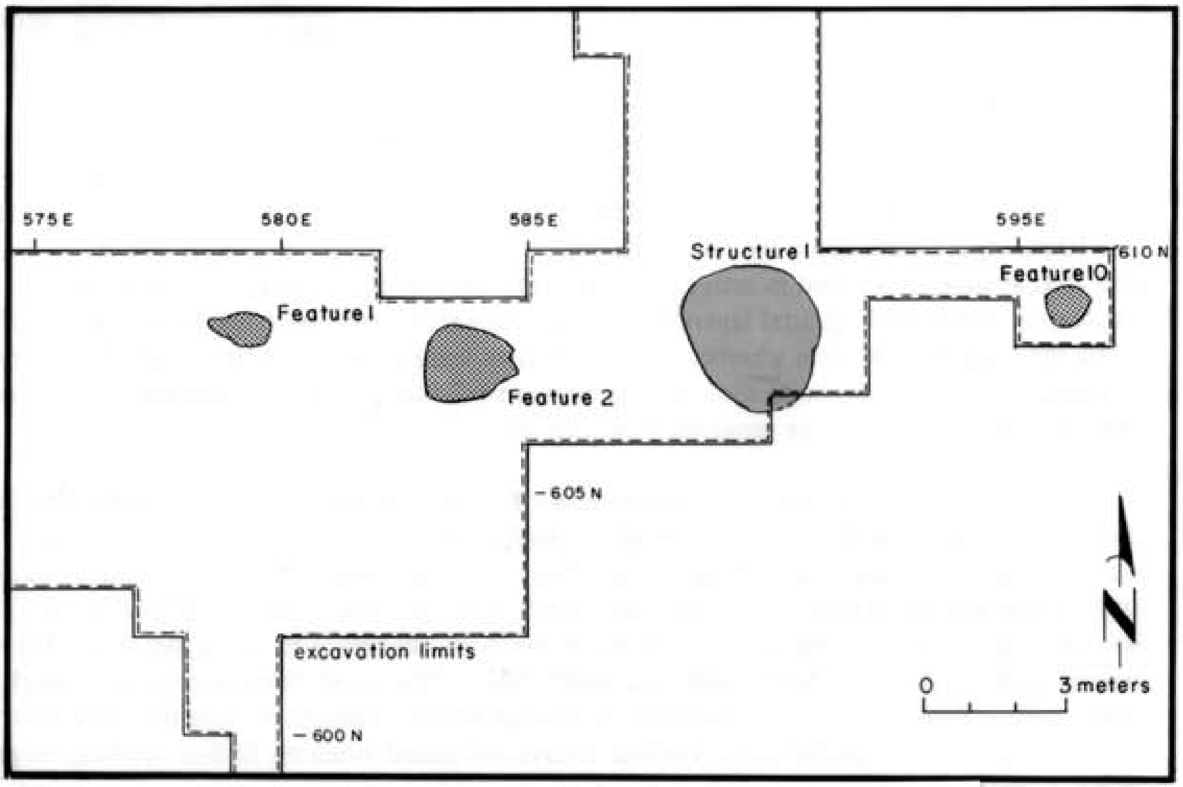

Figure 8-2. Plan of Excavation Area 1, Subarea 1, at the Mockingbird site.

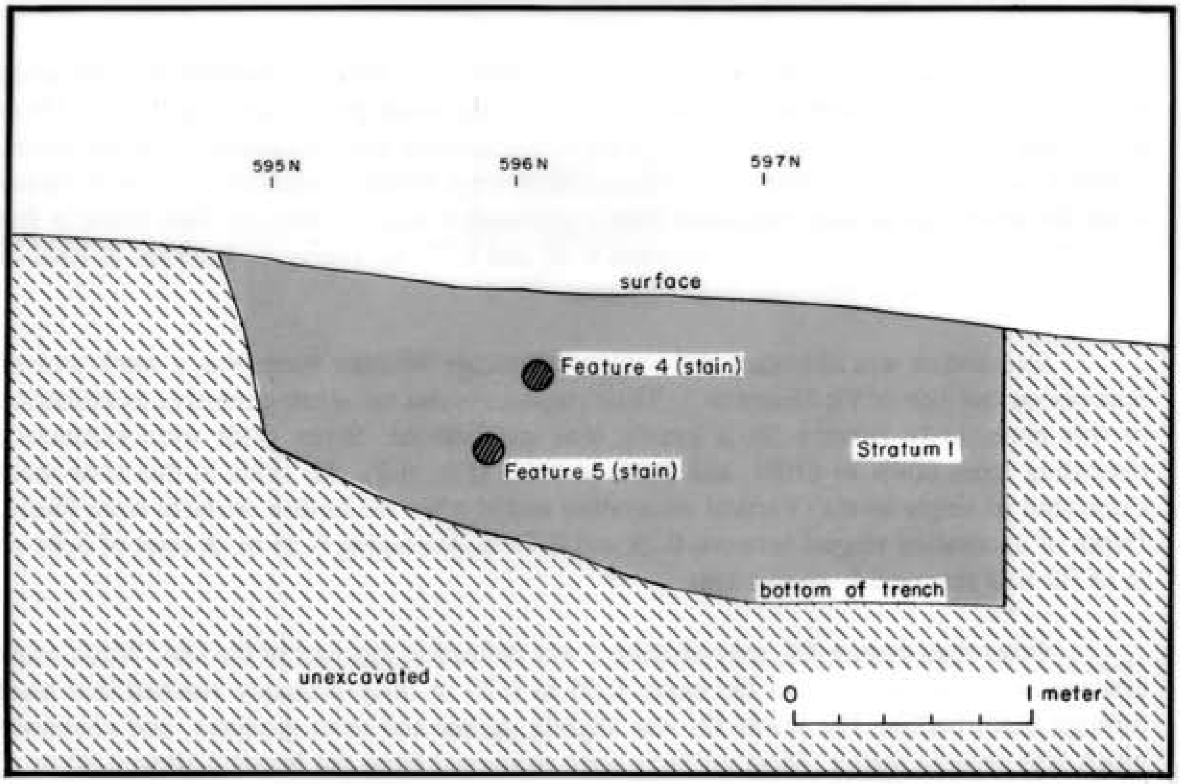

Figure 8-3. Profile of the south end of BT-15 showing the locations of Features 4 and 5.

features were found during excavation, one to the west of the structure, one to the east, and one inside it.

Excavation in the central part of the subarea was aimed at investigating Pit Structure 1, which was exposed in the profile of BT-4 during testing. Eighteen grids were dug in this area, extending from 607N to 610N, and 588E to 592E (Fig. 8-2). This area was excavated in 0.10 m levels except along the 588E line, where fill was removed in one or two levels per grid. Excavation proceeded in arbitrary levels until the top of Pit Structure 1 was exposed. Excavation continued in natural layers within the structure. One or more levels were removed below the floor to determine whether interior features were present, leading to the discovery of Feature 11. Depth of excavation ranged between 0.25 and 0.70 m, averaging 0.49 m. A total of 8.78 cu m of fill was removed from this area.

There were two reasons for excavating the western extension. First, a probable hearth (Feature 1) was found there during testing. Investigating the relationship between Feature 1 and Pit Structure 1, and establishing the function of this area was the second reason. A total of 95 grids was excavated, extending from 600N to 610N, and 575E to 587E (Fig. 8-2). Several grids were excavated in 0.10 m levels to establish the nature of fill in this zone. They included 608N/579-580E, 609N/580E, and 609N/584E. Other grids were excavated in single levels unless features were encountered. A second hearth (Feature 2) was the only other cultural feature found in this area. Vertical excavation ended when no further artifacts were found. Horizontal excavation ended when the number of artifacts recovered from a grid neared zero. Depth of excavation ranged between 0.11 and 0.56 m, averaging 0.42 m. A total of 39.75 cu m of fill was removed from this area.

The northern extension was excavated to determine whether features or work areas existed north of Pit Structure 1. A total of 31 grids was excavated, extending from 611N to 617N, and 587E to 591E (Fig. 8-2). All grids in this subarea were excavated in single levels. Vertical excavation ended when no further artifacts were found; horizontal excavation ended when the number of artifacts recovered from a grid neared zero. No features were found in this area. Depth of excavation ranged between 0.40 and 0.71 m, averaging 0.63 m. A total of 19.58 cu m of fill was removed from this area.

Excavation was extended eastward to determine whether there was a work area or features on that side of Pit Structure 1. Time constraints did not allow extensive examination of this zone. Only Feature 10, a hearth, was encountered. Seven grids were excavated, extending from 609N to 610N, and 593E to 597E (Fig. 8-2). All grids in this zone were excavated in single levels. Vertical excavation ended when no further artifacts were found. Depth of excavation ranged between 0.28 and 0.77 m, averaging 0.55 m. A total of 3.84 cu m of fill was removed from this area.

Other than feature fill, only Stratum 1 was defined in this part of the site. While some artifacts were recovered from the upper 0.05 to 0.20 m, they probably reached that level through bioturbation. The lower fill was slightly darker and more compact, and contained much less organic matter. Most artifacts were recovered from the lower 0.10 to 0.20 m of excavation. Trenches that were mechanically excavated for geomorphic examination revealed that the upper part of unit Q4a was stained by organic matter through much of this area and was slightly darker than the natural color of the stratum. Unfortunately, this could not be distinguished during excavation.

Subarea 2. Subarea 2 contained a single grid examined during testing. Grid 600N/587E was excavated to a depth of 0.68 m in 0.10 m arbitrary levels. Two pieces of debitage found in the lower 0.20 m of excavation were the only artifacts recovered. Only Stratum 1 was encountered in this area. Because the results of testing were minimal, excavation was not continued during data recovery. A total of 0.68 cu m of fill was removed from this subarea.

Subarea 3. Subarea 3 contained five grids examined during testing and data recovery. Grid 600N/600E was excavated to a depth of 0.33 m in 0.10 m arbitrary levels during testing. Although a few artifacts were found in the upper 0.20 m of this unit, excavation would not have been continued during data recovery if two stains had not been found in the profile of a mechanically dug trench (BT-15). These were Features 4 and 5 (Fig. 8-3), which excavation determined to be natural occurrences. Four grids were excavated in 0.10 m arbitrary levels to examine these stains, extending from 595N/600E to 598N/600E. Only Stratum 1 was encountered in this area. Depth of excavation ranged between 1.15 and 1.34 m, averaging 1.24 m. A total of 5.30 cu m of fill was removed from this subarea.

Subarea 4. Subarea 4 contained a single grid that was examined during testing. Grid 601N/606E was excavated to a depth of 0.37 m in four levels. Only Stratum 1 was encountered in this area. A piece of debitage, the only artifact recovered, was found in the upper 0.10 m of excavation. Only Stratum 1 was encountered in this area. Because the results of testing were minimal, excavation was not continued during data recovery. A total of 0.37 cu m was removed from this subarea.

Excavation Area 2

Excavation Area 2 (EA-2) contained 77 grids in seven subareas, and three mechanically dug trenches (Fig. 8-4). Four subareas (1, 2, 3, and 6) were excavated to examine anomalies identified during the magnetometer survey. Other subareas were excavated during testing (Subarea 7) or expanded from test trenches that contained relatively large numbers of artifacts (Subarea 4), or to examine stains found in mechanically dug trenches (Subarea 5). In general, excavation continued until numbers of artifacts dropped off, suggesting that the edge of work or trash disposal areas had been reached. Of the three mechanically dug trenches in this area, two (BT-2 and BT-3) were excavated during testing, and one (BT-18) was dug during data recovery.

Subarea 1. Subarea 1 was excavated to examine an anomaly defined during the magnetometer survey. Eight grids were examined, extending from 570N to 572N, and 580E to 582E. Most were excavated in 0.10 m levels to establish the nature of the fill. Only Stratum 1 was encountered in this area. Depth of excavation ranged between 0.19 and 0.46 m,

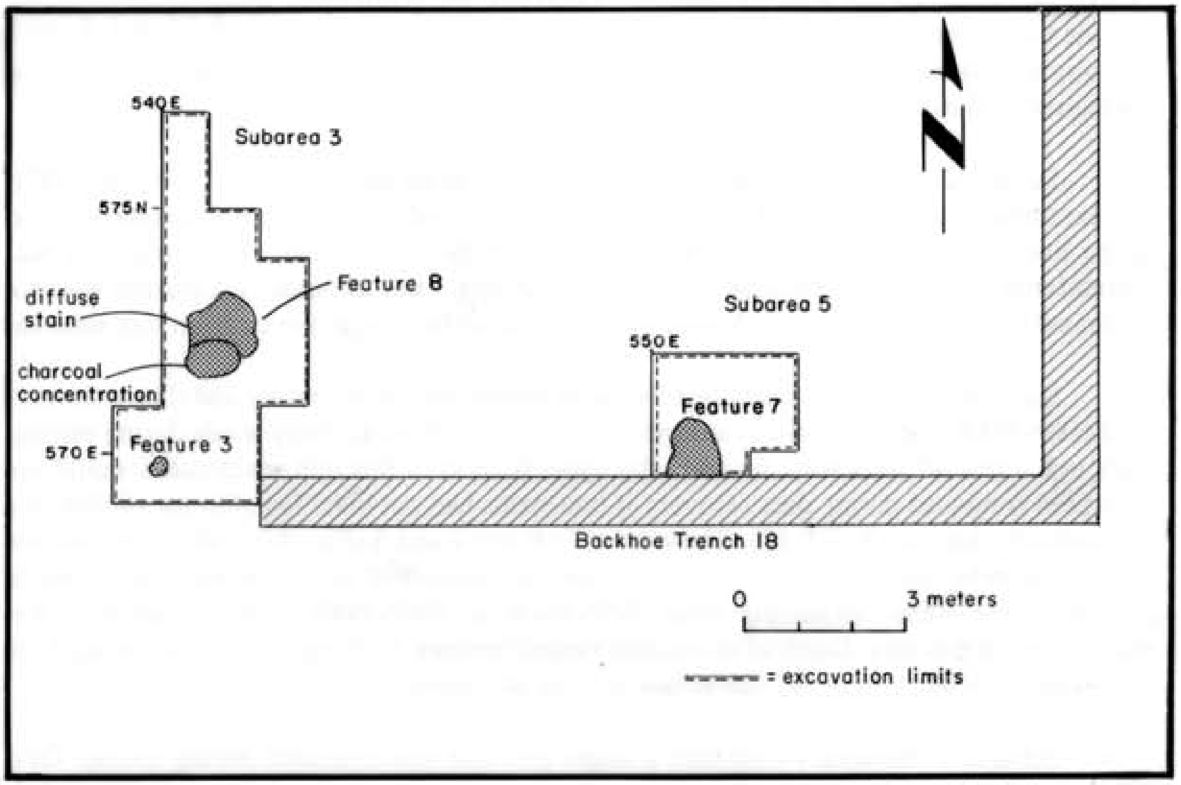

Figure 8-4. Plan of Excavation Area 2, Subareas 3 and 5, at the Mockingbird site.

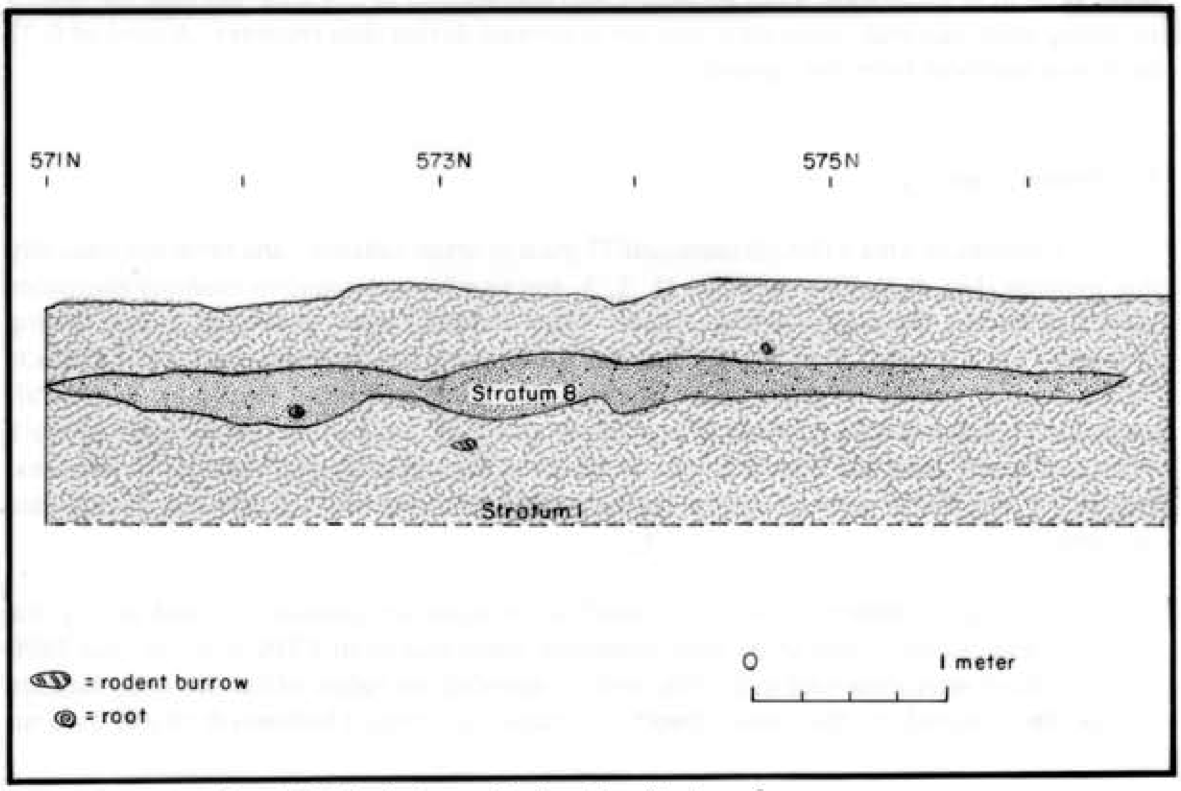

Figure 8-5. Profile of EA-2, Subarea 3, showing Stratum 8.

averaging 0.38 m. A total of 3.03 cu m of fill was removed from this subarea.

No evidence for the source of the magnetic anomaly was found. There were no features in this area, nor were there any deposits of rock that could have been detected by the magnetometer. Small numbers of artifacts were found throughout this subarea, but in only one case was there more than one artifact in a 0.10 m level. Because we were unable to identify the source of the magnetic signature and no substantial cultural deposits were found, excavation in this area was terminated.

Subarea 2. Subarea 2 was excavated to examine an anomaly defined during the magnetometer survey. Eight grids were examined, extending from 570N to 572N, and 561E to 563E. Most were excavated in 0.10 m levels to establish the nature of fill. Only Stratum 1 was encountered in this area. Depth of excavation ranged between 0.12 and 0.50 m, averaging 0.25 m. A total of 2.03 cu m of fill was removed from this subarea.

Excavation revealed a network of burned roots that appear to have been the source of the magnetic anomaly. Small numbers of artifacts were found throughout this subarea, but in only one case was there more than one artifact in a 0.10 m level. Because of the natural origin of this anomaly and the lack of substantial cultural deposits, excavation was terminated.

Subarea 3. Subarea 3 was excavated to examine an anomaly defined during the magnetometer survey. Nineteen grids were examined, extending from 570N to 577N, and 540E to 543E (Fig. 8-4). These grids were removed in 0.10 m arbitrary levels until natural strata were defined, which then became the units of excavation. While Stratum 1 was found through this area, a zone within it that was stained a darker color by cultural inclusions was defined as Stratum 8. Depth of excavation ranged between 0.56 and 1.02 m, averaging 0.83 m. A total of 15 cu m of fill was removed from this subarea.

Stratum 8, which began approximately 0.50 m below the surface, was 0.05 to 0.30 m thick (Fig. 8-5). It was comprised of a fine-grained sand containing less than 2 percent small pebble inclusions. This layer was stained gray by charcoal and ash, though the former was powdered and did not occur as recoverable chunks. Numerous rodent burrows were noted, cutting through this stratum and carrying charcoal stained sand outside its limits. While chipped stone artifacts and sherds were rather rare, fire-cracked rock was comparatively common. Both features in this part of the site were within Stratum 8, and it is likely that the charcoal and ash that stained this unit were derived from those hearths.

The probable hearths (Features 3 and 8) were undoubtedly responsible for the magnetic anomaly. Only a few artifacts were found in this subarea, which was expanded until the nature of Stratum 8 was determined. Since it was resolved that this stratum represented a work area rather than a structure or large feature, excavation was terminated.

Subarea 4. Subarea 4 was excavated to examine a zone found to contain numerous artifacts during testing. Twenty-nine grids were examined, extending from 584N to 592N, and 559E to 562E. Fill was removed in 0.10 m arbitrary levels in the south part of this area.

Elsewhere, excavation proceeded in one or two levels, since no stratigraphic breaks were visible. When excavation in this area was finished, however, a separate cultural layer (Stratum 11) was defined in profile. As in Subarea 3, Stratum 11 was a lightly stained zone in Stratum 1. Depth of excavation ranged between 0.23 and 0.80 m, averaging 0.51 m. A total of 14.40 cu m of fill was removed from this subarea.

Stratum 11 began between 0.17 and 0.50 m below the surface (Fig. 8-6). Its upper articulation with Stratum 1 was at a relatively constant depth below datum, but part of this area was covered with a coppice dune, creating an undulating surface. It was 0.32 to 0.50 m thick and was difficult to distinguish from overlying and underlying portions of Stratum 1. This unit was dominantly yellow brown; however, in places it has a slight grayish tint that allowed it to be distinguished in profile. It was comprised of a fine-grained compacted sand containing less than 1 percent small pebble inclusions. Numerous rodent burrows and root casts were noted cutting through this stratum and carrying stained sand beyond its limits. While artifacts were recovered from this stratum, no evidence of associated features was found. Thus, the staining is probably from culturally discarded organic materials.

No features were found in this area, and Stratum 11 was indistinguishable from Stratum 1 except in profile. Excavation continued until the number of artifacts recovered dropped off, suggesting that the edge of cultural deposits had been reached. Excavation was then terminated.

Subarea 5. Subarea 5 contained eight grids to examine a stain found in the wall of a mechanically dug trench (BT-18) excavated during data recovery. Only the north half of two grids (570N/551-552E) were excavated because the rest was removed by BT-18 (Fig. 8-4). These grids contained a hearth (Feature 7). The six remaining grids (571-572N/551-553E) were used to examine the area around the hearth and were fully excavated. Except in the hearth, only Stratum 1 was encountered in this area. All grids were excavated in 0.10 m arbitrary levels. The horizontal limits of this subarea were defined arbitrarily. Depths of excavation ranged between 0.13 and 0.34 m and averaged 0.26 m. A total of 2.05 cu m of fill was removed from this subarea.

Subarea 6. Subarea 6 was excavated to investigate an anomaly defined during the magnetometer survey. Four grids were examined, extending from 561N to 562N, and 570E to 571E. All were excavated in 0.10 m arbitrary levels to establish the nature of the fill. Only Stratum 1 was encountered in this area. Unit Q4b comprised the upper 0.40 to 0.50 m of fill and was underlain by Unit Q4a. Unit Q4b was relatively thick because this area contained coppice dune deposits. Depth of excavation ranged between 0.44 and 0.57 m, averaging 0.50 m. A total of 2.01 cu m of fill was removed from this subarea.

Subarea 7. Subarea 7 contained a single grid examined during testing. Grid 573N/570E was excavated to a depth of 0.67 m in seven levels. Only Stratum 1 was encountered in this area. Four pieces of debitage from a zone between 0.30 and 0.60 m below the surface were recovered. Because the results of testing were minimal, excavation was not continued during data recovery. A total of 0.67 cu m of fill was removed from this subarea.

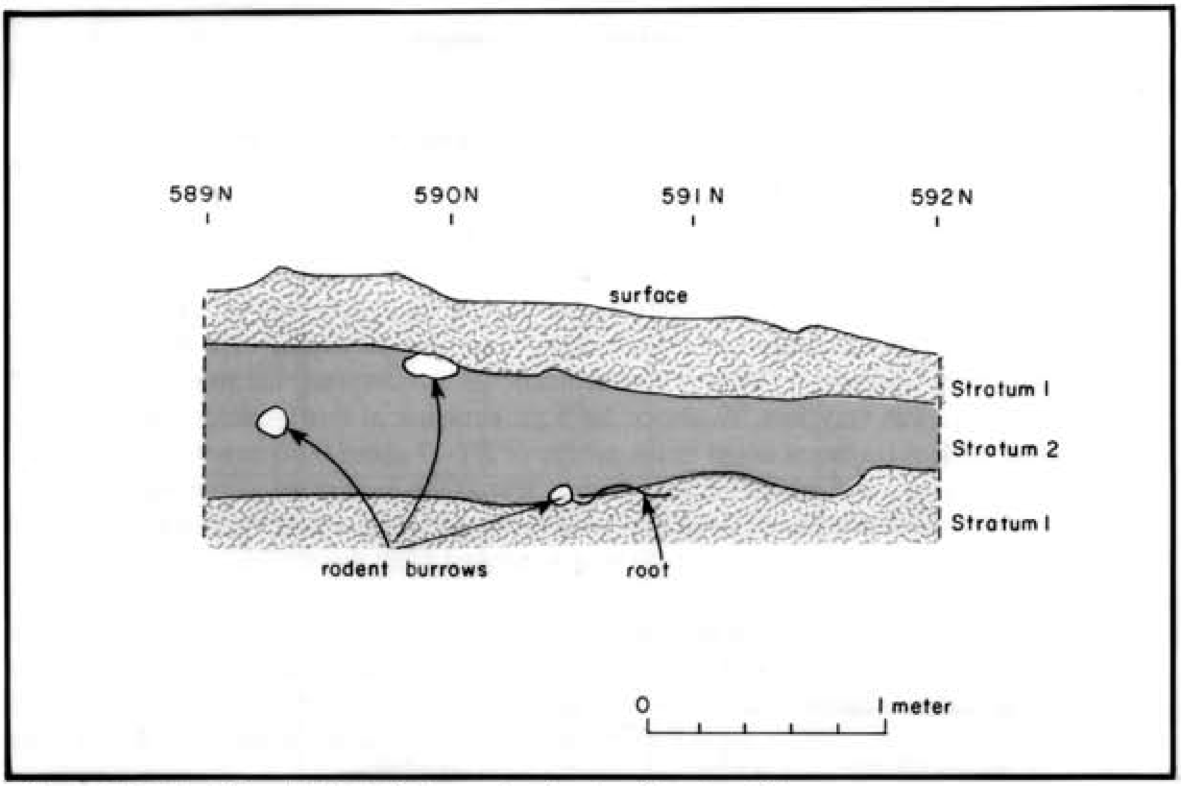

Figure 8-6. Profile of EA-2, Subarea 4, showing Stratum 11.

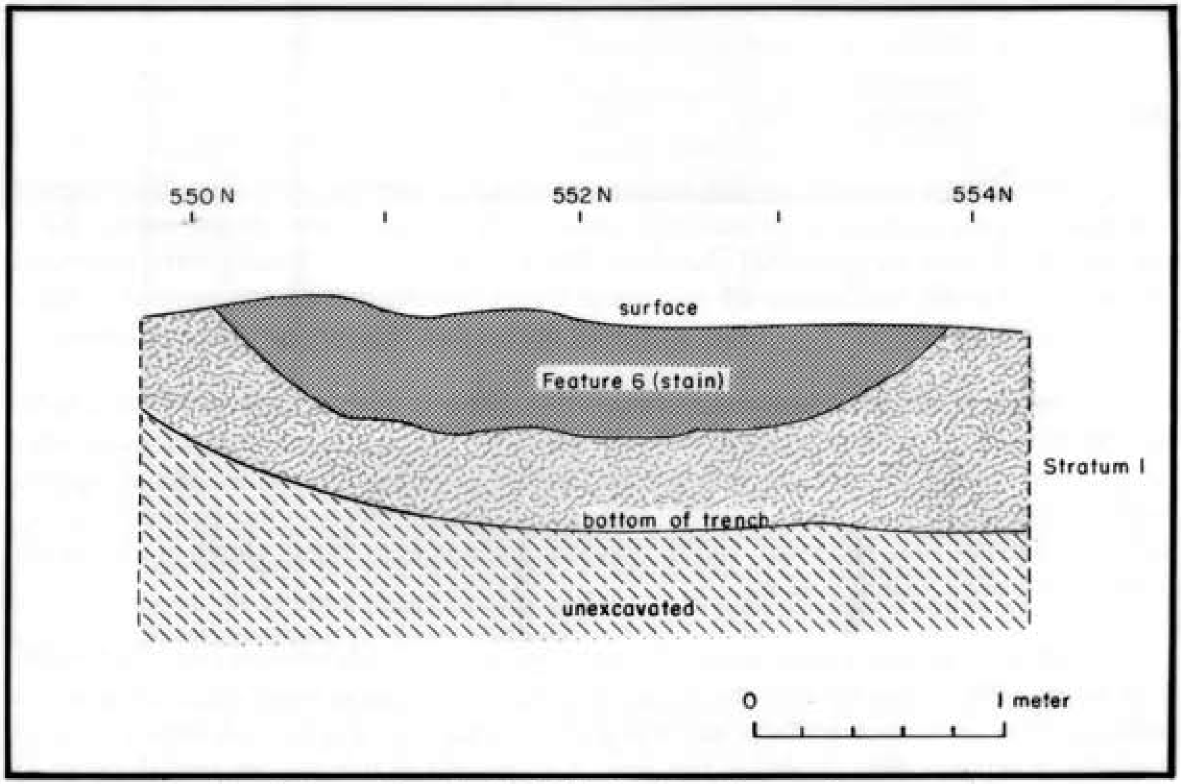

Figure 8-7. Profile of the south end of BT-17, showing Feature 6.

Other Excavated Grids

Five grids were dug outside the excavation areas, three during data recovery and one during testing. The former were excavated to investigate potential features found in the profiles of mechanically dug trenches. The latter (550N/533E) was used to examine an area containing a light scatter of artifacts and is described elsewhere (Moore 1992:28).

Grids 552-554N/595E. These grids were excavated to investigate Feature 6, a possible pit structure found in the profile of BT-17. They were dug to depths of 0.48 to 0.60 m, encountering only Stratum 1. While a few artifacts were recovered, the overall density of cultural materials was very low. Evidence for a pit structure at this location consisted of a ground stone artifact fragment noted in the profile of BT-17 about 0.50 m below the surface and a textural change that suggested this artifact was at the base of an unburned structure. Excavation determined that the difference in texture was natural and that Feature 6 was not of cultural origin. A total of 1.66 cu m of fill was excavated from these grids.

Grid 601N/542E. This grid was excavated to investigate Feature 9, a stain noted in the profile of BT-20. It was excavated to a depth of 0.25 m, encountering only Stratum 1. No cultural materials or evidence of a feature were encountered. However, subsequent erosion of backdirt from BT-20 revealed a deposit of burned caliche and darkly stained soil adjacent to the feature. This material probably represents the bulk of Feature 9, which appears to have been a hearth. Only the edge of the feature was left in place in the profile of BT-20. The rest was removed during mechanical trenching. A total of 0.25 cu m of fill was removed from this grid.

Mechanically Excavated Trenches

Twenty-one mechanically dug trenches were used to examine parts of the Mockingbird site that were not investigated by hand-dug grids. Eight were excavated during testing (BT-2 through BT-9) and are described elsewhere (Moore 1992:33-35). Twelve were excavated during data recovery and include BT-10 through BT-21. All trenches are summarized in Table 8-1 and illustrated in Fig. 8-1. Those excavated during data recovery are discussed below.

BT-10. This was a linear trench oriented from north to south between grids 591N/645E and 600N/645E. It cut through the easternmost perimeter of the surface scatter across the edge of an artifact cluster and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, and no potential features were found. Depth of excavation ranged between 0.73 and 0.82 m.

BT-11. This was a linear trench oriented from north to south between grids 591N/640E and 600N/640E. It cut through the center of a shallow deflation basin which contained a concentration of surface artifacts and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, and no potential features were found. Depth of excavation ranged between 0.82 and 1.00 m.

Table 8-1. Summary of mechanically dug trenches at the Mockingbird site

Trench Number	Length (m)	Width (m)	Depth (m)	Phase
2	10.6	0.9	1.2	testing
3	16.8	0.8	1.2	testing
4	7.5	1.0	0.9	testing
5	8.3	1.0	1.0	testing
6	12.0	0.9	1.2	testing
7	12.3	1.0	1.1	testing
8	14.1	0.9	1.1	testing
9	13.9	1.0	1.5	testing
10	10.0	0.6	0.8	data recovery
11	10.4	0.6	1.0	data recovery
12	10.4	0.6	1.2	data recovery
13	13.4	0.6	1.5	data recovery
14	14.0	0.6	1.2	data recovery
15	15.5	0.6	1.2	data recovery
16	9.0	0.6	1.0	data recovery
17	16.0	0.6	1.0	data recovery
18	31.8	0.7	1.0	data recovery
19	11.8	0.6	1.1	data recovery
20	10.9	0.7	1.0	data recovery
21	18.8	0.7	1.0	data recovery

BT-12. This was a linear trench oriented from north to south between grids 591N/632E and 600N/632E. It was excavated along the west edge of a shallow deflation basin that contained a cluster of surface artifacts and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, and no potential features were found. Depth of excavation ranged between 0.93 and 1.15 m.

BT-13. This was a linear trench oriented from north to south between grids 596N/624E and 610N/624E. It cut through the center of a shallow deflation basin that contained a cluster of surface artifacts and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, and no potential features were found. Depth of excavation ranged between 1.4 and 1.5 m.

BT-14. This was a linear trench oriented from north to south between grids 581N/619E and 594N/619E. It cut through a shallow deflation basin that contained a cluster of surface artifacts and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, and no potential features were found. Depth of excavation was 1.15 m.

BT-15. This was a linear trench oriented from north to south between grids 596N/600E and 610N/600E. It cut through a shallow deflation basin approximately 10 m east of Pit Structure 1 and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, but two stains (Features 4 and 5) were identified near the south end of the trench. Further investigation (EA-1, Subarea 3) showed that these were natural rather than cultural features. Depth of excavation ranged between 1.07 and 1.20 m.

BT-16. This was a linear trench oriented from north to south between grids 561N/610E and 570N/610E. It cut through a shallow deflation basin near the southeast perimeter of the site and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, and no potential features were found. Depth of excavation ranged between 0.82 and 1.00 m.

BT-17. This was a linear trench oriented from north to south between grids 550N/595E and 568N/595E. It cut through an anomaly identified during the magnetometer survey and was used to determine whether subsurface cultural features or deposits were present in that area. The south half of the trench was excavated two buckets wide to search for the source of the anomaly. A single unit of fine-grained sand (Stratum 1) was encountered. A fragment of a ground stone tool was the only artifact recovered, and a slight darkening and textural change in the sand near this artifact suggested that a feature might be present. This was defined as Feature 6, a possible pit structure (Fig. 8-7). Subsequent excavation in grids 552-554N/595E suggested that these variations were natural rather than cultural in origin. Depth of excavation ranged between 0.80 and 1.00 m.

BT-18. This was an L-shaped trench. One leg was oriented from north to south between grids 570N/559E and 584N/559E. The other was oriented from east to west between grids 570N/543E and 570N/559E. BT-18 was used to examine the zone between EA-2 Subareas 3 and 4, both of which contained cultural strata. A single unit of fine-grained sand (Stratum 1) was encountered. The north to south leg contained no cultural materials or features. However, a stain was identified in the north wall of the east to west leg. Excavation identified the stain as Feature 7, a simple hearth that was bisected by the trench. Depth of excavation ranged between 0.93 and 1.20 m.

BT-19. This was a linear trench oriented north to south between grids 590N/550E and 601N/550E. It cut across the east edge of a shallow deflation basin that contained a cluster of surface artifacts and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, and no potential features were found. Depth of excavation ranged between 1.00 and 1.08 m.

BT-20. This was a linear trench oriented from north to south between grids 600N/540-541E and 610N/540-541E. It cut through the center of a shallow deflation basin that contained a cluster of surface artifacts and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, but a stain was noted in one wall of the trench (Fig. 8-8). This appears to have been a hearth (Feature 9) that was mostly removed by BT-20 and was examined by grid 601N/542E. Depth of excavation ranged between 0.45 and 1.04 m.

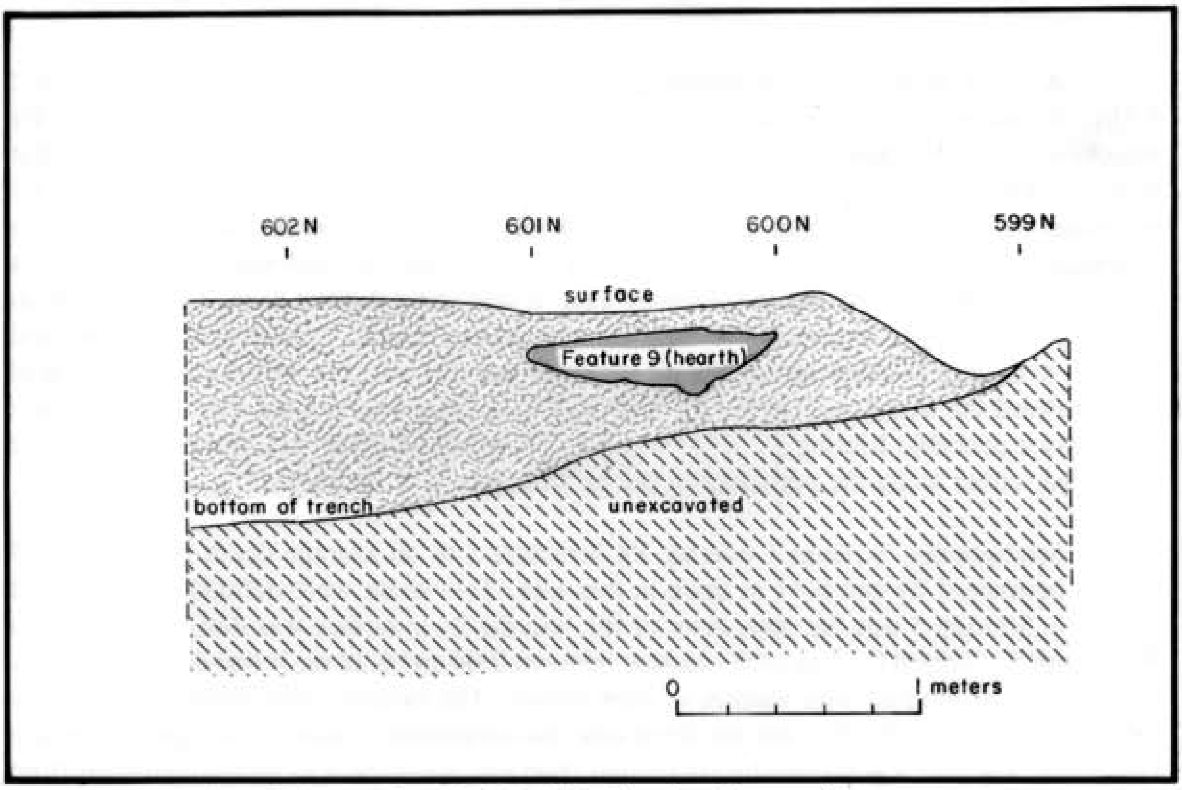

Figure 8-8. Profile of the south end of BT-20, showing Feature 9.

BT-21. This was a linear trench oriented from north to south between grids 581N/525E and 600N/525E. It cut through a mesquite anchored coppice dune and was used to determine whether subsurface cultural features or deposits were present in that area. A single unit of fine-grained sand (Stratum 1) was encountered. No cultural materials were recovered, and no potential features were found. Depth of excavation ranged between 0.90 and 1.04 m.

Structures and Features

One pit structure and 11 features were initially defined at the site during testing and data recovery. While the pit structure was real, several features were found to be noncultural. Features 4 and 5 were small round stains identified in the profile of BT-15. Further investigation suggested they were rodent burrows. Similarly, Feature 6 was identified as a possible pit structure in the profile of BT-17. It, too, was determined to be of natural origin. Since these features were determined to be noncultural, they were not investigated in detail, nor are they described below.

Pit Structure 1

A single pit structure was located and excavated at the Mockingbird site (Figs. 8-9 and 8-10). It was in the central part of EA-1 and occurred in grids 607-610N/589-591E. Pit Structure 1 was first identified in BT-4 during testing (Moore 1992:34). It was bisected by that trench, which removed most of the southwest and part of the southeast quadrants. The pit structure was roughly circular in shape, but a slight compression on the southeast edge distorted it somewhat. Pit Structure 1 measured 3.20 m along its northwest to southeast axis and 2.95 m along its northeast to southwest axis. It was about 0.30 m deep, but bioturbation had blended the upper section of wall into the surrounding matrix, rendering it indistinct and difficult to define. In cross section the pit structure was dish-shaped, with a floor that sloped down toward the center and curved up into the walls. Only one internal feature was found. This was a probable heating pit adjacent to the east wall (Feature 11). No postholes were identified, either along the perimeter of the pit structure or in its floor.

Stratigraphy. Stratum 1 overlay Pit Structure 1 to an average depth of 0.38 m and ranged between 0.29 and 0.51 m thick in this area. Two strata were defined within the pit structure. Stratum 3 was the main layer of fill, and the floor surface was designated Stratum 7. Stratum 3 averaged 0.15 m thick, ranging between 0.04 and 0.22 m. It was dominantly dark yellow brown, mottled with patches of dark brown. The mottling was probably caused by bioturbation. Texturally, this was the same sand that comprised Stratum 1, the main difference being that this unit was stained by pulverized charcoal, allowing it to be distinguished from the surrounding matrix. Stratum 7 was an arbitrary unit with no actual thickness. There was no structure to the floor; it merely represented the articulation of Stratum 3 with the base of the pit. The floor was an average 0.52 m below the surface, ranging between 0.39 and 0.63 m. It was dominantly dark yellow brown, mottled with patches of very dark brown sand.

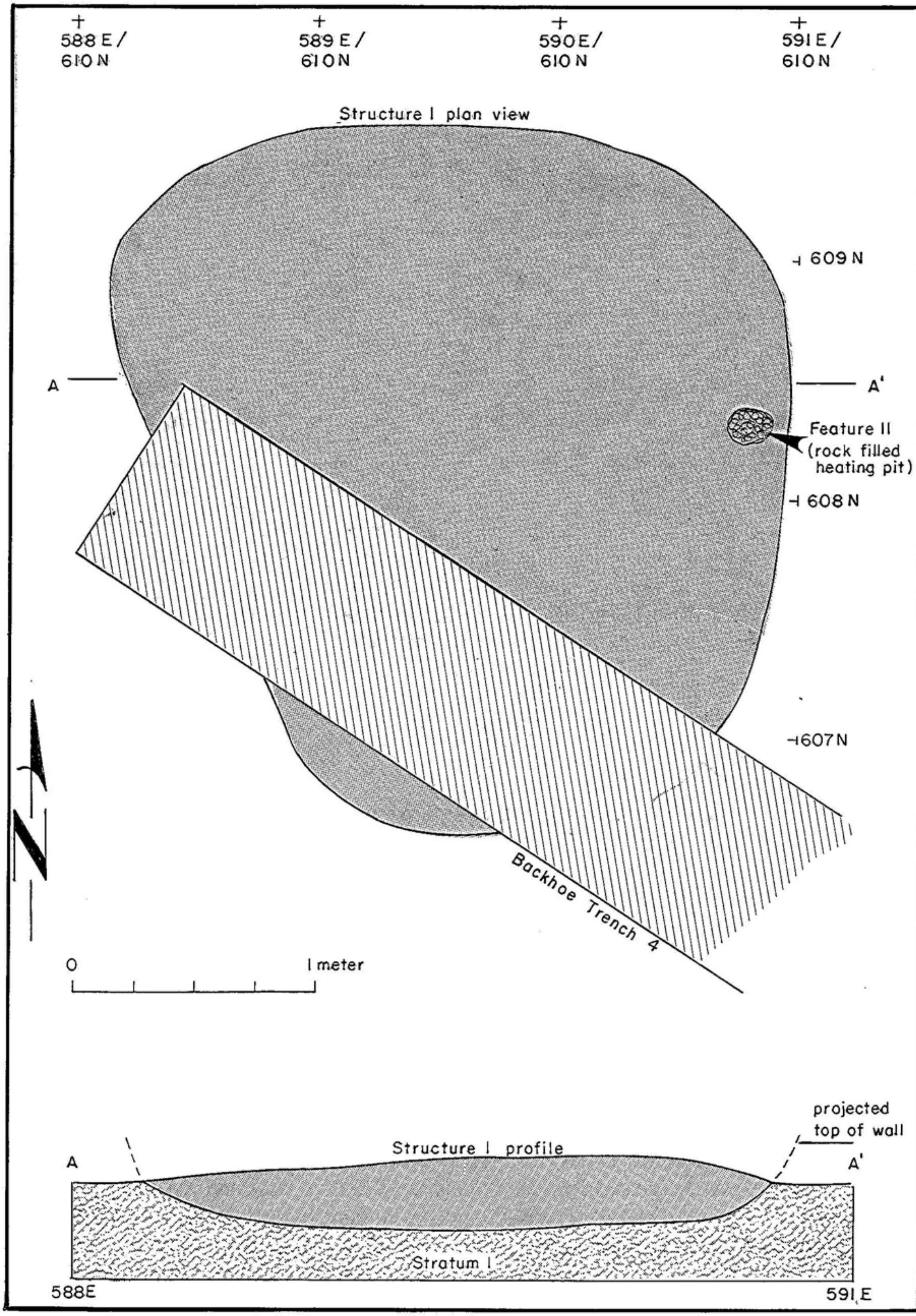

Figure 8-9. Plan and profile of Structure 1 at the Mockingbird site.

Figure 8-10. View of Structure 1 at the Mockingbird site.

Feature 1

Feature 1 was a simple hearth in the western extension of EA-1 (Fig. 8-2). It was in grids 609N/579-580E (Fig. 8-11) and was initially encountered during testing (Moore 1992:33). This feature was roughly oval, but its west end was necked down into a narrower extension of the main pit, making it resemble a bowling pin in plan. This part of the hearth was shallower than the main basin on the east side. While initially thought to have been the result of rodent disturbance, comparison with similar features at the Santa Teresa site suggests that this shape had a cultural function. This hearth measured 0.68 m long by 0.34 m wide and was up to 0.22 m deep. Only one piece of fire-cracked rock weighing 8.1 g was recovered from this feature. Some evidence of bioturbation was noted. An association with Pit Structure 1 is suggested by its location 8 m west of that structure and its occurrence within what appears to be a related work area.

Stratigraphy. Feature 1 was overlain by Stratum 1 to a depth of 0.42 cm. The fill within this feature was designated Stratum 2. It averaged 0.21 m thick and was a compact fine-grained sand. This stratum was dominantly brown, with mottled areas of dark grayish brown and light grayish brown caused by bioturbation. It was darkly stained by pulverized charcoal, few fragments of which could be recovered for identification.

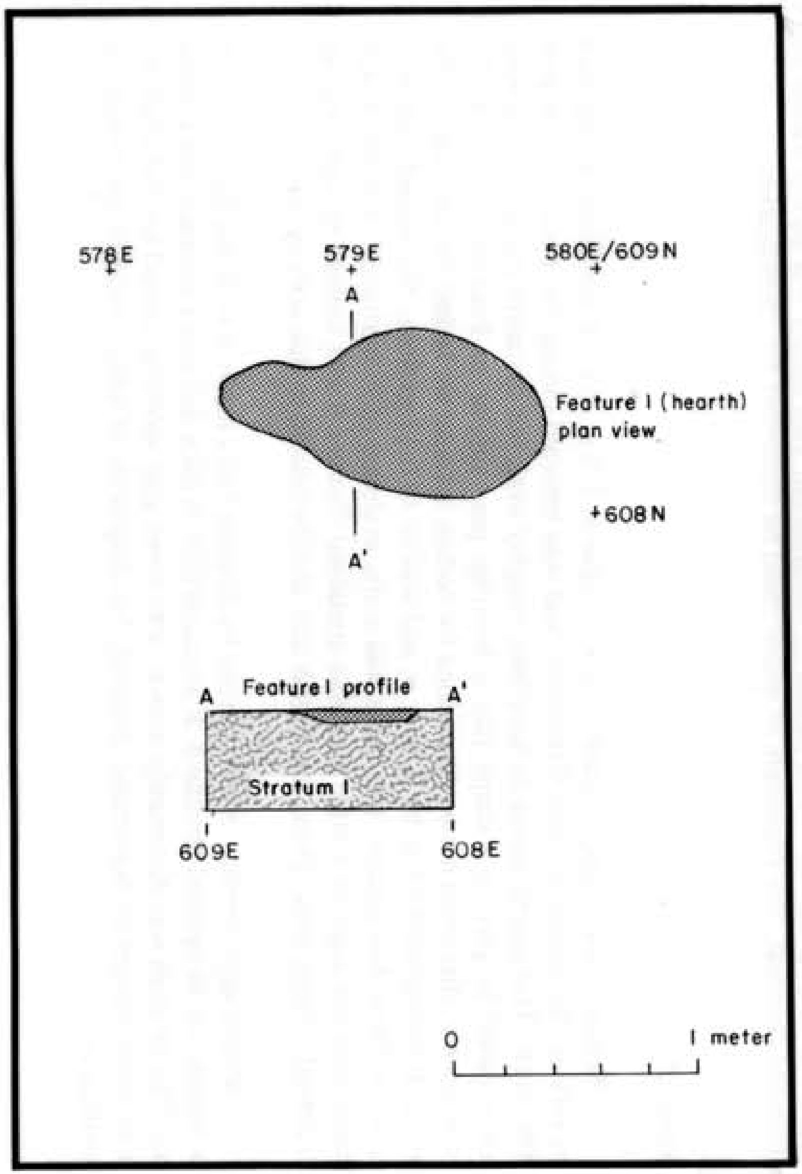

Figure 8-11. Plan and profile of Feature 1 at the Mockingbird site.

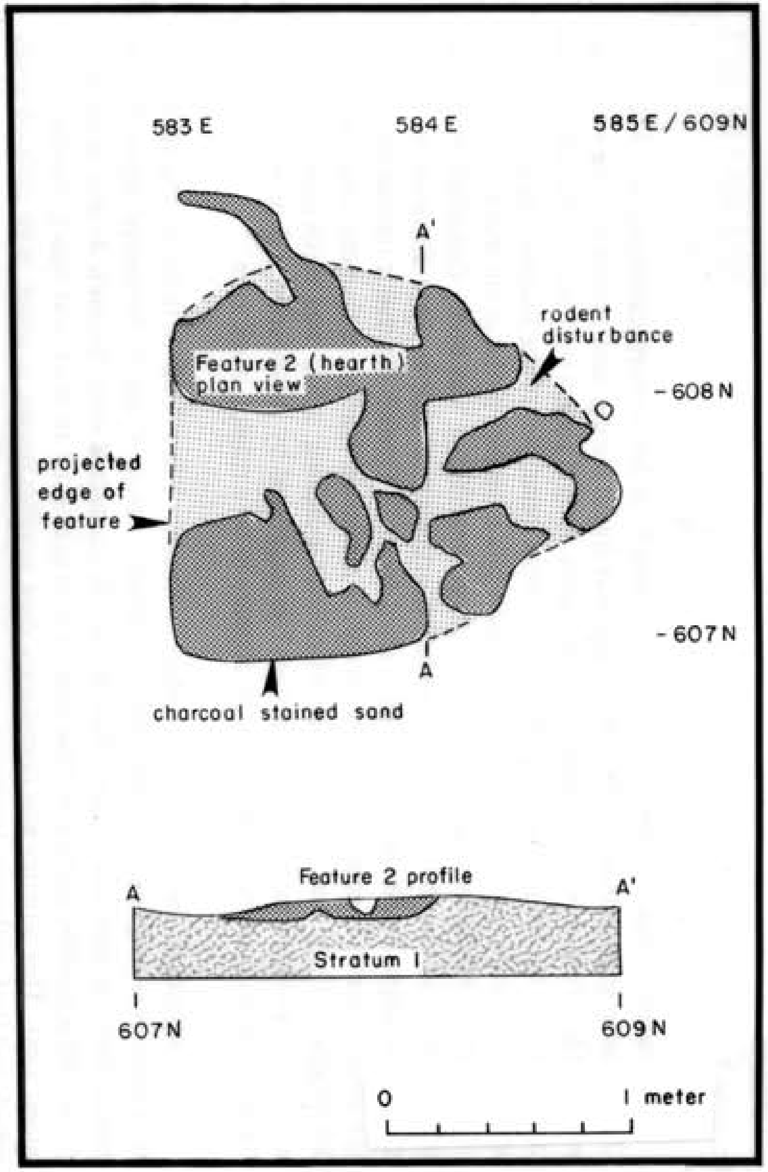

Figure 8-12. Plan and profile of Feature 2 at the Mockingbird site.

Feature 2

Feature 2 was a probable large simple hearth in the western extension of EA-1 (Fig. 8-2). It was in grids 607-609N/583-585E and was found during data recovery. The stain that comprised this feature was discontinuous and cut by several rodent burrows, so that its original shape could not be determined (Fig. 8-12). The most intact part of the feature was profiled and contained a shallow pit. A string of three small pits extended to the south but are not shown in the profile. While this feature may be a large hearth that was badly disturbed by rodent burrows, it could also be a cluster of several hearths whose shapes were distorted by rodent activity or a single hearth and associated discard zone. The possibility that it represents a single large simple hearth is considered most likely. It measured 1.84 m in diameter and was up to 0.10 m deep. Only one piece of burned caliche weighing 1.5 g was recovered from this feature. An association with Pit Structure 1 is suggested by its location 3.5 m west of that structure and its occurrence within what appears to be a related work area.

Stratigraphy. Feature 2 was overlain by Stratum 1 to a depth of 0.33 m. The fill within this feature was originally broken into two layers, Strata 4 and 5. However, upon further consideration, it was determined that the hearth contained only Stratum 4, and Stratum 5 represented a mottled portion of that unit. It averaged 0.07 m thick and was a compact fine-grained sand. This stratum was dominantly dark grayish brown in color, with mottled areas of black and dark yellowish brown caused by bioturbation. This feature was darkly stained by pulverized charcoal, few fragments of which could be recovered for identification.

Feature 3

Feature 3 was a simple hearth in EA-2, Subarea 3 (Fig. 8-4). It was found during data recovery in the profile of grid 570N/540E and was bisected during the excavation of grid 570N/541E. This hearth seems to have been roughly oval, but the north end may have been necked down to give it a shape like a bowling pin, similar to Feature 1 (Fig. 8-13). Unfortunately, this could not be determined for certain because we lacked the east part of the feature. It measured 0.47 m by 0.30+ m and was up to 0.11 m deep. No burned rock was recovered from this feature, and there was some evidence of bioturbation. Feature 3 was located near the edge of a stain that also contained Feature 8 and seemed to represent an extramural activity area. Thus, this hearth may also be related to that activity area.

Stratigraphy. Feature 3 was overlain by Stratum 1 to a depth of 0.70 m. The fill within this feature was designated Stratum 6. It averaged 0.07 m thick and was a compact fine-grained sand. This stratum was dominantly brown, with some gray mottling caused by bioturbation. It was darkly stained by pulverized charcoal, few fragments of which could be recovered for identification.

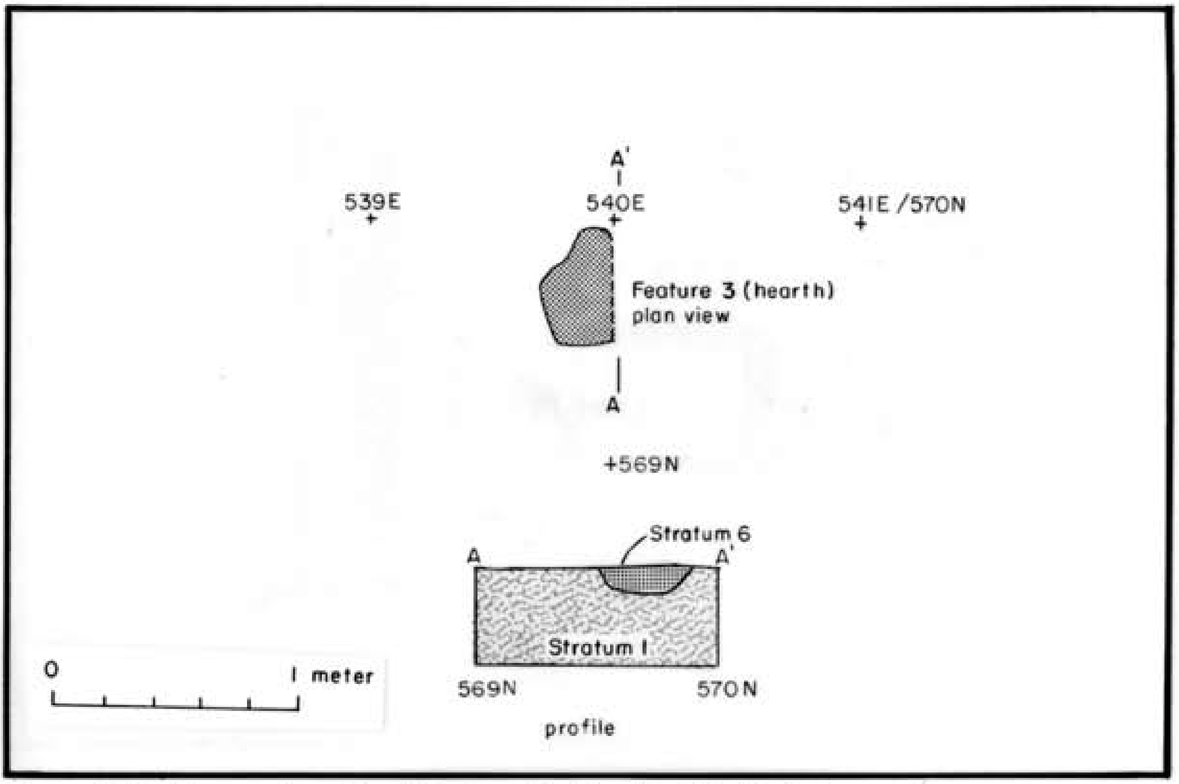

Figure 8-13. Plan and profile of Feature 3 at the Mockingbird site.

Feature 7

Feature 7 was a simple hearth in EA-2, Subarea 5 (Fig. 8-4). It was found during data recovery in the profile of the east to west leg of BT-18 and was in grids 570-571N/550-551E. The hearth was bisected by that trench, and its southern half was missing. It appears to have been oval (Fig. 8-14), but this could not be determined for certain. The remaining part of the hearth measured 1.04 by 0.88 m and was up to 0.20 m deep. For the most part, this feature was a shallow basin. However, an area measuring 0.80 by 0.38 m in what was originally its center was deeper by 0.09 m than the rest of the basin. No burned rock was recovered from this feature, and there was some evidence of bioturbation. Since it was located near the cluster of features and possible extramural work area in Subarea 3 of EA-2, it may be related to their use.

Stratigraphy. Feature 7 was overlain by Stratum 1 to a depth of 0.29 m. The fill within this feature was designated Stratum 10. It averaged 0.16 m thick and was a compact fine-grained sand. This stratum was dominantly gray in color, with some yellowish brown mottling caused by bioturbation. While this feature was darkly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

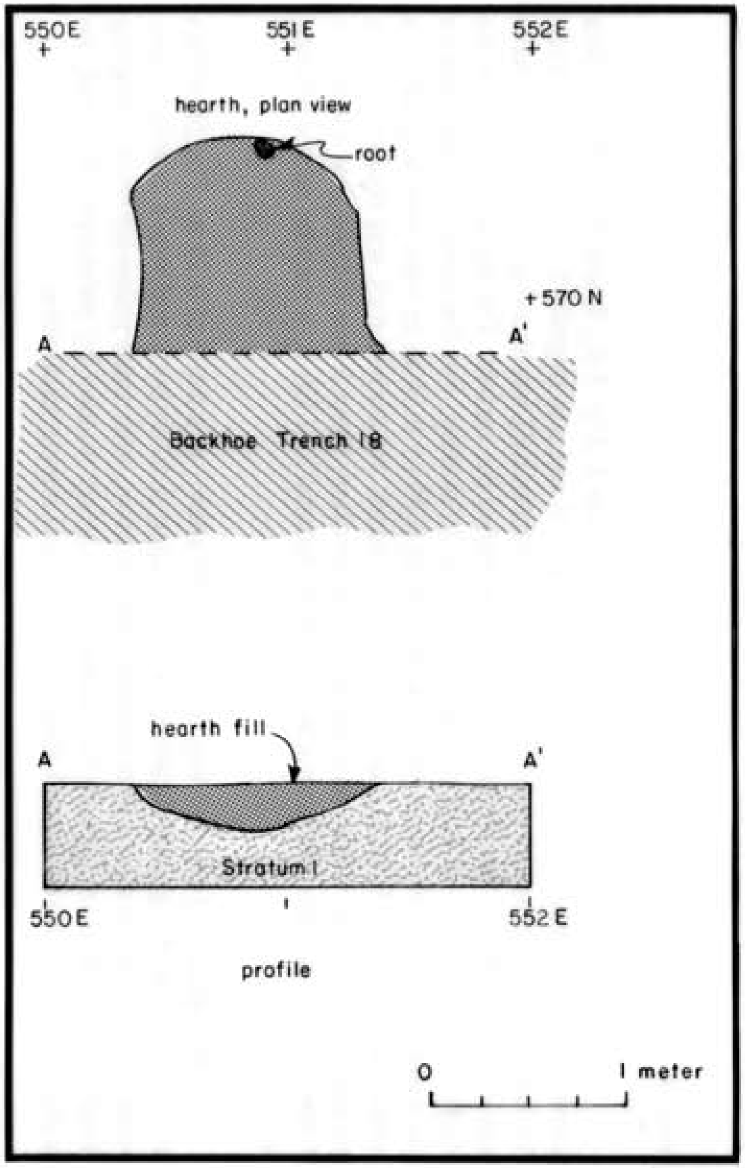

Figure 8-14. Plan and profile of Feature 7 at the Mockingbird site.

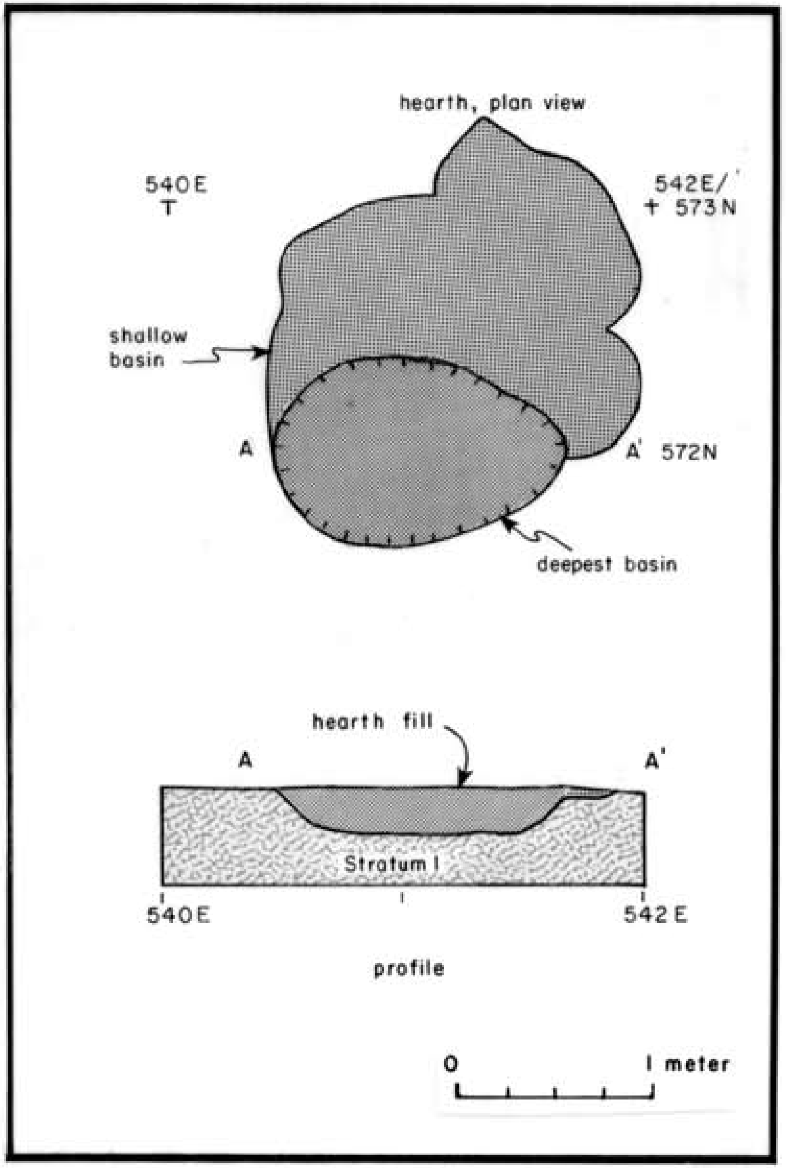

Figure 8-15. Plan and profile of Feature 8 at the Mockingbird site.

Feature 8

Feature 8 was a disturbed and discontinuous stain in EA-2, Subarea 3 (Fig. 8-4). It occurred within Stratum 8 in grids 572-572N/541-542E, a unit of charcoal-stained sand that was found through much of this area. Feature 8 was a darker stain and may represent a simple hearth and associated stained area to its north (Fig. 8-15). However, bioturbation was severe in this area, making it impossible to accurately define the hearth. The entire stain measured 1.72 by 1.52 m and was up to 0.18 m deep. The possible hearth basin was along the south edge of the stain and measured 1.16 by 0.76 m. No fragments of burned rock were recovered, and, as noted above, there was much evidence of bioturbation. Since this hearth was within Stratum 8, it is undoubtedly related to the use of that area and may in fact be responsible for much of the staining in this part of the site.

Stratigraphy. Feature 8 was overlain by Stratum 1 to a depth of 0.56 m. The fill within this feature was designated Stratum 9. It averaged 0.10 m thick and was a compact fine-grained sand. This stratum was dark grayish brown, mottled with lighter areas caused by bioturbation. The hearth was stained by pulverized charcoal, a few flecks of which were noted.

Feature 9

Feature 9 was a stain in the east profile of BT-19 (Fig. 8-8). It was found during data recovery and was bisected and mostly removed by that trench. Thus, only the edge of the feature remained, and it was impossible to derive accurate measurements. The stain seemed to represent the edge of a simple hearth and was at least 1.00 m long by 0.29 m deep. Nearly all of its fill was redeposited in nearby backdirt and included three pieces of burned rock weighing 354.9 g. However, the amount of darkly stained soil in the backdirt was insufficient to fill a feature as large as the profile suggested this one may have originally been. During excavation of 601N/542E, which contained the remaining portion of stain, the edge of the feature proved to be nearly impossible to define because it was only slightly darker than the surrounding sand. Thus, it is likely that the stain represents the edge of a halo of slightly discolored sand surrounding the actual feature, which was probably smaller than suggested above. Since Feature 9 was not defined in situ, no stratigraphic designation was assigned.

Feature 10

Feature 10 was a simple hearth in the eastern extension of EA-1 (Fig. 8-2). It was in grids 609-610N/596-597E and was discovered during data recovery. This hearth was nearly round, and dish-shaped in cross section (Fig. 8-16). It measured 0.95 by 0.85 m and was up to 0.33 m deep. No burned rock was recovered from this feature, and little evidence of bioturbation was noted. An association with Pit Structure 1 is suggested by its location 4.6 m east of that structure.

Stratigraphy. Feature 10 was overlain by Stratum 1 to a depth of 0.42 m. The fill

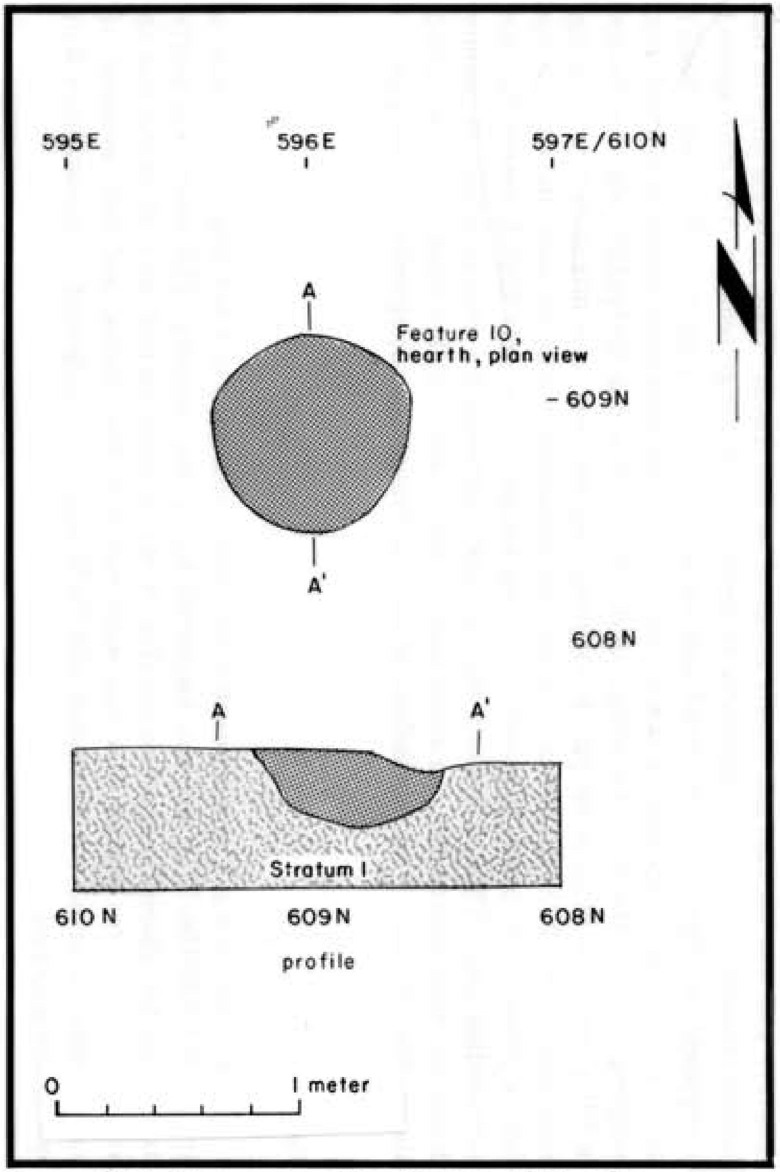

Figure 8-16. Plan and profile of Feature 10 at the Mockingbird site.

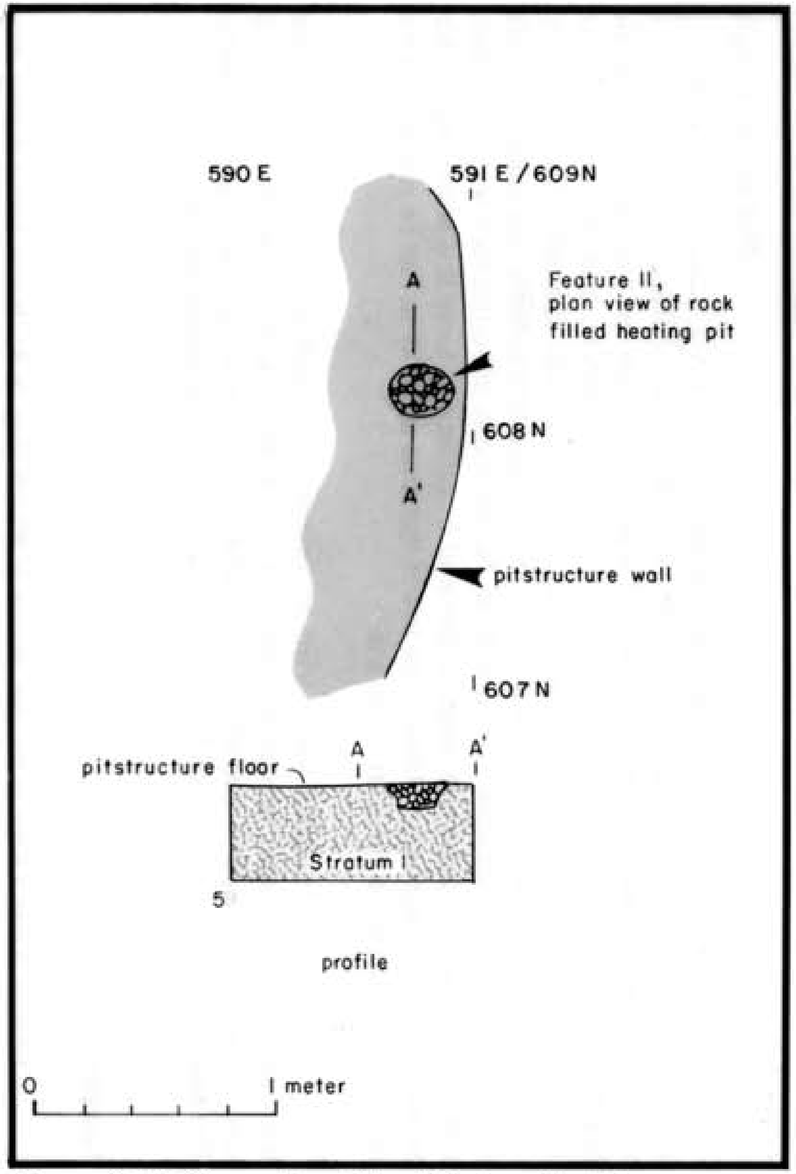

Figure 8-17. Plan and profile of Feature 11 at the Mockingbird site.

within this feature was designated Stratum 12. It averaged 0.23 m thick and was a compact fine-grained sand. This stratum was very dark brown, with a slight mottling of lighter sand resulting from bioturbation. Though this hearth was darkly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 11

Feature 11 was a probable heating pit near the east wall of Pit Structure 1 in EA-1 (Fig. 8-2). It was in grid 609N/591E and was found during data recovery. The pit was oval. Its upper half was relatively wide and dish-shaped, while the lower half was more constricted (Fig. 8-17). It measured 0.27 by 0.21 m and was up to 0.12 m deep. This feature was filled with 103 pieces of burned rock and unburned pebbles weighing a total of 2448.8 g. Its mouth articulated with the floor surface of Pit Structure 1, indicating that it was related to the occupation of that hut.

Stratigraphy. Feature 11 was overlain by Strata 1 and 3 to a depth of 0.51 m. The fill within the feature was designated Stratum 13. It averaged 0.12 m thick and was a mixture of fine-grained sand and rock. The sand was light yellowish brown, with no evidence of burning. While much of the rock in the pit showed no overt evidence of heating, numerous other pieces were burned, suggesting that the entire assemblage was heated and placed in the pit to warm the interior of the structure without risking an open fire.

Chronometrics

Two types of chronometrically sensitive materials were recovered from the Mockingbird site: charcoal and pottery. Unfortunately, the dates provided by these materials do not agree, and radiocarbon dates suggest a much earlier date than the pottery. This is undoubtedly due to both the nature and condition of the samples submitted for radiocarbon dating.

There can be many problems associated with the use of wood charcoal for dating site occupations. In particular, radiocarbon dates may suggest a much earlier date than other temporally sensitive materials. This is a consequence of the use of old wood for construction materials or fuel. The latter use, in particular, can yield highly erroneous dates. Smiley (1985) addressed this problem for sites on Black Mesa in northeast Arizona. He concluded that error creeps into the dating of woody materials in several ways, including preservation conditions and the cross-section effect. The latter reflects the tendency of sections of tree wood to contain numerous rings, each reflecting a different period of growth and, consequently, a differential C-14 content (Smiley 1985:385). Thus, a large error in age estimation can occur in arid or high- altitude situations where tree ring density may be high and dead wood can preserve for extremely long periods of time. Disparities as large as 1,000+ years were found in the Black Mesa dates, and there was an 80 percent chance that dates were overestimated by more than

200 years, and a 20 percent chance that the disparity was over 500 years (Smiley 1985:385-386). There was a much greater disparity in dates when fuel wood rather than construction wood was used for dating (Smiley 1985:372).

Samples considered to be low quality include those consisting of sections of construction or fuel woods that have no bark or outer growth rings, and scattered charcoal samples from contexts like hearths (Smiley 1985:71-72). Charcoal from annuals (particularly cultigens), sections of construction wood containing outer growth rings, and twigs or small branches are more desirable for dating (Smiley 1985:71-72). Unfortunately, we recovered only low-quality samples from the Mockingbird site. Thus, we can expect discrepancies between different types of temporally sensitive materials, and the radiocarbon samples *should* date much earlier than the pottery.

Radiocarbon Dates

Three radiocarbon dates were obtained for this site (Table 8-2). Two very small samples (Beta-80966 and Beta-80969) were given extended counting time. Mesquite wood dominated in two samples (Beta-80966 and Beta-80967) and constituted all of the charcoal submitted in the third (Beta-80969). As recommended by Beta Analytic, who processed the samples, the 2 sigma calibrated results are used in our interpretation of these dates. This provides a 95 percent level of confidence that the carbonized wood dates to that temporal range. However, it must be remembered that the wood was dated, not the event in which it was used. Since none of these samples appeared to contain outer sections of trunks or branches, they should be considered low quality (Smiley 1985:71-72). Thus, discrepancies of up to several hundred years between the timing of sample dates and feature use can occur, and these dates should be considered relative rather than absolute indicators of temporal association.

Table 8-2. Summary of radiocarbon dates from the Mockingbird site

Sample Number	Location of Sample	Conventional Radiocarbon Date	Intercept of Radiocarbon Age with Calibration Curve	1 Sigma Calibrated Results	2 Sigma Calibrated Results
Beta 80966	Feature 2	1390 + 70 B.P.	A.D. 655	A.D. 620 to 685	A.D. 555 to 780
Beta-80967	Structure 1	1350 ± 60 B.P.	A.D. 670	A.D. 650 to 705	A.D. 615 to 790
Beta-80969	Feature 7	2040 ± 70 B.P.	35 B.C.	115 B.C. to A.D. 55	195 B.C. to A.D. 110

Radiocarbon dates for Pit Structure 1 and Feature 2 are very similar. These features were in close proximity to one another and seemed closely related, so this result was not unexpected. Feature 7 had a much earlier radiocarbon date. This hearth was in a different part of the site and was not closely associated with other dated features. Thus, the dates provided by radiocarbon samples suggests that the Mockingbird site was occupied on more than one occasion. The earlier occupation sees to have been during the Late Archaic between ca. 195

B.C. and A.D. 110. The later occupation appears to have been during the middle of the Mesilla phase, ca. A.D. 555 to 790.

Ceramic Dates

Elsewhere in this volume ("Analysis of Ceramic Artifacts from the Santa Teresa Sites"), Wilson discusses the ceramic assemblage from the Mockingbird site in detail. His analysis produced mixed results. For the most part, the ceramic assemblage consists of brown ware body sherds with a few rims, exhibiting characteristics suggesting a Mesilla phase occupation. This would be consistent with the radiocarbon dates. However, two other pottery types were also defined. Two sherds were white wares tempered with crushed rock and (probably) sherd. One was slipped on the interior, and the other had mineral paint on its rim, indicating that different vessels are represented. A manufacturing date after A.D. 1000 can be suggested for these sherds but is certainly not definite. Seven sherds from one El Paso Polychrome jar were also recovered. While only neck sherds are represented, enough were present to suggest that the vessel did not possess the flared rim characteristic of late El Paso phase vessels.

The presence of El Paso Polychrome sherds indicates a later occupation than suggested by the radiocarbon dates and the El Paso Brown sherds. Wilson believes this assemblage may reflect a Doña Ana or early El Paso phase occupation in EA-1. Elsewhere on the site (EA-2, Subareas 3, 4, and 5), the assemblage is more indicative of an Early Formative period date, though this is not reflected by associated radiocarbon dates.

Discussion

The chronometric data from this site are problematic. The radiocarbon dates do not mesh with some of the pottery, and the ceramic assemblage contains types that are traditionally indicative of different phases. Had the seven pesky El Paso Polychrome sherds not been recovered there would be no contradictions, and a Mesilla phase date would have been confidently assigned. Unfortunately, the El Paso Polychrome sherds complicate the dating of this site. If these sherds are an integral part of the ceramic assemblage from EA-1, Subarea 1, the radiocarbon dates from Pit Structure 1 and Feature 2 are 300 to 400 years too early. If not, more than one occupation in that part of the site may be indicated. Thus, one of the most important questions that must be addressed concerns the relationship of the temporally diagnostic sherds. Are they all from one area of the site and therefore indicative of a single occupation between ca. A.D. 1100 and 1250, or are these differences evidence of multiple occupations during different phases? Also, what about the radiocarbon date for Feature 7? There are three hearths in relatively close horizontal and vertical proximity in that part of the site (EA-2, Subareas 3 and 5), and a few sherds were found in association with them. Does this mean that old wood was dated in this hearth as well, and that a later, probably Early Formative period, date should be considered? These questions are considered in "Settlement and Subsistence at the Santa Teresa Port-of-Entry and Conclusions: Interpreting Cultural Remains at the Santa Teresa Port-of-Entry."

Chipped Stone Artifacts

A total of 461 chipped stone artifacts were recovered from the Mockingbird site (Table 8-3). Forty-five (9.7 percent) are fragments of three materials with a tabular fracture. Most are a siliceous rhyolite (93.3 percent), while the rest are a flow-banded rhyolite (4.4 percent) and a metaquartzite (2.3 percent). Ten pieces of siliceous rhyolite have ground surfaces, suggesting they were struck from ground stone tools. Three core flakes of this material were also recovered but are not included with the tabular assemblage because they broke conchoidally. This material tended to break into pieces that lacked diagnostic characteristics which would allow classification as debitage. However, the presence of a few definite siliceous rhyolite flakes suggests these artifacts represent one or more ground stone tools that were recycled as cores. Thus, they are included in the chipped stone assemblage. None of the tabular flow-banded rhyolite or metaquartzite fragments have ground surfaces or possess any flake characteristics. However, considering our findings concerning the siliceous rhyolite, these artifacts probably represent other materials that fractured tabularly, and they are also included in the chipped stone assemblage.

Igneous materials dominate the assemblage. A total of 65.7 percent of the chipped stone artifacts fall into this category and include a variety of rhyolites and aphanitic rhyolites, basalt, obsidian, and undifferentiated igneous rocks. Sedimentary materials are the next most common, comprising 31.9 percent of the assemblage. This category contains a variety of cherts, silicified woods, sandstone, siltstone, silicified limestone, and quartz arenite. Metamorphic materials are the rarest rocks. They comprise only 2.4 percent of the assemblage and include undifferentiated metamorphic materials and quartzites.

Few formal tools or evidence of their manufacture occur in the assemblage. Debitage reflecting tool manufacture or use include one aphanitic rhyolite biface flake and three hammerstone flakes of rhyolite and aphanitic rhyolitic. The latter are flakes struck accidentally from hammerstones during use and are more indicative of tool use than core reduction. The only complete tool recovered was a hammerstone, which was unmodified apart from battering. Four biface fragments were also found. Three were broken during the early stage of manufacture, and one was too fragmentary to determine its manufacturing stage.

Most of the assemblage consists of debitage produced during core reduction. Excluding hammerstone flakes, and considering tabular fragments to be angular debris, there are 1.64 flakes for every piece of angular debris, suggesting that expedient core-flake reduction predominated. Ten cores were recovered. Most are rhyolite or aphanitic rhyolitic, though a few other cherts are also represented.

Table 8-3. Chipped stone artifact assemblage from the Mockingbird site, illustrating artifact morphology by material type (frequencies and row percentages)

Material Types	Angular Debris	Core Flakes	Biface Flakes	Hammerstone Flake	Cores	Cobble Tools	Bifaces	Tabular Fragments	Totals
Cherts	30 33.0	55 60.4	0 0.0	0 0.0	4 4.4	0 0.0	2 2.2	0 0.0	91 19.7
Silicified woods	2 66.7	1 33.3	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 0.7
Obsidians	0 0.0	4 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	4 0.9
Undifferentiated igneous	0 0.0	6 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	6 1.3
Basalt	3 50.0	3 50.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	6 1.3
Rhyolites	47 25.7	82 44.8	0 0.0	2 1.1	5 2.7	1 0.5	2 1.1	44 24.0	183 39.7
Rhyolites, aphanitic	19 18.3	82 78.8	1 1.0	1 1.0	1 1.0	0 0.0	0 0.0	0 0.0	104 22.6
Silicified limestone	2 66.7	1 33.3	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 0.7
Sandstone	1 33.3	2 66.7	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 0.7
Siltstone	3 60.0	2 40.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	5 1.1
Undifferentiated metamorphic	2 50.0	2 50.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	4 0.9
Quartzite	2 28.6	4 57.1	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 14.3	7 1.5
Quartz arenite	12 28.6	30 71.4	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	42 9.1
Totals Percent	123 26.7	274 59.4	1 0.2	3 0.7	10 2.2	1 0.2	4 0.9	45 9.8	461 100.0

Burned and Fire-Cracked Rock

This category includes thermally altered rock and rock from thermal features that are not included in other assemblages. For example, many ground stone artifacts were reused in thermal features and are burned or heat-fractured. Even though they were reused in thermal features, these artifacts are discussed with the other ground stone tools. A total of 343 non–ground stone artifacts were thermally altered or found in thermal features. As shown in Table 8-4, slightly more than a third are unburned. The unburned rock was recovered from Feature 11, a probable warming pit, and were mixed with thermally altered rocks. Thus, they were used in the feature but apparently not heated to the point where visible physical alteration occurred.

Table 8-4. Thermally altered rock and rock from thermal features for the Mockingbird site (frequencies and row percentages)

Material Type	Burned Rock	Fire-cracked and Burned Rock	Unburned Rock	Totals
Undifferentiated igneous	3 8.1	3 8.1	31 83.8	37 10.8
Rhyolite	0 0.0	6 50.0	6 50.0	12 3.5
Thunderbird rhyolite	0 0.0	7 38.9	11 61.1	18 5.2
Rhyolitic chert	0 0.0	2 66.7	1 33.3	3 0.9
Sandstone	71 35.0	87 42.9	45 22.2	203 59.2
Undifferentiated metamorphic	2 20.0	6 60.0	2 20.0	10 2.9
Quartzite	0 0.0	0 0.0	2 100.0	2 0.6
Quartzitic sandstone	5 23.8	2 9.5	14 66.7	21 6.1
Caliche	22 59.5	9 24.3	6 16.2	37 10.8
Total Percent	103 30.0	122 35.6	118 34.4	343 100.0

By count, sandstone was the most common material used in thermal features. Undifferentiated igneous rocks and caliche were the next most common, but they occur in considerably smaller numbers. All thermally altered rock exhibits signs of burning, and a little over a third was also fire-cracked.

The distribution of materials is somewhat different when weight is considered (Table 8-5). While sandstone remains the most abundant material, caliche becomes the second most common. Undifferentiated igneous rocks are a distant third, followed rather closely by Thunderbird rhyolite. When all three rhyolitic materials are combined, they are slightly more common than undifferentiated igneous materials.

Table 8-5. Thermally altered rock and rock from thermal features for the Mockingbird site (counts and total weights)

Material Type	Count	Total Weight (g)
Undifferentiated igneous	37	597.20
Rhyolite	12	143.40
Thunderbird rhyolite	18	429.50
Rhyolitic chert	3	40.90
Sandstone	203	2844.70
Undifferentiated metamorphic	10	122.00
Quartzite	2	45.80
Quartzitic sandstone	21	346.90
Caliche	37	1063.50

Unburned rocks are removed from consideration in Table 8-6. This eliminates artifacts from Feature 11 that demonstrate no overt signs of thermal alteration and changes the structure of the assemblage considerably. While sandstone and caliche continue to dominate in both count and weight, other materials occur in much smaller amounts. In particular, there is a large reduction in igneous and metamorphic rocks. This is probably because those materials were either created or altered under conditions of high heat or pressure and are less prone to alteration in thermal features than are sedimentary rocks.

Table 8-6. Thermally altered rock from the Mockingbird site (counts and total weights)

Material Type	Count	Total Weight (g)
Undifferentiated igneous	6	267.20
Rhyolite	6	67.40
Thunderbird rhyolite	7	175.20
Rhyolitic chert	2	6.80
Sandstone	158	2048.40

Material Type	Count	Total Weight (g)
Undifferentiated metamorphic	8	61.20
Quartzitic sandstone	7	112.90
Caliche	31	950.20

Ground Stone Artifacts

This category includes all fragments of rock with ground surfaces or edges, including specimens that were burned. A total of 72 ground stone artifacts were recovered, but only 2 specimens were whole. Fragments of manos, metates, and shaped slabs dominate the assemblage. As we conclude in "Analysis of Ground Stone Artifacts from the Santa Teresa Sites," nearly all of the fragmentary specimens probably represent broken or discarded ground stone tools from earlier sites that were recycled as hearth elements. Thus, there is little direct evidence for the use of grinding tools at this site. The only possible exception is a one-hand mano, since the only other whole ground stone artifact was a shaped slab found in a thermal feature.

Ceramic Artifacts

A total of 290 ceramic artifacts were recovered from this site. Most of the assemblage is comprised of unidentified brown ware body sherds (92.8 percent). These sherds could either be fragments of El Paso Brown vessels or the unpainted parts of El Paso Polychrome vessels, but it was impossible to assign them to either type. El Paso Brown rims make up a small percentage of the assemblage (3.4 percent), as do sherds from a single El Paso Polychrome jar (2.4 percent). Other types noted include a white slipped brown ware (0.7 percent) and an unpainted white ware (0.7 percent). The former could represent the local use of a slip or may be from unpainted parts of Mimbres series vessels with paste and temper similar to those used in the El Paso area. The white wares are the only sherds that were definitely produced outside the southern Jornada region, but it is uncertain whether they originated in the Mimbres or Anasazi areas.

Bone Artifacts

Forty-four fragments of bone were recovered from this site. All were associated with EA-1, Subarea 1, and came from the area west of Pit Structure 1. This assemblage includes one fragment of rabbit bone (*Sylvilagis* sp.), a piece of pocket gopher bone (*Thymomys* sp.), and 42 fragments of large mammal bone that appear to represent a single lower leg from a mule deer (*Odocoileus hemionus*). The latter came from three adjacent grids and exhibit some signs of butchering.

Flotation Analysis

Sediment samples from 20 proveniences were examined for botanical remains. Charred specimens of three economic species were recovered, as well as an unidentified species. Sunflower seeds (*Helianthus* sp.) were found in Features 1 and 8. Purslane seeds (*Portulaca* sp.) were recovered from Pit Structure 1 and Feature 7. Dropseed grass (*Sporobolus* sp.) seeds were the most common macrobotanical remain, occurring in samples from Features 1, 2, 8, and Pit Structure 1. The unidentified species was recovered from Features 1 and 3. Fragments of charcoal from fuel woods were also recovered. Examination of these materials found evidence for the use of mesquite wood (*Prosopis* sp.) and an unidentified nonconifer.

THE SANTA TERESA SITE (LA 86780)

James L. Moore

Though this area was examined by earlier surveys (Camilli et al. 1988; Ravesloot 1988a), the Santa Teresa site was not identified until a detailed study of the port-of-entry location was conducted in 1990 (Stuart 1990). This is because about two vertical meters of sand were removed from this area by a brush rake mounted on a bulldozer at some time between these dates, revealing the cultural deposits that we investigated. Since no site was recorded in this area during earlier surveys, it is assumed that there was little or no evidence of these deeply buried deposits on the original dune surface.

The site was found within a parabolic dune that also contained the Mockingbird site (LA 86774). Coppice dunes on adjacent surfaces are modern features of the landscape, while the parabolic dune is a much older landform that has been forming continuously for more than 4,000 years. This geomorphic situation is different from that which usually prevails in the region. Sites in this part of the state are normally deflated, a process that tends to uncover and concentrate artifacts on the surface. Since there is no evidence for this process at the Santa Teresa site, it is likely that occupations separated by long time periods will occur at different levels in the dune and will not be concentrated in a single layer. This depositional regime may provide an unusual look at site formation processes in the region.

Initial Definition of the Site during Survey

The Santa Teresa site was first recorded as a scatter of chipped stone, ground stone, and ceramic artifacts and designated in the field as BK240 (Stuart 1990:25-26). As first defined, it covered an area of 4.7 ha directly west of a small playa and was thought to have functioned as a processing and procurement locale (Stuart 1990). Cultural materials were concentrated in two loci. Locus 1 contained most of the artifacts and all of the features noted and was exposed in a large shallow basin. Locus 2 was a small cluster of artifacts separated from the main site by eolian sand deposits. Undifferentiated brown ware sherds were the only diagnostic artifacts found, suggesting a general date of A.D. 200 to 1450.

Evaluation of the Site by Testing

The site was later tested to determine whether it contained potentially important subsurface cultural remains or features (Moore 1992). It appeared to be less extensive than was thought during survey and was estimated to contain 500+ artifacts in a 2.8 ha area. Surface artifacts and features were distributed through a shallow basin created by mechanical disturbance. It is likely that this disturbance ended slightly above the level that contained the cultural materials, which were subsequently exposed by eolian processes. Thirteen features were defined during testing, including four charcoal stains and nine clusters of burned rock. While artifacts were scattered across the site, three concentrations were noted. Only four brown ware sherds were found during this phase of investigation, two of which were corrugated. While the presence of these artifacts suggested an occupational date between A.D. 200 and 1100, the paucity of sherds suggested that a Formative period date was questionable and that the bulk of materials probably dated to the Archaic period. In addition, since 1 to 2 m of overburden was removed from the site prior to excavation, the possibility that the sherds were moved around and redeposited by mechanical equipment was considered very likely. This is discussed in more detail in a later section of this report.

Four methods were used to investigate the site: hand-dug grids, surface stripping, auger tests, and mechanically dug trenches. Test pits were used to examine features and areas judged to have potential to contain subsurface cultural deposits. Auger tests were placed in the bottoms of excavated grids and were used to examine a zone along the international border where construction of a temporary road was planned. Mechanically dug trenches were used to examine the east edge of the artifact scatter and the temporary road right-of-way to determine whether buried cultural remains encompassed a larger area than was indicated by surface remains.

Testing suggested that at least five features were intact. While few artifacts were recovered in test grids, it appeared that the upper 10 to 20 cm of sand in the artifact concentrations contained cultural materials. Augering and mechanical trenching encountered few cultural remains. A small stain was found in BT-12, but it was probably noncultural. Since no subsurface cultural materials and fewer than five surface artifacts were found in the area containing the proposed temporary road, no further work was suggested for that area. However, the presence of apparently intact cultural features, numerous surface artifacts, and a potential for other subsurface deposits suggested that this site could contain important information on local prehistory, and a data recovery plan was prepared (Moore 1992).

Summary of Data Recovery Efforts

Site boundaries were the same as defined during testing. LA 86780 measured 280 by 100 m and covered 2.8 ha (Fig. 9-1). Many more artifacts were recovered than our original estimates suggested would be present. They included chipped stone, ground stone, and ceramic artifacts, fragments of burned rock, and botanical specimens. The assemblage is described by artifact category in a later section of this chapter.

Several methods were used to define potential features and subsurface deposits. The most useful was a close examination of the surface for evidence of discolored soil, clusters of burned rock, or concentrations of other cultural materials. In addition, a magnetometer survey was used to examine the central part of the site to determine whether that area contained more deeply buried features or structures. The initial placement of excavation grids was biased toward areas that contained visible features or artifact concentrations. As these areas were explored by series of adjacent grids, other features and artifact deposits were found and examined. A total of 429 grids was excavated by hand, removing nearly 65 cu m of soil.

Mechanically excavated trenches were the final method used to search for subsurface remains. Thirteen trenches were mechanically excavated during testing, but the only trenches that were mechanically excavated during data recovery were those used to examine dune stratigraphy by the geomorphologists. Since testing had indicated that cultural deposits were concentrated in the shallow basin, no further efforts were expended on peripheral zones. Nearly 459 cu m of soil were mechanically removed during testing.

Excavation Methods

All proveniencing was tied to the main datum, between LA 86774 and LA 86780. Two methods were used to collect surface materials. Artifacts were collected in 1 by 1 m grids in areas containing moderate to dense surface scatters and were provenienced to those units. Where artifacts were more widely scattered, they were collected by point provenience. Following our return to the laboratory their locations were plotted on site plans, and they were assigned grid designations to make their proveniences consistent with the rest of the assemblage.

Excavation areas were selected using the criteria discussed above. Data recovery efforts concentrated on zones containing visible features or artifact concentrations, and only a few grids were excavated outside these areas to examine potential features defined during the magnetometer survey. While our excavation areas represent the imposition of arbitrary limits on cultural deposits, analysis suggests that many actually can be defined as different occupational clusters. Thus, most of the arbitrary divisions also represent groups of features and artifacts that can be empirically separated. Because of this, each of these areas is considered separately.

General Site Stratigraphy

Geomorphic studies indicate there were two main strata at this site (see "Geomorphology of the Santa Teresa Sites"). Up to 0.98 m of sand along the eastern edge of the site was deposited in cross-bedded coppice dunes. This is Unit Q4b, which exhibits no soil development and is probably less than 100 years old. Below this is a massive sand unit (Q4a), which exhibits a similar lack of soil development. This stratum is much older than Q4b and extends to an undetermined depth. Unit Q4b was removed from the site when the shallow basin that contains it was formed by mechanical disturbance. The upper 4 to 5 cm of remaining sand was dry and loose, and represents newly deposited eolian sand or the upper part of Unit Q4a, which was churned by surface traffic and bioturbation. The latter is considered more likely.

Archaeologically, strata were distinguished in a different manner. This was partly because the geomorphic study was not completed until excavations were finished. Also, natural strata could not be differentiated during excavation unless they were discolored by cultural inclusions; they were simply too similar to separate. Indeed, except for feature fill, only one stratum was defined. Stratum 1 comprised the upper portion of Unit Q4a and consisted of a brownish yellow, fine-grained sand. Small pebbles comprised less than 1 percent of this unit and included a mixture of cherts, basalts, unidentified igneous materials, and a small amount of obsidian. Evidence of a considerable amount of bioturbation was noted.

Excavation Areas

Eleven excavation areas were defined, based on the proximity of grids. A few other zones were investigated by grids or mechanically excavated trenches but were not assigned to specific excavation areas and are discussed separately. Three large areas were surface stripped to investigate clusters of artifacts and features, and six individual features or groups of features. The two remaining excavations areas were used to search for evidence of cultural deposits or features. As noted earlier, while excavation areas were defined arbitrarily, several may represent actual clusters of artifacts and features. In particular, Excavation Areas 1, 2, 3, 4, 5, 7, and 8 seem to represent discrete occupation zones. The division between Excavation Areas 2 and 3 was arbitrarily formed by a chain link fence that bisected the site, and those areas might actually be part of the same occupation. Analysis of the spatial distribution of features and artifacts is completed in a later chapter. For the rest of this discussion we consider the excavation areas listed above to potentially represent individual occupational episodes, and they are referred to as residential groups or clusters.

Excavation Area 1

Excavation Area 1 (EA-1) contained 121 grids in three subareas and was near the center of the site (Fig. 9-1). All subareas were excavated to examine potential features represented by patches of stained sand. Subareas 1 and 2 contained Features 5 and 6, which were identified during testing, and Subarea 3 was excavated to expose a stain found during data recovery. Excavation continued until the occurrence of cultural materials dropped off and all visible stains were examined, suggesting the edges of associated work or trash disposal areas had been reached.

Subarea 1. A total of 108 grids was excavated in Subarea 1, extending from 361N to 370N, and 546E to 557E (Fig. 9-2). This zone was excavated to examine Feature 5, which was partly exposed during testing and found to contain four discrete stains (Moore 1992:46). Three of these stains were identified as hearths during data recovery and designated Features 5, 17, and 18. As the zone around these features was stripped, three other hearths (Features 19, 20, and 21) and several amorphous stains were encountered. Excavation continued until all visible stains were investigated and artifact density dropped off. Grids 361N/546-555E were excavated

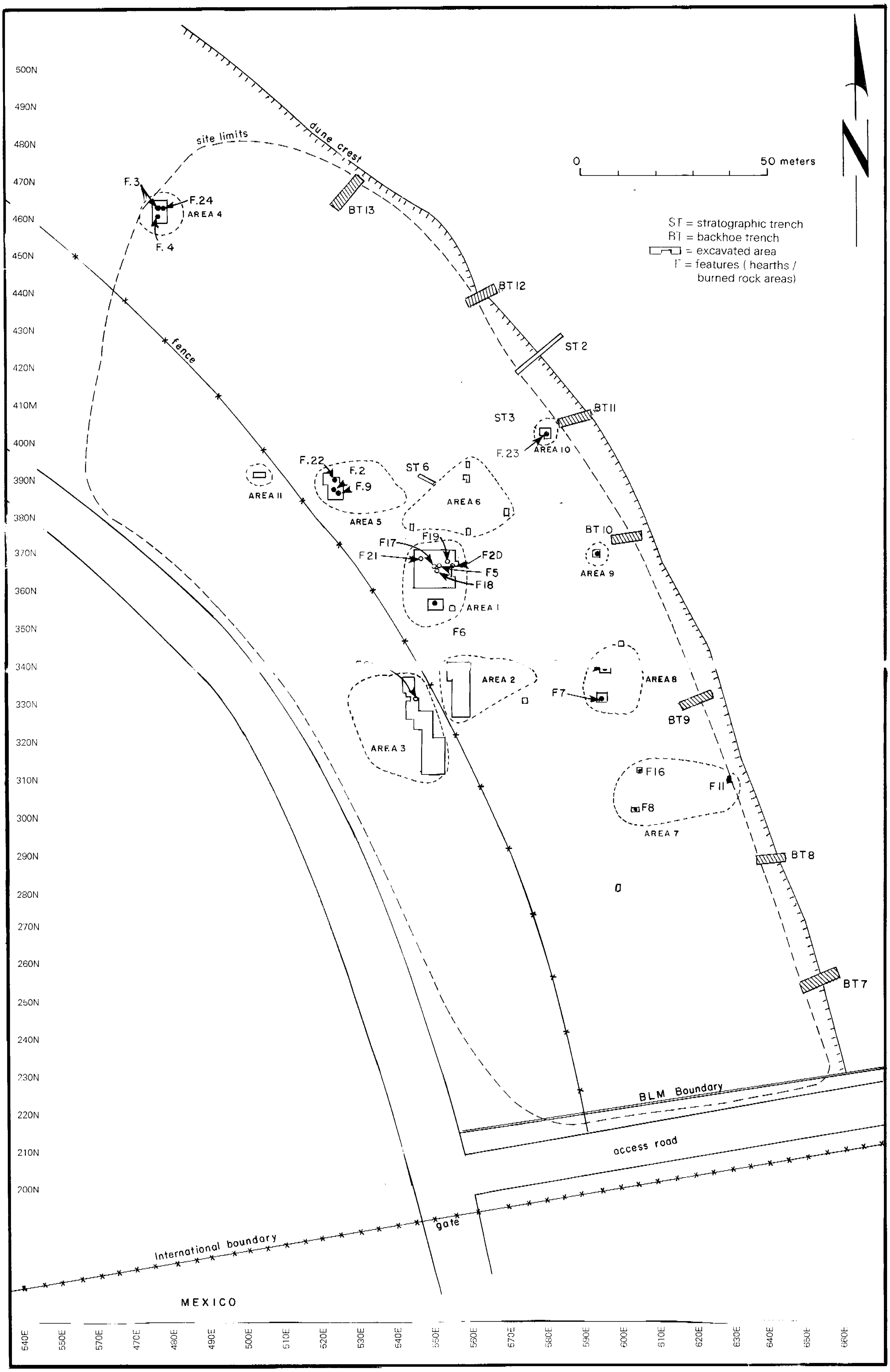

Figure 9-1. Plan of the Santa Teresa site, LA 86780.

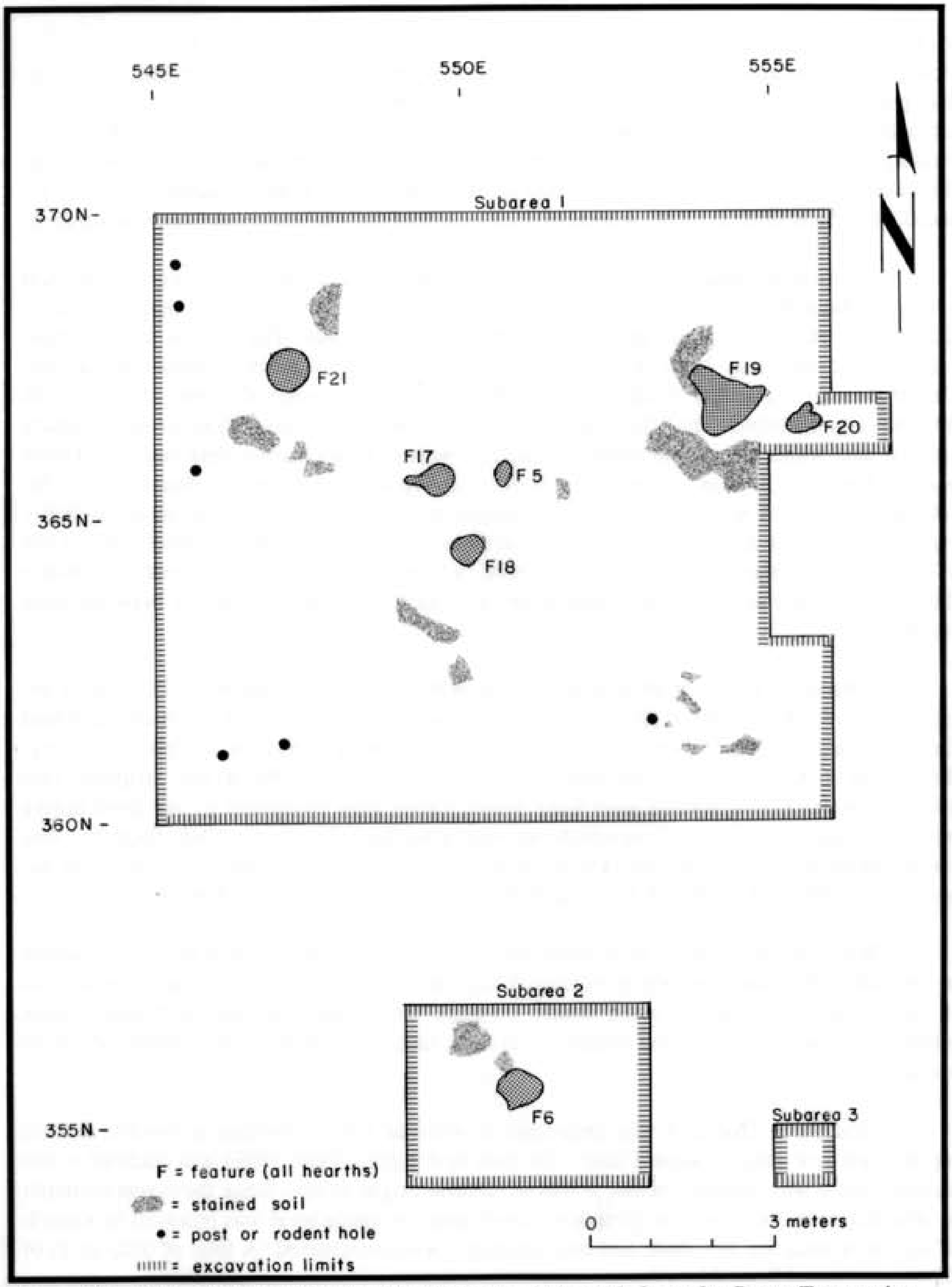

Figure 9-2. Plan of Excavation Area 1, Subareas 1 through 3, at the Santa Teresa site.

to an average depth of 0.31 m in 0.10 m levels to examine cultural deposits and define stratigraphy. Excavation ended at this level because the density of artifacts recovered had dropped to nearly zero. Except in features, only Stratum 1 was encountered. Since most artifacts were confined to the upper 0.10 m or so of fill and only one stratum was defined, the remaining grids in this subarea were stripped in a single level unless features were present. In that case, excavation was completed in two levels. Depth of excavation ranged between 0.03 and 0.34 m, averaging 0.11 m. A total of 19.91 cu m of fill was removed from this subarea.

Stains other than hearths can be divided into two categories. Six were round and averaged about 0.10 m in diameter. While they could represent postholes, they formed no discernable pattern and were probably actually rodent burrows. The stained sand in these probable burrows may have come from features that were formerly at higher elevations. Unfortunately, all direct evidence of such features was removed when the site was mechanically disturbed. The other category of stains consisted of amorphous zones of darkly colored sand which had no real depth or structure. At least 14 such areas were noted, and most occurred next to hearths. However, a cluster of five amorphous stains was found in the southeast corner of Subarea 1, where no hearths were located. While most stains probably represent charcoal and ash spread from nearby hearths, those in the southeast part of the subarea could be the remains of a discard zone, a deteriorated hearth, or rodent disturbance that spread stained soil downward. Insufficient data exist to allow us to choose between these possibilities.

Subarea 2. Twelve grids were excavated in Subarea 2, extending from 355N to 357N, and 550E to 553E (Fig. 9-2). This zone was excavated to examine Feature 6, which was found during testing but was not examined in detail at that time (Moore 1992). This feature was defined as a hearth during data recovery, and as the area around it was stripped, two amorphous patches of stained sand were found. Grids were excavated in one level unless potential features were present, in which case they were dug in two levels. Only Stratum 1 was encountered, except in features. Depth of excavation ranged between 0.03 and 0.18 m, averaging 0.09 m. A total of 1.12 cu m of fill was removed from this subarea.

Both amorphous stains were small zones of darkly colored sand that had no real depth or structure. Their location next to Feature 6 suggests they were related to it in some way. It is likely that they formed when hearth contents were spread to the northwest, either intentionally while cleaning the feature or through natural processes such as eolian action or bioturbation.

Subarea 3. One grid was excavated in Subarea 3 to investigate a possible feature represented by a patch of stained sand. The stain in this grid (355N/556E) was confined to the surface, and it was unclear whether it was of cultural origin or not. Since there was no depth or structure to it, the latter was considered most likely. A single level was removed to a depth of 0.03 m to examine this stain, and only Stratum 1 was encountered. A total of 0.03 cu m of fill was removed from this subarea.

Excavation Area 2

Excavation Area 2 (EA-2) contained 80 grids and was in the south-central part of the site (Fig. 9-1). This area was not subdivided and was excavated to examine a cluster of surface artifacts defined during testing (Moore 1992). No features were found. Excavation continued until the occurrence of cultural materials dropped off, suggesting the edge of the artifact concentration had been reached.

This excavational area extended from 326N to 340N, and 555E to 560E. It was surface stripped in one level per grid to recover whatever cultural materials were present and to search for features. Only Stratum 1 was encountered. Depth of excavation ranged between 0.07 and 0.20 m, averaging 0.11 m. A total of 8.42 cu m of fill was removed from this area.

Excavation Area 3

Excavation Area 3 (EA-3) contained 126 grids in two subareas and was near the west-central edge of the site (Fig. 9-1). Subareas were excavated to examine potential features represented by patches of stained sand and an artifact concentration defined during testing (Moore 1992). Excavation continued until the occurrence of cultural materials dropped off and all potential features had been examined.

Subarea 1. A total of 120 grids was excavated in Subarea 1, extending from 311N to 356N, and 543E to 553E. While this area was primarily examined to investigate an artifact concentration found during testing, a cluster of burned rock was located during data recovery and defined as Feature 25, a possible hearth. While no fire pit was associated with the burned rock, a small amorphous charcoal stain near the feature suggested that it represented a deteriorated hearth. Grids 336N/543-545E, 325N/547-550E, and 311-313N/553E were excavated to average depths of 0.32 m in 0.10 m levels to examine cultural deposits and define stratigraphy. Excavation ended at this level because the density of artifacts had dropped to zero, and only Stratum 1 was encountered. Since most artifacts were confined to the upper 0.10 m or so of fill, the remaining grids in this subarea were surface stripped in one level unless potential features were present. In that case, excavation was completed in two levels. Depth of excavation ranged between 0.03 and 0.39 m, averaging 0.14 m. A total of 16.27 cu m of fill was removed from this subarea.

Feature 25 was a cluster of burned rock northwest of an amorphous patch of stained sand similar to those encountered in EA-1, Subarea 1. There was no depth or structure to the stain, and we were unable to determine for certain what it represented. It is likely that the rocks are the remains of a deteriorated hearth. However, it is also feasible that they simply represent an area where charcoal, ash, and burned rock were dumped after a hearth was cleaned. Insufficient information exists to allow us to choose between these possibilities.

Subarea 2. Six grids were excavated in Subarea 2, which was comprised of two separate areas of excavation. Grids 330-331N/530-531E were excavated to investigate a stain defined as Feature 1 during testing (Moore 1992:40, 45). This possible feature was determined to be a burned root and was dropped from further consideration. Grids 333N/532-533E were excavated to examine an area that contained a cluster of corrugated sherds and determine whether a partial ceramic vessel or pit in which it was stored were present. No evidence of a complete vessel or storage pit were found. However, as is discussed in a later chapter, most of the sherds from the site were found in this area and belong to a single corrugated jar, suggesting that a buried vessel or large sherd was hit by the brush rake and scattered over several square meters. Again, as is discussed later, these sherds are evidence of a later Formative period occupation. Excavation ended when it was determined that no cultural features were present, and only Stratum 1 was encountered. Depth of excavation ranged between 0.08 and 0.18 m, averaging 0.12 m. A total of 0.67 cu m of fill was removed from this subarea.

Excavation Area 4

Excavation Area 4 (EA-4) contained 24 grids at the northwest edge of the site (Fig. 9-1). It extended between grids 459N and 464N, and 476E and 479E. EA-4 was not subdivided. It was investigated to examine a patch of stained sand and a cluster of burned rock defined during testing. These were Features 3 and 4, determined to be hearths during data recovery (Fig. 9-3). As the area around Feature 3 was surface stripped, a third stain was found and excavated. This was Feature 24, also a hearth. Two grids (459-460N/479E) were excavated to an average depth of 0.30 m in 0.10 m levels to determine whether cultural deposits were present in this area. No evidence of such was found, and the rest of the area was surface stripped in one level per grid. Excavation ended when the areas directly adjacent to and between features were exposed and it had been determined that no other cultural features were present. Only Stratum 1 was encountered, except in features. Depth of excavation ranged between 0.02 and 0.30 m, averaging 0.07 m. A total of 1.65 cu m of fill was removed from this area.

Excavation Area 5

Excavation Area 5 (EA-5) contained 26 grids in the north-central part of the site (Fig. 9-1). It extended between grids 385N and 391N, and 522E and 526E. EA-5 was not subdivided. It was investigated to examine two concentrations of burned rock found during testing. These were Features 2 and 9. Unfortunately, only Feature 2 could be relocated during data recovery. However, when this area was surface stripped to search for associated features, two patches of stained sand were found. The designation of Feature 9 was reassigned to one, and the other was labeled Feature 22 (Fig. 9-4). All three features were hearths. Two grids (385N/524-525E) were excavated to an average depth of 0.15 m to determine whether cultural deposits were present in this area. No evidence of such was found, and the rest of the area was surface stripped in one level per grid. Excavation ended when the areas directly adjacent to and between features were exposed, and it was determined that no other cultural features were present. Only Stratum 1 was encountered, except in features. Depth of excavation ranged

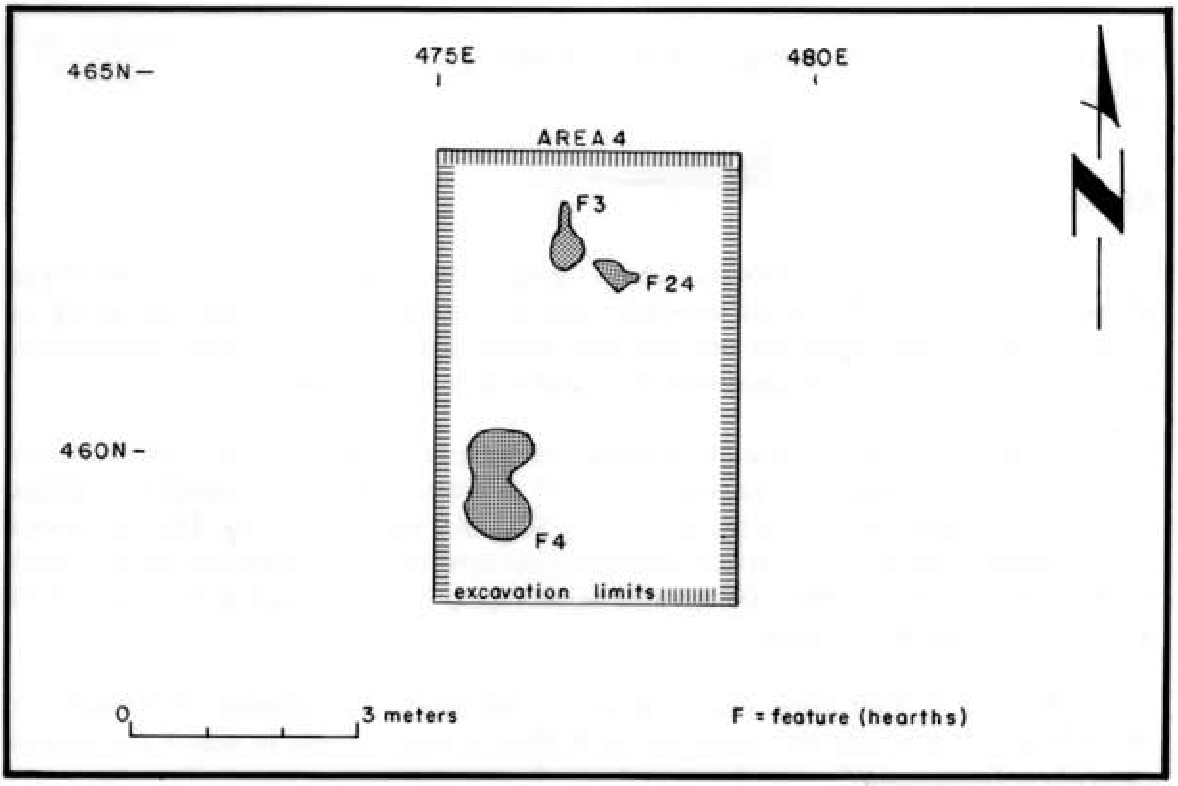

Figure 9-3. Plan of Excavation Area 4 at the Santa Teresa site.

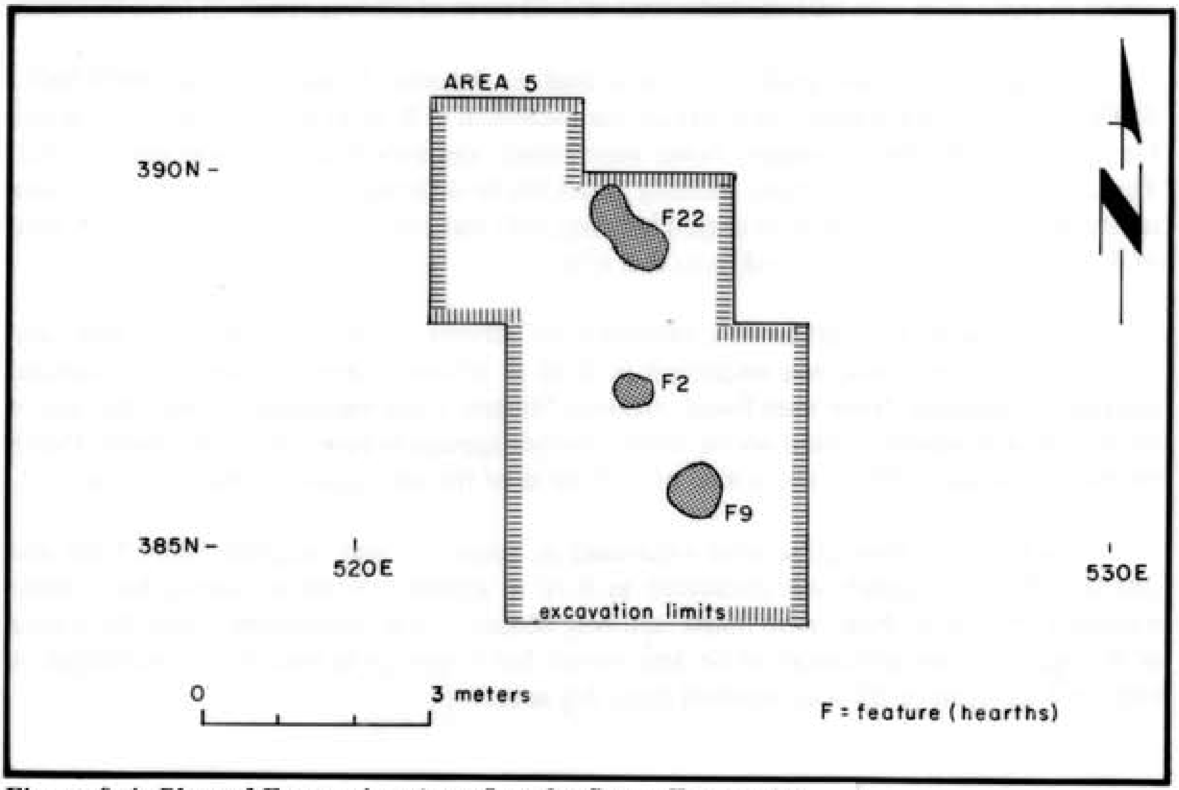

Figure 9-4. Plan of Excavation Area 5 at the Santa Teresa site.

between 0.03 and 0.15 m, averaging 0.06 m. A total of 1.64 cu m of fill was removed from this area.

Excavation Area 6

Excavation Area 6 (EA-6) contained 11 grids in five subareas in the north-central part of the site (Fig. 9-1). All subareas were excavated to examine anomalies identified during the magnetometer survey. Since the magnetometer should have been able to detect anomalies to a depth of about 1 m, all trenches were excavated to at least that depth.

Subarea 1. Two grids were excavated in Subarea 1 and included 376N/545E and 377N/545E. This trench was excavated in 0.10 m arbitrary levels to search for cultural materials or features. None were found, and only Stratum 1 was encountered. Thus, the source of the magnetic anomaly could not be determined but appears to have been noncultural. Depth of excavation ranged between 1.00 and 1.02 m, averaging 1.01 m. A total of 2.02 cu m of fill was removed from this subarea.

Subarea 2. Two grids were excavated in Subarea 2 and included 392N/560E and 393N/560E. This trench was excavated in 0.10 m arbitrary levels to search for cultural materials or features. None were found, and only Stratum 1 was encountered. Thus, the source of the magnetic anomaly could not be determined, but it appears to have been noncultural. Depth of excavation was 1.01 m, and a total of 2.02 cu m of fill was removed from this area.

Subarea 3. Three grids were excavated in Subarea 3 and included 388N/560E, 389N/559E, and 389N/560E. This trench was excavated in 0.10 m arbitrary levels to search for cultural materials or features. None were found, and only Stratum 1 was encountered. Thus, the source of the magnetic anomaly could not be determined but appears to have been noncultural. Depth of excavation ranged between 1.02 and 1.05 m, averaging 1.04 m. A total of 3.12 cu m of fill was removed from this area.

Subarea 4. Two grids were excavated in Subarea 1 and included 375N/560E and 376N/560E. This trench was excavated in 0.10 m arbitrary levels to search for cultural materials or features. None were found, and only Stratum 1 was encountered. Thus, the source of the magnetic anomaly could not be determined but appears to have been noncultural. Depth of excavation was 1.02 m, and a total of 2.04 cu m of fill was removed from this area.

Subarea 5. Two grids were excavated in Subarea 5 and included 380N/570E and 381N/570E. This trench was excavated in 0.10 m arbitrary levels to search for cultural materials or features. None were found, and only Stratum 1 was encountered. Thus, the source of the magnetic anomaly could not be determined, but it appears to have been noncultural. A total of 2.27 cu m of fill was removed from this area.

Excavation Area 7

Excavation Area 7 (EA-7) contained five grids in three subareas in the east-central part of the site (Fig. 9-1). All subareas were excavated to investigate potential features represented by clusters of burned rock. Subareas 1 and 2 contained Features 8 and 11, which were identified during testing. Subarea 3 was used to investigate Feature 16, which was found during data recovery. Excavation continued until features were completely exposed. The lack of surface artifacts in this part of the site suggested that no substantial work areas were associated with these hearths.

Subarea 1. Two grids were excavated in Subarea 1 to investigate a cluster of burned rock defined as Feature 8 during testing (Moore 1992:40). Grids 301N/604-605E were surface stripped to examine this feature (Fig. 9-5). No patches of stained sand were found under the cluster of burned rock, and excavation ended at that point. Only Stratum 1 was encountered. Depth of excavation ranged between 0.01 and 0.04 m, averaging 0.03 m. A total of 0.03 cu m of fill was removed from this subarea.

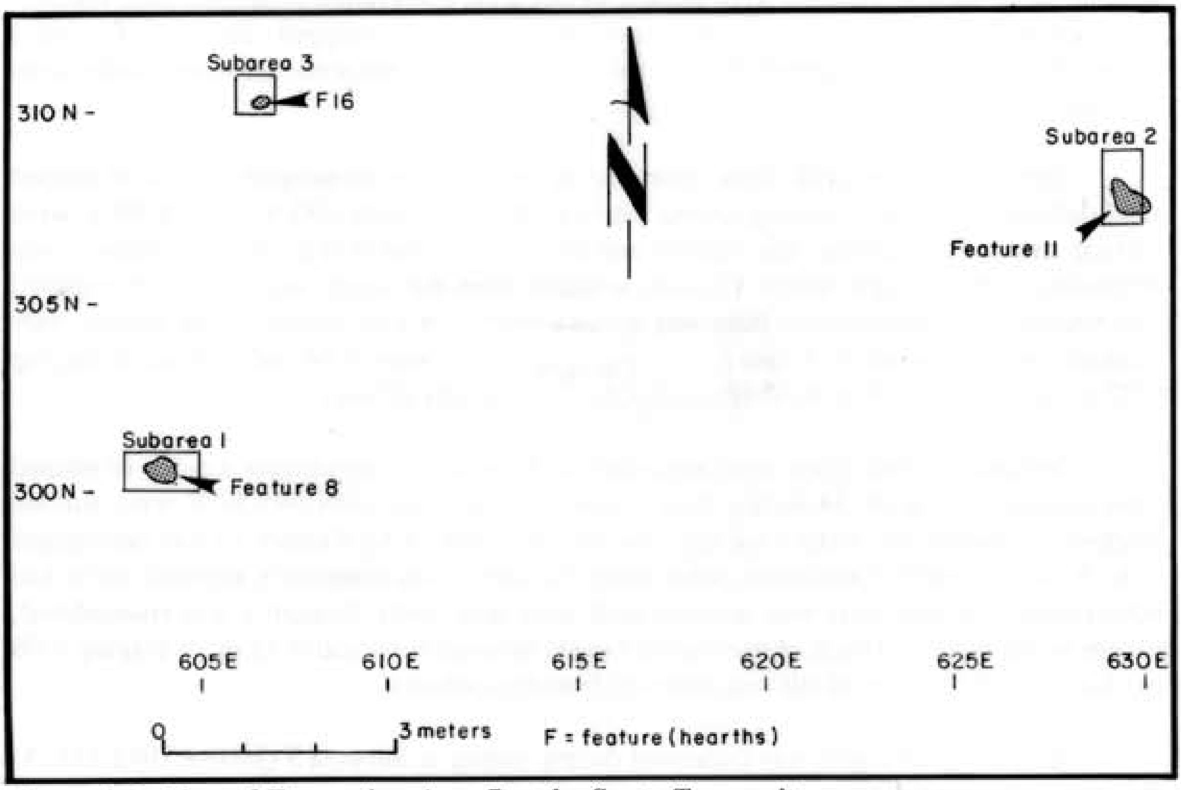

Figure 9-5. Plan of Excavation Area 7 at the Santa Teresa site.

Subarea 2. Two grids were excavated in Subarea 2 to investigate a cluster of burned rock defined as Feature 11 during testing (Moore 1992:40). Grids 308-309N/630E were surface stripped to examine this feature (Fig. 9-5). No patches of stained sand were found under the surface cluster of burned rock, and excavation ended at that point. Only Stratum 1 was encountered. Depth of excavation was 0.04 m, and a total of 0.08 cu m of fill was removed from this subarea.

Subarea 3. One grid was excavated in Subarea 3 to investigate a cluster of burned rock defined as Feature 16 during data recovery. Grid 311N/607E was surface stripped to examine this feature (Fig. 9-5). No patches of stained sand were found under the cluster of burned rock, and excavation ended at that point. Only Stratum 1 was encountered. Depth of excavation was 0.03 m, and 0.03 cu m of fill was removed from this subarea.

Excavation Area 8

Excavation Area 8 (EA-8) contained 19 grids in three subareas and was in the east-central part of the site (Fig. 9-1). Two subareas were excavated to investigate potential features represented by patches of stained sand, and one was excavated during testing to determine whether other cultural deposits were present in this area. Excavation continued until features were completely exposed and adjacent zones had been surface stripped. The lack of cultural materials in this area suggested that no substantial work areas were associated with these hearths.

Subarea 1. Nine grids were excavated in Subarea 1 to investigate a patch of stained sand defined as Feature 7 during testing (Moore 1992:40). Grids 330-332N/595-597E were surface stripped to examine this feature and the zone around it (Fig. 9-6). Feature 7 was determined to be a simple hearth. Excavation ended when the hearth was completely exposed and it had been determined that there was no associated work area. Except in the feature, only Stratum 1 was encountered. Depth of excavation ranged between 0.04 and 0.09 m, averaging 0.07 m. A total of 0.59 cu m of fill was removed from this subarea.

Subarea 2. Nine grids were excavated in Subarea 2 to investigate a patch of stained sand defined as Feature 14 during data recovery. Grids 338-340N/595-597E were surface stripped to examine this feature and the zone around it (Fig. 9-6). Feature 14 was determined to be a simple hearth. Excavation ended when the hearth was completely exposed and it had been determined that there was no associated work area. Only Stratum 1 was encountered, except in the feature. Depth of excavation ranged between 0.03 and 0.12 m, averaging 0.08 m. A total of 0.70 cu m of fill was removed from this subarea.

Subarea 3. One grid was excavated during testing in Subarea 3 (Moore 1992:45). At that time, this area seemed to have had the least amount of sand removed from it, and grid 346N/601E was examined to determine whether undisturbed cultural deposits were present. Only Stratum 1 was encountered, and no artifacts were recovered. A small stain was noted in the north wall of this grid, but it appeared to be noncultural. Depth of excavation was 0.37 m, and 0.37 cu m of fill was removed from this subarea.

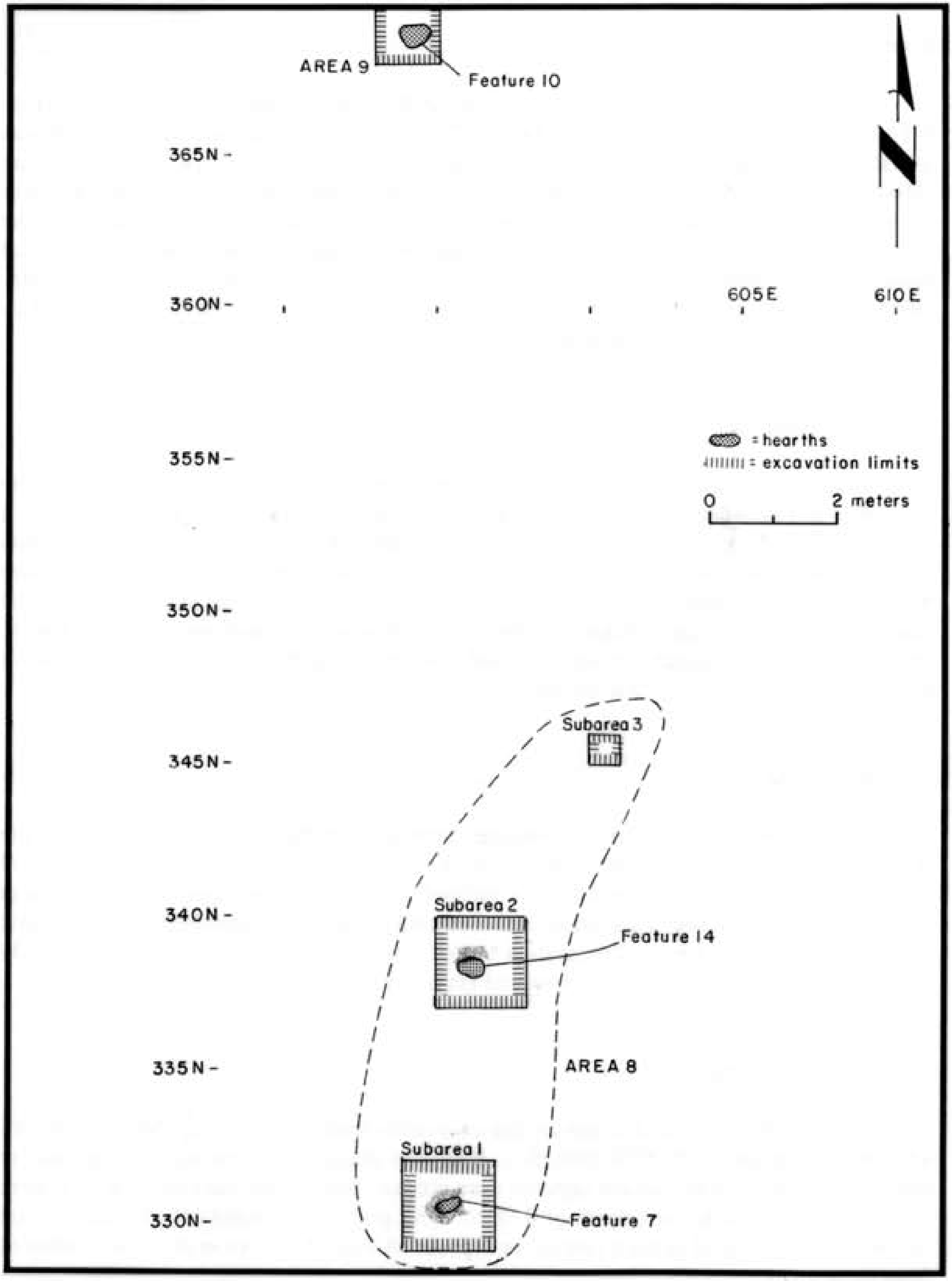

Figure 9-6. Plan of Excavation Areas 8 and 9 at the Santa Teresa site.

Excavation Area 9

Excavation Area 9 (EA-9) contained four grids in the east-central part of the site (Fig. 9-1) and included grids 369-370N/344-345E (Fig. 9-6). EA-9 was not subdivided. It was investigated to examine a concentration of burned rock defined as Feature 10 during testing (Moore 1992:40). A patch of stained sand was found in association with the burned rock during data recovery and determined to be a simple hearth. Excavation continued until the feature was completely exposed and adjacent zones were surface stripped. The lack of cultural materials in this area suggested that no substantial work area was associated with the hearth. Depth of excavation ranged between 0.02 and 0.03 m, averaging 0.03 m. A total of 0.12 cu m of fill was removed from this subarea.

Excavation Area 10

Excavation Area 10 (EA-10) contained eight grids in the east-central part of the site (Fig. 9-1) and included grids 401-403N/580-582E (Fig. 9-7). EA-10 was not subdivided. It was investigated to examine a patch of stained sand defined as Feature 23 during data recovery, which was determined to be a simple hearth. Excavation continued until the feature was completely exposed and adjacent zones had been surface stripped. The lack of cultural materials in this area suggested that no substantial work areas were associated with this hearth. Depth of excavation ranged between 0.03 and 0.10 m, averaging 0.06 m. A total of 0.46 cu m of fill was removed from this subarea.

Excavation Area 11

Excavation Area 11 (EA-11) contained three grids in the west-central part of the site (Fig. 9-1) and included grids 391N/503-505E. EA-11 was not subdivided. It was excavated to investigate an area that seemed to have suffered less damage from mechanical equipment than other parts of the site. Excavation continued until it had been determined that no cultural deposits were present. Depth of excavation ranged between 0.30 and 0.31 m, averaging 0.30 m. A total of 0.91 cu m of fill was removed from this subarea.

Other Excavated Grids

Two grids were dug in zones outside excavation areas during testing (Moore 1992:40, 45), 280N/600E and 330N/575E (Fig. 9-1). Both were placed in concentrations of artifacts to determine whether buried cultural deposits were present. The former was excavated to a depth of 0.27 m and the latter to a depth of 0.08 m. Both grids encountered only Stratum 1, and neither contained buried cultural features or deposits. A total of 0.35 cu m of fill was removed from these areas.

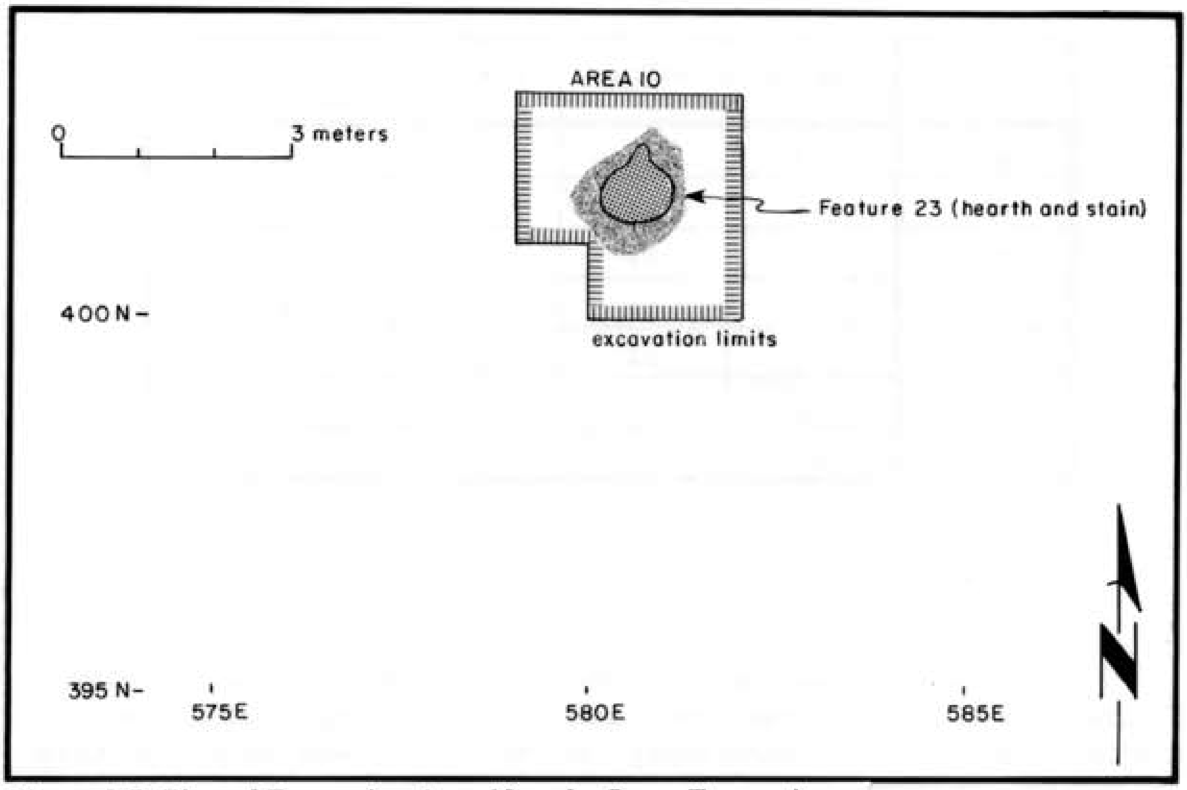

Figure 9-7. Plan of Excavation Area 10 at the Santa Teresa site.

Mechanically Excavated Trenches

Except to examine dune stratigraphy for the geomorphic study, no trenches were mechanically excavated at the Santa Teresa site during data recovery. Stratigraphic trenches are discussed in "Geomorphology of the Santa Teresa Sites." All other mechanically excavated trenches were dug during testing and are discussed in detail elsewhere (Moore 1992). Information concerning these trenches is summarized in Table 9-1.

Table 9-1. Summary of mechanically dug trenches at the Santa Teresa site

Trench	Length (m)	Width (m)	Depth (m)	Amount of Fill Removed (cu m)
BT-1	3.4	2.0	2.3	15.6
BT-2	3.6	3.1	2.2	24.6
BT-3	4.0	2.5	2.2	22.0
BT-4	5.1	2.5	2.3	29.3
BT-5	5.3	2.3	2.3	28.0
BT-6	5.4	2.5	2.4	32.4

Trench	Length (m)	Width (m)	Depth (m)	Amount of Fill Removed (cu m)
BT-7	7.9	2.6	2.0	41.1
BT-8	4.9	2.7	2.4	31.8
BT-9	7.4	2.9	2.2	47.2
BT-10	7.0	2.8	2.2	43.1
BT-11	7.1	2.8	2.5	49.7
BT-12	7.3	2.8	2.2	45.0
BT-13	9.0	2.6	2.1	49.1

Features

Twenty-five features were initially defined at the site during testing and data recovery. Features 1 and 15 were determined to be noncultural and were dropped from consideration. In addition, two features found during testing (Features 12 and 13) were not relocated during data recovery. The former was a cluster of burned rock, and the latter a patch of stained sand. It is likely that natural erosive processes either destroyed these features in the time between testing and data recovery or covered them to the point where they could not be relocated.

Feature 2

Feature 2 was a simple hearth in EA-5 (Fig. 9-4). It was in grids 387-388N/524E (Fig. 9-8) and initially encountered during testing (Moore 1992:40). This hearth was oval, and the western fifth was shallower than the main pit, forming a small shelf. It measured 0.56 by 0.50 m and was up to 0.18 m deep. Only one fragment of burned caliche weighing 1.3 g was found inside the feature. While there was some evidence of root disturbance and insect burrows, they were minor. The close proximity of this hearth to Features 9 and 22 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 2 was visible on the surface as a patch of stained sand. Surface stripping showed that most of it was concealed beneath a thin veneer of Stratum 1. Fill within this feature was designated Stratum 10. It averaged 0.18 m thick and was a compact, fine-grained, black sand. No mottling was noted. While the feature was darkly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

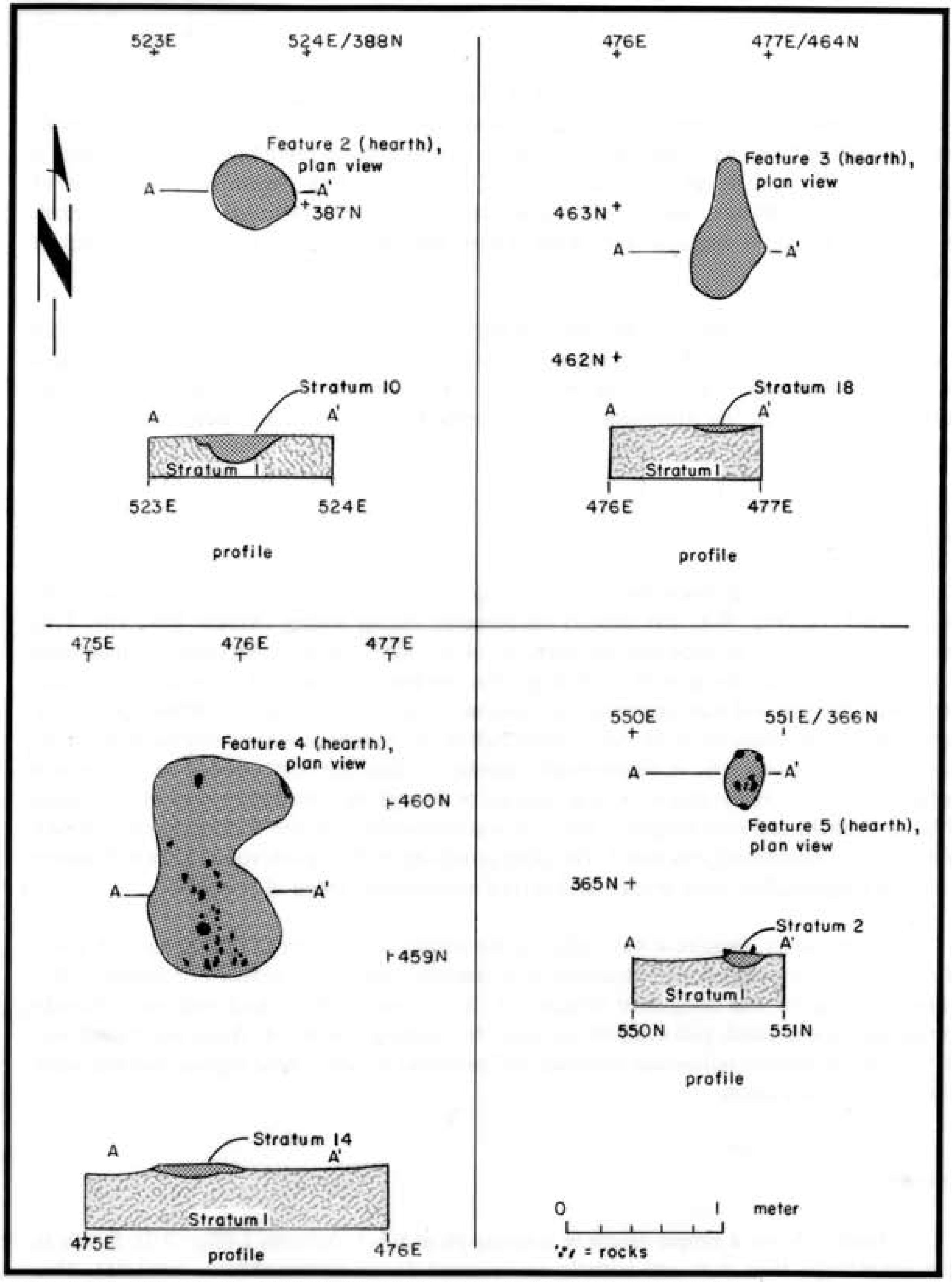

Figure 9-8. Plans and profiles of Features 2–5 at the Santa Teresa site.

Feature 3

Feature 3 was a simple hearth in EA-4 (Fig. 9-3). It was in grids 463-464N/477E (Fig. 9-8) and initially encountered during testing (Moore 1992:40). This hearth was roughly oval, but the north end may have been necked down to give it a shape resembling a bowling pin. It measured 0.92 by 0.48 m and was up to 0.05 m deep. There were no overt signs of disturbance in this feature, and it contained no burned rock. The close proximity of this hearth to Features 4 and 24 suggests they were related and were part of a residential group of features.

Stratigraphy. Feature 3 was visible on the surface as a patch of stained sand. Fill within it was designated Stratum 18. It averaged 0.05 m thick and was a compact, fine-grained, dark brownish yellow sand. No mottling was noted. While this feature was lightly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 4

Feature 4 was a simple hearth or roasting pit in EA-4 (Fig. 9-3). It was in grids 459-461N/476-477E (Fig. 9-8) and initially encountered during testing (Moore 1992:46). This feature was irregular in shape and was made up of two lobes joined in the center. It measured 1.44 by 0.92 m and was up to 0.11 m deep. The southern half seemed to be the most intact part of the feature and may represent the original location of the fire pit. While subsurface burned rock was recovered from the southern half of the feature, it was mainly surficial in the northern half and occurred in much smaller numbers. Thus, the northern half may represent materials spread from the feature during cleaning or through bioturbation. A total of 124 pieces of burned caliche and rock weighing 3083.6 g was recovered from this feature. Some evidence of minor root disturbance was noted. The close proximity of this hearth/roasting pit to Features 3 and 24 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 4 was visible on the surface as a cluster of burned rock. A patch of stained sand was encountered beneath these materials and a thin veneer of Stratum 1. Fill within this feature was designated Stratum 14. It averaged 0.08 m thick and was a loosely compacted, fine-grained, yellowish brown sand. No mottling was noted. While this feature was very lightly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 5

Feature 5 was a simple hearth or roasting pit in EA-1, Subarea 1 (Fig. 9-2). It was in grid 366N/551E (Fig. 9-8) and initially encountered during testing (Moore 1992:46). This feature was first recognized as a cluster of burned rock. Surface stripping revealed four patches of stained sand, and all were labeled Feature 5 at that time. The original number was retained for the cluster of burned rock and its associated stain during data recovery, while new numbers were assigned to the other stains. Only three of the stains were found to be cultural features. Feature 5 was a small oval pit with burned rock on the surface but not within its fill. It measured 0.40 by 0.26 m and was up to 0.12 m deep. A total of 14 pieces of burned rock weighing 612.7 g were recovered from this feature. Some evidence of root disturbance and insect burrows was noted. The close proximity of this hearth/roasting pit to Features 17 through 21 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 5 was visible on the surface as a cluster of burned rock. A patch of stained sand was encountered beneath these materials and a thin veneer of Stratum 1. Fill within this feature was designated Stratum 2. It averaged 0.08 m thick and was a compact, fine-grained, dark brown sand; some mottling caused by bioturbation was noted. While this feature was stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 6

Feature 6 was a simple hearth in EA-1, Subarea 2 (Fig. 9-2). It was in grids 356N/551-552E (Fig. 9-9). This feature was initially defined as a cluster of burned rock during testing (Moore 1992:40). However, the burned rock cluster was not relocated during data recovery, but a patch of stained sand was found in its general vicinity, and the feature number was transferred to it. This hearth consisted of a shallow pit that was a slightly irregular oval. It measured 0.86 by 0.83 m and was up to 0.12 m deep. No signs of disturbance were noted, and it contained no burned rock. The close proximity of this hearth to Features 5 and 17 through 21 suggests they might have been related and were part of a residential group of features.

Stratigraphy. Feature 6 was visible on the surface as a patch of stained sand. Surface stripping showed that most of it was concealed beneath a thin veneer of Stratum 1. Fill within this feature was designated Stratum 3. It averaged 0.10 m thick and was a compact, fine-grained, very dark gray sand. No mottling was noted. While this feature was stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 7

Feature 7 was a simple hearth in EA-8 (Fig. 9-6). It was in grids 330-331N/595-596E (Fig. 9-9) and initially encountered during testing (Moore 1992:46). This feature was oval and surrounded by lightly stained sand. The stain around the feature probably represented hearth materials that were spread by cultural means or bioturbation. The hearth itself measured 0.70 by 0.50 m and was up to 0.06 m deep, while the entire stained area measured 1.07 by 0.86 m. Only one piece of burned caliche weighing 77.1 g was found in this feature. Some evidence of bioturbation was noted, but it was minor. The relatively close proximity of this hearth to Feature 14 suggests they might have been related and were part of a residential group of features.

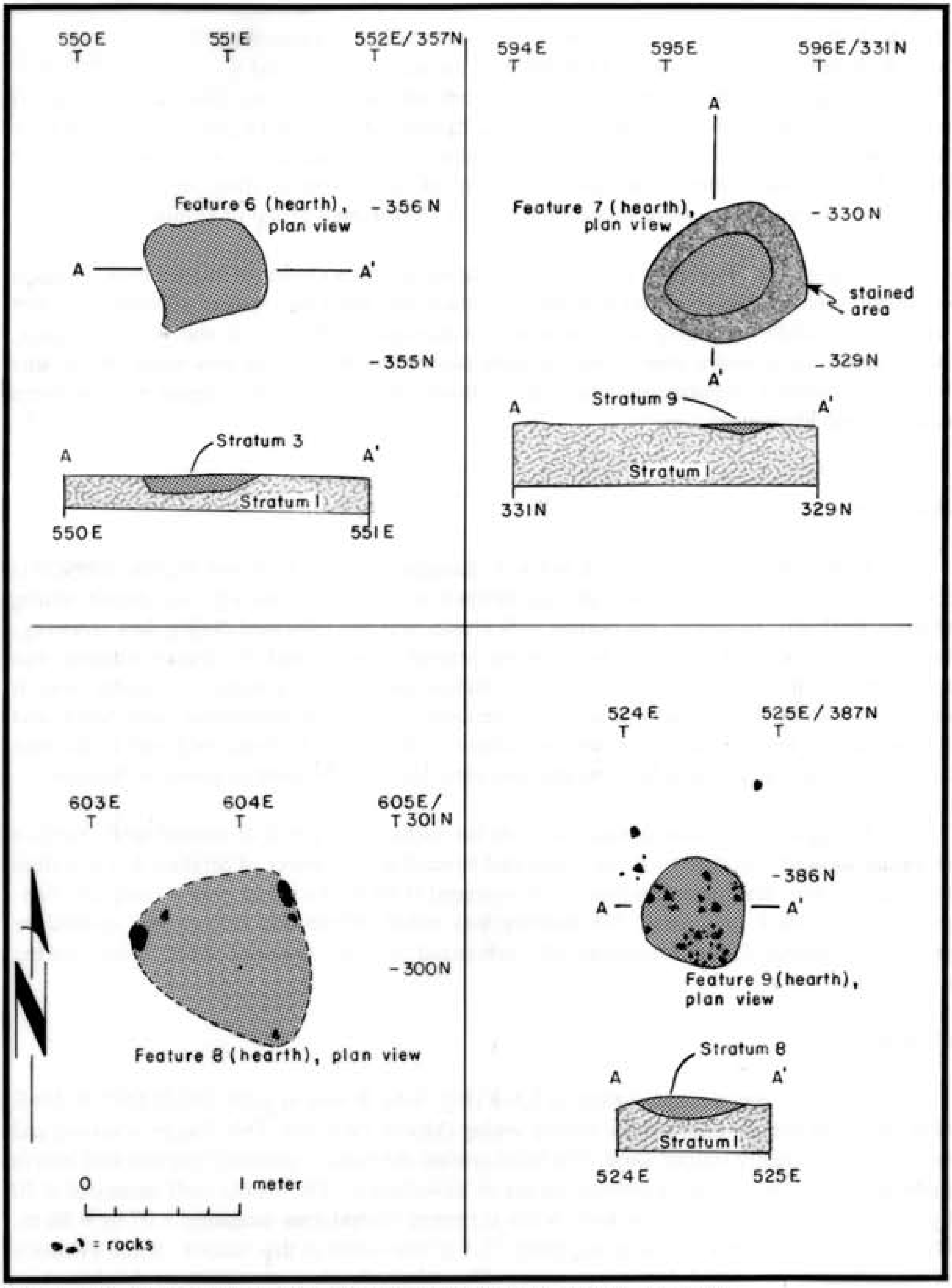

Figure 9-9. Plans and profiles of Features 6–9 at the Santa Teresa site.

Stratigraphy. Feature 7 was visible on the surface as a small patch of stained sand. Surface stripping during testing showed that most of it was concealed beneath a thin veneer of Stratum 1. Fill within this feature was designated Stratum 9. It averaged 0.08 m thick and was a compact, fine-grained, grayish brown sand that was slightly mottled by bioturbation. While this feature was stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 8

Feature 8 was a cluster of burned rock in EA-7 (Fig. 9-5). It was in grids 300-301N/604-605E (Fig. 9-9) and initially encountered during testing (Moore 1992:40). Seven pieces of burned caliche and burned rock weighing 499.7 g were recovered from this feature. The burned rock was distributed in no particular pattern, and surface stripping located no fire pit. Thus, it was uncertain whether this cluster represented a deflated thermal feature or materials removed from a hearth during cleaning and discarded in this area. Maximum dimensions were 1.18 by 1.12 m. There was no depth to these deposits, and only Stratum 1 was noted during excavation. The rather close proximity of this burned rock cluster to Features 11 and 16 suggests they might have been related and were part of a residential group of features.

Feature 9

Feature 9 was a simple hearth or roasting pit in EA-5 (Fig. 9-4). It was in grids 386-387N/525E (Fig. 9-9) and initially encountered during testing (Moore 1992:40). This feature was roughly circular and contained quite a bit of burned rock. A total of 48 pieces of burned caliche and burned rock weighing 1136.8 g was recovered from this feature, which measured 0.74 by 0.70 m and was up to 0.14 m deep. While there was some evidence of root disturbance and insect burrows, they were minor. The close proximity of this hearth/roasting pit to Features 2 and 22 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 9 was visible on the surface as a cluster of burned rock. A patch of stained sand was encountered beneath these materials and a thin veneer of Stratum 1. Fill within this feature was designated Stratum 8. It averaged 0.13 m thick and was a compact, fine-grained, yellowish brown sand that was slightly mottled by bioturbation. While this feature was lightly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 10

Feature 10 was a simple hearth in EA-9 (Fig. 9-6). It was located in grids 369-370N/594-595E (Fig. 9-10). While this feature was initially defined as a cluster of burned rock during testing (Moore 1992:40), that feature could not be relocated during data recovery.

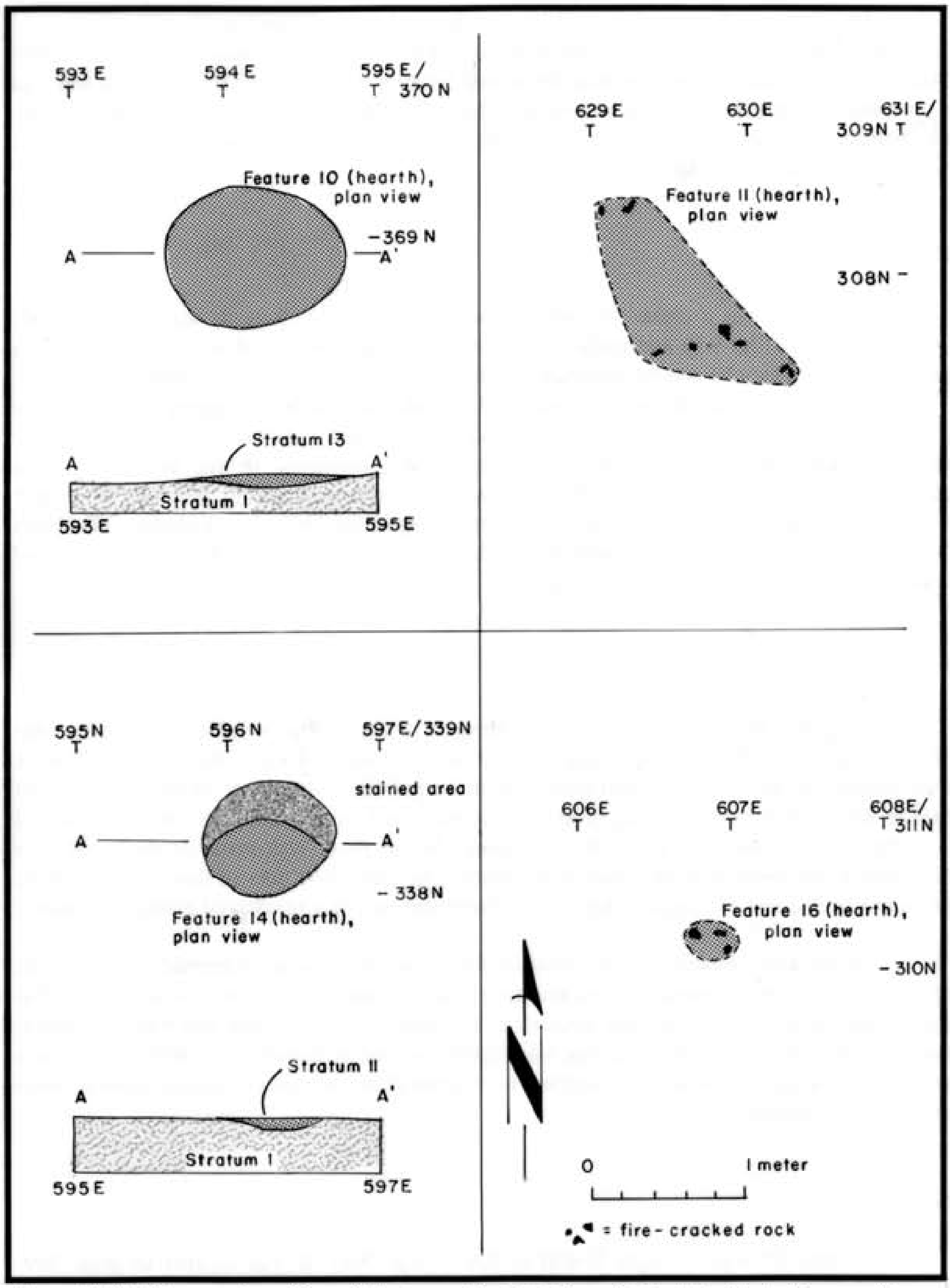

Figure 9-10. Plans and profiles of Features 10, 11, 14, and 16 at the Santa Teresa site.

However, a patch of stained sand was found in its general vicinity, and the feature number was transferred to it. Feature 10 was oval and contained no burned rock. It measured 1.18 by 0.92 m and up to 0.08 m deep. No evidence of bioturbation was noted. This hearth appeared to be isolated, with no other features in close association.

Stratigraphy. Feature 10 was visible on the surface as a patch of stained sand, partially obscured by a thin veneer of Stratum 1. Fill within this feature was designated Stratum 13. It averaged 0.05 m thick and was a compact, fine-grained, very dark brown sand. No mottling was noted. While this feature was darkly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 11

Feature 11 was a cluster of burned rock in EA-7 (Fig. 9-5). It was in grids 308-309N/630-631E (Fig. 9-10) and initially encountered during testing (Moore 1992:40). This feature contained several fragments of burned rock in no particular pattern, and surface stripping found no associated hearth pit. Thus, it was uncertain whether it represented the remains of a deflated hearth or materials cleaned out of a hearth and discarded in this area. It contained 13 pieces of burned caliche and rock weighing 207.7 g. Maximum dimensions for the cluster were 1.72 by 0.70 m. There was no depth to these deposits, and only Stratum 1 was encountered during excavation. The relatively close proximity of this burned rock cluster to Features 8 and 16 suggests they may have been related and were perhaps part of a residential group of features.

Feature 14

Feature 14 was a simple hearth in EA-8 (Fig. 9-6). It was in grids 339N/596-597E (Fig. 9-10) and identified as a patch of stained sand during data recovery. This feature was oval, with a lighter area of surface staining to its north. The latter probably represents hearth materials spread by either cultural means or bioturbation. It contained one piece of burned rock weighing 18.6 g. The probable hearth pit measured 0.78 by 0.50 m and was up to 0.09 m deep, while the entire feature measured 0.88 by 0.72 m. No evidence of disturbance was noted. The close proximity of this hearth to Feature 7 suggests they might have been related and were part of a residential group of features.

Stratigraphy. Feature 14 was visible on the surface as a patch of stained sand, and much of it was concealed beneath a thin veneer of Stratum 1. Fill within this feature was designated Stratum 11. It averaged 0.05 m thick and was a compact, fine-grained, yellowish brown sand with a gray cast. While this feature was lightly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 16

Feature 16 was a small cluster of burned rock in EA-7 (Fig. 9-5). It was in grid 311N/607E (Fig. 9-10) and identified during data recovery. The cluster contained only a few fragments of burned rock in no particular pattern, and surface stripping found no associated hearth pit. Thus, it was uncertain whether it represented the remains of a deflated hearth or materials removed from a hearth during cleaning and discarded in this area. It contained only three pieces of burned caliche and rock weighing 90.4 g. Maximum dimensions for the cluster were 0.36 by 0.18 m. There was no depth to these deposits, and only Stratum 1 was encountered during excavation. The relatively close proximity of this burned rock cluster to Features 8 and 11 suggests they may have been related and were perhaps part of a residential group of features.

Feature 17

Feature 17 was a simple hearth in EA-1, Subarea 1 (Fig. 9-2). It was in grid 366N/550E (Fig. 9-11) and originally defined as part of Feature 5 during testing (Moore 1992:46). This feature was roughly oval, but its west end may have been necked down to give it a bowling pin shape. There was also a small lighter surface stain on the south side of the feature. The hearth measured 0.74 by 0.48 m and was up to 0.10 m deep, and the entire feature measured 0.74 by 0.56 m. The west end was also shallower than the main pit, a maximum of 0.04 m deep. No burned rock was recovered from this feature, and some evidence of root disturbance and insect burrows was noted. The close proximity of this hearth to Features 5 and 18 through 21 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 17 was found under a thin veneer of Stratum 1. Fill within this feature was designated Stratum 2. It averaged 0.07 m thick and was a compact, fine-grained, dark brown sand, with some mottling caused by bioturbation. While this feature was stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 18

Feature 18 was a simple hearth in EA-1, Subarea 1 (Fig. 9-2). It was in grids 365N/550-551E (Fig. 9-11) and originally defined as part of Feature 5 during testing (Moore 1992:46). This feature was roughly circular, and the western fifth was shallower than the rest of the pit, forming a small shelf. It measured 0.50 m in diameter and was up to 0.08 m deep, though the west end was only 0.03 m deep. No burned rock was recovered from this feature, and some evidence of root disturbance and insect burrows was noted. The close proximity of this hearth to Features 5, 17 and 19 through 21 suggests they were related and part of a residential group of features.

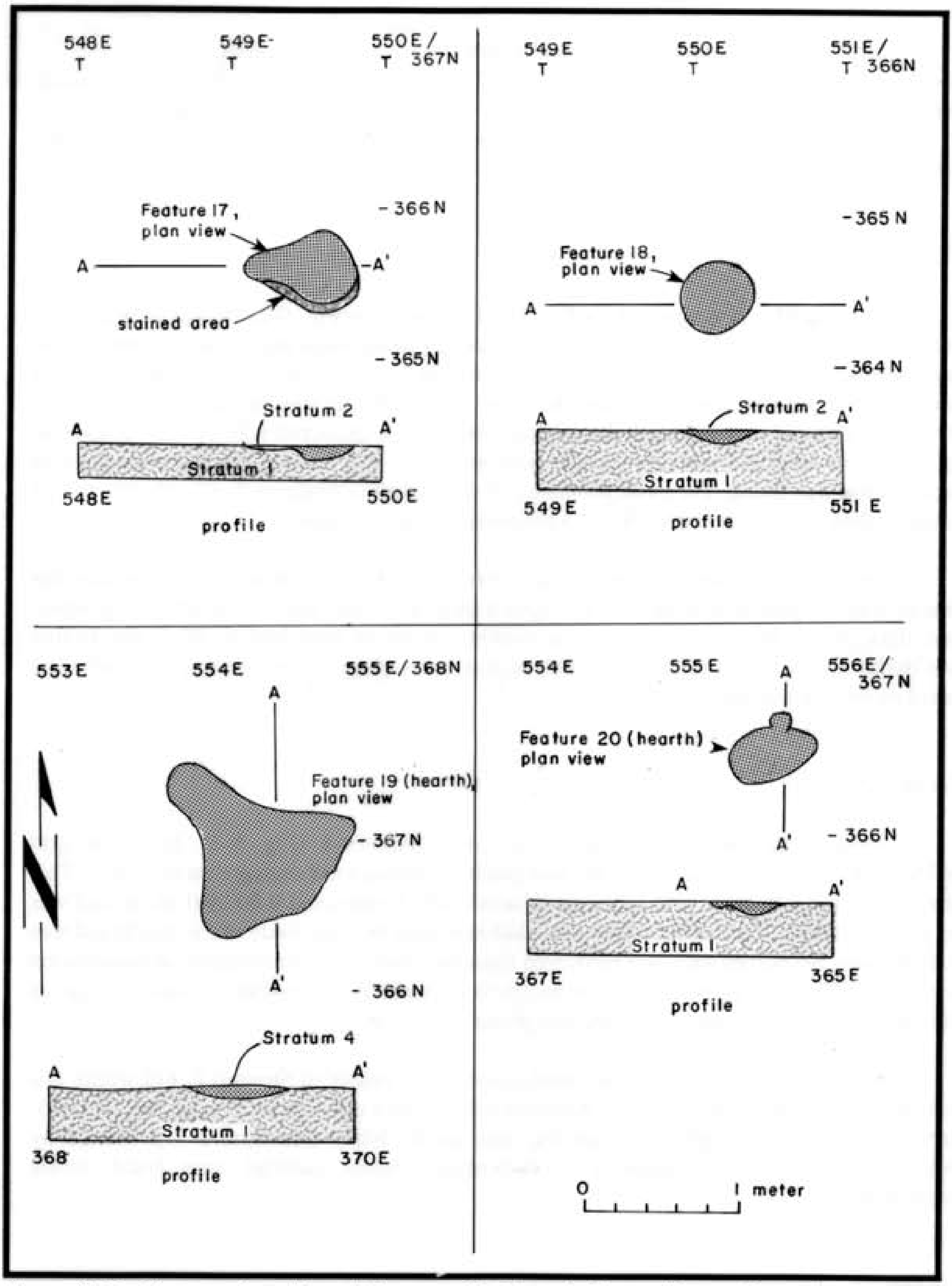

Figure 9-11. Plans and profiles of Features 17–20 at the Santa Teresa site.

Stratigraphy. Feature 18 was found under a thin veneer of Stratum 1. Fill within this feature was designated Stratum 2. It averaged 0.06 m thick and was a compact, fine-grained, dark brown sand, with some mottling caused by bioturbation. While this feature was stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 19

Feature 19 was a simple hearth in EA-1, Subarea 1 (Fig. 9-2). It was in grids 367-368N/554-555E (Fig. 9-11) and identified as a patch of stained sand during data recovery. This feature was irregular in shape, with a narrow lobe on its northwest side. Compared to other features with similar configurations, the lobe in this hearth was its deepest rather than shallowest part and may represent the original hearth pit. It measured 1.24 by 1.18 m and was up to 0.10 m deep. No burned rock was recovered from this feature, and some evidence of bioturbation was noted. The close proximity of this hearth to Features 5, 17, 18, 20, and 21 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 19 was found under a thin veneer of Stratum 1. Fill within this feature was designated Stratum 4. It averaged 0.08 m thick and was a compact, fine-grained, very dark grayish brown sand, with some mottling caused by bioturbation. While this feature was darkly stained by pulverized charcoal, no fragments of carbonized vegetal materials were noted during excavation.

Feature 20

Feature 20 was a simple hearth in EA-1, Subarea 1 (Fig. 9-2). It was in grid 367N/556E (Fig. 9-11) and identified as a patch of stained sand during data recovery. This feature was roughly oval, with a lobe on its north side. It measured 0.60 by 0.46 m, and was up to 0.06 m deep. The northern lobe was shallower than the main body of the hearth and was 0.03 m deep. No burned rock was recovered from this feature, and no evidence of bioturbation was noted. The close proximity of this hearth to Features 5, 17 through 19, and 21 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 20 was found under a thin veneer of Stratum 1. Fill within this feature was designated Stratum 5. It averaged 0.06 m thick and was a compact, fine-grained, dark yellowish brown sand. No mottling was noted. While this feature was stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 21

Feature 21 was a hearth or roasting pit in EA-1, Subarea 1 (Fig. 9-2). It was in grids

368N/547-548E (Fig. 9-12) and identified as a cluster of burned rock above a patch of stained sand during data recovery. This feature was roughly round and contained burned rock within its fill as well as on its surface. It measured 0.72 by 0.68 m and was up to 0.12 m deep. A total of 93 pieces of burned caliche and rock weighing 4840.9 g were recovered from this feature. The only evidence of disturbance were small rootlets that had penetrated into its fill. The close proximity of this hearth/roasting pit to Features 5 and 17 through 20 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 21 was found under a thin veneer of Stratum 1. This feature contained two layers of fill, designated Strata 6 and 7. Stratum 6 averaged 0.09 m thick and was a compact, fine-grained, yellowish brown sand containing fragments of burned rock. No mottling was noted. Stratum 7 averaged 0.03 m thick and also was a compact fine-grained sand, but it was brown, with some mottling caused by bioturbation. Both strata had a grayish cast, but while they were stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 22

Feature 22 was a probable simple hearth in EA-5 (Fig 9-4). It was in grids 389-390N/524-525E (Fig. 9-12) and identified during data recovery. This feature was roughly peanut-shaped and contained no burned rock. While possible that it represents a discard area for material cleaned from nearby fire pits, its shape and cross section suggest that it too was a hearth. It measured 1.24 by 0.60 m and was up to 0.08 m deep. Minor root disturbance was noted. The close proximity of this possible hearth to Features 2 and 9 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 22 was concealed under a thin veneer of Stratum 1 and was not discovered until this area was surface stripped. Fill within this feature was designated Stratum 12. It averaged 0.08 m thick and was a compact, fine-grained, dark yellowish brown sand. No mottling was noted. While this feature was lightly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 23

Feature 23 was a probable simple hearth in EA-10 (Fig. 9-7). It was in grids 401-403N/580-582E (Fig. 9-12) and identified as a patch of stained sand during data recovery. This feature was rather amorphous in shape, its perimeter was indistinct, and it contained no burned rock. The main basin was oval, with a lobe on its north side. While this aspect makes it similar to several other features at the site, a considerable amount of root disturbance was noted in the lobe, suggesting that it could have been the result of natural disturbance. The main basin measured 1.06 by 0.92 m and was up to 0.10 m deep. It was surrounded by a lighter surface stain that probably resulted from hearth materials spread by cultural means or bioturbation. The entire stained area measured 1.68 by 1.40 m. No other features were found nearby.

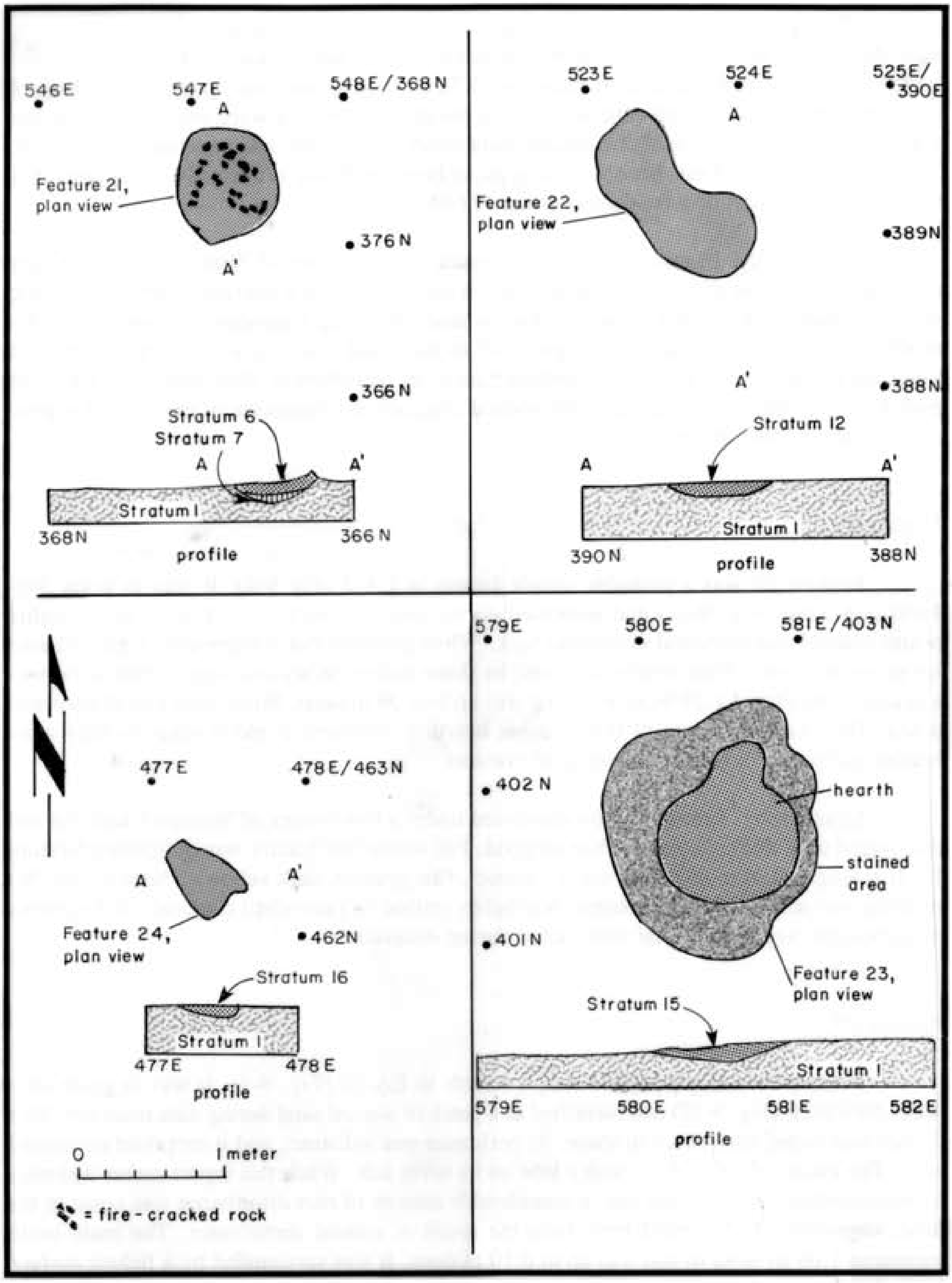

Figure 9-12. Plans and profiles of Features 21–24 at the Santa Teresa site.

Stratigraphy. Feature 23 was visible on the surface as a patch of stained sand. Surface stripping showed that most of it was concealed beneath a thin veneer of Stratum 1. Fill within this feature was designated Stratum 15. It averaged 0.08 m thick and was a compact, fine grained, yellowish brown sand with a gray cast. While this feature was lightly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 24

Feature 24 was a simple hearth in EA-4 (Fig. 9-3). It was in grid 463N/478E (Fig. 9-12) and identified as a patch of stained sand during data recovery. This feature was irregularly shaped and contained no burned rock. It measured 0.56 by 0.28 m and was up to 0.08 m deep. No burned rock was recovered from this feature, nor was any evidence of disturbance noted. The close proximity of Features 3 and 4 suggests they were related and part of a residential group of features.

Stratigraphy. Feature 24 was concealed under a thin veneer of Stratum 1 and was not discovered until this area was surface stripped. Fill within this feature was designated Stratum 16. It averaged 0.06 m thick and was a compact, fine-grained, dark yellowish brown sand. No mottling was noted. While this feature was lightly stained by pulverized charcoal, no fragments of carbonized vegetal material were noted during excavation.

Feature 25

Feature 25 was a cluster of burned rock and associated patch of stained sand in EA-3, Subarea 1. It was in grids 331N/546-547E (Fig. 9-13) and identified during data recovery. This feature contained several fragments of burned rock concentrated in an area measuring 0.28 by 0.15 m. Twenty-three pieces of burned caliche and rock weighing 562.8 g were recovered from this feature. While there was no stain beneath the rock, a small patch of stained sand measuring 0.78 by 0.28 m was 0.12 m southwest of it. Excavation showed that the stain was very shallow and had no structure. These materials probably represent the remains of a deflated hearth. No other features were found nearby.

Chronometrics

Three types of chronometric data are available for this site: projectile points, pottery, and charcoal. Broad date ranges can be assigned to projectile points, but specific styles are rarely limited to short time periods. Certain types even cross the boundaries archaeologists have built between cultural periods and phases. After all, those boundaries were constructed for the benefit of the modern student of prehistory and were almost certainly meaningless to those who lived through the often subtle changes used to partition prehistory. Thus, projectile points generally provide only a relative date, often spanning many centuries.

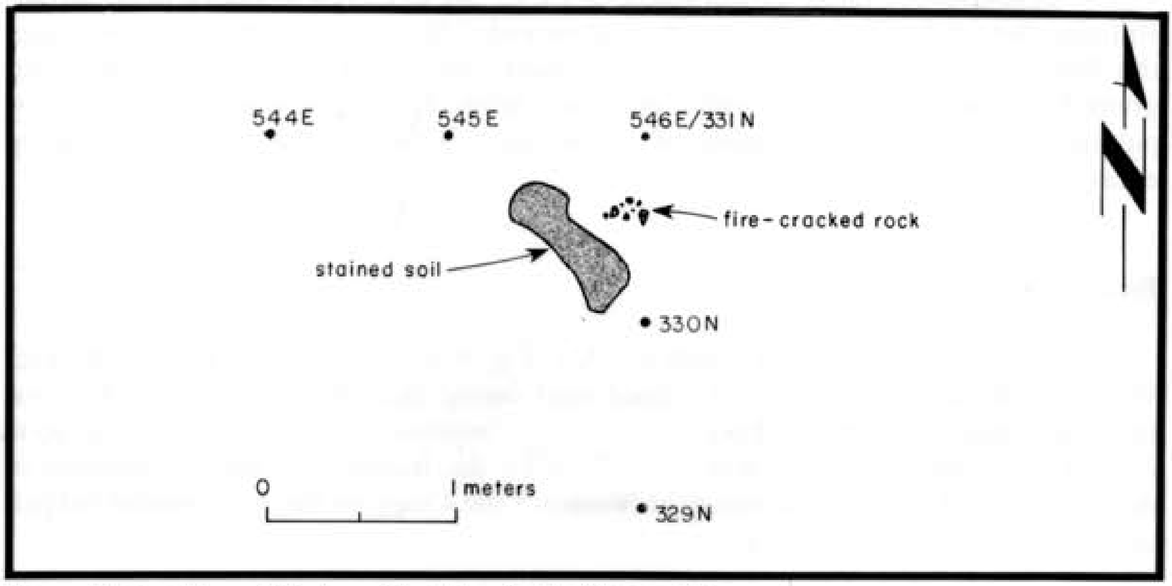

Figure 9-13. Plan of Feature 25 at the Santa Teresa site.

Pottery is usually a better chronometric tool. However, this category also has its limitations, particularly at sites like this one, where sherds were rare, and most belong to a single corrugated vessel. Thus, few vessels are represented in the pottery assemblage, and sherds are unevenly distributed across the site. Ceramic dates also differ considerably from those provided by other techniques. This suggests that an interesting situation prevails: the pottery may not be associated with other materials. It is likely that when the top of the dune was removed, most Formative period deposits were transported away. Only a few artifacts from later occupations seem to have been left on or near the new surface, contaminating the Preceramic remains that were thus exposed.

The accuracy of radiocarbon dates is problematic for the same reasons discussed in "The Mockingbird Site (LA 86774)." The nature and quality of these samples suggests that they overestimate the age of the site, perhaps by several hundred years. Thus, the dates of occupation provided by all three classes of temporally sensitive materials should be considered relative rather than absolute. Still, they should allow us to place the site within the chronology developed for the region.

Projectile Points

Four projectile points were recovered from the surface of the site, making their association with excavated materials difficult to establish. Two specimens are complete, one is represented by a base, and the fourth is nearly complete but missing about half its base (Fig. 9-14). All were manufactured from high-quality materials including fine-grained chert (3) and obsidian (1).

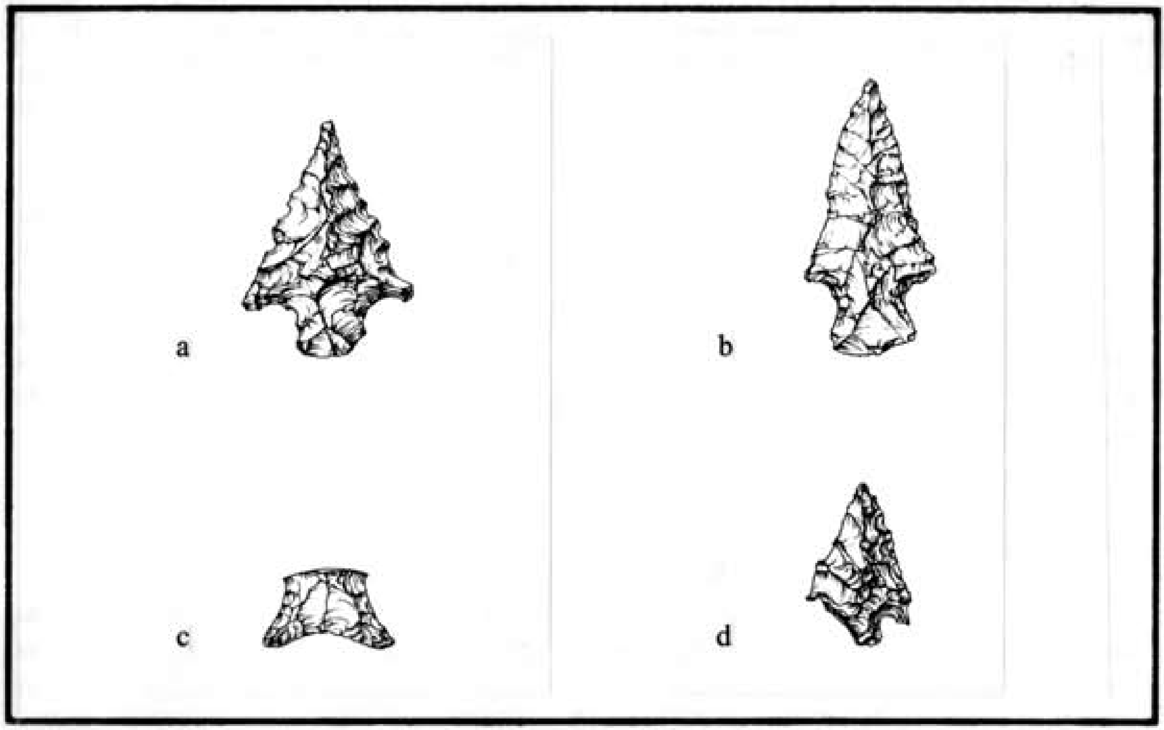

Figure 9-14. Projectile points from the Santa Teresa site (scale 1:1): (a) Hatch point; (b) San Pedro point; (c) Fairland or San Jose point; (d) small San Pedro or Early Formative period arrow point.

The complete specimens include a Hatch point and a San Pedro point. MacNeish and Beckett (1987:19) suggest that Hatch points were used during the late Hueco and early Mesilla phases, between ca. 500 B.C. and A.D. 900. They have slightly to greatly expanding stems, straight to convex bases that are not ground, and serrated blades (MacNeish and Beckett 1987:19). Our specimen fits this description fairly well, though its stem is straight rather than expanding (Fig. 9-14a). It was found between EA-4 and EA-5, and cannot be confidently associated with either. The other complete specimen is a resharpened San Pedro point (Fig. 9-14b). This style tends to have a long narrow blade, a convex base, and broad shallow notches somewhere between side and corner styles. MacNeish and Beckett (1987:16) consider them diagnostic of the Hueco phase (ca. 900 B.C. to A.D. 200+). However, Carmichael (1986a:92-94) indicates that both large and small varieties of this style occur in Late Archaic and Early Formative contexts. This specimen was found just east of EA-1 and is probably associated with that cluster of features and artifacts. Both of these styles appear to overlap the Late Preceramic and Early Ceramic periods in this region.

One point is represented by a chert base with ground edges (Fig. 9-14c). Edge grinding is usually an attribute of Early and Middle Archaic projectile point manufacturing technology. In form, this specimen is similar to the Fairland point of Texas and Oklahoma (Bell 1960:38), a type thought to date ca. 1000 B.C. to A.D. 500 (Bell 1960:38). However, it is also similar to variants of the San Jose type from the southern Tularosa Basin (Carmichael 1986a:91). As such, a Middle Archaic date (ca. 3200 to 1800 B.C.) could also be assigned to this specimen. The latter is probably a more accurate reflection of its cultural affiliation in this region, and the Middle Archaic date will be used. It was found just north of EA-4 and may be affiliated with the use of that area.

The last specimen is a small corner notched point that could fit into either the small San Pedro dart point or Early Formative arrow point categories (Fig. 9-14d). It has been resharpened and is made from Polvedera obsidian, a material that is generally only available as small pebbles in gravel deposits along the Rio Grande. Thus, its small size may be more related to raw material size than function. Unfortunately, even with this in mind, this style can only be assigned a very general Late Archaic to Early Formative period affiliation. Our specimen was recovered from EA-7 and is probably related to use of that area.

Pottery

Only 17 sherds were recovered from this site, 14 of which were from a single vessel that was manufactured locally but resembles Mimbres Corrugated (see "Santa Teresa Project Ceramic Trends"). These sherds were all in EA-3; 12 were in Subarea 2, while the others were 15 m to the southeast between Subareas 1 and 2. They are probably either from a whole vessel or a large sherd that was shattered and smeared across the area when overburden was removed by a brush rake, and it is difficult to determine whether or not they were associated with the chipped stone assemblage from that area. A comparison of the EA-3 assemblage with those from other areas may allow us to ascertain which possibility is more likely. If the sherds are associated with other materials from EA-3, a late Mesilla phase date can be ascribed to this cluster of artifacts. If they are not associated we can only conclude that a late Mesilla phase component existed at a higher elevation but was eradicated when the sand was removed.

The remaining pottery represents two vessels and includes two brown ware body sherds and an El Paso Brown rim. The body sherds were found in the southern part of the site and were not associated with any excavation areas. These sherds cannot be assigned to a specific phase and could have been manufactured at any time during the Formative period. The El Paso Brown rim sherd probably reflects a Mesilla phase occupation. It was recovered near EA-4 in the north part of the site and creates a situation similar to that discussed above. Was this artifact associated with other nearby cultural materials, or is it intrusive? Again, this can only be determined by a comparison of the character of assemblages from various parts of the site.

Table 9-2. Summary of radiocarbon data from the Santa Teresa site

Sample Number	Location of Sample	Conventional Radiocarbon Age	Intercept of Radiocarbon Age with Calibration Curve	1 Sigma Calibrated Results	2 Sigma Calibrated Results
Beta-80961	Feature 17	2080 ± 60 B.P.	60 B.C.	175 to 5 B.C.	330 to 330 B.C. 205 B.C. to A.D. 65
Beta-80962	Feature 7	4210 ± 60 B.P.	2875 B.C.	2895 to 2860 B.C. 2815 to 2680 B.C.	2910 to 2595 B.C.
Beta-80963	Feature 9	2400 ± 50 B.P.	410 B.C.	515 to 395 B.C.	760 to 635 B.C. 560 to 380 B.C.
Beta-80964	Feature 14	4200 ± 60 B.P.	2875 B.C. 2790 B.C. 2780 B.C.	2890 to 2855 B.C. 2820 to 2665 B.C.	2910 to 2590 B.C.
Beta-80965	Feature 4	2270 ± 60 B.P.	375 B.C.	390 to 345 B.C. 310 to 210 B.C.	405 to 180 B.C.

Radiocarbon Dates

Five radiocarbon dates were obtained from this site (Table 9-2). All samples were very small (between 0.01 and 0.08 g) and dated by accelerator mass spectrometer (AMS). They contained fragments of wood charcoal that were probably mesquite but were too small for positive identification. As recommended by Beta Analytic, who processed the samples, the 2 sigma calibrated results are used in our interpretation of these dates. This provides a 95 percent level of confidence that the carbonized wood dates to that temporal range. However, it must be remembered that the wood was dated, not the event in which it was burned. Since we were unable to definitely ascertain the types of wood in these samples, much less whether the outer sections of trunks or branches were present, these samples should be considered low-quality (Smiley 1985:71-72). Thus, discrepancies of up to several hundred years between the timing of sample dates and feature use can occur, suggesting that these dates should be considered relative rather than absolute indicators of temporal association.

While it would have been preferable to obtain dates for all of the features that contained charcoal, this was not feasible. The number of samples that could be analyzed was limited by the expense of obtaining AMS dates. Thus, samples were selected to provide dates for groups of features. While we assumed that the features in these groups were associated, this analysis unfortunately provides no data to corroborate this possibility. In only one case were multiple dates obtained from a group.

Dates were obtained for features in EA-1, EA-4, EA-5, and EA-8. No charcoal was recovered from features in EA-3 or EA-7, and EA-2 contained no features. EA-9 and EA-10 were not dated because they contained few artifacts and only one feature apiece. Thus, at least one date was obtained for all but one group of features. The results of this analysis suggest that features in EA-1 date to the Late Archaic period, ca. 205 B.C. to A.D. 65. Features in EA-4 also appear to date to the Late Archaic period, ca. 405 to 180 B.C. Similarly, a Late Archaic date was obtained for a feature in EA-5, though it was somewhat earlier, with ranges of 760 to 635 B.C. and 560 to 380 B.C. Two features in EA-8 were dated to the Middle Archaic, with ranges of 2910 to 2595 B.C. and 2910 to 2590 B.C.

Discussion

While the projectile point and radiocarbon dates are in general agreement, the pottery dates are questionable. However, those data provide a tentative late Mesilla phase date for EA-3, which otherwise contains no temporally sensitive materials. It may be possible to assess the accuracy of this date using other information, and this will be attempted in a later section.

Two classes of data suggest that the group of features and related artifacts in EA-1 date to the Late Archaic. Not only did a radiocarbon date suggest that Feature 17 was used during that period, but also, a Late Archaic San Pedro point was found in probable association nearby. A Late Archaic radiocarbon date was obtained for Feature 4 in EA-4, and a probable Middle Archaic San Jose point was found near that area, as was an Early Formative period El

Paso Brown rim sherd. Only one type of temporally sensitive information was available for EA-5, a radiocarbon date that again suggests Late Archaic use. While it is possible that the radiocarbon dates reflect the use of old wood for fuel and that these features were actually used during the Early Formative period, this is unlikely. The virtual lack of pottery from that period and the fact that none was directly associated with any of the groups of features and artifacts support this interpretation. However, a more detailed analysis of these assemblages and comparison with materials from other dated sites in the region is needed before it can either be verified or rejected.

Calibrated radiocarbon dates from these features were compared to determine whether any were potentially from the same sample population using the University of Washington Quaternary Isotope Laboratory Radiocarbon Calibration Program (version 3.0.3, 1993). This suggested that samples from Features 4 and 9 were statistically the same at the 95 percent level of confidence. Thus, it is possible that these features, and consequently the groups of features and artifacts they are located within, were used at about the same time. Conversely, wood of similar age could have been used at widely varying times to fuel these hearths. Unfortunately, there are not enough data available to fully assess these possibilities.

A projectile point provides the only temporally specific information for EA-7. Unfortunately, the use of this type of point spans a long period and suggests a Late Archaic or Early Formative period date. All three features in this area were burned rock clusters, which lacked associated fire pits or charcoal stains.

Radiocarbon dates were obtained for both features in EA-8. These dates were nearly identical and were statistically the same at the 95 percent level of confidence. Both dates were solidly in the Middle Archaic period, even when the possibility of a 200 to 500 year lag between times of wood growth and use as fuel is considered.

Thus, tentative dates can be proposed for six excavation areas, including all of the clusters of features and artifacts defined. Only individual features and clusters of artifacts lacking associated features are not dated in some way. While the problems discussed above make it difficult to assign absolute dates to this site, several conclusions can be drawn. First, it should be obvious that several general periods of occupation are represented in our data, and at least one period is probably represented by multiple occupations. Radiocarbon dates from EA-8 are indicative of a Middle Archaic occupation during the late Keystone or early Fresnal phase. All other radiocarbon dates suggest late Hueco phase uses. The array of projectile points are in general agreement with the radiocarbon data, with the exception of the probable San Jose point found near EA-4. However, given the propensity for reuse of materials from earlier sites in this region, it is likely that it was salvaged and reused at a much later time.

While it is uncertain whether the pottery from EA-3 was related to the rest of that assemblage, it certainly indicates a late Mesilla phase occupation. The few other sherds recovered may also be related to that use, but this is impossible to determine for certain. Thus, this site appears to have been used during the Middle and Late Archaic periods, as well as the early Formative period.

Artifact Summaries

Chipped Stone Artifacts

A total of 902 chipped stone artifacts were recovered from the Santa Teresa site (Table 9-3). Three (0.3 percent) are fragments of two materials that fractured in a tabular fashion and are identical to two of the three tabular materials from the Mockingbird site. They include a fragment of siliceous rhyolite and two of metaquartzite, and are probably pieces of recycled ground stone tools like those at that other site. Unfortunately, the sample size is so small that no fragment possesses characteristics of either chipped or ground stone artifacts. However, because of their similarity to artifacts at LA 86774, they are included with the chipped stone.

Sedimentary materials are the most common types. A total of 50.4 percent of the chipped stone artifacts fall into this category and include a variety of cherts, silicified woods, sandstone, siltstone, limestone, and quartz arenite. Igneous materials also make up a substantial part of the assemblage, comprising 45.0 percent of the total. This category includes a variety of rhyolites and aphanitic rhyolites, obsidian, basalt, and undifferentiated igneous rocks. Metamorphic materials make up only 4.6 percent of the assemblage and include quartzite and undifferentiated metamorphic rocks.

Few formal tools or evidence of their manufacture occur in the assemblage. Debitage reflecting tool manufacture include seven chert and two aphanitic rhyolite biface flakes. Three additional chert and two aphanitic rhyolite flakes were probably also struck from bifaces but do not fulfill enough conditions of the polythetic set to be classified as biface flakes. This increases the amount of debitage potentially related to biface manufacture to 1.4 percent of the assemblage. Seven bifaces were also recovered; four were finished projectile points, while three were broken during the middle stage of manufacture. The only other tools found were quartzite and rhyolite hammerstones (one of each), and a rhyolite chopper-hammerstone. At least the former two and possibly all three tools were used in chipped stone reduction activities.

Most of this assemblage consists of debitage produced during core reduction. Excluding biface flakes and considering tabular fragments to be angular debris, there are 2.91 flakes for every piece of angular debris, suggesting that expedient core-flake reduction predominated. Twenty cores were recovered. Most are cherts or aphanitic rhyolites. One example of basalt also occurs. In addition, a chert core platform rejuvenation flake was identified.

Burned Rock

This category includes thermally altered rocks as well as unaltered rocks thought to have been used in thermal features that are not included in other assemblages. Many ground stone artifacts were used in thermal features and are burned or heat-fractured but are discussed

Table 9-3. Chipped stone artifact assemblage from the Santa Teresa site, illustrating artifact morphology by material type (frequencies and row percentages)

Material Type	Angular Debris	Core Flakes	Biface Flakes	Cores	Cobble Tools	Bifaces	Tabular Fragments	Totals
Cherts	109 27.6	260 65.8	7 1.8	13 3.3	0 0.0	6 1.5	0 0.0	395 43.8
Chalcedonies	7 28.0	17 68.0	0 0.0	1 4.0	0 0.0	0 0.0	0 0.0	25 2.8
Silicified woods	4 50.0	4 50.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	8 0.9
Obsidians	1 12.5	6 75.0	0 0.0	0 0.0	0 0.0	1 12.5	0 0.0	8 0.9
Undifferentiated igneous	1 11.1	8 88.9	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	9 1.0
Basalt	4 23.5	12 70.6	0 0.0	1 5.9	0 0.0	0 0.0	0 0.0	17 1.9
Rhyolites	24 30.8	51 65.4	0 0.0	0 0.0	2 2.6	0 0.0	1 1.3	78 8.6
Rhyolites, aphanitic	42 14.3	245 83.3	2 0.7	5 1.7	0 0.0	0 0.0	0 0.0	294 32.6
Limestone	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.1
Silicified limestone	6 28.6	15 71.4	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	21 2.3
Sandstone	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.1
Siltstone	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 0.2
Undifferentiated metamorphic	3 33.3	6 66.7	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	9 1.0

Material Type	Augular Debris	Core Flakes	Biface Flakes	Cores	Cobble Tools	Bifaces	Tabular Fragments	Totals
Quartzite	16 50.0	13 40.6	0 0.0	0 0.0	1 3.1	0 0.0	2 6.3	32 3.5
Quartz arenite	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 0.2
Totals Percent	218 24.2	642 71.2	9 1.0	20 2.2	3 0.3	7 0.8	3 0.3	902 100.0

with other ground stone tools rather than here. A total of 778 pieces of burned rock that did not fit into other artifact categories was analyzed. As shown in Table 9-4, only around 5 percent are unburned. Fifteen unburned fragments (37.5 percent) were recovered from hearths. Feature 21 contained six unburned sandstone and three caliche fragments, while Feature 25 contained six unburned fragments of sandstone. While these materials appear to have been used in hearths, they were apparently not heated to the point where visible physical alteration occurred. This may also be true of other fragments of unaltered rock.

Table 9-4. Thermally altered rock and rock from thermal features for the Santa Teresa site (frequencies and row percentages)

Material Type	Burned Rock	Fire-cracked and Burned Rock	Unburned Rock	Totals
Chert	0 0.0	1 100.0	0 0.0	1 0.1
Undifferentiated igneous	0 0.0	4 66.7	2 33.3	6 0.8
Basalt	1 20.0	4 80.0	0 0.0	5 0.6
Vesicular basalt	1 50.0	1 50.0	0 0.0	2 0.3
Rhyolite	2 22.2	7 77.8	0 0.0	9 1.2
Thunderbird rhyolite	0 0.0	8 72.7	3 27.3	11 1.4
Undifferentiated sedimentary	0 0.0	2 28.6	5 71.4	7 0.9
Sandstone	317 56.7	218 39.0	24 4.3	559 71.9
Undifferentiated metamorphic	0 0.0	0 0.0	1 100.0	1 0.1
Quartzite	0 0.0	0 0.0	1 100.0	1 0.1
Quartzitic sandstone	0 0.0	1 100.0	0 0.0	1 0.1
Caliche	70 40.2	101 58.0	3 1.7	174 22.4
Unknown	0 0.0	0 0.0	1 100.0	1 0.1
Total Percent	391 50.3	347 44.6	40 5.1	778 100.0

Six fragments of unburned sandstone were recovered from EA-2, five of which were from a single grid. While these artifacts are considered to be part of the burned rock assemblage, it is also possible that they represent a deteriorated ground stone tool. Thus, they should probably be eliminated from later discussions of burned rock at the site. However, in all other cases it is likely that visibly unaltered rock used in thermal features is represented. Ten of 13 unburned rock fragments from EA-3 were found in grids next to Feature 25 and were probably used in that hearth. While the three remaining specimens from this area were found up to 7 m away from the hearth, they were probably also related to its use. Similarly, three unburned rock fragments in EA-5 and 9 in EA-10 were scattered around hearths and undoubtedly associated with their use.

By count, sandstone was the most common material used in thermal features. Caliche was the next most commonly used type, and no other material comprised more than 1.4 percent of the total. All thermally altered rock exhibits signs of burning, and nearly half was also fire-cracked.

When weight is considered, the distribution of materials is somewhat different (Table 9-5). While sandstone remains the most common material, it constitutes only about 50 percent by weight, rather than the nearly 72 percent represented by count. Conversely, caliche comprises over 36 percent of the assemblage by weight, while it makes up only about 22 percent by count. Other materials that comprise higher percentages by weight than count are basalt, rhyolite, and Thunderbird rhyolite.

Unburned rocks are removed from consideration in Table 9-6. This does little to change the structure of the assemblage. Percentages of sandstone and caliche rise slightly (52 and 38 percent, respectively), and undifferentiated metamorphic, quartzite, and unidentified materials drop from the assemblage. Thus, no matter how this assemblage is examined, sandstone and caliche dominate it. While igneous and metamorphic materials occur, they comprise slightly less than 11 percent of the total.

Table 9-5. Thermally altered rock and rock from thermal features for the Santa Teresa site (counts and total weights)

Material Type	Count	Total Weight (g)
Chert	1	27.00
Undifferentiated igneous	6	166.90
Basalt	5	409.74
Vesicular basalt	2	19.40
Rhyolite	9	816.30
Thunderbird rhyolite	11	689.60
Undifferentiated sedimentary	7	75.40

Material Type	Count	Total Weight (g)
Sandstone	559	9240.92
Undifferentiated metamorphic	1	17.00
Quartzite	1	32.50
Quartzitic sandstone	1	145.30
Caliche	174	6655.80
Unidentified	1	31.10

Table 9-6. Thermally altered rock from the Santa Teresa site (counts and total weights)

Material Type	Count	Total Weight (g)
Chert	1	27.00
Undifferentiated igneous	4	73.10
Basalt	5	409.74
Vesicular basalt	2	19.40
Rhyolite	9	816.30
Thunderbird rhyolite	8	419.00
Undifferentiated sedimentary	2	53.10
Sandstone	535	9140.02
Quartzitic sandstone	1	145.30
Caliche	171	6652.50

Ground Stone Artifacts

This category includes all fragments of rock with ground surfaces or edges, including specimens that are burned. A total of 75 ground stone artifacts were recovered, but only two specimens are whole. Fragments of manos and metates dominate the assemblage. As we conclude in "Analysis of Ground Stone Artifacts from the Santa Teresa Sites," nearly all of the fragmentary specimens probably represent the use of broken or discarded ground stone tools from earlier sites as hearth stones. Both Roney and Simons (1988) and O'Leary (1987) excavated pit structures in the area that had earlier dates than many of the features at the Santa Teresa site. Earlier sites certainly occur in the region, and it is likely that some served as sources for these materials. Thus, there is little direct evidence for the use of grinding tools at this site, with the possible exceptions of an abrader and a one-hand mano.

Ceramic Artifacts

Only 17 sherds were recovered from this site. As discussed in "Santa Teresa Project Ceramic Trends," 14 sherds appear to be from a single Mimbres Corrugated vessel that was manufactured locally. The rest of the assemblage includes an El Paso Brown Rim and two El Paso Brown Body sherds that represent at least two separate vessels. As we discuss in more detail in later chapters, it is likely that these artifacts are unrelated to most of the other archaeological remains and represent tantalizing clues to a later occupation that was removed during mechanical alteration of the site.

Flotation Analysis

Sediment samples from 17 proveniences were examined for botanical remains. Two contained no botanical specimens. Evidence for the use of plant foods was very rare. Charred specimens of only two economic species were recovered, as well as an unidentified charred seed. Part of a sunflower seed (*Helianthus* sp.) was found in a sample from Feature 20, and dropseed grass seed (*Sporobolus* sp.) occurred in a sample from Feature 7. The unidentified seed was found in Feature 19. Small fragments of charcoal from fuel woods were also recovered. None could be positively identified, but in most cases mesquite wood (*Prosopis* sp.) seems to be represented.

GEOPHYSICAL SURVEYS AT THE SANTA TERESA PORT-OF-ENTRY

David A. Hyndman

Geophysical surveys were conducted at LA 86774 and LA 86780 in the vicinity of the temporary Santa Teresa Port-of-Entry facility. Survey activities were conducted between July 7 and 10, 1994. The surveys were conducted to provide a nondestructive subsurface investigation in advance of physical sampling. Equipment, labor, and geophysical expertise were provided by Sunbelt Geophysics of Albuquerque. Guidance and oversight were provided by the OAS. This report documents the geophysical activities and presents the results.

The primary geophysical targets were fire-altered soil and rock, as might be expected in hearths and the walls of pit structures. The heat from wood fires is sufficient to alter iron minerals in soil or rock. The primary alteration of interest is the reduction of hematite (FE_2O_3) to magnetite (FE_3O_4). Magnetite has a significantly higher magnetic susceptibility than hematite, and this higher magnetic susceptibility can often be measured with portable instruments.

There are two cost-effective field methods for measuring the effects of fire alteration on iron minerals in soil or rocks. A magnetometer can be used to detect local anomalies (changes) in the earth's magnetic field generated by lateral changes in magnetic susceptibility. Generally, the magnetic anomaly from fire-altered soil or rock appears as an isolated magnetic high or a magnetic dipole consisting of a magnetic high and associated low. A second method is to measure spatial changes in magnetic susceptibility directly using induced electromagnetic methods. The in-phase electromagnetic response of ground conductivity meters allow such a measurement of relative changes in magnetic susceptibility. An increase in magnetic susceptibility will be measured as an increase in the in-phase response.

Secondary targets were pit structures filled by eolian deposits. Most New Mexico soils contain 1 percent or so of magnetic minerals. An excavation such as a pit structure that has been filled with eolian deposits is likely to appear as an inclusion in naturally occurring soil, lacking in magnetic minerals. Such a structure would generate a mild magnetic low.

Two sites in the vicinity of the Santa Teresa Port-of-Entry were surveyed. Approximately 0.28 ha (0.7 acre) of the Santa Teresa site (LA 86780) was surveyed by magnetometer, and part of that area was also examined with a ground conductivity meter. Only the magnetometer was used to examine approximately 0.69 ha (1.7 acres) of the Mockingbird site (LA 86774).

Methodology

Spatial control of data acquisition at the sites was maintained by establishing parallel baselines, intermediate lines, and endlines bracketing each survey area. A 2 m increment was marked along these lines with plastic stemmed pinflags. A tape with flags marking every 2 m was stretched between the baseline and endline, generating a uniform, 2 by 2 m measurement grid. The grid was integrated with spatial coordinates previously established by the OAS.

Magnetic field data were acquired at each grid node utilizing a Geometrics G-856-AX proton precession magnetometer. The magnetometer was deployed in the vertical gradient mode, with two magnetic sensors mounted on a vertical staff. The bottom sensor was positioned 0.76 m above the ground and the second sensor 1.5 m above the ground. Magnetometer data were recorded with an internal data logger and transferred to a personal computer for reduction and processing. The MAGLOC program (Geometrics, Inc.) was used for data reduction. The Geosoft Mapping and Processing package (Geosoft, Inc.) was used for preparation of the final data presentations.

Electromagnetic data were acquired with a Geonics EM-38 ground conductivity meter. This instrument utilizes two coils, with a transmitting coil generating a magnetic dipole that penetrates the subsurface and induces small eddy currents in the soil. A second receiver coil measures the magnetic field generated by these eddy currents. The in-phase response of the magnetic field generated by the eddy currents can be relegated to the magnetic susceptibility of the soil.

The EM-38 was operated in vertical dipole mode, investigating the soil to a depth of approximately 1.5 m. The EM-38 data were acquired over a portion of the area examined at the Santa Teresa site in a 1 m grid. The data were recorded with a data logger and transferred to a personal computer for processing. The DAT38 program (Geonics, Ltd.) was used for data reduction. The Geosoft Mapping and Processing package (Geosoft, Inc.) was used for preparation of the final data presentations.

Results

The vertical magnetic gradient data from the Santa Teresa site are presented in Fig. 10-1. The unit of measure is nanoTeslas per meter (nT/m). The vertical gradient displays only mild variation over the survey area, ranging from about -15 to 15 nT/m, and little variation suggesting the presence of significant archaeological features is seen. High gradients due to a metal chain link fence which bisects the site are observed along the western edge. Two areas of low gradient (labeled A and B in Fig. 10-1) suggest possible excavations filled with eolian sand. A single mild dipole feature is seen and is labeled C. It is interesting to note that the magnetic features seem to disappear to the east of 565E.

The EM-38 in-phase response is depicted in Figure 10-2. The unit of measure is parts per thousand (ppt), a ratio of primary (transmitted) magnetic field strength to measured (induced) magnetic field strength. The contrast across the site is again rather mild, as with the vertical magnetic gradient. There appears to be a change in measured response to the east of

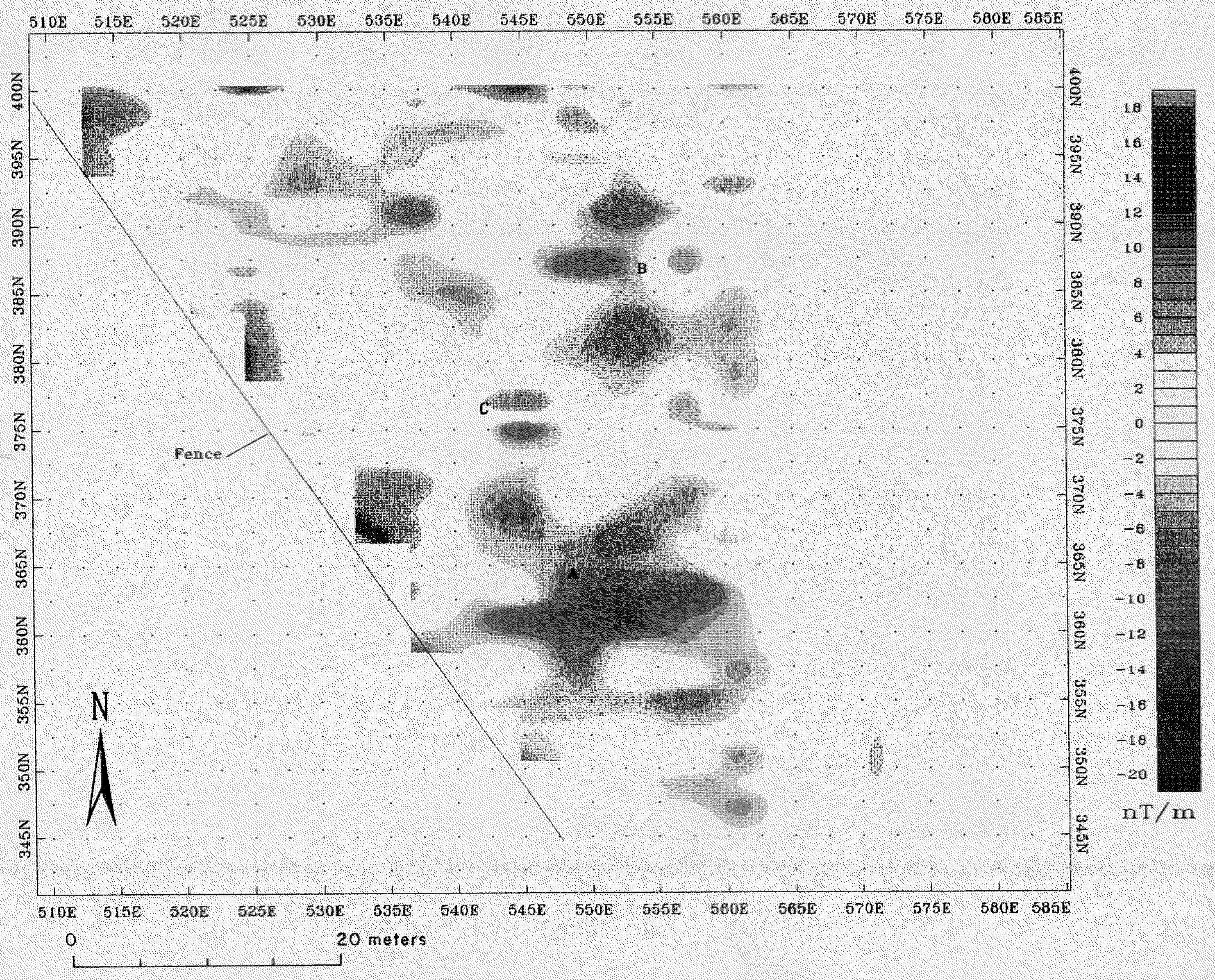

Figure 10-1. Magnetometer survey at the Santa Teresa site.

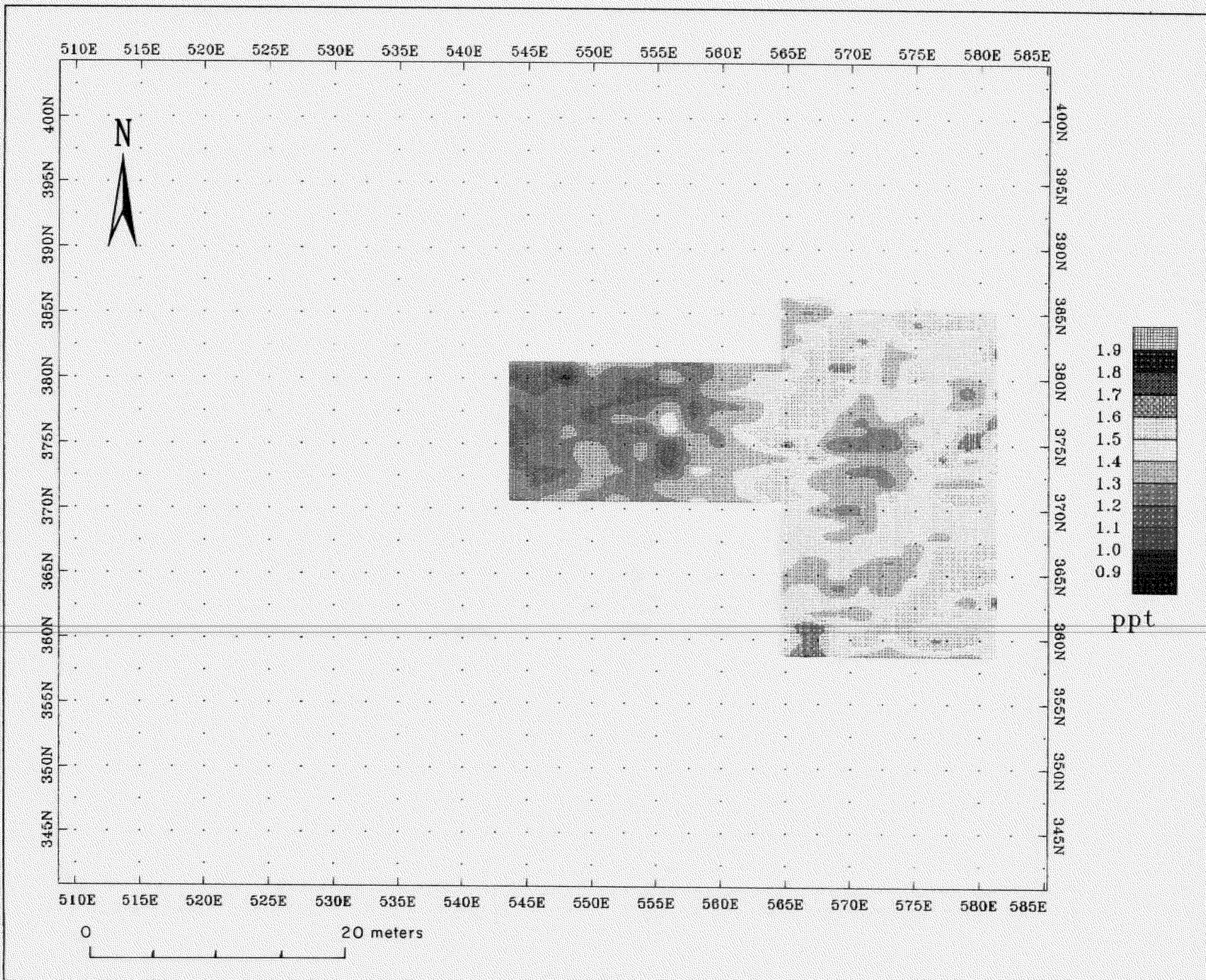

Figure 10-2. Electrical conductivity survey at the Santa Teresa site.

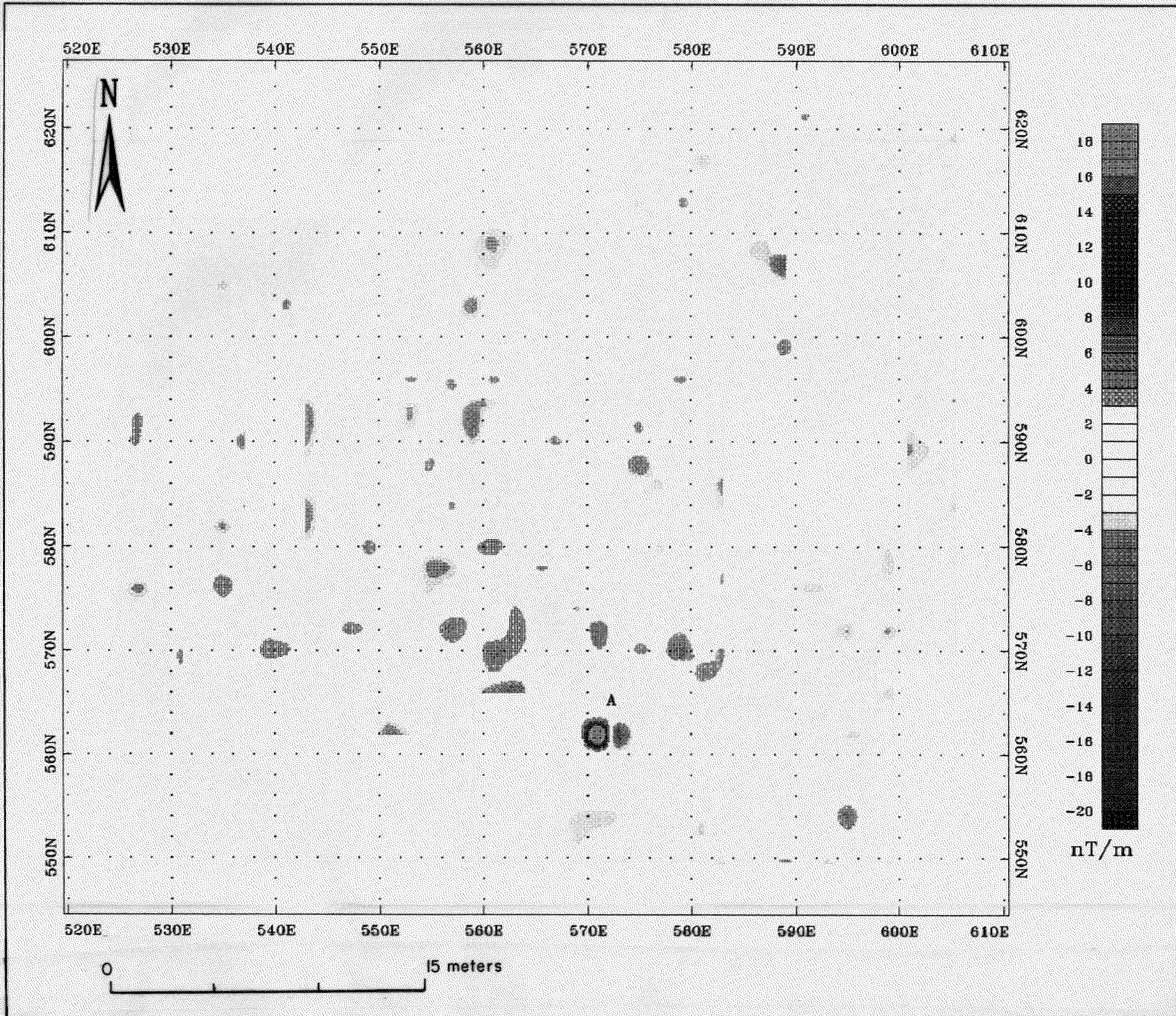

Figure 10-3. Magnetometer survey at the Mockingbird site.

565E, correlating with the change observed in the magnetic data. The changes in both magnetic and electromagnetic response to the east of 565E do not appear to be related to any archaeological feature. It is more likely due to grading and earth moving activities at this site, or shallow geomorphology.

The vertical magnetic gradient data from the Mockingbird site are presented in Fig. 10-3. Blanks in the data coverage are due to mesquite hummocks that prevented complete coverage. One significant, rather strong, magnetic dipole feature is seen at 570N/562E. It is labeled A. This strong response is likely the result of scrap iron (not observed on the surface) or a hearth or burned feature.

There are several other magnetic features within the survey area. A near linear row of magnetic highs can be seen running along 570N. These anomalies are large in areal extent (several square meters) although fairly mild in magnitude. These may also be burned features. There are several significant magnetic lows near the center of the surveyed area, which may be pit structures. These anomalies appear similar to a known pit structure partially captured at 607N/590E.

Conclusions

The geophysical surveys at the Santa Teresa Port-of-Entry were partially successful in providing subsurface information prior to physical sampling. The results at the Santa Teresa site were not encouraging, providing only two possible shallow pit structures, and a single weak dipole feature. It is likely that past earth moving activities have disturbed critical features, if present. Survey at the Mockingbird site was successful in locating one major dipole feature, indicative of a hearth, and several other possible areas of burned soil. Several possible pit structures, magnetically similar to a known pit structure, were observed.

GEOMORPHOLOGY OF THE SANTA TERESA SITES

Paul Drakos

Glorieta Geoscience, Inc. (GGI), was contracted by the OAS to perform a geomorphological study at the Santa Teresa Port-of-Entry. The purpose of this study was to examine LA 86774 and LA 86780 to determine their relative position within the eolian stratigraphy in the vicinity of the border crossing and, if possible, to determine whether these sites were occupied contemporaneously or represent temporally separate occupations. Geomorphic evidence was also used to assess whether site occupation was relatively continuous or transitory and intermittent in nature.

Methods

The geomorphic characterization of LA 86774 and LA 86780 involved a combination of field mapping, soil, and stratigraphic descriptions. The area was examined on the ground to define stratigraphic units, examine soils, complete grain-size analysis of vertical profiles, and make general observations of geological settings. Definition of site stratigraphy was based on three profiles described at LA 86774 and three at LA 86780 (see Figs. 8-1 and 9-1). Stratigraphic units identified at these sites are compared to stratigraphic units identified in the southern Tularosa Basin by Blair et al. (1990).

Backhoe trenches and excavation walls were cleaned off to prepare for soil and stratigraphic descriptions. Soils were described using methods described by Soil Survey Staff (1975) and Birkeland (1984) using a hand lens, Munsell soil color charts, 2 mm sieve, 10 percent hydrochloric acid, and a trowel or soil knife. Grain-size analyses were completed in the field using a Keck Instruments Model SS-81 nested mechanical sieve analysis field kit.

Geologic Setting

The Santa Teresa Port-of-Entry sites are on the West Mesa in the Mesilla Basin (sometimes referred to as the Mesilla Bolson), one of a series of downdropped basins which comprise the Rio Grande Rift. The Mesilla Basin in the site vicinity has two major geomorphic subdivisions: Mesilla Valley of the Rio Grande; and the La Mesa surface, a broad bolson-floor remnant lying about 100 m above the valley floor and extending west to the Potrillo Mountains (Lovejoy and Hawley 1978). The La Mesa geomorphic surface was constructed by the ancestral Rio Grande during final depositional stages of the Camp Rice formation in early to middle Pleistocene time (Lovejoy and Hawley 1978). The Rio Grande likely incised episodically into the La Mesa surface during glacial periods in the southern Rocky Mountains. Within the study area and in the site vicinity, the Camp Rice formation and La Mesa surface are overlain by recent eolian deposits comprising sand sheet, coppice dune, and parabolic dune forms. Earlier studies identified several geomorphological subzones in the area characterized by a predominance of coppice dunes, parabolic dunes, sand sheets, mixed parabolic and coppice dunes, or overgrazed areas (Davis and Nials 1988; Stuart 1990). Stuart (1990) determined that LA 86774 lies within the mixed coppice and parabolic dune subzone, and LA 86780 lies within the parabolic dune subzone. The parabolic dune overlying LA 86780 was, however, removed using a sand rake sometime between 1990 and 1992, so no attempt will be made to evaluate the earlier geomorphic site classifications in this report.

The Camp Rice formation is exposed along the West Mesa escarpment, where it consists of a sequence of gray to buff-colored calcite-cemented sandstone; gray, green, and red mudstone; and conglomerate. This sequence is capped by a partially eroded petrocalcic soil with a Stage IV carbonate morphology (terminology from Gile et al. 1966). The gravel composition of the conglomerate includes welded tuff, rhyolite, fine-grained micaceous sandstone, chert, basalt, and quartzite pebbles. This area is mapped as the fluvial facies of the Camp Rice formation by Seager et al. (1987). The petrocalcic soil horizon could have provided material for use in hearth construction. Clay layers within the Camp Rice formation may have provided raw materials for ceramics.

Site Stratigraphy and Soils

The overall site stratigraphy consists of historic or modern (400 years old or less) coppice dune deposits overlying late Holocene (400 to 2,000 year old) massive sand deposits that likely represent a sand sheet. LA 86780 was formerly overlain by a parabolic dune (Stuart 1990), which sat on top of the sand sheet. A series of trenches excavated at LA 86774 and LA 86780 indicate a minimum of 4.6 m of eolian deposits overlying the Camp Rice formation. The relatively young age of the deposits is supported by the lack of soil development observed in either sedimentary unit.

Stratigraphy of LA 86774

Three profiles were described in stratigraphic trenches and excavation walls at LA 86774. Each profile shows cross-bedded dune deposits overlying massive sand (Fig. 11-1). The cross-bedded sand is generally 0.15 to 0.6 m thick and represents historic or modern coppice dune deposits. The underlying sand appears to be extensively bioturbated. Based on grain-size analysis (discussed below), the massive sand likely represents a sand sheet which underlies the site. The upper cross-bedded sand is informally designated Unit Q4b, and the lower massive sand is informally designated Unit Q4a (Table 11-1).

Soils. Eolian sediments at LA 86774 exhibit very little or no pedogenic alteration. Unit Q4b (Horizon IC in ST1, ST4, and ST5) exhibits no soil development; structure is massive to weak subangular blocky; and clay films, precipitation of calcium carbonate, and darkening of the surficial horizon were absent (Table 11-1).

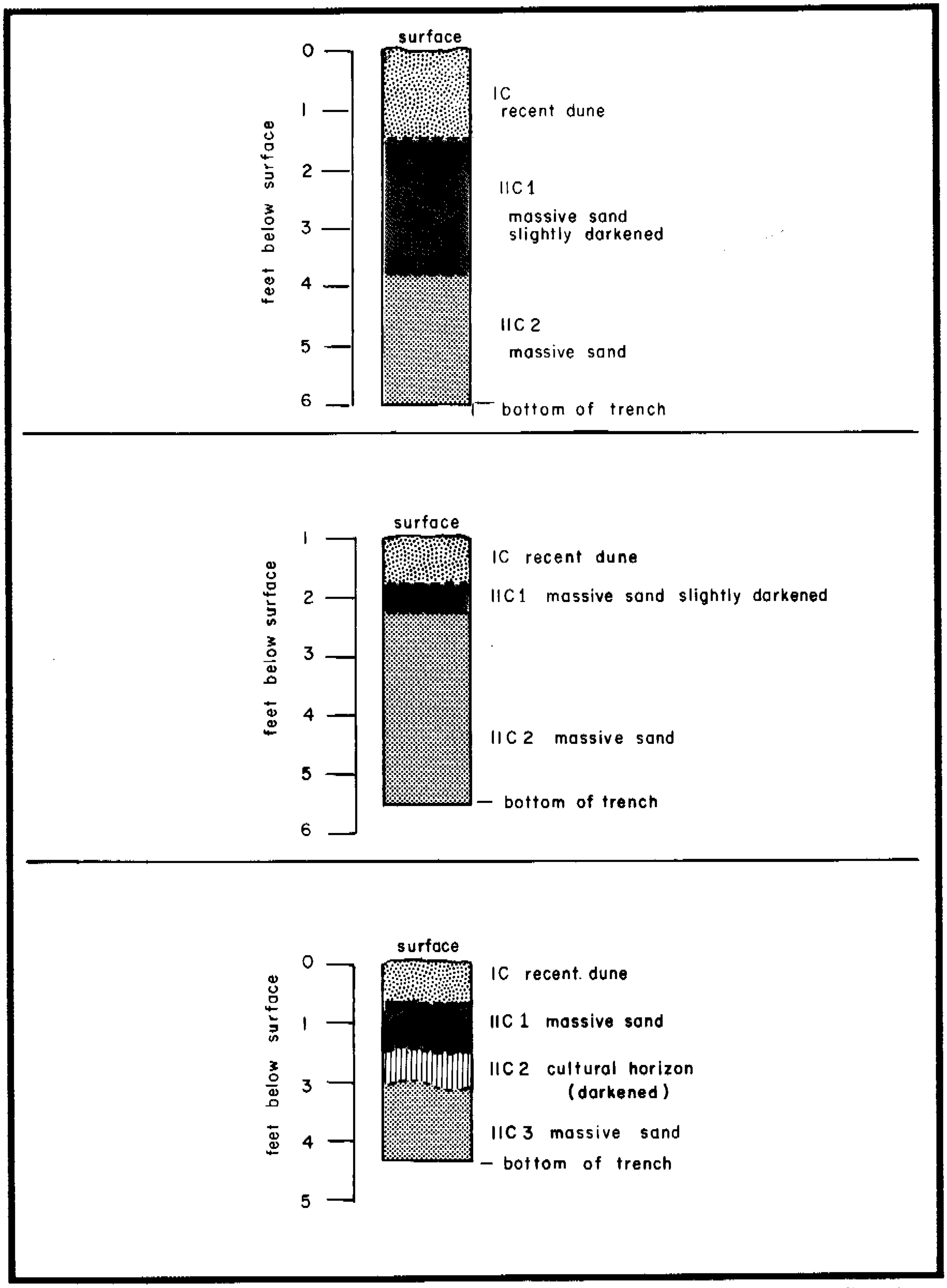

Figure 11-1. Soil stratigraphic descriptions from LA 86774, Santa Teresa Border Crossing.

Table 11-1. Summary of soil characteristics and stratigraphic nomenclature, Santa Teresa Port-of-Entry sites

Unit	Grain Size	Soil Horizon	Structure	Clay Films	CaCO3	Maximum Darkening	Location of Cultural Materials	Age Estimate
LA 86774								
Q4b	fine to medium sand	IC	massive to weak subangular blocky	n.o. [?]	none	7.5YR 5/6	none[1]	modern (< 100 years)
Q4a	medium sand	IIC	massive to weak subangular blocky	n.o.	none	7.5YR-10YR 5/4	.27 to .45 m below top of horizon	400 to 800 years
LA 86780								
Q4b	fine sand	IC	massive	n.o.	none[2]	7.5YR 6/5	none[1]	modern (< 100 years)
Q4a	medium sand[3]	IIC	massive	n.o.	none	7.5YR 5/4	1.5 to 2.4 m below top of horizon	400 to 1800 years

[1] Some modern or late historic materials (e.g. steel nails) were observed in Q4b sediments.
[2] Horizon IC1 at ST2 is very slightly effervescent but exhibits no carbonate morphology.
[3] Contains small percentages of fine and coarse sand.

Unit Q4a soils (Horizon IIC at ST1, ST4, and ST5) exhibit a similar lack of soil development. Q4a soils have massive to weak subangular blocky structure and lack clay films or development of carbonate morphology. Some darkening was observed, however, at the top of Unit Q4a at ST1 and ST4. This very slight darkening (from 7.5YR 6/5 to 7.5YR 5/4) represents initial A horizon development, darkening due to cultural activities at the site, or the variability of sediment hue throughout the site. The cultural horizon at ST5 (IIC2) was also slightly darkened and was less red (10YR versus 7.5YR) than all other soil horizons observed at either site.

Grain-Size Analysis. Q4b sediments are predominantly fine to medium sand and are well sorted (Table 11-1). This size range (particularly fine sand) is characteristic of dune sand (Mabbutt 1977). Q4a sediments are predominantly medium sand, which is a size range more characteristic of sand sheets (Mabbutt 1977). Based on this distribution, it appears that Q4b sediments are derived from unconsolidated Q4a eolian sands, likely from blowouts eroded into Q4b. The grain size of the cultural horizon sediments at ST5 is similar to the grain size of overlying and underlying sediments in the profile. Cultural activities at the site therefore do not appear to have had a significant effect on grain-size distributions.

Age of Deposits. The main cultural occupation at LA 86774 has been assigned to the Formative period, based on pottery types found at the site. Since the cultural horizon is located near the top of Unit Q4a, Unit Q4a within LA 86774 has an estimated age of 700 to 1400 years B.P. This age is consistent with the extensive bioturbation but lack of soil development observed in Q4a. Overlying Unit Q4b contains some modern materials (e.g., steel nails), is composed of loose, fresh-appearing sand, exhibits primary sedimentary structures, and lacks any evidence of soil development. The estimated age of Unit Q4b is therefore 100 years B.P. or less (modern).

Stratigraphy of LA 86780

Three profiles were described in stratigraphic trenches and excavation walls within LA 86780. ST2 shows two cross-bedded dune deposits overlying massive sand (Fig. 11-2). The cross-bedded sand is approximately 1.07 m thick and represents historic or modern coppice dune deposits (Q4b). ST3 and ST6 lie stratigraphically below ST2 and were excavated primarily into the underlying massive sand deposit (Q4a). The underlying sand is extensively bioturbated. Based on grain-size analysis (discussed below) the massive sand likely represents a sand sheet that underlies the site. The entire site was apparently overlain by a large parabolic dune which was removed by the former land owner.

Soils. Eolian sediments at LA 86780 exhibit very little or no pedogenic alteration. Unit Q4b (Horizon IC in ST2, ST3, and ST6) exhibits no soil development; structure is massive, and clay films, precipitation of calcium carbonate, or darkening of the surficial horizon was absent (Table 11-1).

Unit Q4a soils (Horizon IIC at ST2, ST3, and ST6) exhibit a similar lack of soil development. Q4a soils have massive to weak subangular blocky structure and lack clay films or development of carbonate morphology. Slightly darkened sediment was observed in the IIC2 horizon at ST6 in the stratigraphically lowest horizon observed at either site. This very slight darkening (from 7.5YR 6/5 to 7.5YR 5/4) likely represents the variability of sediment hue throughout the site and is not related to pedogenic processes. No features were exposed at LA 86780 during our visit, so potential darkening or other soil variability associated with cultural activities could not be assessed.

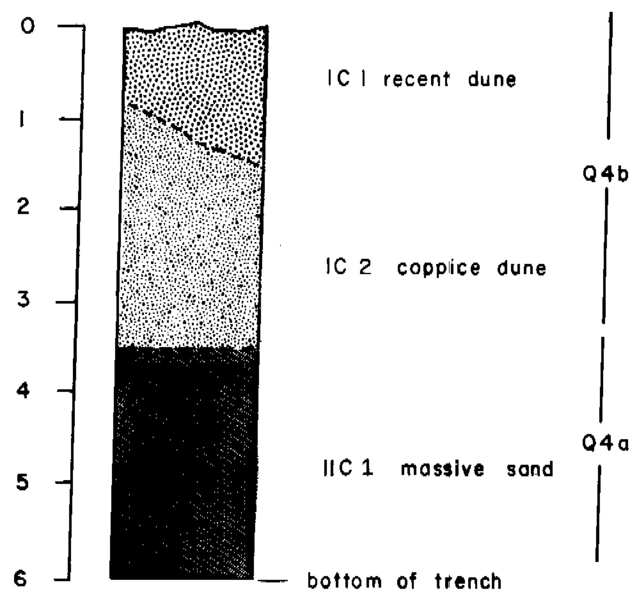

Figure 11-2. Soil stratigraphic description of ST2, LA 86780, Santa Teresa Border Crossing.

Grain Size Analysis. Q4b sediments are predominantly fine sand and are well-sorted (Table 11-1). This size range is characteristic of dune sand (Mabbutt 1977). Q4a sediments are predominantly medium sand, which is a size range more characteristic of sand sheets (Mabbutt 1977). Based on this grain-size distribution, it appears that Q4b sediments are derived from unconsolidated Q4a eolian sands, likely from blowouts eroded into Q4b.

Age of Deposits. The cultural occupation at LA 86780 has been assigned to the Middle and Late Archaic periods, with a probable Mesilla phase occupation that was destroyed when sand was removed from the site. Based on feature elevations provided by OAS, features were located 1.5 to 2.4 m below the top of Unit Q4a. Based on the age of cultural materials and their depth of burial within Q4a, the conservatively estimated age of unit Q4a within 86780 is 700 to 4200 years B.P. This age is consistent with the extensive bioturbation but lack of soil development observed in Q4a. Overlying Unit Q4b contains some modern materials, exhibits primary sedimentary structures, and lacks any evidence of soil development. The estimated age of Unit Q4b is therefore 100 years B.P. or less (modern).

Correlation with Regional Eolian Stratigraphy

An extensive study examining the geomorphic setting of small site distributions in the southern Tularosa Basin by Blair et al. (1990) provides a basis for comparison of the Santa Teresa sites with regional eolian stratigraphy. Blair et al. (1990) define four units, Q1 through Q4, from oldest to youngest. Units Q1 and Q2 exhibit well-developed soil carbonate morphology, have estimated ages of greater than 9400 years B.P., and are not correlatable with stratigraphic units defined in this study. Unit Q3 deposits exhibit a slightly darkened surface horizon and a Stage I carbonate horizon (Blair et al. 1990). Unit Q3 also contains artifacts which are indicative of the Early Archaic through Late Formative periods. Unit Q4 generally does not contain features indicative of soil development, is characterized by loose sand with well-preserved sedimentary structures disturbed only minimally by bioturbation, and has an age of less than 100 years. The southern Tularosa Basin Unit Q4 is correlatable to Unit Q4b defined in this study. Blair et al. (1990) attribute deposition of Q4 to landscape destabilization due to overgrazing during the nineteenth century and the subsequent development of the mesquite coppice dune topography that dominates the landscape of the present-day southern Rio Grande Rift basins.

Unit Q4a is not directly correlatable with any of the stratigraphic units defined by Blair et al. (1990). Unit Q4a overlaps the broad time range assigned to Q3 (7300 to 100 years B.P.) but lacks the soil characteristics used to define Unit Q3. The presence of Stage I carbonate morphology in soils developed in Unit Q3 sediments suggests that an age range of approximately 3,000 to 7,300 years (encompassing the older half of the time range) may be a more appropriate age estimate for Unit Q3 (see Machette [1985] for a discussion of age estimates based on soil carbonate development). Because of similar soil characteristics, the lower deposit at the Santa Teresa sites is included within Unit Q4 as Unit Q4a. Unit Q4 is therefore subdivided into Unit Q4a (late Holocene, 4200 to 700 B.P.), and Unit Q4b (less than 100 B.P.).

Stratigraphic Position and Occupation of LA 86774 and LA 86780

LA 86774 and LA 86780 are located within Unit Q4a at depths ranging between 0.27 and approximately 2.4 m below the contact between Unit Q4a and Unit Q4b. LA 86780 is buried deeper within the sand sheet (or parabolic dune) than LA 86774. This is consistent with the older age assigned to LA 86780. The presence of these two sites, located at different depths within Unit Q4a, indicates that eolian deposition has been characterized by relatively continuous accretion of sand. The absence of a stratigraphic break or buried soil between LA 86780 and LA 86774 does not allow these sites to be distinguished temporally based on eolian stratigraphy. The absence of features indicative of soil development in either Unit Q4a or Q4b is consistent with the estimated ages of the two sites, which range from 700 to 4200 B.P.

Based on the soil description and grain-size profile completed at ST5, the cultural occupation at LA 86774 had no effect on grain-size distributions and resulted in a slight darkening of the soil horizon. This may indicate that occupation of LA 86774 was intermittent or seasonal in nature rather than continuous.

Conclusions

The overall site stratigraphy consists of historic or modern (100 years old or less) coppice dune deposits (Q4b) overlying late Holocene (400 to 4,200 year old) massive sand deposits that likely represent a sand sheet (Q4a). LA 86780 was formerly overlain by a parabolic dune (Stuart 1990), which sat on top of the sand sheet.

The absence of features indicative of soil development in either Unit Q4a or Q4b is consistent with the estimated ages of the two sites, which range from 700 to 4200 B.P. The presence of LA 86780 and LA 86774 at different depths within Unit Q4a indicates that eolian deposition has been characterized by relatively continuous accretion of sand between at least 4200 and 700 B.P. The greater depth of burial within the sand sheet of LA 86780 relative to LA 86774 is consistent with the older age assigned to LA 86780.

Based on the soil description and grain-size profile completed at ST5, ST4 and ST1, the cultural occupation at LA 86774 had no effect on grain-size distributions and resulted in a slight darkening of the soil horizon. This may indicate that occupation of LA 86774 was intermittent or seasonal in nature rather than continuous.

Unit Q4b defined in this study is correlatable with the southern Tularosa Basin Unit Q4 defined by Blair et al. (1990). Because of similar soil characteristics, the lower deposit at the Santa Teresa sites is included within Unit Q4 as Unit Q4a. Older eolian stratigraphic units defined in the Tularosa Basin (Q1, Q2, and Q3) were not observed at these sites.

PART 3: ARTIFACT ANALYSIS

ANALYSIS OF THE SANTA TERESA CHIPPED STONE ARTIFACT ASSEMBLAGES

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Both sites excavated at the Santa Teresa Port-of-Entry contained sizeable chipped stone assemblages. The Santa Teresa site was a collection of Archaic artifacts and features with a Formative period occupation represented by a few sherds scattered around the site. Radiocarbon dates suggest at least two major periods of occupation during the Middle and Late Archaic periods. In contrast, the Mockingbird site was a residential locale occupied during the Late Archaic period, possibly during the Mesilla phase, and on one or more occasions during the Late Formative period (late Doña Ana phase or early El Paso phase).

Several questions were developed in the research orientation for this project, and analysis of the chipped stone artifacts is integral to many of them. For example, the distribution of discrete material types can shed light on the geomorphic processes affecting sites. It can also provide crucial data about site structure and will potentially aid in defining the extent of separate components. An examination of materials should yield interesting results concerning patterns of lithic material acquisition and may give us some idea of the areal extent of movement. Comparison of these assemblages should provide information on differing scales of mobility and the variations in reduction strategy that accompany changes in mobility. Finally, examination of tools will provide an idea of the activities that occurred at the sites and their roles in the settlement systems. While some of these questions are addressed in a general fashion, this chapter is mainly concerned with describing the chipped stone assemblages. Even though the possibility of multiple occupations has been noted for both sites, assemblages are not subdivided in this discussion. Possible components as well as most of the questions posed in the research orientation are addressed in a later chapter.

Mobility and Reduction Strategies

Two basic reduction strategies have been identified in the Southwest. Curated strategies entail the manufacture of bifaces that serve 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). Technology is often related to lifestyle. Curated strategies are usually associated with a high degree of residential mobility, while expedient strategies are typically associated with sedentism. 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). Prehistoric Southwestern biface reduction strategies were similar to the blade technologies of Mesoamerica and western Europe in that they focused on efficient reduction with little waste. While initial production of large bifaces was labor intensive and resulted in a fair amount of waste, the finished tool could be easily and efficiently reduced.

Curated strategies allow flintknappers to produce the maximum length of useable edge per biface. By maximizing their return they were able to reduce the volume of raw material required for the production of informal tools. This helped lower the amount of weight transported between camps. Neither material waste nor transport cost were important considerations in expedient strategies: flakes were simply struck from cores when needed. Thus, analysis of the reduction strategy used at a site allows us to estimate whether its occupants were residentially mobile, sedentary, or somewhere in between.

An important corollary to this concerns exceptions to the use of curated strategies by mobile societies. From survey data gathered around Santa Teresa, Camilli (1988) proposes that distinctions between curated and expedient strategies might not be clear cut in that area:

> Evidence exists . . . for at least two strategies of tool production and use at places containing lithic assemblages associated with projectile points: one incorporating carried tools and cores, and the other using expediently produced flakes manufactured from local materials. Rather than an emphasis on biface production during the Archaic and on flake production during later periods, expedient flake production may have been a technological option of occupations that were widely separated in time. (Camilli 1988:158)

This conclusion is based on evidence for the importation and use of partly decorticated cores on Archaic and Formative period sites. While naturally occurring materials were used, they tend to be uncommon in the desert basins. High-quality chert and obsidian nodules occur but are usually small and unsuitable for the manufacture of large tools. Another source of raw material was debris discarded at sites. Later occupants of the region seem to have recycled materials rejected by earlier peoples. Thus, lithic materials were acquired in three ways: they were obtained at nonlocal sources and transported into the basins, they occurred naturally as small nodules, or they were scavenged from earlier sites and reused.

These possibilities have several important implications. It is possible that materials suitable for the manufacture of large general purpose bifaces do not occur in the region or are very rare. If so, there should be little evidence for the manufacture and use of such tools. Correspondingly, there may be few technological differences between chipped stone assemblages produced by mobile versus sedentary groups. If this is the case, we must look elsewhere for evidence of differences in the scale of mobility.

An examination of material sources is also critical to a discussion of mobility. Materials were classified as local or exotic depending on how distant their sources were from the study area. In general, materials were considered local if a source was no more than 10 to 15 km from a site. This distance is based on ethnographic studies which suggest that a 20 to 30 km round trip is the maximum distance that hunter-gatherers will walk comfortably in a day (Kelly 1995:133). While more distant regions were undoubtedly also used, this zone represents the area that was most heavily exploited around residential sites.

By comparing and contrasting these assemblages with data from sites located elsewhere in the Southwest, it should be possible to identify some of the factors that produced either similarities or differences in assemblage structure. In turn, this should allow us to test some of the ideas proposed about residential mobility and how it is defined in the archaeological record.

Material Selection and Sources

Table 12-1 illustrates the distribution of lithic material types for each site. A total of 1,363 chipped stone artifacts were analyzed, nearly two-thirds of which were from LA 86780. In terms of these gross categories, the assemblages contain much the same array of materials, though in greatly different proportions. The LA 86780 assemblage contains all of the listed categories, while LA 86774 lacked chalcedonies and silicified limestone.

When possible, materials were visually divided into more specific varieties based on color, texture, and inclusions. These varieties should represent materials from the same source, if not the same nodule. Archaeologists from Fort Bliss were completing a study of regional material sources at the time this analysis was conducted, and type specimens were submitted to them for identification. Tim Church of the Cultural Resource Branch of the Directorate of Environment at Fort Bliss examined our specimens and provided important data on material types and potential sources. Most of our discussion of probable sources is based on this information.

Discrete material varieties were generally defined when more than one piece of debitage from a specific source was identified. However, several types were defined early in the analysis on the basis of a single piece of debitage, and no similar materials were subsequently found. Since these varieties were submitted for sourcing, they are included in the array of discrete material types. However, the normal procedure was to classify unique materials in a more general category. For example, a gray-brown chert of which only a single example was found would be classified as a generic chert. However, if other examples of this type were encountered it would be reclassified and given a unique code. Materials which retain a generic classification were not matched to identified types or lacked characteristics diagnostic of known sources.

Chert is the most common material category, comprising 35.7 percent of the composite assemblage. However, there are large differences between site assemblages. LA 86780 contains a much higher percentage of cherts than LA 86774. Fifteen chert varieties were defined (Table 12-2), but only two are named types. Pedernal chert outcrops in the Chama Valley of northern New Mexico and occurs in gravel deposits along the Rio Chama and Rio Grande. Rather than being obtained directly from the source, this material was undoubtedly procured from gravel deposits in the Rio Grande Valley near El Paso. Rancheria chert was identified using a description provided by Miller and Carmichael (1985:201-202). If our identification is correct, this material outcrops in the Rancheria formation in the Franklin Mountains and probably also occurs in gravels along associated streams and the Rio Grande.

Table 12-1. Distribution of chipped stone material types for each site (frequencies and column percentages)

Material Type	LA 86774	LA 86780	Totals
Cherts	91 19.7	395 43.8	486 35.7
Chalcedonies	0 0.0	25 2.8	25 1.8
Silicified woods	3 0.7	8 0.9	11 0.8
Obsidians	4 0.9	8 0.9	12 0.9
Undifferentiated igneous	6 1.3	9 1.0	15 1.1
Basalt	6 1.3	17 1.9	23 1.7
Rhyolites	183 39.7	78 8.6	261 19.1
Rhyolites, aphanitic	104 22.6	294 32.6	398 29.2
Limestone	0 0.0	1 0.1	1 0.1
Silicified limestone	3 0.7	21 2.3	24 1.8
Sandstone	3 0.7	1 0.1	4 0.3
Siltstone	5 1.1	2 0.2	7 0.5
Undifferentiated metamorphic	4 0.9	9 1.0	13 1.0
Quartzite	7 1.5	32 3.5	39 2.9
Quartz arenite	42 9.1	2 0.2	44 3.2
Totals Percent	461 33.8	902 66.2	1363 100.0

Table 12-2. Descriptions of material varieties identified in the composite assemblage

Material Category	Variety Code	Description
Cherts	2	Pedernal chert: chalcedonic; generally white or clear, sometimes with red or yellow streaks, occasionally black; small inclusions with a range of colors including red, black, purple, and yellow
	12	Rancheria chert: rarely lustrous, color band of yellow, gray, brown, or black
	16	gray chert, numerous crystal inclusions
	19	red chert
	23	light red chert with some white splotches, possible bioclasts present
	25	brown chert with some color banding
	29	gray chert containing numerous tiny bioclasts
	32	mottled red and brown chert breccia
	33	gray-brown chert with a very uniform structure and no bioclasts
	34	gray chert with numerous unidentified bioclasts; some spines and chalcedony in filled fractures
	35	gray chert with no bioclasts
	36	red chert with a very uniform structure and no bioclasts
	37	black chert with numerous sand inclusions and no bioclasts
	39	gray chert with numerous vugs and fossil casts, mainly shell fragments
	40	whitish chert with a very uniform structure and no bioclasts, similar to chert Variety 22
Chalcedonies	82	brown chalcedony with faint fusilids, spines, and other bioclasts
	83	white chalcedony with a cortex of coarser material; no bioclasts, some black inclusions and dendrites
	84	gray chalcedony with black and white inclusions
	85	light gray chalcedony containing numerous spheres; possibly oolite or the spheres could be the remains of organisms
	86	brown and gray chalcedony with a few black dendrites, a large white spongy mass, and no bioclasts
Silicified woods	102	brown silicified wood, structure visible under low magnification
	103	grayish silicified wood, structure visible under low magnification

Material Category	Variety Code	Description
Rhyolites	342	Thunderbird rhyolite: porphyritic rhyolite; red, gray, or dark gray in color; phenocrysts of black biotite, clear and white quartz, and pink or white feldspar
	370	black siliceous rhyolite with large phenocrysts of white crystals; some flow-banding
	371	brown material, probably rhyolite; contains large amounts of gold/copper-colored material; some flow-banding
Aphanitic rhyolites	347	gray cryptocrystalline material with white phenocrysts, probably an aphanitic rhyolite
	348	black-green aphanitic rhyolite with some clear quartz and pink (probably feldspar) phenocrysts
	350	probable aphanitic rhyolite; purple with microcrystalline banding toward outer rims containing concentrations of small black crystals
	351	red aphanitic rhyolite with inclusions of small pieces of lighter red rhyolite
	360	red-brown aphanitic rhyolite with flow-banding and small black crystals oriented along flow layers; grades into a porphyritic rhyolite with phenocrysts of clear and white quartz
	361	red-brown aphanitic rhyolite with flow banding
	362	dark brown aphanitic rhyolite with flow-banding with pink (probably feldspar) and black (probably biotite) phenocrysts oriented with the flows
Metamorphics	501	Undifferentiated metamorphic variety 1: unidentified material, probably metamorphic in origin; crypto- to microcrystalline, very uniform in structure with faint banding; no bioclasts
Quartzites	511	gray microcrystalline quartzite; probably a metaquartzite
	512	gray microcrystalline quartzite; probably a metaquartzite
	513	gray quartzite; quartz grains well rounded and sorted; probably a metaquartzite
Quartz arenites	531	white microcrystalline quartz arenite; silicification not intense; possible silcrete or metaquartzite
	532	white microcrystalline quartz arenite; quartz grains well rounded and sorted
	533	tan microcrystalline quartz arenite; quartz grains fairly well sorted and moderately well rounded

Church (pers. comm., 1995) identified potential sources of a few other types of chert. Variety 32 is a chert breccia similar to some of the Marathon uplift cherts in Texas. Varieties 34 and 39 may be from Pennsylvanian formations, possibly outcropping in the

Jarilla/Sacramento or Caballo Mountains. If from the latter source, they were probably procured from gravels along the Rio Grande. The Rancheria formation in the Franklin Mountains is a possible source of Variety 37 and would technically be categorized as Rancheria chert. However, since it is distinct from the other cherts thought to be derived from that source, it will continue to be classified separately. It is likely that most of the other cherts, including those in the generic category, were obtained from gravel deposits along the Rio Grande.

Several varieties of chalcedony were also identified at LA 86780 (Table 12-2). Chalcedony is a cryptocrystalline material similar to chert but with an even finer microcrystalline structure. Our analysis usually does not separate these categories because differences between them are very difficult to distinguish at the level of magnification used. However, in this case several varieties of chalcedony were identified (Church, pers. comm., 1995) and are therefore considered separately. Chalcedony is rare, comprising only 1.8 percent of the composite assemblage and 2.8 percent of the chipped stone from LA 86780. While five varieties were defined, no sources were identified, and it is likely that these materials were obtained from gravel deposits along the Rio Grande.

A small amount of silicified wood was found at both sites, making up 0.8 percent of the composite assemblage. This material was slightly more abundant at LA 86780 but common at neither site. While two varieties were defined, no sources were identified, and it is likely that these materials were obtained from gravel deposits along the Rio Grande.

Obsidian was somewhat more common, constituting 0.9 percent of the composite assemblage. While twice as much obsidian was recovered from LA 86780 than LA 86774, it makes up the same percentage of both assemblages. No major obsidian sources exist near the project area. However, small obsidian nodules have been noted around Kilbourne Hole (Ravesloot 1988a:98) and represent a possible, though limited, source of this material. Otherwise, obsidian occurs in Rio Grande gravels and as pebbles in some desert basins. Small obsidian pebbles were collected from the surface of both sites, so this material was locally available in small quantities. No varieties of obsidian could be distinguished visually.

Undifferentiated igneous materials and basalt made up small percentages of both assemblage. The former are materials of igneous origin that could not be positively identified. They comprise 1.1 percent of the total assemblage, while basalt makes up 1.7 percent. Similar percentages of each occurred on both sites. No sources were identified for these categories.

Two general categories of rhyolites were identified: rhyolites and aphanitic rhyolites. The former are usually macrocrystalline with large phenocrysts and rarely possess a conchoidal fracture. The latter are microcrystalline to cryptocrystalline in structure and are sometimes difficult to distinguish from cherts except by small phenocrysts. Aphanitic rhyolites are sometimes termed rhyolitic cherts, and cryptocrystalline varieties break conchoidally. As a general class, rhyolites are the most abundant materials, making up 48.3 percent of the composite assemblage. They comprise 62.3 percent of the chipped stone from LA 86774 and 41.2 percent of the LA 86780 assemblage. Thus, this is the most common class of material from LA 86774 and is a close second to chert at LA 86780.

Macrocrystalline rhyolite comprises the largest percentage of materials at LA 86774 but is much less common at LA 86780 (Table 12-1). These materials outcrop in many places regionally, but only one variety was defined. Thunderbird rhyolite has a gray, dark gray, or red matrix (often aphanitic), which contains large and abundant phenocrysts of quartz, biotite, and feldspar. Even though its matrix is often aphanitic, the numerous phenocrysts prevent it from breaking conchoidally. Thunderbird rhyolite outcrops in the southern Franklin Mountains and is also available in gravel deposits below the mountains and in the Rio Grande Valley. Various other rhyolites are also found in gravel deposits along the Rio Grande.

Aphanitic rhyolites constitute large percentages of both assemblages and are the second most common category at LA 86780 and third most common at LA 86774 (Table 12-1). Like the macrocrystalline rhyolites, these materials are available from numerous sources in the region. Seven varieties were defined, and potential sources of four were identified (Church, pers. comm., 1995). The most distinctive type is Variety 348, which outcrops in the upper rhyolite flows of the Bell Top formation in the Sierra de las Uvas. Because of the location of those outcrops, Church doubts it would occur in gravel beds along the Rio Grande. Variety 360 grades in texture from aphanitic to porphyritic and may have originated in one of the Robledo Mountain flows. The southern Organ Mountains are the probable source for Variety 361, which may be one of the Achenbach Tuff rhyolites. Variety 362 is probably from the Palm Park formation in the Sierra de las Uvas. Because of drainage patterns, Church feels that this material does not occur in Rio Grande gravel beds. Thus, both aphanitic rhyolites from the Sierra de las Uvas were probably procured at or near their sources. Other varieties were probably obtained from Rio Grande gravels.

Several sedimentary materials were found in small numbers. Only a single specimen of limestone was recovered from LA 86780. Silicified limestone makes up 1.8 percent of the composite assemblage. While significantly more of this material was found at LA 86780 than at LA 86774, it was common at neither. Sandstone and siltstone were occasionally used, comprising 0.3 and 0.5 of the total assemblage, respectively. Sources of most of these materials are undetermined. However, the silicified limestone is tentatively identified as part of the Rancheria formation of the northern Franklin Mountains. Thus, it is probably another variety of Rancheria chert but is retained as a separate category because it can be distinguished from other materials from that source.

Undifferentiated metamorphic materials make up small percentages of both assemblages and 1.0 percent of the total assemblage. These are rocks of probable metamorphic origin that could not be accurately categorized by type. However, one variety was consistently identified. Variety 501 is a brown microcrystalline to cryptocrystalline material that is very uniform in color with a slight banding. The source of this material could be determined.

The last group of materials to be discussed are quartzitic. Small amounts of quartzite were found on both sites, and this material constitutes 2.9 percent of the total assemblage. Three varieties were identified: 511, 512, and 513. All are gray in color and are probably metaquartzites from the southern Franklin Mountains. Varieties 511 and 512 may be from the Lanoria formation (Church, pers. comm., 1995). Quartz arenite was slightly more common than quartzite, comprising 3.2 percent of the total assemblage. However, most was from LA 86774. Only two pieces were found at LA 86780. Quartz arenite is a clastic sedimentary rock made up entirely of quartz grains cemented together by siliceous material. Three varieties were identified; all are probably from the Lanoria formation in the southern Franklin Mountains.

Exotic versus Local Material Sources

Knowing whether materials used at a site are of local or exotic origin is critical to our discussion of reduction strategies. Tools were produced in anticipation of need in curated strategies, while they were usually only made when needed in expedient strategies. These strategies constitute the opposite ends of a behavioral continuum (Bamforth 1989), and it is likely that the way in which materials were reduced usually fell somewhere in between. Most groups probably used a combination of curated and expedient reduction, depending on the availability of suitable materials and the requirements of their settlement and subsistence system. Kelly (1988) associates curated strategies with mobility, while Bamforth (1986) argues that they are more closely related to the availability of high-quality materials. Both positions are probably correct. Studies at Archaic sites near San Ildefonso showed a differential reduction of local and exotic materials (Moore 1993, n.d.). While local materials were primarily reduced in an expedient manner, exotics were mostly used to make curated bifaces. Exotic materials were probably reduced efficiently because they were desirable, of high quality, and in limited supply. Local materials were expediently reduced because they were easily obtained and plentiful, making conservation unnecessary.

Materials are divided into local and exotic categories based on the distance of their source from the site at which they were found. As noted above, most materials used at the Santa Teresa sites were probably collected from gravel deposits along the Rio Grande. These deposits are considered local because they are within a single day's foraging range. However, several materials were not available in Rio Grande gravels, including two varieties of aphanitic rhyolite and one of quartz arenite. The former outcrop in a part of the Sierra de las Uvas that does not drain into the Rio Grande. The latter is probably from the southern Franklin Mountains but is not well silicified and would probably abrade away before reaching the Rio Grande (Church, pers. comm., 1995). Other materials were probably available in Rio Grande gravels, whether obtained from them or not. Thus, sources are also classified as primary or secondary. Primary sources are at or near outcrops, while materials from secondary sources were transported away from outcrops and deposited elsewhere, usually by water action.

Though most of the materials used at these sites could have been obtained from Rio Grande gravels, they were also available at their sources. Those sources are generally beyond the 10 to 15 km radius considered to be a single day's foraging range, so materials obtained from primary sources are technically exotic resources. Considering both primary and secondary material sources complicates this discussion. Fortunately, type of cortex can often indicate the source being exploited. Materials with cortex that was battered and smoothed by mechanical transport in water were almost certainly obtained from secondary sources such as stream-deposited gravels. Cortex on materials procured from primary sources is often chemically weathered but lacks evidence of water transport. Thus, the type of cortex on a material is an important clue to the type of deposit from which it was obtained.

Table 12-3 shows cortex type by material for each site. Cortex occurred on 28.2 percent of the LA 86774 assemblage and 28.8 percent of the chipped stone from LA 86780, so it is not possible to determine the exact source of every artifact. Overall, 64.6 percent of the cortex from LA 86774 was waterworn, and 26.9 percent was nonwaterworn. In contrast, only 34.2 percent of the cortex from LA 86780 was waterworn, while 60.0 percent was nonwaterworn. Thus, the predominance of secondary and primary sources is opposite at these sites.

As noted earlier, the materials on these sites are dominated by various cherts, rhyolites, and aphanitic rhyolites. Cherts and rhyolites at LA 86774 were mostly obtained from secondary gravel deposits. In contrast, aphanitic rhyolites were more likely to be obtained from primary sources, though a large percentage also came from gravels. No waterworn cortex was noted on obsidian artifacts, and procurement from a primary source is suggested. However, obsidian nodules with nonwaterworn cortex occur naturally in the Santa Teresa area and were collected from the surface of both sites. Thus, it is not possible to determine whether they represent local or exotic resources at this level of analysis.

The distribution of cortex types for these materials at LA 86780 is quite different. Both cherts and aphanitic rhyolites were dominantly obtained from primary sources, while rhyolite was almost evenly split between primary and secondary sources. Waterworn cortex occurred on one piece of obsidian, indicating that it came from gravel deposits. However, most of the cortex on obsidian was nonwaterworn, indicating procurement at primary sources. Again, whether that source was on-site or elsewhere was undetermined.

Other materials are represented by only a few examples of cortical debitage apiece and are comparatively rare in the overall assemblages as well. While undifferentiated igneous materials from LA 86774 all seem to have come from secondary sources, siltstone was obtained at primary sources. Silicified woods, undifferentiated igneous and metamorphic materials, and limestone from LA 86780 were collected from secondary sources, while silicified limestone came from primary sources. Other materials were procured from both types of source.

Since cherts, rhyolites, and aphanitic rhyolites comprise the bulk of each assemblage and were divided into varieties, it may be instructive to examine these materials in more detail. Table 12-4 shows cortex type by chert variety. The category of undifferentiated cherts includes specimens that did not match any others and represent curated materials or debitage from individual cores. Most were obtained from gravel deposits by residents of both sites, but a rather significant percentage also came from primary sources. All cortex on Pedernal chert is waterworn, indicating that it was obtained from gravels along the Rio Grande, as expected. Most other cherts were also obtained from secondary sources. The few specimens of chert

Varieties 23, 29, 32, 34, and 35 had waterworn cortex. Cortex on one of two pieces of chert Variety 40 was waterworn, and it was indeterminate on the other, suggesting procurement from secondary deposits. The only cortical specimen of chert Variety 39 was of indeterminate type, so no source can be suggested.

Table 12-3. Cortex types for each site by material type (frequencies, row percentages by site)

Material Type	Mockingbird Site (LA 86774)			Santa Teresa Site (LA 86780)		
	waterworn	nonwaterworn	indeterminate	waterworn	nonwaterworn	indeterminate
Cherts	19 63.3	8 26.7	3 10.0	41 27.9	100 68.0	6 4.1
Chalcedonies	0 0.0	0 0.0	0 0.0	7 87.5	0 0.0	1 12.5
Silicified woods	0 0.0	0 0.0	0 0.0	7 100.0	0 0.0	0 0.0
Obsidians	0 0.0	3 100.0	0 0.0	1 16.7	5 83.3	0 0.0
Undifferentiated igneous	2 100.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Basalt	2 66.7	0 0.0	1 33.3	2 50.0	2 50.0	0 0.0
Rhyolites	40 85.1	5 10.6	2 4.3	8 44.4	9 50.0	1 5.6
Rhyolites, aphanitic	13 39.4	16 48.5	4 12.1	15 27.8	35 64.8	4 7.4
Limestone	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Silicified limestone	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0
Siltstone	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 100.0
Undifferentiated metamorphic	0 0.0	0 0.0	1 100.0	4 100.0	0 0.0	0 0.0
Quartzite	1 50.0	1 50.0	0 0.0	2 33.3	2 33.3	2 33.3
Quartz arenite	7 87.5	1 12.5	0 0.0	0 0.0	1 100.0	0 0.0

Only two varieties of chert do not follow a general pattern of procurement from secondary sources. All cortical specimens of chert Variety 16 and most of the Rancheria chert had nonwaterworn cortex. This suggests that chert Variety 16 outcrops somewhere around El Paso, though no specific area can be defined. The predominance of nonwaterworn cortex on

Table 12-4. Cortex on chert artifacts from each site (frequencies and row percentages by site)

Material Type	LA 86774			LA 86780		
	Waterworn	Nonwaterworn	Indeterminate	Waterworn	Nonwaterworn	Indeterminate
Undifferentiated cherts	9 75.0	2 16.7	1 8.3	20 76.9	5 19.2	1 3.8
Pedernal chert	3 100.0	0 0.0	0 0.0	5 100.0	0 0.0	0 0.0
Rancheria chert	6 50.0	6 50.0	0 0.0	10 9.4	91 85.8	5 4.7
Chert, gray (Variety 16)	0 0.0	0 0.0	0 0.0	0 0.0	4 100.0	0 0.0
Chert, red w/brown (Variety 23)	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0
Chert, gray-brown (Variety 29)	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Chert, mottled brown-red (Variety 32)	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Chert, light and dark gray (Variety 34)	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Chert, mottled red, gray, white (Variety 35)	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Chert, gray w/voids (Variety 39)	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0
Chert, whitish (Variety 40)	1 50.0	0 0.0	1 50.0	0 0.0	0 0.0	0 0.0

Rancheria chert suggests that our identification of this locally available type was correct, and it was obtained from both primary and secondary sources.

Table 12-5 shows cortex type for varieties of rhyolite. Red and gray rhyolites are general rather than specific categories; only the flow-banded and Thunderbird rhyolites represent specific varieties. Red rhyolite was obtained from both primary and secondary sources, while most gray rhyolite came from secondary sources. These categories probably contain materials from a variety of outcrops, both local and up the Rio Grande. Cortex on the only cortical specimen of flow-banded rhyolite was waterworn, suggesting it was from a secondary source. Thunderbird rhyolite outcrops in the southern Franklin Mountains and was procured from both primary and secondary sources.

Cortical specimens of aphanitic rhyolite are shown in Table 12-6. Three types (red, gray, and dark gray) are general categories rather than specific varieties and may represent materials from several outcrops. All of the red aphanitic rhyolite appears to be from secondary sources, while procurement from both primary and secondary sources is indicated for the other two categories. Aphanitic rhyolite Variety 348 is represented by a single specimen with waterworn cortex; all other varieties contain specimens from both primary and secondary sources.

Since waterworn cortex dominated most chert varieties, the bulk of these materials were from secondary sources, probably Rio Grande gravels. Pedernal chert could only have been obtained from Rio Grande gravels, since it outcrops far to the north along a tributary of that river. Some undifferentiated cherts had nonwaterworn cortex, indicating they came from primary sources. Unfortunately, it was impossible to determine whether they outcrop locally or were transported into the region. Only Rancheria chert and chert Variety 16 seem to outcrop locally and were available in both primary and secondary deposits.

Most rhyolites and aphanitic rhyolites appear to outcrop in the general El Paso area and were available from both primary and secondary sources. Of the four types of aphanitic rhyolite thought to be of exotic origin (Varieties 348, 360, 361, and 362), most cortical specimens are from primary sources. As noted above, aphanitic rhyolite Variety 348 is an exception to this, with only waterworn cortex represented. Aphanitic rhyolite Varieties 348 and 362 probably outcrop in the Sierra de las Uvas, and should not be available in Rio Grande gravels. Thus, even though they were obtained from both primary and secondary sources, these materials are of exotic origin. While aphanitic rhyolite Varieties 360 and 361 outcrop outside the El Paso area, only specimens with nonwaterworn cortex can be considered exotic, since they are probably also available in Rio Grande gravels.

This discussion leaves us with a jumbled perception of where the materials used on these sites came from. In order to get a clearer view of this, we must combine many aspects of the preceding discussion. If we consider only materials that are known to be of nonlocal origin and could not be obtained from Rio Grande gravels, only 0.4 percent of the LA 86774 assemblage and none of the LA 86780 assemblage are of exotic origin. When artifacts with waterworn or nonwaterworn cortex are added to this small assemblage, 50.3 percent of the

Table 12-5. Cortex on rhyolite artifacts from each site (frequencies and row percentages by site)

Material Type	LA 86774			LA 86780		
	Waterworn	Nonwaterworn	Indeterminate	Waterworn	Nonwaterworn	Indeterminate
Rhyolite, red	4 100.0	0 0.0	0 0.0	4 36.4	6 54.5	1 9.1
Rhyolite, gray	4 80.0	1 20.0	0 0.0	1 100.0	0 0.0	0 0.0
Rhyolite, flow-banded	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Thunderbird rhyolite	31 83.8	4 10.8	2 5.4	3 50.0	3 50.0	0 0.0

Table 12-6. Cortex on aphanitic rhyolite artifacts from each site (frequencies and row percentages by site)

Material Type	LA 86774			LA 86780		
	Waterworn	Nonwaterworn	Indeterminate	Waterworn	Nonwaterworn	Indeterminate
Rhyolite, aphanitic, red	3 100.0	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0
Rhyolite, aphanitic, gray	2 50.0	2 50.0	0 0.0	3 75.0	1 25.0	0 0.0
Rhyolite, aphanitic, dark gray	0 0.0	0 0.0	0 0.0	1 33.0	2 66.7	0 0.0
Rhyolite, aphanitic Variety 347	1 50.0	1 50.0	0 0.0	0 0.0	0 0.0	0 0.0
Rhyolite, aphanitic Variety 348	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Rhyolite, aphanitic Variety 350	0 0.0	0 0.0	0 0.0	3 33.3	5 55.6	1 11.1
Rhyolite, aphanitic Variety 360, flow-banded	3 27.3	7 63.6	1 9.1	2 13.3	12 80.0	1 6.7
Rhyolite, aphanitic Variety 361, flow-banded	3 25.0	6 50.0	3 25.0	2 111	14 77.8	2 11.1
Rhyolite, aphanitic Variety 362, flow-banded	0 0.0	0 0.0	0 0.0	2 66.7	1 33.3	0 0.0

LA 86774 assemblage and 78.0 percent of the LA 86780 assemblage are classified as exotics. However, since only 35 and 44 percent of the LA 86774 and LA 86780 assemblages, respectively, are represented, these percentages are probably skewed. By considering all noncortical artifacts and those on which cortex type could not be defined to be from local sources, 17.6 percent of the LA 86774 assemblage and 34.1 percent of the LA 86780 assemblage are classified as exotic. While these percentages are probably more realistic, there are still problems with this approach. In particular, what if all the noncortical artifacts and those with indeterminate cortex type were not from local sources? What if many of these materials were actually obtained from primary sources? How would this change the above distributions?

Percentages of materials from exotic and local sources were recalculated for each assemblage using proportions of artifacts with nonwaterworn cortex. This was done individually by material category for each site. For example, if only waterworn cortex was identified, or no cortical artifacts were found in a particular material type, all artifacts were considered to be from local sources. However, if part of the cortical assemblage was nonwaterworn, that percentage determined the *potential* ratio of that material category considered to be of exotic origin. Thus, if cortex on 30 percent of the cortical Thunderbird rhyolite artifacts was nonwaterworn, 30 percent of all Thunderbird rhyolite artifacts were considered to be of exotic origin. While this approach also provides tentative results, it is thought to be somewhat more accurate than those used previously. Proportionately, 19.1 percent of the LA 86774 assemblage and 64.2 percent of the LA 86780 assemblage could be of exotic origin. While there was only a slight upward change in the former case, this approach almost doubled the percentage of artifacts thought to be derived from exotic sources for the latter site.

Considering only materials known to be of nonlocal origin or those that retain cortical surfaces probably did not provide a very accurate idea of the proportion of these assemblages obtained at either primary or secondary sources. While there are also problems with the other approaches, they probably provide a somewhat more accurate idea of where materials came from. In both cases, a significantly higher proportion of the LA 86780 assemblage was obtained at primary sources. This suggests that the occupants of LA 86780 moved around the landscape more than did the occupants of LA 86774.

Material Texture

Different materials are suited to different tasks (Chapman 1977). For example, while obsidian is eminently suited to the production of cutting tools because it is easily flaked and possesses very sharp edges, it is too fragile for use in heavy-duty chopping activities. Conversely, though basalt and quartzite have duller edges and often are less efficient as cutting tools, they are perfect for heavy-duty use like chopping and pounding because they are durable and resist shattering. The suitability of materials for specific tasks also varies according to texture. Fine-grained materials produce sharper edges than coarse materials and are more amenable to the manufacture of formal tools because they are easily and predictably flaked.

For instance, fine-grained basalt produces nearly as good a cutting edge as obsidian or chert, while coarse-grained basalt may only be suitable for chopping or battering. Thus, the texture of materials selected for reduction can provide an indication of the uses to which they were put.

Table 12-7. Textures for each material type by site

Material Type	Material Quality	LA 86774		LA 86780	
		Number	Percent	Number	Percent
Cherts	fine-grained medium-grained coarse-grained	70 21 0	76.9 23.1 0.0	242 149 4	61.3 37.7 1.0
Chalcedonies	fine-grained	0	0.0	25	100.0
Silicified woods	fine-grained medium-grained	3 0	100.0 0.0	7 1	87.5 12.5
Obsidians	glassy	4	100.0	8	100.0
Undifferentiated igneous	fine-grained medium-grained coarse-grained	1 5 0	16.7 83.3 0.0	0 3 6	0.0 33.3 66.7
Basalt	fine-grained medium-grained	3 3	50.0 50.0	15 2	88.2 11.8
Rhyolites	fine-grained medium-grained coarse-grained	5 69 109	2.7 37.7 59.6	5 37 36	6.4 47.4 46.2
Aphanitic rhyolites	fine-grained medium-grained coarse-grained	65 39 0	62.5 37.5 0.0	155 136 3	52.7 46.3 1.0
Limestone	fine-grained	0	0.0	1	100.0
Silicified limestone	fine-grained medium-grained coarse-grained	3 0 0	100.0 0.0 0.0	7 13 1	33.3 61.9 4.8
Sandstone	medium-grained coarse-grained	2 1	66.7 33.3	0 1	0.0 100.0
Siltstone	fine-grained medium-grained	3 2	60.0 40.0	0 2	0.0 100.0
Undifferentiated metamorphic	fine-grained medium-grained	1 3	25.0 75.0	3 6	33.3 66.7
Quartzite	fine-grained medium-grained	4 3	57.1 42.9	18 14	56.3 43.8
Quartz arenite	fine-grained medium-grained coarse-grained	1 18 23	2.4 42.9 54.8	0 1 1	0.0 50.0 50.0

Textures for each material type are shown by site in Table 12-7. With chertic materials (cherts, chalcedonies, silicified woods) combined, there was a greater tendency for fine-grained textures to be selected at LA 86774 (77.7 percent) than at LA 86780 (64.0 percent). These percentages are skewed by the differential occurrence of Rancheria chert at the sites. That variety makes up 44 percent of the cherts from LA 86780 but only 22 percent of those from LA 86774. It outcrops in the Franklin and Organ Mountains and seems to be the most abundant variety available in the area. Unfortunately, it is not a high-quality chert, and Miller and Carmichael (1985:202) indicates that it often has poor conchoidal qualities. With Rancheria chert removed, percentages of fine-grained chertic materials are 78.4 percent at LA 86774 and 84.4 percent at LA 86780. Thus, when only chertic materials that were mainly obtained from Rio Grande gravels are considered, fine-grained materials were somewhat more common at LA 86780. Overall, however, the large percentage of Rancheria chert in that assemblage dilutes the quality of chertic materials used there.

Table 12-8 illustrates the distribution of material texture by site. Few glassy materials occurred at either site, but since only obsidian was classified as glassy, this distribution simply reflects the frequency of that material. Fine- and medium-grained materials comprise similar percentages of the LA 86774 assemblage, and coarse-grained materials are nearly as common. In contrast, fine-grained materials dominate the LA 86780 assemblage, comprising over half the total. Medium-grained materials are also common, but there is only a small percentage of coarse-grained materials. Thus, when total site assemblages are considered, there are distinct differences in selection parameters.

Table 12-8. Distribution of material textures by site

Site Number	Glassy	Fine-grained	Medium-grained	Coarse-grained
LA 86774	4 0.9	159 34.5	165 35.8	133 28.9
LA 86780	8 0.9	478 53.0	364 40.4	52 5.8

When materials are separated into cryptocrystalline and noncryptocrystalline categories, these differences are even more distinct. Cryptocrystalline materials have a very fine crystalline structure in which individual grains can only be distinguished under magnification (Crabtree 1972:57). They tend to break conchoidally and are well suited to the production of sharp cutting edges or modification into formal tools. Coarser, noncryptocrystalline materials do not fracture conchoidally, produce duller edges, and are less suitable for the manufacture of formal tools. The array of cryptocrystalline materials in these assemblages includes cherts, chalcedonies, silicified woods, obsidians, aphanitic rhyolites, limestone, and silicified limestone. These materials comprise 44.5 percent of the LA 86774 assemblage and 83.4 percent of the LA 86780 assemblage. Not only did more fine-grained materials occur at LA 86780, considerably more cryptocrystalline materials were also used. Thus, most materials at LA 86780 had better flaking qualities and produced sharper cutting edges than those used at LA 86774. Materials seem to have been selected both for durability and good flaking characteristics at that site.

Reduction Strategy

There are two basic aspects to the reduction process, strategy and technique. Both are related to how a material is flaked. While strategy is mostly a mental process, technique is physical. As discussed earlier, two basic reduction strategies are defined in the Southwest: curated and expedient. The strategy used to reduce a specific nodule was dependent on several factors, including material availability, nodule size, and mobility. When desirable materials were rare or difficult to access they could be reduced in a way that maximized return even when the overall strategy was expedient in nature. Conversely, when suitable materials were locally abundant they could be expediently reduced, even by mobile groups. Nodule size was sometimes an important factor in reduction strategy. Expedient reduction may be the only option when materials occur as small nodules because it may be impossible to more efficiently reduce them. Mobility must also be taken into account. Mobile peoples often require tool kits that are generalized and easily transported. In the Southwest, this need was filled by large general purpose bifaces that could serve as unspecialized tools, cores, and preforms for specialized tools.

Reduction technique refers to the physical methods used to remove material from a core or tool. Two techniques were used in the Southwest: percussion and pressure. Percussion flaking involved the striking of a core or tool with a hammer to remove flakes. Both hard and soft hammers were used, and flakes produced by these tools can often be distinguished from one another. Pressure flaking involved the use of a tool to press flakes off the edge of an artifact. In general, hard hammers were used for core reduction, while soft hammers and pressure flaking were used to make tools. However, use of these techniques often overlapped: hard hammers were sometimes used for initial tool manufacture, and soft hammers to reduce cores. Removal of flakes from a core or tool can be facilitated by modifying platforms to prevent crushing or shattering. The edge of a platform is often very sharp and fragile; modification by abrasion increases that angle and strengthens the edge so it can better withstand the force applied to it. Platform modification was most common during tool manufacture, though core platforms were sometimes also modified. Thus, platform modification is generally related to reduction strategy.

The following discussion is mostly concerned with the reduction strategies used at these sites. Only a few observations will be made concerning reduction techniques, since that topic was not a focus of this analysis. Several attributes are examined to determine whether reduction strategies focused on use of large bifaces or core-flake reduction. However, it must be remembered that these strategies are not mutually exclusive. Mobile hunter-gatherers used both curated and expedient strategies, and sedentary farmers often used large bifaces.

Several characteristics of debitage, cores, and formal tools can provide insight into the reduction strategy used at a site. Debitage are important indicators of reduction strategy because they are rarely curated and often constitute the only remaining evidence of reduction when formal tools and cores were removed at the time of abandonment. When they occur, the types and condition of cores and formal tools can also be important evidence of reduction strategy. The approach used in this study is complicated because the lithic reduction process is often complex. Our approach is typological because it is possible to use certain debitage characteristics to determine whether a flake was removed from a core or tool.

The Debitage Assemblage

Eight debitage assemblage attributes were selected as indicators of reduction strategy. They include percentages of noncortical debitage, manufacturing flakes, and modified platforms; flake to angular debris ratio; flake breakage patterns; platform lipping; the presence of opposing dorsal scars; and flake to core ratio. Though only the proportion of biface flakes can be considered directly indicative of reduction strategy, when combined with the other attributes a clearer picture of the strategy(s) used at a site can be derived.

Unfortunately, baseline data against which these results can be measured are rare. Thus, many of our expectations are preliminary and will require modification as more information becomes available. However, it is possible to predict what purely expedient or curated debitage assemblages should look like and compare our results to those expectations. This will allow us to determine whether a certain strategy or combination of strategies was used at a site.

Curated and Expedient Debitage Assemblages Modeled. Debitage assemblages reflecting a purely expedient reduction strategy should contain lower percentages of noncortical debitage than those in which a purely curated strategy was employed. In both cases most debitage created during reduction should be noncortical, but the percentage in curated strategies should be significantly higher. Cortex is the weathered outer rind on nodules; it is often brittle and chalky and does not flake with the ease or predictability of unweathered material. This can cause problems during tool manufacture, so cortex is usually removed during the early stages of tool production. As noted earlier, the manufacture of large bifaces is rather wasteful, and quite a bit of debitage must be removed before the proper shape is achieved. These flakes must be carefully struck and are generally smaller and thinner than flakes removed from cores. Thus, as a large biface is manufactured, large numbers of interior flakes lacking cortical surfaces are removed, and the proportion of noncortical debitage increases.

The presence of biface flakes is usually good evidence that tools were manufactured at a site, though it is often difficult to determine number or type. As discussed in "Field and Analytic Methods," biface flakes were distinguished from core flakes by a polythetic set of attributes. Flakes fulfilling at least 70 percent of the attributes were biface flakes, while those that did not were core flakes. Biface flake length is indicative of the size of the tool being made, and lengths of 15 to 20 mm or more suggest that large bifaces were reduced. However, when only small biface flakes are found, the converse is not necessarily true. While the presence of small biface flakes may suggest that small specialized bifaces were made, the possibility that they are debris produced by retouching large biface edges must also be considered. Large percentages of biface flakes in an assemblage suggests that tool production was an important activity. When those flakes are long, it is likely that large bifaces were manufactured or used, and this in turn suggests a curated reduction strategy. While the lack of similar artifacts in an assemblage is not definite proof of an expedient strategy, it does suggest that reduction did not focus on tool manufacture.

Though platform modification is used by the polythetic set to help assign flakes to core or biface categories, it can also be used as an independent indicator of reduction strategy. This is because the polythetic set only identifies ideal examples of flakes removed during tool production. Many flakes produced during initial shaping and thinning are difficult or impossible to distinguish from core flakes. However, even at this stage of manufacture platforms were usually modified to facilitate removal. While core platforms were also modified on occasion, this technique was not as commonly used to facilitate removal of flakes from cores because the same degree of control over size and shape was unnecessary unless a core was being systematically reduced. Since this rarely occurred in the Southwest, it is likely that a large percentage of modified platforms in an assemblage is indicative of tool manufacture, while the opposite denotes core reduction. When there is a high percentage of modified platforms in an assemblage but few definite biface flakes, early tool manufacture may be indicated.

Since tool manufacture is generally more controlled than core reduction, fewer pieces of angular debris are produced. Thus, a high ratio of flakes to angular debris should indicate tool manufacture, while a low flake to angular debris ratio suggests core reduction. Unfortunately, this is a bit simplistic, because the production of angular debris is also dependent on the type of material being worked, the technique used to remove flakes, and the amount of force applied. Brittle materials shatter more easily than elastic materials, and hard hammer percussion tends to produce more recoverable pieces of angular debris than soft hammer percussion or pressure flaking. The use of excessive force can also cause materials to shatter. In general, though, as reduction proceeds, the ratio of flakes to angular debris should increase. Thus, late-stage core reduction as well as tool manufacture should produce high ratios.

Flake breakage patterns are also indicative of reduction strategy. Experimental data suggest there are differences in fracture patterns between flakes struck from cores and tools (Moore n.d.). Though reduction techniques are more controlled during tool manufacture, flake breakage increases because debitage get thinner as reduction proceeds. Thus, there should be more broken flakes in an assemblage in which tool were manufactured than in one that simply reflects core reduction. However, trampling, erosional movement, and other postreduction impacts can cause considerable breakage and must also be taken into account.

Much flake breakage during reduction is caused by secondary compression, in which outward bending causes flakes to snap (Sollberger 1986). Certain characteristics of the broken ends of flake fragments can be used to determine whether breakage was caused by this sort of bending. When a step or hinge fracture occurs at the proximal end of distal or medial fragments, they are classified as broken during manufacture. Characteristics diagnostic of manufacturing breakage on proximal fragments include "pieces a languette" (Sollberger 1986:102), negative hinge scars, positive hinges curving up into small negative step fractures on the ventral surface, and step fractures on dorsal rather than ventral surfaces (Fig. 12-1). Breakage by processes other than secondary compression tends to cause snap fractures. This pattern is common on debitage broken by natural processes like trampling or erosional movement but can also occur during reduction. Core reduction tends to create a high percentage of snap fractures, while biface reduction results in a high percentage of manufacturing breaks. But, since snap fractures are also indicative of postreduction damage, this is perhaps the weakest of the attributes used to examine reduction strategy.

The presence of platform lipping is indicative of reduction technology and only marginally related to strategy. Platform lipping is usually indicative of pressure flaking or soft-hammer percussion, though it sometimes occurs on flakes removed by hard hammers (Crabtree 1972). The former techniques were usually used to manufacture tools, though they could also be used in core reduction. Thus, a high percentage of lipped platforms may suggest a focus on tool manufacture rather than core reduction. Other data are necessary to corroborate this conclusion, however, and as an independent indicator of reduction strategy this attribute has limited utility.

The pattern of scars left by earlier removals on the dorsal surface of a flake can also help define reduction strategy. Since bifacial reduction removes flakes from opposing surfaces and edges, some scars originate beyond the distal end of a flake and run toward its proximal end. These are opposing scars and indicate reduction of a surface from opposite edges. Opposing dorsal scars are indicative of biface manufacture but also occur when cores are reduced bidirectionally (Laumbach 1980:858). Thus, this attribute is not directly indicative of tool production but can help in defining the reduction strategy used.

The ratio of flakes to cores on a site is another potential indicator of reduction strategy. As the amount of tool manufacture increases, so should the ratio between flakes and cores. The opposite should be true of assemblages in which expedient core reduction predominated; in that case the ratio between flakes and cores should be relatively low. A potential problem, of course, is that cores were often curated and carried to another location if still useable, while debris from their reduction was left behind. This would tend to inflate the ratio and suggest that tool manufacture rather than core reduction occurred. In addition, the systematic reduction of cores also produces high flake to core ratios. As an independent predictor of reduction strategy, this attribute has limited utility.

Of the debitage assemblage attributes examined by this study, few are accurate independent indicators of reduction strategy. However, when combined, they should allow us to fairly accurately determine how materials were reduced at a site. A purely curated debitage assemblage should contain very high percentages of noncortical debitage, biface flakes, modified platforms, manufacturing breaks, lipped platforms, and flakes with opposing dorsal

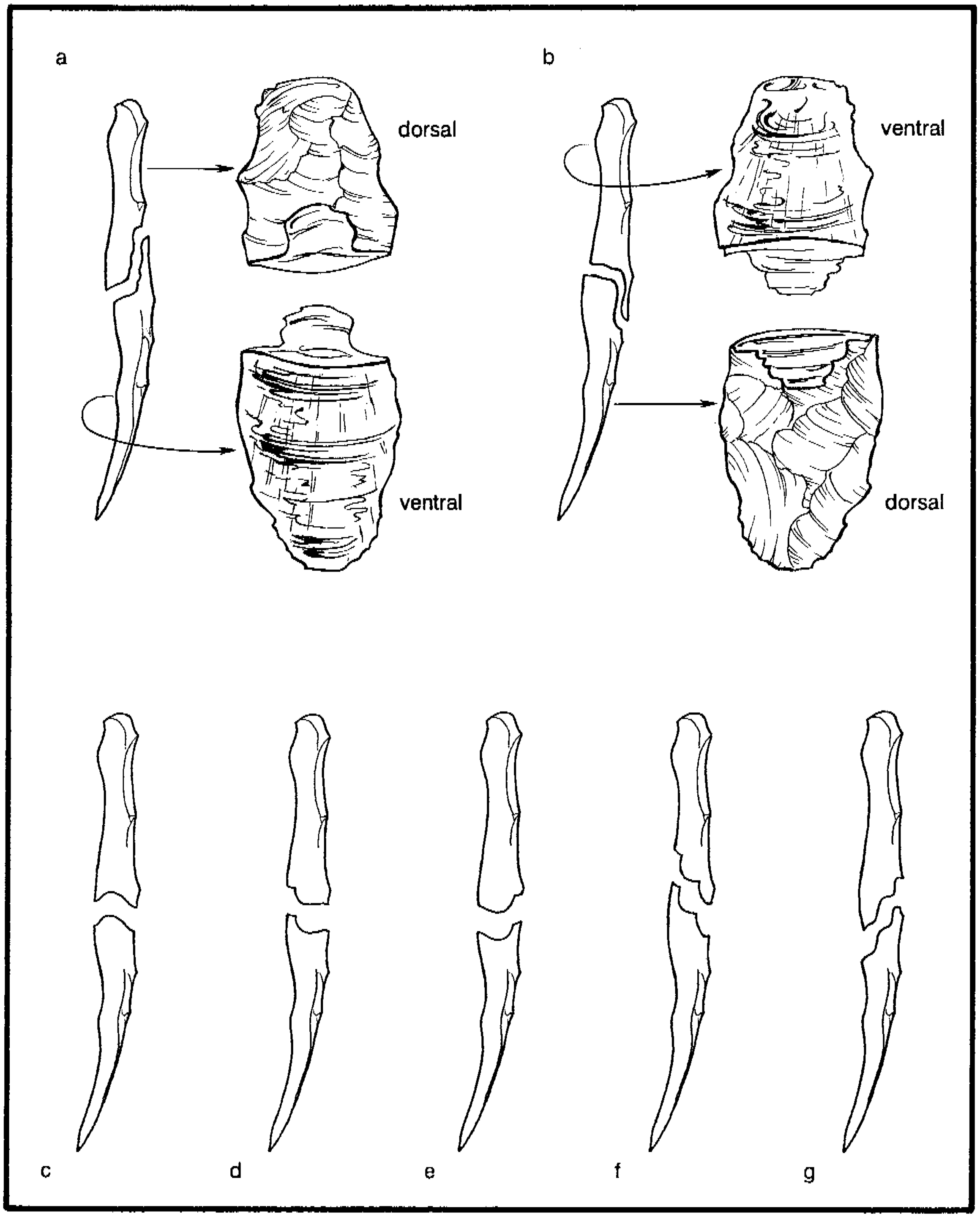

Figure 12-1. Manufacturing breakage patterns on flakes: (a-b) pieces à languette, adapted from Sollberger (1986:102); (c) negative proximal hinge, positive distal hinge; (d) positive proximal hinge with small step off ventral surface, negative distal hinge; (e) positive proximal hinge, negative distal hinge; (f) proximal step, distal step off distal surface; (g) reverse proximal step, distal step off ventral surface. Note that proximal fragments of (e) and (f) resemble natural core terminations and would usually be defined as such.

scars. In addition, they should have high flake to angular debris and flake to core ratios. Purely expedient debitage assemblages should contain lower percentages of noncortical debitage and very low percentages of biface flakes, modified platforms, manufacturing breaks, lipped platforms, and flakes with opposing dorsal scars. They should also have low flake to angular debris and flake to core ratios. Unfortunately, "pure" assemblages are rare, and most can be expected to combine tool manufacture and core reduction.

Dorsal Cortex and Reduction Stage. While cortex has been discussed in the context of material source, its relation to reduction stage remains to be considered. Cortex, the weathered outer rind on nodules, is rarely suitable for flaking or tool use. Further, outer sections of nodules that were transported by water often contain microcracks created by cobbles striking against one another, producing a zone with unpredictable flaking characteristics. Thus, cortical zones are typically removed and discarded because they flake differently from nodule interiors and may be cracked and flawed. Flakes have progressively less dorsal cortex as reduction proceeds, so dorsal cortex data can be used to examine reduction stages. Early stages are characterized by high percentages of flakes with lots of dorsal cortex, while the opposite suggests the later stages.

Reduction can be divided into two basic stages: core reduction and tool manufacture. Flakes are removed for use or further modification during core reduction. *Primary* core reduction includes initial core platform preparation and removal of the cortical surface. *Secondary* core reduction is the removal of flakes from core interiors. During reduction, this difference is rarely as obvious as these definitions make it seem. Both processes often occur simultaneously and rarely is all cortex removed before secondary reduction begins. In essence, they represent opposite ends of a continuum, and it is difficult to determine where one stops and the other begins. In this analysis, primary core flakes are those with 50 percent or more of their dorsal surfaces covered by cortex, and secondary core flakes are those with less than 50 percent dorsal cortex. This distinction provides information on the condition of cores used at a site. For example, a lack of primary flakes suggests that initial reduction occurred elsewhere, while the presence of few secondary flakes may indicate that cores were carried elsewhere for further reduction. Tool manufacture refers to the purposeful modification of debitage into specific forms. Primary core flakes represent the early stage of reduction, while secondary core flakes and biface flakes represent the later stages.

Table 12-9 contains dorsal cortex information for flakes from both sites. Three categories are shown: 0 percent, 1 to 49 percent, and 50 to 100 percent. The first two represent secondary core reduction, and the latter represents primary reduction. The distribution of dorsal cortex percentages at the sites is very similar. LA 86774 has slightly more primary flakes, and LA 86780 slightly more flakes with 1 to 49 percent dorsal cortex. Secondary core reduction seems to have dominated at these sites, though a fair amount of primary reduction also occurred. These distributions are consistent with the occurrence of in situ core reduction, though there are slightly higher percentages of primary flakes and smaller percentages of cortical secondary flakes than expected.

Table 12-9. Percentages of dorsal cortex on flakes (frequencies and row percentages)

Site Number	0%	1-49%	50-100%
LA 86774	213 76.6	31 11.2	34 12.2
LA 86780	502 76.9	87 13.3	64 9.8

While it is difficult to determine which artifacts were made from materials procured from primary versus secondary deposits for the assemblage overall, it can be determined for the cortical debitage. Table 12-10 shows the distribution of cortical flakes by source and percentage of dorsal cortex. It has already been determined that aphanitic rhyolite Varieties 348 and 362 and quartz arenite Variety 531 could not have been obtained from Rio Grande gravels, so cortical examples of these materials were considered exotic no matter what type of cortex was present. Exotic materials seem to have been partially reduced before transport, though all cortex was certainly not removed from them. This may mean that much of the nonusable rind was removed at quarries, or that cores were previously used at other sites and transported to these locations. Larger percentages of primary flakes from local sources occur in both assemblages, suggesting that more of these materials were reduced in situ from nodules rather than prepared or partially reduced cores. Surprisingly, these trends are much clearer in the LA 86774 assemblage, which is opposite the expected pattern.

Flake Platforms. Platforms are remnants of core or tool edges that were struck to remove flakes. Various types of platforms can be distinguished, providing information about the condition of the artifact from which a flake was removed as well as reduction technology. Cortical platforms are usually evidence of early stage core reduction, particularly when dorsal cortex is also present. Single facet platforms can occur at any time during reduction but are most often associated with flakes removed from cores. Multifacet platforms are evidence of previous removals along an edge. They occur on both core and biface flakes and suggest that the parent artifact was subjected to a considerable amount of earlier reduction.

Table 12-10. Dorsal cortex percentages by proposed source for all cortical flakes (frequencies and row percentages)

Source Type	LA 86774		LA 86780	
	1-49% Dorsal Cortex	50-100% Dorsal Cortex	1-49% Dorsal Cortex	50-100% Dorsal Cortex
Local	13 37.1	22 62.9	25 52.1	23 47.9
Exotic	14 56.0	11 44.0	60 60.0	40 40.0

Platforms were often modified to facilitate flake removal. Two types of modification were used: retouch and abrasion. While abrasion occurs on all types of platforms, retouch is a distinct platform type. Thus, abrasion can occur on single facet and multifacet platforms, but retouch cannot. Both modifications result from rubbing an abrader across an edge. Movement perpendicular to the edge removes microflakes and retouches it, while parallel movement produces abrasion. These processes increase the angle of an edge, strengthening it and reducing the risk of shattering. Stronger platforms also increase control over the shape and length of flakes removed from a core or tool.

Flake platform types could not be defined in many instances. The most common reason was breakage in which the proximal fragment (including the platform) was absent. Two other processes also obscured platforms during reduction. A platform that is unmodified or poorly prepared will sometimes crush when force is applied. Crushing can also occur when excessive force is used. While the point of impact is often still visible on a crushed platform, its original configuration is impossible to determine. Platforms can also collapse when force is applied. Collapsed platforms detach separately from flakes, leaving a scar on the dorsal or ventral surface. Occasionally a small part of the platform is preserved on one or both sides of the scar. While these remnants are usually too small to allow definition of the original platform, they show where impact occurred and indicate that while the platform is missing, flake dimensions are complete. Platforms can also be damaged by use or impact from natural processes. These were recorded as obscured.

The array of platforms from all components is shown in Table 12-11. The distribution of platform types is fairly similar between sites, though there was a smaller percentage of cortical platforms and a larger percentage of single facet platforms at LA 86780. In addition, several categories found at LA 86780 did not occur at LA 86774. Platform types are condensed into three general categories in Table 12-12. The unmodified category includes cortical, single facet, and multifacet platforms. The modified category includes all abraded and retouched platforms, while the obscured category includes flakes with missing or damaged platforms. No modified platforms were found at LA 86774, while a small percentage occurred at LA 86780. Similar percentages of platforms were obscured or missing, though the percentage is somewhat higher for LA 86774.

The high percentage of obscured platforms is probably skewing the other distributions for LA 86780, so in Table 12-13 they are dropped from consideration. Modified platforms continue to comprise only a small percentage of this assemblage, but the proportion is somewhat higher when only unobscured platforms are considered. Little difference is discernable between platforms on local versus exotic materials, since only one flake could be confidently placed in either category.

Debitage Type and Condition. Table 12-14 illustrates flake to angular debris ratios and distributions of proximal and distal flake fragments for both sites. Flake to angular debris ratios are rather low for both sites, comparable to those from Anasazi residential sites in the Taos area, which had flake to angular debris ratios of 2.42 and 3.12 (Moore 1994). In comparison, flake to angular debris ratios from Archaic components at a site near San

Table 12-11. Platform types for each site (frequencies and column percentages)

Platform Type	LA 86774	LA 86780
Cortical	36 13.1	60 9.2
Single facet	93 33.8	247 37.9
Single facet and abraded	0 0.0	6 0.9
Multifacet	34 12.4	90 13.8
Multifacet and abraded	0 0.0	2 0.3
Abraded	0 0.0	2 0.3
Collapsed	35 12.7	69 10.6
Crushed	5 1.8	6 0.9
Absent (snap)	38 13.8	77 11.8
Absent (broken in manufacture)	34 12.4	92 14.1

Table 12-12. Platform categories for each site (frequencies and row percentages)

Site Number	Unmodified	Modified	Obscured
LA 86774	163 59.3	0 0.0	112 40.7
LA 86780	397 61.0	10 1.5	244 37.5

Table 12-13. Platform categories for each site, obscured platforms dropped (frequencies and row percentages)

Site Number	Unmodified	Modified
LA 86774	163 100.0	0 0.0
LA 86780	397 97.5	10 2.5

Ildefonso ranged between 6.68 and 11.77 (Moore n.d.). While analysis of the Taos assemblages suggested use of an expedient strategy, the San Ildefonso components focused on a curated strategy. The comparability of the Santa Teresa assemblages to the former suggests that a mostly expedient strategy was used.

Table 12-14. Chipped stone assemblage attributes for both sites (percentages in parentheses)

Site Number	Flake to Angular Debris Ratio	Proximal Fragments	Distal Fragments
LA 86774	2.24	44 (16.0)	55 (20.0)
LA 86780	2.55	134 (20.6)	122 (18.7)

Equivalent numbers of distal and proximal fragments in an assemblage can suggest postreduction breakage by trampling or other natural processes. If distal fragments significantly outnumber proximal fragments, most breakage probably occurred during reduction. This situation arises because our analytic scheme identifies whole flakes as artifacts having striking platforms and natural terminations. While some breaks attributable to secondary compression can be identified on proximal fragments, others are indistinguishable from natural terminations on whole flakes. Thus, some artifacts classified as whole flakes with hinge or step terminations may actually be the proximal ends of broken flakes. In addition, observations made during experimental flintknapping suggest that proximal ends often shatter during reduction, leaving only medial or distal fragments. Distal fragments outnumber proximal fragments in the LA 86774 assemblage, while the opposite is true for LA 86780. The ratio between fragment types is 1.25 for the former and 0.91 for the latter. These ratios are rather small and may indicate postreduction breakage.

Table 12-15 shows flake breakage patterns for each site, separating manufacturing breaks from snap fractures. While snap fractures occur during reduction, there is no way to segregate them from breaks caused by postreduction damage. Thus, it is impossible to determine the cause of most snap fractures. For medial and lateral fragments which display breaks at both proximal and distal ends, one manufacturing break was enough to consider a flake broken in manufacture. In general, flakes broken during manufacture are more common in both assemblages than are those displaying only snap fractures. However, the differences between fracture patterns are very small and are probably negligible at LA 86774 in particular.

In order to examine flake breakage patterns in more detail, broken flakes were recovered during core reduction and tool manufacture experiments, and breaks on those fragments were studied. Four obsidian nodules (three Jemez obsidian and one Mexican obsidian) were reduced using a small basalt hammerstone in the core flake breakage experiment. Only broken flakes were kept for study, and flakes that shattered completely were not retained. Several specimens which fractured into pieces that would normally be identified as whole flakes, and angular debris were also eliminated as unsuitable for this study. A total of 48 fragments from 25 flakes was recovered. including 20 proximal, 3 medial, and 25 distal portions. Fractures indicative of manufacturing breakage occurred in 18 cases (37.5 percent), and snap fractures were found in 30 (62.5 percent).

Table 12-15. Flake breakage patterns for each site (frequencies and row percentages by site)

Fragment	LA 86774		LA 86780	
	Snap Fracture	Broken in Manufacture	Snap Fracture	Broken in Manufacture
Proximal	20 45.5	24 54.5	63 47.4	70 52.6
Medial	6 46.2	7 53.8	10 25.6	29 74.4
Distal	29 52.7	46 47.3	59 48.4	63 51.6
Lateral	2 50.0	2 50.0	11 61.1	7 38.9
Totals Percent	57 49.1	59 50.9	143 45.8	169 54.2

Numerous bifaces reduced over a long period of time provided data for the manufacturing flake breakage study. As with the core flake experiment, only obsidian was used and included varieties from the Jemez Mountains and unidentified Mexican sources. Again, only broken flakes were retained, and fragments from 62 flakes were examined. Nearly half (28, 45.2 percent) are represented by distal fragments only, the proximal ends having shattered. A total of 103 fragments was available for study, including 30 proximal, 9 medial, and 64 distal portions. Since medial fragments have two broken ends, 112 individual breaks were examined. Fractures indicative of manufacturing breakage occurred in 82 cases (73.2 percent), and snap fractures in 29 (25.9 percent). In one case (0.9 percent), the type of break could not be defined.

Though hardly scientific, these results suggest that even though manufacturing and snap fractures both occur during core reduction and tool manufacture, there are differences in their prevalence. Core reduction tends to produce many more snap fractures than manufacturing breaks, while tool manufacture seems to produce the opposite result. That the experiments did not replicate the patterns seen at the Santa Teresa sites is probably not important since they were limited in scope and involved only one material. Thus, their results are instructive but by no means comprehensive. What is important is the large percentage of flakes broken during manufacture in both assemblages. As discussed earlier, similar percentages of proximal and distal fragments might be considered evidence of postreduction breakage by natural processes such as trampling or erosional movement. However, high percentages of manufacturing breaks in both assemblages suggest that most fracturing occurred during reduction. Thus, while flake breakage data cannot define the reduction strategy used at these sites, they do suggest that breakage tended to occur during reduction rather than afterwards.

Platform Lipping and Dorsal Scar Orientation. Platform lipping and dorsal scar orientation data are shown in Table 12-16. Neither assemblage contains large percentages of lipped platforms or opposing scars. Thus, there is little evidence for the use of soft hammer percussion or reduction of bifacial tools or cores in either assemblage. However, percentages are slightly higher for LA 86780 than for LA 86774, suggesting that soft hammer percussion may have been somewhat more common there and that a little more bifacial reduction may have occurred.

Table 12-16. Platform lipping and dorsal scarring information for both sites (frequencies and row percentages by site)

Site Number	Platform Lipping		Dorsal Scars	
	Present	Not Present	No Opposing Scars	Opposing Scars
LA 86774	3 1.6	186 98.4	255 98.5	4 1.5
LA 86780	21 4.6	438 95.4	609 96.8	20 3.2

Flakes to Cores and Large Bifaces. Frequencies of flakes, cores, and large bifaces are shown in Table 12-17. Only whole flakes and proximal fragments are considered, providing a minimum number of individual removals. Tools considered examples of large bifaces are all fragmentary. Only fragments longer than 3 cm were considered potentially indicative of this type of tool. Ratios of core flakes to cores are relatively low, and ratios of biface flakes to large bifaces are even lower, especially since no large bifaces were found at LA 86774. Cores were obviously reduced at these sites. Either numerous flakes were removed from most cores, or many cores were removed from these sites for reuse elsewhere. Conversely, these assemblage characteristics suggest that large bifaces were not manufactured at these sites and that there was very little reduction of that type of tool.

Summary. The eight debitage assemblage attributes examined as indicators of reduction strategy are summarized in Table 12-18. Nearly all of the indicators suggest that core reduction dominated at these sites. While some of the indicators are better predictors of reduction strategy than others, by taking all of them into consideration a more accurate analysis of reduction strategy is possible. This analysis shows that both assemblages contain distributions of dorsal cortex that seem indicative of core reduction. Both contained only small percentages of biface flakes, modified platforms, opposing dorsal scars, and lipped platforms, all of which are indicative of core reduction. The lack of many examples of lipped platforms also suggests that most reduction was accomplished using hard hammers, a technique that is rarely used in biface reduction. Finally, ratios of flakes to angular debris and core flakes to cores also suggest that core reduction predominated.

Table 12-17. Frequencies of flakes, cores, and large bifaces for both sites, and ratios of flakes to cores and bifaces

Variable	LA 86774	LA 86780
Core flakes	181	437
Cores	10	20
Core flake to core ratio	18.1	21.9
Biface flakes	1	8
Large bifaces	0	2
Biface flake to large biface ratio	0.0	4.0

Table 12-18. Summary of reduction strategy indicators

Attribute	LA 86774	LA 86780
% noncortical debitage	core	core
% biface flakes	core	core
% modified platforms	core	core
Flake/angular debris ratio	core	core
% manufacture breaks	indeterminate	indeterminate
Platform lipping	core	core
Dorsal scarring	core	core
Flake/core ratio	core	core
Reduction strategy	core	core

An interesting aspect of this analysis is the utility of the polythetic set used to define biface flakes. Had only one or two attributes been used to assign flakes to this category, our idea of how much biface reduction occurred at these sites would have been skewed. Attributes like the presence of opposing dorsal scars, platform modification, and platform lipping could be used as evidence of biface reduction, but as Table 12-19 shows, the use of these attributes would have resulted in completely different results. In two cases no biface reduction would have been identified at LA 86774, and in the third case the number of biface flakes would have been over-represented. All three of these variables would have resulted in over-representation of biface flakes in the LA 86780 assemblage. It is even more interesting to note that the use of opposing scars or platform modification would have identified none of the flakes classified as removals from bifaces by the polythetic set, and platform lipping would have identified only half of them.

Table 12-19. Frequencies and percentage of biface flakes in assemblages as assigned by various attributes and the polythetic set of conditions

Attribute	LA 86774	LA 86780
Opposing dorsal scars	0 0.0	20 2.2
Platform modification	0 0.0	10 1.1
Platform lipping	3 0.7	21 2.3
Polythetic set	1 0.2	9 1.0

Granted that the percentages involved in this discussion are quite small and would have caused no appreciable change in our results, the utility of a more precise definition of such an important indicator of reduction strategy should be obvious. While it is possible that flakes with opposing dorsal scars, modified platforms, and lipped platforms were removed during the early biface manufacture, it is equally likely that they were struck from cores.

Cores and Large Bifaces

The types and states of cores and large bifaces at a site can provide corroborative data concerning reduction strategy. Table 12-20 shows numbers of cores and large bifaces by morphology for each site. Unidirectional cores had flakes removed from only one platform, bidirectional cores had flakes removed from two opposing platforms, and multidirectional cores had flakes removed from two (nonopposing) or more platforms. Debitage cores are flakes or pieces of angular debris that were used as cores but retain enough of their original morphology to be recognized as debitage. Bifaces are tools that were purposely flaked on both surfaces to produce a particular shape or edge angle.

Table 12-20. Number of cores and large bifaces for each site

Artifact morphology	LA 86774	LA 86780
Unidirectional cores	6	5
Bidirectional cores	3	2
Multidirectional cores	1	13
Debitage cores	5	6
Large bifaces	0	2
Totals	16	28

Little can be done with the small array of debitage cores in Table 12-20. These artifacts probably represent pieces of debitage that were large enough to produce useable flakes. Flaking patterns were uneven and often consist of only a few scars. The position and patterning of scars are not suggestive of rejected attempts at the production of formal tools; rather, they resemble scars seen on cores. The only difference is that the parent material was a piece of debitage rather than a nodule. Such artifacts occur in both assemblages, though by proportion they are more common at LA 86774.

Fragments of large bifaces were identified only at LA 86780. While one such artifact from LA 86774 was initially identified, it was made from a coarse material and the edge is heavily battered, indicating it is actually a chopper fragment. Most cores from LA 86774 (60 percent) are unidirectional, while most from LA 86780 (65 percent) are multidirectional. In general it might be supposed that the more platforms per core, the further they were reduced. This suggests that unidirectional cores should be larger than bidirectional cores, and both should be larger than multidirectional cores. The amount of cortex present should vary in the same way. Average volume and cortex coverage by core type are shown in Table 12-21. Volume was obtained by multiplying length by width by thickness to obtain a relative rather than absolute measure. Our predictions are not completely upheld in this table, but it does indicate that multidirectional cores were reduced to a greater extent than were other types. Since bidirectional cores have, on the average, less cortical surface than unidirectional cores, it is likely they were reduced to a greater extent. Thus, the average bidirectional core seems to have started out as a larger nodule and had more material removed from it than did the unidirectional cores. The average multidirectional core was reduced to an even greater extent and was much smaller and had less remaining cortex when discarded.

Table 12-21. Core type by average size and percentage of cortex present for both sites

Core Type	Volume	Cortex (%)
Unidirectional	73.47 cm^3	39.1
Bidirectional	300.59 cm^3	32.0
Multidirectional	29.13 cm^3	20.0

The degree to which cores were reduced also depended on material. For this analysis the array of materials is combined into three categories: chertic (cherts and chalcedonies), aphanitic rhyolites, and coarse igneous materials (basalts and rhyolites). Chertic cores are predominantly multidirectional (66.7 percent), coarse igneous cores are mostly unidirectional (83.3 percent), and aphanitic rhyolite cores are evenly split between the three categories (all 33.3 percent). Cortex coverage averaged 22.2 percent on chertic cores, 53.3 percent on coarse igneous cores, and 25.0 percent on aphanitic rhyolite cores. These attributes suggest that materials can be ranked according to degree of reduction. Chertic cores were reduced to the greatest extent, followed by aphanitic rhyolite and coarse igneous. This ranking is verified by core volume data. Chertic cores average 47.5 cu cm, aphanitic rhyolite cores 92.69 cu cm, and coarse igneous materials 217.8 cu cm.

Thus, the extent to which nodules were reduced was material-dependent. Coarse igneous materials were mostly reduced as unidirectional or bidirectional cores and were discarded while still much larger than cores of other materials. Aphanitic rhyolite cores are smaller and retain less cortical surface than coarse igneous cores. Thus, they were reduced further. Chertic cores were flaked to the greatest extent and tend to have multiple striking platforms and the least amount of remaining cortex.

Differences in extent of flaking also occur between sites. Cores from LA 86774 average 175.46 cu cm, and 41 percent of their surfaces is covered by cortex. In contrast, cores from LA 86780 average 48.22 cu cm, and 23 percent of their surfaces is covered by cortex. Thus, cores from LA 86780 were reduced to a greater extent than those from LA 86774. Of course, much of this difference could be due to variation in material selection. A higher proportion of coarse materials in an assemblage could push these percentages upward, even though similar materials may have been reduced to a similar degree in both assemblages. Table 12-22 provides size and cortex data by material category for each site. Mean core volume is considerably smaller for each material category at LA 86780. Chertic cores from that site also had a much smaller mean cortical cover. Aphanitic rhyolites and coarse igneous materials both had more cortical coverage at LA 86780, but there was only one coarse igneous core from LA 86780 and one aphanitic rhyolite core from LA 86774. Thus, the differences are probably due to sample error, and these materials are not readily comparable between sites. Even so, it appears that the discrepancy in mean core volume between sites is real rather than due to differences in the variety of materials being reduced.

Table 12-22. Comparisons of core reduction by material category for each site

Material Type	LA 86774		LA 86780	
	Mean Volume (cu cm)	Mean Cortical Surface (%)	Mean Volume (cu cm)	Mean Cortical Surface (%)
Chertic materials	97.29	32.5	33.27	19.3
Coarse igneous materials	233.67	52.0	139.54	60.0
Aphanitic rhyolites	197.12	20.0	71.80	26.0

There should also be variation between materials procured at primary and secondary sources. Since the acquisition or transport of the former should have been more costly than the latter, cores from primary sources should be reduced to a greater extent than those from secondary sources. Unfortunately, 23.3 percent of the core assemblage retains no cortical surface and can only be assigned to primary or secondary sources under certain conditions. Most cherts were probably obtained from gravel deposits along the Rio Grande and are considered local unless they have nonwaterworn cortex. Aphanitic rhyolite Variety 362 is considered a nonlocal material, no matter what type of cortex is present (see above discussion). Thus, only five cores could not be assigned to a specific source type, including four cores of Rancheria chert and one of aphanitic rhyolite Variety 2, and are excluded from this discussion.

Table 12-23 illustrates size and cortical data for source type by material category for each site. Since this sample is very small, several categories cannot be compared because they lack specimens from one or more source. Only cherts are really comparable between sites. Aphanitic rhyolites can be compared for LA 86780, but only coarse igneous cores from secondary sources were identified in our sample. In general, cores from primary sources are larger than those from secondary sources. However, cores from secondary sources usually have more cortex than those from primary sources. Cherts from LA 86780 are an exception to this, but the difference between mean cortex percentages is so small that it is probably negligible.

Table 12-23. Comparisons of core reduction by material category and source for each site

Material Type	Material Source	LA 86774		LA 86780	
		Mean Volume (cu cm)	Mean Cortical Surface (%)	Mean Volume (cu cm)	Mean Cortical Surface (%)
Chertic	Primary	183.61	25.0	41.64	28.0
	Secondary	10.98	40.0	35.65	26.0
Aphanitic rhyolite	Primary	197.12	20.0	76.91	26.7
	Secondary	-	-	31.68	50.0
Coarse igneous	Primary	-	-	-	-
	Secondary	233.67	52.0	139.54	60.0

These data do not support our predictions. Cores from primary sources tend to have less or equivalent amounts of cortex than those from secondary sources. This suggests that they were reduced to an equal if not greater extent. However, they were also larger in size when discarded. The reason for this probably lies in the size of nodules available from different sources. Materials from secondary deposits were transported by water, which tends to degrade them by breakage and abrasion. This suggests they will be smaller than nodules from primary sources. This is particularly true for cherts, which are easily fractured and probably carried a long distance before being deposited in this region. Nodules from primary sources have not been subjected to similar amounts of impact and should, on the average, be larger than those from secondary deposits.

Several conclusions have been drawn from this analysis. Debitage-cores occurred at both sites and represent the reduction of large pieces of debitage after they were struck from cores. Whether these artifacts are examples of the recycling of materials from earlier sites or represent the reduction of large debitage removed from cores in situ is unknown. While the latter is likely, the former cannot be discounted. Large bifaces were used at LA 86780 but apparently not manufactured there. The use of this type of tool was very restricted and less common than would be expected at an Archaic site.

Most of this analysis focused on our small population of cores. Even though this assemblage is limited in size, several trends seem clear. First, the extent to which nodules were reduced depended on the type of material being flaked, with finer-grained materials like cherts and aphanitic rhyolites reduced to a much greater extent than coarser-grained materials like basalt and rhyolite. Second, cores from LA 86780 are smaller and were reduced to a greater extent than those from LA 86774. Finally, nodules obtained from primary sources are larger but were reduced to the same extent or further than those from secondary sources. Thus, the reduction of cores varied according to the type of material being flaked, the source of that material, and the site where it was found.

Tool Use

An examination of tool use patterns can provide information that can be used to determine site functions. Tool assemblages are broken into two categories: informal and formal tools. Informal tools are debitage used without modification, or with modification limited to marginal retouch. Very conservative standards were applied when defining edge damage as evidence of use. This was necessary because trampling and erosional movement can cause damage that might be mistaken for cultural use. Only when scar patterns were consistent along an edge and the edge margin was regular (no extreme scoops or projections) were artifacts categorized as informal tools. In general, these tools exhibit little modification of shape or edge angle.

Formal tools are debitage whose shape was purposely altered to produce a specific shape or edge angle. Flaking patterns are unifacial or bifacial, and artifacts are classified as early-, middle-, and late-stage tools based on the extent of flaking and edge condition. Early-stage tools have an irregular outline and widely and variably spaced flake scars which often do not extend completely across surfaces. Middle-stage tools have a semiregular outline and closely or semiregularly spaced scars that sometimes extend completely across surfaces. Late-stage tools have a regular outline and closely or regularly spaced scars that usually extend completely across surfaces. While these categories may reflect manufacturing stages, this is not always true. For example, flaking is often confined to margins on one or more surfaces of late prehistoric projectile points, suggesting the early or middle stage of tool manufacture, even though they are finished tools. Thus, tools can not be judged as finished or unfinished on the basis of morphology alone.

Informal Tools

Thirty-two informal tools were identified, including 29 pieces of utilized or retouched debitage and 3 utilized cores (Table 12-24). Mostly core flakes were used at LA 86774 (90 percent), while a wider variety of debitage and cores was used at LA 86780. All three utilized cores are aphanitic rhyolite. The number of damaged edges varies between one and three, for a total of six edges. All are battered, and this wear pattern occurs on no other type of informal tool. These tools were undoubtedly used for pounding or chopping, and the extent of edge damage suggests they were used against hard anvils. While this material is fairly fine-grained, it is coarser and more durable than cherts but should produce sharper edges than coarse igneous materials.

Table 12-24. Numbers and types of informal tools for each site

Artifact Morphology	LA 86774	LA 86780
Angular debris	1	3
Core flakes	9	15
Biface flakes	-	1
Unidirectional cores	-	2
Multidirectional cores	-	1
Totals	10	22

Table 12-25. Wear patterns on informally used debitage edges by material category

Wear pattern	Chertic	Aphanitic Rhyolite	Obsidian	Basalt
Unidirectional utilization	14	2	1	-
Bidirectional utilization	2	2	-	-
Unidirectional retouch	-	1	-	-
Bidirectional retouch	1	1	-	-
Rounding	-	1	-	1
Rounding and unidirectional retouch	-	1	-	-
Unidirectional retouch and wear	4	-	-	-

A total of 31 utilized edges on 29 pieces of debitage were identified. All but one of these tools is cryptocrystalline. Chertic materials were most commonly used, comprising 65.5 percent of the total as well as all examples with more than one utilized edge. Aphanitic rhyolites are the next most common material category, comprising 27.6 percent of the sample. Single examples of obsidian and basalt (3.4 percent apiece) were also used. Three basic damage patterns were defined: utilization, retouch, and rounding. Utilized edges exhibit attrition scars less than 2 mm long, while scars on retouched edges are longer than 2 mm. Rounding is an extreme form of abrasion that is often accompanied by polish. Each pattern can occur in combination with one or more of the others.

Table 12-25 illustrates wear patterns for all edges by material type. Damage on chertic

Table 12-26. Wear patterns on informally used debitage edges by material category and site

Wear Pattern	LA 86774			LA 86780		
	Chertic	Aphanitic Rhyolite	Basalt	Chertic	Aphanitic Rhyolite	Obsidian
Unidirectional utilization	5	-	-	9	2	1
Bidirectional utilization	1	-	-	1	2	-
Unidirectional retouch	-	1	-	-	-	-
Bidirectional retouch	-	1	-	1	-	-
Rounding	-	-	1	-	1	-
Rounding and unidirectional retouch	-	1	-	-	-	-
Unidirectional retouch and wear	1	-	-	3	-	-

edges is mostly unidirectional utilization (66.7 percent) or unidirectional retouch and utilization (19.1 percent). Bidirectional utilization (9.5 percent) and bidirectional retouch (4.8 percent) are the only other patterns found on these materials. The types of wear on aphanitic rhyolite are more varied and evenly distributed among types. Unidirectional and bidirectional utilization each comprise 22.2 percent, while other wear patterns each make up 11.1 percent. The distribution of wear patterns by material type and site is shown in Table 12-26. Unidirectional utilization is the most common type of wear in both assemblages. Two patterns (unidirectional retouch, rounding and unidirectional utilization) are only found at LA 86774.

Because of the small size of this sample, most edge angle data are contrasted by wear patterns but not by site or material type in Table 12-27. The unidirectional utilization categories (with and without rounding) have the smallest mean edge angles, though it should be noted that one pattern is represented by only one specimen. Bidirectional utilization and bidirectional retouch have very similar mean edge angles and ranges. Likewise, unidirectional retouch patterns (with and without utilization) have similar means and relatively similar ranges. Rounded edges have the largest mean edge angle and range.

Table 12-27. Edge angle information for informally used debitage by wear pattern

Wear Pattern	Mean Edge Angle	Range of Edge Angles
Unidirectional utilization	39.7	23 to 65
Bidirectional utilization	47.5	44 to 54
Unidirectional retouch	55	one example
Bidirectional retouch	46	41 to 51
Rounding	90.5	71 to 110
Rounding and unidirectional utilization	38	one example
Unidirectional retouch and utilization	57	43 to 73

Only two wear patterns are represented by more than one example in each assemblage. Twelve edges from LA 86780 and four from LA 86774 exhibit unidirectional utilization scars, while three edges from LA 86780 and two from LA 86774 have bidirectional utilization scars. A comparison of edge angles for these patterns from each site should tentatively suggest whether similar ranges of edge angles were selected. The mean angle of unidirectionally utilized edges is 37.3 degrees for LA 86774 and 39.8 degrees for LA 86780, while the mean angle for bidirectionally utilized edges is 47.5 degrees for LA 86774 and 48.3 degrees for LA 86780. These differences are very small and probably insignificant, weakly suggesting that similar ranges of edge angles were selected for similar tasks at both sites.

Types of scars that occur along a utilized edge vary with the way in which a tool was used as well as the material it was used on. Experiments by Vaughan (1985:20) showed that use in a longitudinal direction (cutting) caused mostly bidirectional scarring (65 percent), though a significant number of specimens were scarred on only one surface (17 percent). Transverse use (scraping or whittling) produced bidirectional scarring in 46 percent of his experiments, and unidirectional scarring in 54 percent. Thus, it is difficult to assign a specific function to these patterns. Similarly, rounding occurred when flakes were used in both longitudinal and transverse directions (Vaughan 1985:26). While retouch may represent an attempt to sharpen an edge dulled by use, this is unlikely in most cases. Informal tools were probably discarded when they became dull, and new flakes were struck as replacements because that required less effort than retouching dulled edges. Thus, most of the retouch scars identified by this analysis were probably caused by use rather than resharpening.

Material hardness, both that of the object being processed and the tool, are also important factors in scarring. Vaughan's (1985:22) experiments showed that consistent scarring along the used part of an edge almost always resulted from contact with a hard material. However, nearly half of the edges used on hard materials and 80 percent of those used on medium-hard materials (fresh or soaked wood or antler) were not consistently scarred. These results are similar to those derived by Schutt (1980) from similar experiments, in which consistent edge scarring occurred only when hard materials were contacted.

Scarring also varies with the material used as a tool. Fragile materials like obsidian and chert scar more easily than tough materials like rhyolite and basalt. Further, scars are easier to define on glassy and fine-grained materials than on medium- or coarse-grained rocks. Thus, it is not surprising that most of our informal tools are chert and obsidian, and more durable materials like aphanitic rhyolite are represented by comparatively fewer examples. Likewise, it is no surprise that few use-scars were found on coarse-grained materials. Foix and Bradley (1985) conducted use-wear experiments on rhyolite, including Thunderbird rhyolite from the Franklin Mountains. They found that evidence of wear is nearly invisible on this material, and coarser-grained varieties are more resistant to damage than finer-grained types. So, it is not surprising that the only examples of rhyolite on which cultural edge damage was identified were aphanitic varieties.

Brett and Shelley (1985) provide a further caution about using edge damage as evidence of specific cultural activities. They found that the ratio of flakes damaged during experimental core reduction was similar to that found at surface sites near Mountainair, even when care was taken to prevent contact with the floor or other debitage (Brett and Shelley 1985:123). This suggests that much damage on debitage edges is questionable evidence of cultural use:

> The assumption that macroscopic edge damage is equivalent to use is difficult to support. Retouch or "microflake" removals, edge blunting and rounding may appear on the flake edge as the result of intentional alteration by man, unintentional alteration by man during use, alteration by the depositional environment, microflake removal incurred during reduction, edge damage incurred during excavation and/or subsequently during transport, analysis and curation. A thoughtful reading of articles in the use wear literature . . . points out not only the multitude of processes involved in the formation of edge damage but also the difficulty in determining the origins of the observed

damage, even at high magnifications. (Brett and Shelley 1985:123)

Hopefully, the conservative nature of our use-wear analysis weeded out most examples of noncultural edge damage. Indeed, significant damage was observed on 44 other pieces of debitage, but its patterning was inconsistent and defined as noncultural in origin. Thus, we feel relatively confident that the informal tools in this assemblage are evidence of cultural use. Even so, while we can make suggestions concerning the origin of wear patterns, no definite functions can be assigned.

The presence of obvious signs of wear suggests that most of these tools were used to process hard or medium-hard materials like wood, bone, or antler. Experiments conducted by Schutt (1980) suggest that edge angles over 40 degrees are poorly suited for cutting. Thus, we assume that edges smaller than 40 degrees are best for this purpose, while those larger than 40 degrees are better for scraping. Using this criterion, less than half (41.9 percent) of our edges are suitable for cutting, and more than half (58.1 percent) are suitable for scraping. The array of wear patterns is also rather neatly divided at 40 degrees. Patterns that only occur on angles larger than this include bidirectional utilization, unidirectional and bidirectional retouch, rounding, and unidirectional retouch and utilization. Only the unidirectional utilization categories have edges measuring less than 40 degrees. While a few unidirectionally utilized specimens from LA 86780 are larger than 40 degrees, 75 percent are less than 40 degrees.

It is possible that most of the unidirectionally utilized edges were used for cutting, while the rest of that category and edges with other patterns were used for scraping. While this is by no means definite, it does suggest that informal tools were used in both ways. It is also likely that most informal tools in these assemblages were used to process relatively hard materials. Unfortunately, since the processing of soft materials rarely creates visible scarring, and use on medium hard and hard materials does not always cause consistent scarring, only a small part of the informal tool assemblage was probably identified. Thus, while we can suggest that informal tools were used for cutting and scraping, it is impossible to determine how many artifacts actually functioned in that capacity.

Formal Tools

Only 15 formal chipped stone tools were recovered from these sites. Artifacts in this category include tools shaped by chipping as well as those used in reduction. Thus, hammerstones are also included in this discussion. With the addition of 3 hammerstone flakes, the formal tool assemblage includes 18 artifacts. These tools are shown by site in Table 12-28. Two general categories can be defined: pounding tools and bifaces. Undifferentiated bifacial tools were found at both sites and include fragments of tools that lack any attributes that suggest specialized functions. As discussed earlier, the only large biface from LA 86774 is a fragment from the edge of a chopper, and this artifact is so categorized in Table 12-28. Other biface fragments from this site are from relatively small tools. In contrast, two of three bifaces from LA 86780 are fragments of comparatively large tools. One has a reverse fracture, while the other has an unidentified break that nonetheless appears to have occurred during reduction.

The latter appears to have served as a biface-core but was too thick to be modified into another form when it became too small to serve as a core any longer. None of the biface fragments from LA 86774 seem to have broken during manufacture or use.

Table 12-28. Formal tools from both sites

Tool Type	LA 86774	LA 86780
Hammerstones	1	2
Hammerstone flakes	3	-
Chopper-hammerstones	-	1
Choppers	1	-
Undifferentiated bifaces	3	3
Projectile points	-	4

Projectile points are specialized bifaces used for hunting and sometimes processing game. This type of tool was only recovered from LA 86780. Four dart points were recovered from that site and have been identified as probable Hatch (1), San Pedro (2), and San Jose (1) points. The Hatch point and one of the San Pedro points are complete, while the remaining San Pedro and San Jose points are broken. The Hatch point appears to have been resharpened, though whether this is evidence of recycling or simply the result of damage repair is impossible to determine.

Pounding tools were also found in both assemblages. Since the hammerstone flakes from LA 86774 are all of different materials, they represent separate tools. Thus, there is evidence of at least four hammerstones from LA 86774 and two from LA 86780. One chopping tool was identified in each assemblage, and the specimen from LA 86780 was also used as a hammerstone.

The range of materials used to make formal tools is rather restricted. Two undifferentiated biface fragments from LA 86774 are chert, and the third is Thunderbird rhyolite. All undifferentiated bifaces and three projectile points from LA 86780 are chert, while the fourth point is obsidian. The pounding tools from LA 86774 were made from various rhyolites including a gray variety (2), Thunderbird rhyolite (2), and aphanitic rhyolite (1). Two pounding tools from LA 86780 are made from Thunderbird rhyolite, while the third is quartzite. Thus, most bifaces were made from high-quality cryptocrystalline materials, though there is some evidence of the use of coarser materials at LA 86774. Specialized bifaces, in particular, were made from high-quality materials. Pounding tools were all made from coarse-grained durable materials like quartzite and rhyolite.

Summary and Conclusions

This analysis has examined chipped stone assemblages from two sites in south-central New Mexico. The Santa Teresa site (LA 86780) was a multioccupational Archaic camp. The Mockingbird site (LA 86774) represents a short-term Late Formative period residence, though some parts of the site may have been occupied at earlier times. The possibility of multiple components at these sites is addressed in a later chapter. For the purpose of this discussion, LA 86780 is considered to be an Archaic site, while LA 86774 dates to the Formative period.

Possible differences that could be expected between these assemblages were discussed in "The Santa Teresa Project Research Orientation." In general, that discussion includes a series of predicted differences and similarities between occupations dating to various periods. Such characteristics as reduction strategy, range of materials flaked, and range of tools used were expected to provide us with information that would either help support or reject those predictions.

While these questions cannot be fully addressed before site structure is examined for evidence of multiple occupations, some general statements can be made. For the most part, the reduction strategy used at both sites was expedient in nature. That is, flakes were struck from cores as needed, and there was little effort to maximize the amount of useable edge by systematically reducing cores. Nearly all of the attributes used to examine the debitage assemblages in Table 12-18 suggest expedient reduction. The only exception was the percentage of manufacturing breaks, which was inconclusive. Both assemblages contain small numbers of biface flakes, modified platforms, opposing dorsal scars, and lipped platforms. They have very low ratios of flakes to angular debris and relatively high flake to core ratios. Primary and secondary decortication flakes occur in percentages which suggest that all stages of core reduction were performed at these sites. All of these attributes are characteristic of an expedient reduction strategy. In particular, the veritable lack of modified platforms and platform lipping suggest that little careful, precise reduction occurred at either site. However, there are important differences between these assemblages.

While no modified platforms were found at LA 86774, the LA 86780 assemblage contains 10. These platforms comprise 1.5 percent of the total debitage assemblage, and 2.5 percent with obscured and missing platforms dropped. While these percentages are low, the presence of modified platforms at this site and their absence at LA 86774 is probably important. LA 86780 also contains somewhat higher percentages of lipped platforms and flakes with opposing dorsal scars (Table 12-16). Biface flakes comprise 0.6 percent of the flakes from LA 86774, and 1.8 percent of those from LA 86780. While none of these differences are great, they are consistent in suggesting there was slightly more biface reduction at LA 86780 than at LA 86774. This is partially supported by the presence of two large biface fragments at LA 86780 and the absence of this type of tool from LA 86774. However, since the number of large biface fragments is so small, this distribution has little significance.

Significant differences in material selection are also apparent. Cryptocrystalline materials were overwhelmingly selected for reduction at LA 86780 (83.4 percent), while they comprise less than half the LA 86774 assemblage (44.5 percent). Conservatively, the percentage of exotic materials at LA 86780 is twice that from LA 86774 (34.1 to 17.6 percent). With a little extrapolation the discrepancy becomes even larger. Artifacts of possible exotic origin comprise less than 20 percent of the LA 86774 assemblage and more than 64 percent of LA 86780.

Most materials classified as local were probably obtained from gravels along the Rio Grande. Nearly all of the exotics were procured in the nearby Franklin Mountains, though a few sources are more distant. While the Franklin Mountains are not a great distance from the sites, obtaining materials from sources on their slopes entailed greater effort. The Rio Grande is within a single day's foraging range, so collection of knappable materials from that area was probably embedded in the procurement of other resources, requiring no special effort. The Franklin Mountains are beyond a single day's foraging range. Procuring materials from those sources would have required more effort and perhaps logistical trips. However, these materials could also have been curated as cores or debitage. Logistical trips may have been unnecessary if they were transported from camps in other environmental zones. Unfortunately, the main difference between exotic and local materials is cortex type, and most of our artifacts retain no cortex. Thus, it is impossible to address this problem with the few data available. All that can be concluded is that the much higher percentage of exotics at LA 86780 suggests a higher degree of mobility for the occupants of that site than for those living at LA 86774.

Though our analysis of cores suggests that the degree of reduction and size at the time of discard were largely dependent on the type of material reduced, there are important differences in how cores were treated at these sites. Overall, cores from LA 86780 are smaller and retain much less cortex than those from LA 86774. Cores were also reduced differently. Most cores from LA 86774 were unidirectionally (60 percent) or bidirectionally (30 percent) reduced. In contrast, most from LA 86780 were reduced multidirectionally (65 percent), with unidirectional cores comprising only 25 percent and bidirectional cores 10 percent of this assemblage. Thus, fewer platforms occur on cores from LA 86774 and they were discarded while much larger than those from LA 86780. This suggests a higher degree of core maximization at LA 86780, though this is not visible in the debitage assemblage. On the other hand, that lack might indicate that useable cores were removed from LA 86780 when it was abandoned. Larger cores were discarded at LA 86774, suggesting their transport to another location was not worthwhile.

In general, the array of formal and informal tools is similar for both sites. Each assemblage contains informally utilized debitage, though cores were only used as informal tools at LA 86780. In addition, a biface flake was among the array of utilized debitage at this site and represents 11 percent of that artifact category. Both assemblages contain pounding tools in the form of hammerstones and choppers. Formal flaked tools also occur in both assemblages, though there are some important differences in this artifact class. Only fragmentary bifaces were found at LA 86774. All appear to be from small tools, and no specialized bifaces were found. In contrast, the LA 86780 assemblage contains evidence of large bifaces, small bifaces, and specialized bifaces.

Thus, even though an expedient reduction strategy dominated at both sites, there is enough variation to suggest that they represent different patterns of mobility. Groups using LA 86780 appear to have been very mobile, exploiting a high percentage of materials that could only be procured beyond a day's foraging range of the site. It doesn't matter whether these materials were obtained during special logistical trips or curated as cores. The higher dependence on nonlocal materials is a good indication that these groups moved around more often than did those using LA 86774. The presence of a few large biface fragments and several large biface flakes at LA 86780 are also significant in light of our predictions. At least a few large bifaces were curated by the groups occupying this site. The minimum number that can be determined is seven (five unique types of chert, Rancheria chert, and aphanitic rhyolite Variety 2). While this number is small, it does indicate that large curated bifaces were part of the Archaic tool kit. It is likely that there was little reliance on these tools because of the character of local lithic resources.

High-quality materials like fine-grained chert and obsidian are rare and mostly available only in gravels along the Rio Grande. By the time these materials were deposited, most were reduced to small nodules unsuitable for large biface manufacture. While the use of large bifaces as cores maximizes the amount of useable edge that can be obtained from a single artifact, the manufacture of these tools tends to waste large amounts of material. In order to produce a large biface, one must begin with a flake several times larger than the finished tool. It is likely that few high-quality nodules in the Rio Grande gravels could provide flakes of the requisite size for large biface manufacture. While some local materials were used for this purpose, these materials are less suitable for the production of large bifaces. Rancheria chert tends to be low-quality, and aphanitic rhyolite is tougher than chert for flaking. Thus, large bifaces may not have been the best choice for curation in this area. It may have been easier and more cost effective to simply transport cores from site to site. During later time periods, the recycling of materials from earlier sites may have been an equally effective solution (Camilli 1988).

This analysis suggests that the occupants of LA 86774 were less mobile than the people using LA 86780. This does not mean that they were completely, or even very, sedentary. It simply means their mobility was scaled lower than that of the Archaic population.

ANALYSIS OF GROUND STONE ARTIFACTS FROM THE SANTA TERESA SITES

James L. Moore

Ground stone tools functioned in tasks that required some form of abrading. Thus, they were used to process plant foods as well as to shape other tools. By examining morphology and wear patterns it is often possible to assign a function to ground stone tools, providing insights into the activities that occurred at a site. However, it is also necessary to look for evidence of reuse for similar or different tasks. Ground stone tools often have long use-lives, during which they can go through a series of changes that makes them useful for different purposes. For example, a metate that is broken or worn through may be used to shape wooden or bone tools rather than being discarded. A metate fragment might simply be turned over and used as a smaller base stone. Indeed, the final use of these tools may have little or nothing to do with their original function. Thus, considering the possibility of curation and reuse, the morphology of a tool is not always an accurate indicator of how it functioned at a site, particularly the last task for which it was used.

Theoretical Perspectives

Transportability and Caching

Since ground stone tools are usually large and remain visible on a site unless purposely concealed, they are easy to salvage and reuse elsewhere. This was often done purposely, leaving ground stone tools behind as site furniture so they were available for future use. While this was probably most often done at limited-use sites, ground stone tools were also sometimes cached at abandoned residences. Because these tools were often large and heavy, they caused difficulties for many hunter-gatherers. As Wright (1994:246-247) notes:

> Stone grinding and pounding tools create logistical problems for mobile foragers dependent on foods that require such processing. Such tools must be convenient to the location of consumption, and this may conflict with the need for mobility. Solutions to this problem might include the use of portable, lightweight tools carried from camp to camp; expedient use of nearby stones for a few processing tasks; caching of heavy or fixed tools at residence sites or near wild harvests; or a restriction of the foraging range in order to move staple resources to the location of consumption with minimum traveling distance--in short, a decrease in mobility.

Any of these solutions are possible for our study area, depending on the level of mobility. During the Archaic it is likely that the first two solutions were stressed. A few light ground stone tools may have been carried from site to site, while larger tools were probably cached in or near foraging areas where plant foods that required grinding occurred. There was a reduction in mobility by the Mesilla phase that was probably at least partly caused by population growth. A logistical procurement system appears to have prevailed during at least part of the year and represents use of the third solution: movement of resources to the locus of consumption. However, rather than simply being a consequence of the transportability of tools, it is likely that other factors were also involved.

The level of accessibility of abandoned sites was an important factor in the recycling of materials. Schlanger (1991) studied differences in ground stone assemblages from pithouse sites in the Dolores area of Colorado. Differentiating between structures that were burned and unburned, she determined that floors at the latter tended to contain fewer whole tools than the former. This was attributed to different levels of accessibility. Burned structures represented short periods of access, and unburned structures represented longer periods of accessibility in which tools could be salvaged: "The floor assemblages at longer-access sites show depleted inventories in comparison to shorter-access sites; presumably, tools were removed from these sites during a protracted abandonment process or through postabandonment scavenging or collecting" (Schlanger 1991:470). Overall, there were more broken tools at longer-access sites, indicating that collection of useable tools affected entire assemblages and not just those from structures (Schlanger 1991:470). This suggests that "the act of burning roofs at sites may have served to restrict general postabandonment visitation and scavenging as well as restricting access to structure floors" (Schlanger 1991:470). Thus, the way in which sites were abandoned can affect the nature of assemblages, and some sites are more susceptible to salvaging than others.

Nelson and Lippmeier (1993:287) suggest that the way in which a locale functioned influenced how tools were made and used. They compared ground stone assemblages from reoccupied architectural sites and rock shelters, finding differences that they attributed to the regularity of site reoccupation: "In the sample from the regularly reoccupied architectural sites, manos and metates are made from more durable stone, metates are more often shaped, manos are more standardized in form, and circular and rectangular-shaped manos are longer than in samples from the rockshelters" (Nelson and Lippmeier 1993:301). Thus, there were notable differences in materials, amount of shaping, standardization of shape, and mano length between the two classes of sites.

These studies suggest several possibilities. First, the level of mobility, distribution of food resources requiring grinding, and how ground stone tools were transported or stored by hunter-gatherers were all interrelated. Second, the accessibility of materials at an abandoned site can affect the entire ground stone assemblage. Finally, there may be great differences in attributes related to manufacturing technology and material selection between sites that were regularly reoccupied and those that were only used occasionally.

Grinding Efficiency and Lifestyle

Various researchers have studied variation in ground stone tool efficiency in relation to the user's lifestyle. Martin and Plog (1973:217) suggest that grinding efficiency was improved by increasing the amount of pressure placed on the grinding platform. This was tested by Lancaster (1983) and found to be incorrect. Using data from industrial grinding experiments, he determined that the critical variable was not the magnitude of the load charge but the size of the grinding area (Lancaster 1983:81).

In studying grinding tools from the Mimbres area, Lancaster (1983, 1986) determined that there was a steady rise in efficiency through time. This took the form of increasingly larger grinding surfaces and use of materials with variable textures. While the popularity of basin and slab metates seemed to fluctuate (and these types may have been used as utility grinding implements), trough metate varieties clearly reflect this tendency (Lancaster 1983:48-49). Trough metates were the most popular form during the Early Pithouse period but through time were mostly replaced by the through-trough type (Lancaster 1983:47). The former are open at only one end, while the latter are open at both ends. This modification increased the length of the grinding surface and consequently its area. Trough metates had an average grinding surface of 758 sq cm, while through-trough metates averaged 1,123 sq cm, a 33 percent increase (Lancaster 1983:42-43). Apparent functional differences between trough and basin/slab metates were based on wear patterns. Both varieties of trough metate exhibited striations parallel to the long axis, while striation patterns on a large percentage of basin/slab metates were random (Lancaster 1983:45).

There was also variation in the types and textures of materials used. Trough metates were dominantly made from vesicular basalt and basin/slab metates from nonvesicular basalt and rhyolite. Medium-coarse materials dominated the assemblage before the Classic phase, while during that time the assemblage contained nearly equal amounts of coarse- and fine-grained materials. This seems to indicate the shift from a single-stage to a multistage grinding process (Lancaster 1983:87).

Though Lancaster (1983) was unable to discern any similar patterning in manos, a study by Hard (1986) shows that these tools vary correspondingly. This may be due to the nature of the samples examined. Lancaster did not look at Archaic sites from the Mimbres area, concentrating on sites occupied by groups that were relatively dependent on farming. Hard examined a considerable amount of data on the use of ground stone tools by hunter-gatherers and farmers. Thus, his sample was broader and patterning was undoubtedly easier to recognize.

Hard (1986:105) feels that as reliance on cultigens rises, there is a corresponding increase in both mano length and mean metate grinding surface area. He only examined manos, but Lancaster's (1983) study supports the latter pattern. After an examination of ethnographic and archaeological materials, Hard (1986:161) determined that the degree of reliance on farming can be measured by mano length. The break between hunting and gathering and dependence on cultigens appears to occur between average lengths of 10 and 13 cm. Hunter-gatherer manos average 10.6 cm long, while a mean length of 13 cm corresponds with a substantial dependence on cultigens (Hard 1986:161). The longest mean in his sample was 25 cm, which appears to equate with about a 70 percent dependence on cultigens (Hard 1986:161). The mean length of Tarahumara manos is 20.8 cm, and they depend on cultigens for about 60 percent of their diet (Hard 1986:161).

Thus, as dependence on agriculture increases there are corresponding changes in ground stone assemblages related to the need to improve grinding efficiency. These changes include types of materials used, size of metate grinding surfaces, and mano lengths. At least one of these variables (mano length) may be a good indicator of the degree to which a group was dependent on cultigens.

The Data

The sites excavated by this project represent multiple-use camps dating to the Archaic and Formative periods. The Santa Teresa site contained materials dating to the Middle and Late Archaic periods, while Early and Late Formative occupations are represented at the Mockingbird site. According to the theoretical perspectives presented above there should be significant differences between ground stone assemblages from these sites. By the same token, many differences could be smoothed or obscured by the reuse of ground stone tools by later occupants of the region. Another factor that must be considered is that some or most of the ground stone tools at these sites were probably salvaged from other locations and were perhaps used in ways that were quite different from those they were originally designed for.

A total of 72 ground stone tools were recovered from LA 86774, and 75 were found at LA 86780. Most are fragmentary. Only two whole tools occurred in each assemblage. Table 13-1 illustrates the distribution of tool functions by portions. Various mano and metate forms dominate both assemblages. Only one tool from each site had a different function. A complete small shaped slab with no obvious function was found at LA 86774, and a complete abrader was recovered from LA 86780. The latter was probably used to shape wooden or bone tools. The only other whole tools were one-hand manos, one from each site.

Table 13-2 shows the types of materials used for ground stone tools by their function. Sandstone and quartzitic sandstone dominate both assemblages and occur in fairly similar quantities. Undifferentiated igneous materials were relatively common at both sites, while quartzite and rhyolite were not. No vesicular materials were noted, suggesting that very coarse grinding surfaces were not used at either site. Material type by texture is shown in Table 13-3. Fine-grained materials clearly dominate both assemblages, with medium- and coarse-grained materials comprising substantially smaller percentages. This suggests that a multistage grinding process was not used at either site. Unfortunately, the paucity of complete tools makes this difficult to substantiate. It is possible that we have skewed the distribution by including all ground stone tools in this assemblage. However, there is little change when only manos and metates are considered. Only 25 percent of metates and 33.6 percent of manos from LA 86774 are coarse-grained. Percentages from LA 86780 are almost identical, with only 24 percent of metates and 32.1 percent of manos made from coarse-grained materials. Fine-grained materials comprised over 50 percent of each category, with the exception of manos at LA 86780 (42.9 percent). The dominance of fine-grained materials and considerably smaller percentages of

Table 13-1. Function of ground stone tools by portion (frequencies and row percentages)

Site	Function	Whole	Indeterminate Fragment	End Fragment	Medial Fragment	Edge Fragment	Internal Fragment	Longitudinal Fragment	Corner	Totals
LA 86774	Shaped slab	1 100.0	0 0.0	0 0.0	0 0.0	6 28.6	15 71.4	0 0.0	0 0.0	22 30.6
	Mano, undifferentiated	0 0.0	0 0.0	9 52.9	0 0.0	8 47.1	0 0.0	0 0.0	0 0.0	17 23.6
	One-hand mano	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 1.4
	Metate, undifferentiated	0 0.0	0 0.0	0 0.0	0 0.0	7 28.0	18 72.0	0 0.0	0 0.0	25 34.7
	Slab metate	0 0.0	0 0.0	0 0.0	0 0.0	6 85.7	0 0.0	1 14.3	0 0.0	7 9.7
	Totals	2 2.8	0 0.0	9 12.5	0 0.0	27 37.5	33 45.8	1 1.4	0 0.0	72
LA 86780	Indeterminate fragment	0 0.0	2 9.1	0 0.0	0 0.0	7 31.8	12 54.5	0 0.0	1 4.5	22 29.3
	Mano, undifferentiated	0 0.0	0 0.0	3 11.1	1 3.8	19 73.1	3 11.5	0 0.0	0 0.0	26 34.7
	One-hand mano	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 1.3
	Metate, undifferentiated	0 0.0	0 0.0	0 0.0	0 0.0	6 24.0	17 68.0	0 0.0	2 8.0	25 33.3
	Abrader	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 1.3
	Totals	2 2.6	2 2.6	3 3.9	1 1.3	33 43.4	32 42.1	0 0.0	3 3.9	75

Table 13-2. Material by function for ground stone tools (frequencies and row percentages)

Site	Material	Indeterminate Fragment	Mano, Undifferentiated	One-hand Mano	Metate, Undifferentiated	Slab Metate	Shaped Slab	Abrader	Totals
LA 86774	Undifferentiated igneous	5 50.0	0 0.0	0 0.0	5 50.0	0 0.0	0 0.0	0 0.0	10 13.9
	Sandstone	9 23.1	11 28.2	1 2.6	11 28.2	6 15.4	1 2.6	0 0.0	39 54.2
	Quartzite	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 1.4
	Quartzitic sandstone	6 27.3	6 27.3	0 0.0	9 40.9	1 4.5	0 0.0	0 0.0	22 30.6
	Totals	21 29.2	17 23.6	1 1.4	25 34.7	7 9.7	1 1.4	0 0.0	72
LA 86780	Undifferentiated igneous	6 54.5	1 9.1	0 0.0	4 36.4	0 0.0	0 0.0	0 0.0	11 14.7
	Rhyolite	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 1.3
	Sandstone	9 23.7	16 42.1	1 2.6	11 28.9	0 0.0	0 0.0	1 2.6	38 50.7
	Quartzite	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 1.3
	Quartzitic sandstone	7 30.4	9 39.1	0 0.0	8 34.8	0 0.0	0 0.0	0 0.0	24 32.0
	Totals	22 28.9	27 35.5	1 1.3	25 32.9	0 0.0	0 0.0	1 1.3	75

both medium- and coarse-grained materials in these assemblages suggest that a staged grinding process was probably not used at either site.

Table 13-3. Ground stone tool materials by texture (frequencies and row percentages)

Site	Material	Fine-grained	Medium-grained	Large-grained	Totals
LA 86774	Undifferentiated igneous	4 40.0	3 30.0	3 30.0	10 13.9
	Sandstone	35 89.7	4 10.3	0 0.0	39 54.2
	Quartzite	0 0.0	1 100.0	0 0.0	1 1.4
	Quartzitic sandstone	3 13.6	1 4.5	18 81.8	22 30.6
	Totals	42 58.3	9 12.5	22 29.2	72
LA 86780	Undifferentiated igneous	6 54.5	4 36.4	1 9.1	11 14.7
	Rhyolite	0 0.0	1 100.0	0 0.0	1 1.3
	Sandstone	32 84.2	5 13.2	1 2.6	38 50.7
	Quartzite	0 0.0	1 100.0	0 0.0	1 1.3
	Quartzitic sandstone	2 8.7	4 17.4	18 78.3	24 32.0
	Totals	40 53.3	15 20.0	20 26.7	75

Many ground stone tools from both sites have more than one use-surface. Twenty-five tools from LA 86774 exhibit multiple use-surfaces, but none were used for secondary purposes. They include the one-hand mano, 12 mano fragments, 6 metate fragments, and 6 indeterminate fragments. The LA 86780 assemblage also contains 25 tools with multiple use-surfaces, including 16 mano fragments, 7 metate fragments, and 2 indeterminate fragments. However, in this case a few tools were used for more than one purpose: a piece of quartzitic sandstone whose original function could not be determined was also used as a core, and a sandstone mano fragment was reused as a small metate. Thus, many ground stone tools continued to be used after one surface was worn, most commonly for the same purpose as the first use-surface, though a few exhibit different types of use. Most of these tools were probably used in food processing activities. While the functions of large percentages of both assemblages were not identified, the fact that many exhibit use-wear on more than one surface suggests they are pieces of manos or metates. As noted earlier, only two tools used for other purposes were identified: a ground slab from LA 86774 and an abrader from LA 86780.

Table 13-4. Alterations to ground stone artifacts (frequencies and row percentages)

Site	Portion	No Alterations	Fire-cracked	Thermal Discoloration	Grooved	Totals
LA 86774	Whole	1 50.0	0 0.0	1 50.0	0 0.0	2 2.8
	End fragment	6 66.7	0 0.0	3 33.3	0 0.0	9 12.5
	Edge fragment	4 14.8	9 33.3	14 51.9	0 0.0	27 37.5
	Internal fragment	12 36.4	9 27.3	12 36.4	0 0.0	33 45.8
	Longitudinal fragment	0 0.0	0 0.0	1 100.0	0 0.0	1 1.4
	Totals	23 31.9	18 25.0	31 43.1	0 0.0	72
LA 86780	Whole	1 50.0	0 0.0	0 0.0	1 50.0	2 2.7
	Indeterminate fragment	0 0.0	1 50.0	1 50.0	0 0.0	2 2.7
	End fragment	3 100.0	0 0.0	0 0.0	0 0.0	3 4.0
	Medial fragment	0 0.0	0 0.0	1 100.0	0 0.0	1 1.3
	Edge fragment	11 34.4	7 21.9	14 43.8	0 0.0	32 42.7
	Internal fragment	3 9.4	16 50.0	13 40.6	0 0.0	32 42.7
	Corner	3 100.0	0 0.0	0 0.0	0 0.0	3 4.0
	Totals	21 28.0	24 32.0	29 38.7	1 1.3	75

But were these artifacts actually used for these purposes at our sites? Earlier we discussed Schlanger's (1991) conclusion that the length of time a site was accessible conditions the proportion of broken to whole ground stone tools in assemblages. This suggests that both sites were open to scavengers long after abandonment, since each contained only 2 complete ground stone tools out of assemblages numbering in excess of 70 apiece. But is this really what our data indicate?

Whole tools comprise only 2.8 percent and 2.7 percent, respectively, of the LA 86774 and LA 86780 ground stone assemblages. Many tool fragments exhibit evidence of thermal use occurring as either discoloration or diagnostic breaks (Table 13-4). These categories include 68.1 percent of the LA 86774 assemblage and 70.7 percent of the ground stone from LA 86780. One unbroken ground stone tool from LA 86774 was oxidized, indicating it was probably used as a hearth stone. Since this artifact was recovered from a probable heating pit, such a conclusion seems justified.

Thermally altered ground stone artifacts were found in only one feature at LA 86774, a probable warming pit (Feature 11). However, they occurred near several hearths, including Features 1 (9 specimens), 2 (5), 3 (1), 7 (1), 8 (1) and 10 (1). In addition, three pieces of thermally altered ground stone were found near Structure 1, and three were in cultural deposits in Subarea 1 but could not be assigned to any specific feature. A total of 71.4 percent of the thermally altered ground stone artifacts from LA 86774 were found in or near hearths or Pit Structure 1.

Thermally altered ground stone was recovered from several hearths at LA 86780 including Features 4 (3), 5 (1), 9 (7), and 19 (1). Similarly, several were also recovered from areas around hearths including Features 9 (2), 16 (2), 18 (1), 19 (3), 21 (1), 22 (2), and 25 (1). A total of 45.3 percent of the thermally altered ground stone from LA 86780 was found in or adjacent to hearths. While this is a smaller percentage than at LA 86774, all of the thermally altered artifacts from LA 86780 were found in or around excavation areas that contained one or more hearths.

Large percentages of thermally altered ground stone from both sites were found in or around hearths or near excavation areas that contained one or more hearths. Like the burned rock from these sites, thermally altered ground stone seems to have been used as heating elements. This means we cannot trust the assigned functions, because they generally reflect the primary use, and we cannot demonstrate that these artifacts functioned in those ways at our sites before they served as heating elements. Indeed, since both sites represent limited-use locales, it is unlikely that many of these artifacts were manufactured, used, and then reused by the same occupants. Instead, they probably scavenged at nearby sites for rocks to use as hearth stones, regardless of their original function.

This suggests that the primary functions of most thermally altered ground stone tools should be discounted. Table 13-5 shows material type by function for ground stone tools that were not thermally altered. By removing obvious hearth stones, the assemblages are somewhat simplified. Three materials are now represented at LA 86774, and only two at LA 86780. There are also lower percentages of tools with undetermined functions, though this difference is fairly small for LA 86774. Sandstone and quartzitic sandstone are the predominant materials at both sites, with a few examples of undifferentiated igneous rocks at LA 86774.

Table 13-5. Material by function for portions of assemblages not used as hearth stones (frequencies and row percentages)

Site	Material	Indeterminate Fragment	Shaped Slab	Abrader	Mano, Undiff-erentiated	One-hand Mano	Metate, Undiff-erentiated	Totals
LA 86774	Undifferentiated igneous	2 50.0	0 0.0	0 0.0	0 0.0	0 0.0	2 50.0	4 17.4
	Sandstone	1 10.0	1 10.0	0 0.0	4 40.0	0 0.0	4 40.0	10 43.5
	Quartzitic sandstone	3 33.3	0 0.0	0 0.0	4 44.4	0 0.0	2 22.2	9 39.1
	Totals	6 26.1	1 4.3	0 0.0	8 34.8	0 0.0	8 34.8	23 100.0
LA 86780	Sandstone	1 7.7	0 0.0	1 7.7	7 53.8	1 7.7	3 23.1	13 59.1
	Quartzitic sandstone	3 33.3	0 0.0	0 0.0	2 22.2	0 0.0	4 44.4	9 40.9
	Totals	4 18.2	0 0.0	1 4.5	9 40.9	1 4.6	7 31.8	22 100.0

Function by material texture of unaltered artifacts is shown in Table 13-6. Both assemblages are dominated by fine- and medium-grained materials, though large-grained materials do occur, particularly at LA 86774. In part, graininess depends on material, especially when sandstones and quartzitic sandstones are considered. Sandstones are fine-grained (65.2 percent) or medium-grained (34.8 percent); none were large-grained. Conversely, only 22.2 percent of quartzitic sandstones are fine-grained, 5.6 percent are medium-grained, and 72.2 percent are large-grained. Undifferentiated igneous materials are evenly split between fine- and large-grained. However, large-grained quartzitic sandstone is rarely as coarse as large-grained igneous rocks. Thus, it remains unlikely that there is any evidence for a multistage grinding process in these assemblages, particularly since only small percentages of the metates from both sites were made from very coarse materials.

Table 13-6. Tool function by material texture with thermally altered artifacts eliminated from consideration (frequencies and row percentages)

Site	Function	Fine-grained	Medium-grained	Large-grained	Totals
LA 86774	Indeterminate fragment	2 33.3	0 0.0	4 66.7	6 26.1
	Shaped slab	1 100.0	0 0.0	0 0.0	1 4.3
	Mano, undifferentiated	3 37.5	1 12.5	4 50.0	8 34.8

Site	Function	Fine-grained	Medium-grained	Large-grained	Totals
	Metate, undifferentiated	4 50.0	3 37.5	1 12.5	8 34.8
	Totals	10 43.5	4 17.4	9 39.1	23
LA 86780	Indeterminate fragment	2 50.0	0 0.0	2 50.0	4 18.2
	Abrader	1 100.0	0 0.0	0 0.0	1 4.5
	Mano, undifferentiated	2 22.2	5 55.6	2 22.2	9 40.9
	One-hand mano	1 100.0	0 0.0	0 0.0	1 4.5
	Metate, undifferentiated	4 57.1	1 14.3	2 28.6	7 31.8
	Totals	10 45.5	6 27.3	6 27.3	22

It is interesting that there are no great differences in mean weight between thermally altered and unaltered ground stone at either site. The average weight of thermally altered ground stone from LA 86774 is 93.29 g, but this is skewed upward by a single artifact that weighed over 1,835 g. With that specimen removed from the sample, average weight is reduced to 57.00 g. This is very close to the mean weight of unaltered specimens, which average 59.14 g. Thermally altered artifacts from LA 86780 had a mean weight of 84.53 g, while unaltered specimens average only slightly less at 78.54 g. Since the mean size of specimens in both assemblages is similar, they may all be part of the same populations. If so, it is likely that there was little use of these tools for grinding, and most or all were hearth stones.

While we have already discussed the distribution of thermally altered specimens, the distribution of unaltered ground stone artifacts has not yet been covered. The locations in which unaltered ground stone artifacts were found are shown for both sites in Table 13-7. Only a few specimens were from features, including a heating pit at LA 86774 (Feature 11) and a hearth at LA 86780 (Feature 7). Several specimens were also found near hearths at both sites. At LA 86774, one specimen (angular break) was found near Feature 1, two were near Feature 2 (one with an angular break), and three were near Feature 3 (both with angular breaks). At LA 86780, five specimens were found near Feature 9, one was near Feature 18 (angular break), and two were near Feature 21 (both with angular breaks). Since the breaks on most of these artifacts resemble those caused by heat, they probably were used as hearth stones. Five additional specimens from LA 86774 and four from LA 86780 also have angular breaks. Thus, 52.2 percent of the unaltered ground stone artifacts from LA 86774 and 45.5 percent from LA 86780 were either found in thermal features or exhibit breaks resembling heat fractures.

Table 13-7. Distribution of unaltered ground stone artifacts for each site

Excavation Area	LA 86774	Number in Features	LA 86780	Number in Features
EA-1	15	3	3	0
EA-3	5	0	3	0
EA-8	-	-	1	1
EA-9	-	-	5	0
Outside excavation areas	2	0	10	0
Backhoe trench	1	0	-	-

Only a few ground stone artifacts from both sites exhibited no signs of thermal use. But does this mean they represent tools used at the sites, or were they simply not broken in a way that is diagnostic of thermal use? Because of our previous results, we assume the latter in most cases. Only one complete tool from LA 86774, a one-hand mano, was not thermally altered. The other unbroken tool from this site is a shaped slab that was both thermally altered and found in a heating pit. Only one metate fragment from this site is large enough to be used, but it was burned and exhibited an angular break pattern. Was it used in a thermal feature, or could it have been salvaged from another site for use as a grinding stone, even though it was previously used as a heating element? Unfortunately, we cannot answer this question. Neither whole tool from LA 86780 was thermally altered, and no fragments were large enough to be reused. Thus, we can only be reasonably certain that one artifact from LA 86774 and two from LA 86780 represent in situ use of ground stone tools. Most fragments were probably used as heating elements, and we suspect that the few remaining examples functioned similarly, but do not exhibit overt signs of thermal alteration.

Discussion

Documentary Evidence for Use of Ground Stone as Hearth Elements

The recycling of ground stone tools as hearth elements is an interesting pattern on these sites and appears to be rather common in the Jornada Mogollon region. Most of the grinding tools recovered by O'Laughlin and Greiser (1973:25) at the Northgate site were broken, leading them to suspect use as hearth stones, though no direct evidence of heat-fracturing was noted. O'Laughlin (1979:54) indicates that several ground stone tool fragments from the Transmountain Campus sites were apparently reused as heating elements. While investigating several sites on White Sands Missile Range, Oakes (1981:53) noted that 47 percent of her ground stone artifacts were unidentified because they were small and either weathered or burned. This suggested that ground stone tools were reused as heating elements when no longer suitable for their original purposes. She also notes a close association between ground stone and hearths or pits (Oakes 1981:98-99).

Hard (1983b:68) recovered only 17 ground stone artifacts during excavations at the Castner Range on Fort Bliss but noted that about 65 percent were found in or near hearths and frequently burned or heat-fractured. Most were only lightly worn. During an extensive survey in the Southern Tularosa Basin, Carmichael (1986a:200) found that ground stone tools were common in hearths and notes that this appears to be a common pattern for the region. He suggests that this reflects the recycling of ground stone tools as hearth stones, noting that many exhibit only light to moderate wear. Camilli et al. (1988) surveyed a large parcel of land around Santa Teresa, including our project area. Over one-third of the ground stone artifacts found were used as hearth elements (Camilli et al. 1988:6-48). Most ground stone artifacts from this survey were unidentifiable fragments, and only 11 percent were whole.

During testing and excavation at numerous sites on White Sands Missile Range, Duncan and Doleman (1991) found that 46 percent of ground stone artifacts were thermally altered. Leach (1994:124) notes that predominantly fragmentary ground stone tools were recovered during a survey of the eastern Hueco Bolson and attributed this to use as hearth elements. Finally, Whalen (1994a:110) recovered 256 pieces of ground stone at the Turquoise Ridge site in the Hueco Bolson and indicates they were often badly deteriorated from use as hearth stones.

Assumptions and Empirical Evidence for Ground Stone Recycling

While this survey of the literature is by no means comprehensive, it should serve to demonstrate that reuse of ground stone tools as hearth elements was common in this region and has been recognized for a number of years. It may be that this form of recycling was most common in inner basins, where suitable stone other than small pebbles and caliche was hard to come by. In several cases the fragmented condition of assemblages led investigators to suspect this type of use in the absence of more direct evidence of thermal alteration. This is consistent with some of our findings: not all pieces of ground stone that were apparently used in hearths have fractures or altered colors diagnostic of this use.

This problem has been approached by others, but their conclusions are often based on assumptions, though empirical data are occasionally provided by analysis or experiments. Carmichael (1983, 1986a) was one of the first to posit this question, but few data were offered to substantiate his conclusions. Some of Carmichael's assumptions were tested by Camilli et al. (1988) with data from the Santa Teresa area. They found that many of his assumptions were not supported by their data. For example, Carmichael (1983:191) suggested that sandstone and granitic manos went through different reduction sequences because the latter left the cycle earlier through use as hearth stones. Camilli et al. (1988:6-54) found no evidence to support the contention that certain materials had longer use-lives than others. They also criticize Carmichael's (1983:201) suggestion that distance from rock sources dictated the types of stones used in hearths, since both caliche and discarded ground stone artifacts could be considered locally available materials (Camilli et al. 1988:237). However, Carmichael (1986a:200) did feel that ground stone tools were purposely cached on sites for future use, and this is similar to the concept of local availability suggested by Camilli et al. (1988).

Camilli et al. (1988) make several other suggestions that are less well supported by data. Large-scale recycling of ground stone tools is evidenced by heavy use-wear on the small percentage of whole tools found, a relatively high percentage of thermally altered tools, and a high percentage of broken tools overall. The material that most commonly showed evidence for thermal alteration was quartzite. However, this was not attributed to the predominant selection of quartzite for this use; rather, they feel that it was simply more friable than other materials (Camilli et al 1988:6-54):

> The West Mesa groundstone data do not indicate strong evidence for the more intensive use of sandstone than of volcanic rock. . . . Looking at artifact size class as an indication of the degree of artifact fragmentation, quartzite is more highly fragmented, perhaps because of the qualities of the stone itself, than are other material types. Overall higher frequencies of volcanic rock than of sandstone do appear to have been used as hearth rock, but a greater volume of the latter as indicated by the distribution of items among size classes was used in hearths. (Camilli et al. 1988:6-60)

Carmichael's analysis of ground stone from the Southern Tularosa Basin suggests another important characteristic of these assemblages. Not only were ground stone tools common in hearths, they also rarely exhibited evidence of heavy use before being recycled (Carmichael 1986a:200). As he notes: "Fire-cracked manos are commonly found which exhibit only light to moderate wear. Only rarely are examples of groundstone tools recorded which are worn through. Even specimens that show no modification beyond initial shaping have been used as hearth stones" (Carmichael 1986a:200). When grinding tools were needed for processing food they were carried from site to site or cached in or near the area where future use was expected to occur. They may sometimes have been obtained from abandoned sites, but this probably only occurred under certain circumstances, such as when need was not anticipated. At other times the existence of ground stone tools on earlier sites might have been known from previous use of an area, and their reuse could have been planned for. However, if there was overlap between band territories, it was always possible that the tool could have been salvaged by others. Thus, this strategy might include a risk factor that would usually not occur with purposely cached and concealed tools.

In most cases the need for grinding tools was probably planned for, and scavenging on earlier sites was specifically focused toward the acquisition of materials to be used as hearth elements. Many of the tools recycled in this way may not have been extensively used before they were discarded or abandoned, hence the large number of minimally used but thermally altered ground stone artifacts.

In order to provide baseline evidence for the use of stone as hearth elements, Duncan and Doleman (1991) conducted several experiments. Their study focused on only two materials: monzonite (a granitic rock) and caliche. This allowed them to define certain break patterns as diagnostic of specific uses. In particular, there appear to be differences in the reaction of materials used for stone boiling versus those used for roasting. Caliche used for both purposes experienced a change in color, darkening when it was heated (Duncan and Doleman 1991:319). However, when caliche was used for stone boiling it tended to fall apart during the second use, so this material is unsuitable for extended service. Monzonite provided more satisfactory results. As Doleman and Duncan (1991:322-323) note:

> Though the functional implications are tentative and continued experimentation is needed, recognizable and distinctly different fracture patterns have been confirmed. In general, the breakage patterns of rocks exposed to intense heating and slow cooling (presumably similar to conditions in prehistoric hearths and roasting pits) is a planar to curvilinear fracture pattern often parallel to the rock's outer surface. Those rocks exposed to rapid cooling (expected from stone boiling or steaming) tend to exhibit jagged fractures that are often perpendicular to the surface and produce irregular, blocky fragments.

Thus, jagged and blocky breaks seem related to use in stone boiling, while straight or curved breaks are more indicative of hearth stone use.

Certain other tendencies were recognized in their study that are similar to the results of others researchers. While over 91 percent of artifacts made from monzonite were thermally altered, only 12 percent of their sandstone tools were similarly changed by heat (Duncan and Doleman 1991:330). Unfortunately, sandstone was not included in their experiments, leading them to conclude:

> The current lack of demonstrably consistent criteria identifying thermal alteration in sandstone may have resulted in a failure to recognize substantial numbers of thermally altered sandstone, especially in light of the fragmentary condition of the bulk of the groundstone assemblage. Another possibility is that, while sandstone was a popular material for groundstone tools, it may have been less suitable and was thus not favored for use in hearths. This seems unlikely, however, given that sandstone's thermal properties differ only slightly from those of granitic rocks such as monzonite. . . . It seems quite possible that the characteristics that make certain materials suitable for groundstone manufacture and use, such as high silica content and induration, are related to the thermal properties that make them suitable for use in thermal features. Thus regular or at least expedient recycling of worn out groundstone for use in hearths might be expected to be common. (Duncan and Doleman 1991:330)

As others have also concluded, they feel that the fragmentary nature of many of the sandstone artifacts may indicate thermal use. More importantly, they note that the thermal properties of sandstone and granitic materials are similar, so one should not have been selected for use over the other. The large difference in the percentages of these materials that were demonstrably used in hearths is attributable to the lack of experimentally derived attributes for sandstone that are characteristic of such use (Duncan and Doleman 1991:342).

These studies suggest several tendencies that should be applicable to our assemblage. Certain materials appear to exhibit characteristics diagnostic of thermal alteration, while others may not. In particular, igneous materials and quartzite seem to fracture in ways that are diagnostic of such use. This may be less common with other materials, especially sandstone. However, in the absence of more direct evidence, the fragmentary nature of most sandstone tools may indicate thermal use. Examination of our assemblages shows that many sandstone artifacts exhibit blocky and angular fractures similar to those caused by heat on igneous rocks and quartzite, and this attribute can probably be extended to other materials with some confidence. Other sandstone artifacts exhibit an obvious change in color related to thermal use. But many fragmentary tools that lack these characteristics nonetheless seem to have been used as hearth elements. Type of use and degree of heating may have a lot to do with this lack. Where stone boiling might fracture sandstone in the same way as other materials, hearth stone use may not cause similarly diagnostic breaks. Alterations in color are probably related to the amount of heat applied and the presence of ferrous inclusions, so unless sandstone was heated to the proper temperature and contained the necessary iron compounds, there may be no obvious evidence of thermal use.

It is also possible that heat was not directly responsible for all fracturing of ground stone tools. Most whole manos and metates were probably too large to be used as hearth elements and were broken up to more efficiently function in that manner. Thus, many ground stone tools may have been fractured intentionally, and if only a small amount of heat was applied or they were used in a reducing atmosphere, there would be little visible thermal alteration. Unfortunately, this is speculative and needs to be further investigated with experimental data that do not currently exist.

Reexamination of the Data: Ground Stone Recycling at Santa Teresa

As we concluded earlier, there is little evidence to suggest that many of the ground stone artifacts from LA 86774 and LA 86780 were actually used at those sites. Rather, most appear to have been scavenged from other locales and recycled as hearth elements. We have presented a series of arguments that include both direct and indirect evidence for thermal use. As other researchers have done, we used the locations in which unaltered artifacts were found as well as their condition to suggest that most functioned as hearth stones. How do our results compare with those of others?

First, like the other studies discussed earlier, less than 3 percent of the artifacts from each of our assemblages were whole. While all ground stone artifacts from LA 86774 could at least be assigned to generic tool categories (e.g., undifferentiated manos and metates), nearly 30 percent of the ground stone artifacts from LA 86780 were too fragmentary to be classified at even that level. As noted earlier, there are no great differences between the mean weights of thermally altered ground stone artifacts versus those that were not, provided we discount the large fragment from LA 86774, which skews that sample. It may be important that ground stone artifacts are an average of 30 percent smaller at LA 86774 than at LA 86780. The former site was occupied up to 2,000 years later than the latter, and the smaller size of these artifacts may reflect repeated use as hearth elements. It is logical to assume that the more they were used, the smaller they became. Thus, one would expect hearth elements to be smaller on later sites if they were recycled several times.

Table 13-8. Thermal alteration and break patterns by material (frequencies and row percentages)

Site	Material	Thermal Alteration and Angular Break	Angular Break, No Thermal Alteration	Other Type of Break, No Thermal Alteration	Totals
LA 86774	Undifferentiated igneous	6 60.0	3 30.0	1 10.0	10 18.9
	Sandstone	15 71.4	4 19.0	2 9.5	21 39.6
	Quartzite	1 100.0	0 0.0	0 0.0	1 1.9
	Quartzitic sandstone	12 57.1	2 9.5	7 33.3	21 39.6
	Totals	34 64.2	9 17.0	10 18.9	53 100.0
LA 86780	Undifferentiated igneous	10 100.0	0 0.0	0 0.0	10 16.1
	Rhyolite	1 100.0	0 0.0	0 0.0	1 1.6
	Sandstone	22 81.5	3 11.1	2 7.4	27 43.5
	Quartzite	1 100.0	0 0.0	0 0.0	1 1.6
	Quartzitic sandstone	14 60.9	6 26.1	3 13.0	23 37.1
	Totals	48 77.4	9 14.5	5 8.1	62 100.0

Sandstone and quartzitic sandstone dominate both assemblages. The latter material is actually more of a quartz arenite, which is only slightly better cemented than sandstone. Thus, when various forms of sandstone are combined they comprise between 80 and 85 percent of each assemblage. Igneous materials make up between 14 and 16 percent of each assemblage, and less than 2 percent is quartzite.

Table 13-8 shows combinations of thermal alteration and breakage patterns for each site. Only fragmentary artifacts and those for which breakage patterns were defined are included. What is most interesting about this table is that all thermally altered ground stone artifacts exhibit angular (blocky) breaks. This may support our contention that artifacts with angular breaks that lack other evidence of thermal alteration were indeed used as hearth elements. Less than 20 percent and 10 percent, respectively, of the LA 86774 and LA 86780 samples do not exhibit angular breaks or other evidence of thermal alteration. Ninety percent of these artifacts from LA 86774 and all from LA 86780 are either sandstone or quartzitic sandstone. Thus, only one ground stone artifact in this sample that is not a form of sandstone possessed no evidence of thermal alteration.

The difficulty of determining whether or not certain artifacts were thermally altered is shown by the assemblage from Feature 11 on LA 86774, a probable heating pit. A variety of materials are represented in this assemblage (Table 13-9), including many unshaped chert and igneous pebbles that were probably available on-site. Less than 30 percent of these artifacts evidenced signs of thermal alteration, though it is likely that all were heated before being placed in the feature. Only sandstones exhibit visible thermal alteration. Most of these materials would not have even been considered artifacts had they been found elsewhere on the site.

Table 13-9. Condition of materials from Feature 11, LA 86774 (frequencies and row percentages)

Material	Altered	Not Altered	Totals
Chert	0 0.0	5 100.0	5 4.8
Undifferentiated igneous	0 0.0	24 100.0	24 23.1
Rhyolite	0 0.0	6 100.0	6 5.8
Thunderbird rhyolite	0 0.0	7 100.0	7 6.7
Sandstone	27 69.2	12 30.8	39 37.5
Quartzite	0 0.0	2 100.0	2 1.9
Quartzitic sandstone	3 16.7	15 83.3	18 17.3
Caliche	0 0.0	3 100.0	3 2.9
Totals	30 28.8	74 71.2	104 100.0

Conclusions

While it is impossible to state conclusively that all fragmentary ground stone artifacts on these sites were used as hearth elements, it is equally impossible to determine which, if any, did not function in that way. We have lost much of our theoretical perspective because of this. Ground stone artifacts can provide important information about site formation processes as well as subsistence. Unfortunately, the amount of recycling of these materials that seems to have occurred at our sites and throughout the region makes it difficult to consider in detail any of the theoretical perspectives presented earlier.

Transportability and caching were mentioned as important factors in the logistics of a foraging strategy for balancing mobility with the need to use heavy ground stone tools for processing certain types of food. No caches of tools were found at our sites, indeed there was a definite lack of whole or otherwise useable ground stone tools. Because these sites probably remained fairly accessible for a long time after abandonment, they were open to scavengers seeking rock for use as hearth elements or raw material for the production of tools. Indeed, ground stone tools could have been cached at these sites and recovered for reuse a season or so later, and we would never know they were once present. Considering Schlanger's (1991) conclusions, it is likely that both sites were prone to salvaging after they were abandoned, and this has probably skewed the percentage of whole tools downward.

Unfortunately, the lack of moderately compete tools and the possibility that many if not all of the fragmentary tools were obtained from other sites for use as hearth stones rather than grinding implements makes it impossible for us to address the questions raised by Nelson and Lippmeier's (1993) study. There simply is not enough information available on manufacturing technology, and it is hard to trust material selection data because we don't know whether it reflects use as ground stone tools or hearth elements. However, the latter seems most likely, and if this is so the prevalence of nondurable materials suggests limited use of these sites according to Nelson and Lippmeier's (1993) criteria.

Similarly, there is no way to assess the question of grinding efficiency. There does not appear to be any evidence for a staged corn grinding strategy, but it is impossible to determine whether this is an accurate reflection of the way in which vegetal materials were processed or is simply due to a skewing of the data because of material recycling. For the most part, metate fragments are too small to allow definition of the types of tools represented. Indeed, the only food processing tools that could be categorized are seven slab metate fragments from LA 86774 and one-hand manos from both sites. While through-trough metates do not seem to occur in either assemblage, the scale of material recycling makes it difficult to be certain of this. Similarly, the small size of metate fragments in both assemblages precludes determination of functional differences between various morphological categories.

With only one complete mano in each assemblage, it is difficult to assess them in light of Hard's (1986) findings concerning the relationship between mano length and mobility. At 8.3 cm long, the one-hand mano from LA 86780 is well within the range of mobile hunter-gatherer manos in his study, as is the specimen from LA 86774, which is 9.45 cm long. However, since only one example is available from each site and a range of lengths is required for accurate comparison, little meaning can be ascribed to this.

In some ways the results of this study are disappointing, yet in other ways they provide important information. The fragmentary nature of most artifacts and the close association between ground stone and thermal features suggests that the vast majority of these artifacts represent materials that were recycled as hearth elements. While this does not permit us to discuss food processing activities, it does tell us much about the scale of material recycling. And if these assemblages reflect this degree of recycling of materials from earlier sites, how did later occupations affect them in turn? Unfortunately, while we can suggest what artifacts were salvaged for reuse from earlier sites we cannot similarly determine what artifacts were removed from our sites by later occupants. However, it is likely that the array of intact stone tools at these sites, both ground and chipped, were seriously depleted by later salvagers.

In light of this analysis, the sizes of the ground stone assemblages from these sites are illusory. Very few of these tools seem to have been used for their original purpose at either site. Rather, most appear to be evidence for the recycling of materials from earlier sites for use as heating elements. It is equally likely that if ground stone tools were used at these sites, most were either removed at the time of abandonment or at a later date for use elsewhere.

SANTA TERESA PROJECT CERAMICS TRENDS

C. Dean Wilson

This chapter presents information resulting from the analysis of 290 sherds from LA 86774 and 17 sherds from LA 86780. Pottery was rare at these sites compared to other artifact types, which may reflect patterns resulting from the short-term or seasonal nature of occupations. Data regarding ceramic distributions from both sites provide an opportunity to examine a number of issues regarding the Jornada Mogollon occupation of this area. These concerns include determination of the time of occupation of ceramic-bearing components; characterization of potential patterns of vessel production, exchange, and use; and identification and examination of postdepositional patterns of breakage and wear. In order to accomplish these goals, descriptive attributes and typological categories were recorded for all sherds analyzed. Unfortunately, the general absence of change and variation in the form and decoration of Jornada Mogollon pottery often restricts the recognition of specific temporal occupations as well as the examination of other issues. Some recent studies of Jornada pottery, however, have employed strategies to document patterns associated with the few attributes that may have gradually changed in the largely undecorated and homogeneous ceramic assemblages associated with most occupations of this area (Seaman and Mills 1988; Whalen 1994a). In order to establish continuity with previous studies, many of the same categories and conventions utilized by others are used here. The strategy adapted in this study involved both the recording of various ceramic type categories that have been defined and used by archaeologists in this area as well as the recording of various descriptive attributes.

The recording of descriptive attributes forms the basis for documentation of a variety of temporal, spatial, technological, and functional trends. Attributes recorded for all sherds included temper, pigment, surface manipulation, wall thickness, paste profile, vessel form, rim profile, and modification and wear. Refired paste color was recorded for a small subsample of sherds. Definitions of recognized categories are presented in "Field and Analytic Methods."

The recognition of ceramic types allows for the documentation of most temporal trends and serves as a basis for comparison with ceramics described during other projects. An attempt was made to utilize an analysis system similar to those previously employed by archaeologists in this area, though minor revisions were made in the conventions and terminology used. Type categories included El Paso Brown Rim, El Paso Brown Body, Mimbres Style Corrugated, Slipped Brown, and Unpainted Polished White Ware. The definitions of ceramic type categories employed during this analysis are presented in "Field and Analytic Methods."

The following discussion focuses on patterns noted for sherds recovered during this investigation. Distributions of various ceramic type and attribute categories are first used to determine the potential time of occupation for sites and components. Next, various distributions are used to examine issues including patterns of vessel production, exchange, and use, as well as postdepositional influences.

Dating of Sites

The use of ceramic distributions to date sites and components turned out to be an extremely tricky task. Difficulties encountered in assigning ceramic dates to various assemblages reflect both the very conservative nature of pottery technology and change in the Jornada region and the general absence of independently dated sites. The conservative nature of Jornada ceramic technology is reflected by the very long-lived dominance of brown ware ceramics exhibiting very similar ranges of paste, temper, and surface manipulation. Such similarities have resulted in the placement of most sherds from sites in this area into a small range of analogous El Paso Brown Ware types. Ceramic dating studies in the Jornada region have relied on a variety of comparisons, including cross-dating intrusive types from better dated sites in other regions, use of painted brown wares (such as El Paso Polychrome) to recognize later occupations, and examination of potential changes and trends in surface treatment and rim shape of local brown ware sherds (Lehmer 1948). Given the small number of sherds normally recovered from sites in this region, attempts to date small assemblages using relatively rare types can easily result in sampling error and skewed dates. Still, the very presence of painted brown wares, dated intrusive types, and certain rim profiles may contribute important information regarding the relative time of occupation of a Jornada site or component.

The ceramic occupation of the southern Jornada area has long been divided into a three-phase chronology: the Mesilla (A.D. 200 or 500 to 1100), Doña Ana (A.D. 1100 to 1200), and El Paso (A.D. 1200 to 1400+) phases. The earliest ceramic period (the Mesilla phase) is mostly represented by pithouse occupations and is identified ceramically by the introduction of plain brown ware ceramics between A.D. 200 and 500. It ends about A.D. 1100 with the introduction of local painted types (Lehmer 1948; Whalen 1994a). Pottery may not be common in components dating to the very early Mesilla phase and could be absent from components dating to this phase. Because the presence of pottery forms the basis for phase recognition, Mesilla components lacking pottery would usually not be recognized. Sites dating to this phase are overwhelmingly dominated by undecorated pottery that would be classified here as El Paso Rim or El Paso Body (Hard 1983b; O'Laughlin 1980). Intrusive types may be completely lacking at Mesilla phase sites, even when relatively large assemblages are represented. Intrusive types that are sometime present in components dating to this phase include Mimbres Black-on-white, Mimbres Corrugated, San Francisco Red, and Alma Plain (Lehmer 1948). Some studies have attempted to document certain technological changes associated with the long-lived production of El Paso Brown vessels by lumping these sherds into a series of subtypes distinguished by combinations of paste and surface characteristics (Carmichael 1985a) or through the independent recording and monitoring of potentially sensitive attributes (Whalen 1981b, 1994a). These examinations indicate gradual changes in El Paso Brown Ware pottery which may include a decrease in temper size and an increase in fineness of surface finish and surface hardness through time (Whalen 1994a).

Plain ware vessels appear to have been gradually replaced by painted vessels during the Doña Ana phase (Whalen 1977). Vessels exhibiting painted decoration in one color may represent the first decorated type produced in this area. The Doña Ana phase is thought to date between A.D. 1100 and 1200 and is often characterized by a mixture of ceramic types or attributes defined for the Mesilla and El Paso phases (Carmichael 1986a; Lehmer 1948). Such a definition results in difficulties in distinguishing Doña Ana sites from those containing a mixture of ceramics derived from earlier and later phases. Intrusive types that may be present during the Doña Ana phase include Mimbres Classic Black-on-white, Playas Red Incised, Mimbres Corrugated, Chupadero Black-on-white, Three Rivers Red-on-terracotta, and St. Johns Polychrome. El Paso Polychrome is present at Doña Ana sites but retains a number of El Paso Brown traits including evenly shaped rim profiles (Whalen 1981b).

It is sometimes assumed that a shift toward the almost exclusive production of El Paso Polychrome vessels occurred by the beginning of the El Paso phase. It is likely, however, that the production of some unpainted El Paso Brown vessels continued into the early El Paso phase (Seaman and Mills 1988a). Thus, one can not automatically assume that an assemblage with both El Paso Polychrome and El Paso Brown Rim sherds definitely dates before the El Paso phase. The frequency of unpainted El Paso Brown sherds, however, is significantly lower in El Paso phase components than in those associated with the preceding period. Unfortunately, the total frequency of El Paso Polychrome at a given site may vary significantly depending on conventions in type assignment. Obviously, conventions where unpainted sherds are assigned to El Paso Polychrome result in the identification of much higher frequencies of this type. El Paso Polychrome associated with later occupations is characterized by consistently everted rims of varying wall thickness (Whalen 1981b). A low frequency of textured brown wares may also be present in El Paso phase components, and a very large number of intrusive types may occur. Other Jornada types include Lincoln Black-on-red and Three Rivers Red-on-terracotta. Western Pueblo types include Heshotauthla Polychrome and St. Johns Polychrome. Salado types include Gila Polychrome and Tucson Polychrome. Eastern pueblo types include Chupadero Black-on white, Galisteo Black-on-white, and various Rio Grande Glaze wares. Mexican types include Ramos Black, Ramos Polychrome, Playas Red, Casas Grandes Incised, Carretas Polychrome, Villa Ahumada Polychrome, Madera Black-on-red, and Babicora Polychrome.

Ceramic Dating of LA 86774

Distribution of types associated with the 290 sherds recovered from LA 86774 are illustrated in Table 14-1. The determination of period and integrity of occupation of ceramic bearing components at LA 86774 proved difficult and illustrates potential problems associated with the assignment of dates to small assemblages in this region. Both the associated architecture and radiocarbon dates that spanned the seventh century seemed to indicate a Mesilla phase occupation at LA 86774 (see "The Structure of Archaeological Remains at the Mockingbird Site [LA 86774]"). An occupation dating to this phase for the entire site would have been easily supported by the dominance and associated traits of the El Paso Brown Ware sherds had it not been for seven sherds from a single El Paso Polychrome vessel. The painted sherds classified as El Paso Polychrome were very similar to those assigned to El Paso Body except for the presence of decorations in wide lines applied in a very thin and faded black organic paint and red pigment.

Table 14-1. Distribution of ceramic types from Santa Teresa project sites (frequencies and column percentages)

Ceramic Type	LA 86744	LA 86780	Total
El Paso Brown rim	10 3.4	1 5.9	11
El Paso body	269 92.8	6 35.3	275
Corrugated brown	0 0.0	10 58.8	10
El Paso Polychrome	7 2.4	0 0.0	7
White-slipped brown	2 0.7	0 0.0	2
Unpainted white	2 0.7	0 0.0	2
Total	290	17	307

An examination of vertical and spatial associations of sherds recovered from LA 86774 resulted in placement of 26 sherds into a lower (Early Formative) group and 217 sherds into an upper (Late Formative) group (see "Conclusions: Interpreting Cultural Remains at the Santa Teresa Port-of-Entry"). An examination of type distributions associated with these components (Table 14-2) indicated slight differences, which could be of potential significance. With the exception of a single white ware sherd, all pottery from the early component represented unpainted brown wares. While unpainted brown ware body and rim sherds dominated the later component, a low frequency of El Paso Polychrome sherds was also present. These differences could reflect variation between earlier Mesilla phase and later Doña Ana or El Paso phase occupations. Attempts were made to fine-tune the dating of LA 86774 by examining the distribution of all sherds from the site as well as by comparing sherds associated with the two general components.

Given the absence of painted sherds from the early component, it is likely that all of these sherds were derived from plain brown wares, as would be expected during the Mesilla phase, though great caution should be exercised in any interpretation based on such a small sample. An important issue is whether most of the unpainted El Paso Brown Rim and Body sherds from the upper component could be from El Paso Polychrome vessels (Late Formative) or exhibit characteristics expected for sherds from El Paso Brown Ware vessels dominating the Early Formative period. Examination of the nine sherds classified as El Paso Brown Rim from this component showed they belong to a minimum of five vessels. At least four of these sherds were large enough or associated with enough sherds from the same vessel to indicate that they were definitely from unpainted vessels. These observations contrast with distributions noted at later El Paso phase sites. For example, El Paso Brown Rim sherds were clearly absent from the 740 sherds examined from Pickup Pueblo, although 28 sherds of El Paso Polychrome were identified (Garcia 1988:53).

Distribution of attributes recorded during the analysis of unpainted El Paso Brown Ware sherds from LA 86774 may be compared with those described for other sites in this area to examine various temporal trends. Rim profiles of El Paso Brown sherds from LA 86774 are tapered or angled, and walls tend to be even in thickness beginning close to the rim (Whalen 1981b, 1993). These profiles are similar to the range of variation noted in relatively Early Formative assemblages. Attempts have been made to quantify changes in wall thickness noted in rim profiles through the development of a rim sherd index (RSI) measurement (Carmichael 1983, 1985a; Seaman and Mills 1988a; West 1981; Whalen 1980a), which may reflect changes in vessel size and shape. This index attempts to quantify changes in profile and thickness of rim sherds by calculating the ratio of wall thickness 2 (as the numerator) and 15 mm from the rim. Seven rim sherds were large enough to make measurements to calculate a RSI ratio. All the ratios were under 1, and the average was 0.89. This is very similar to ratios previously described for El Paso Brown rim sherds but differs for those described for later El Paso Polychrome sherds (Seaman and Mills 1988a; Whalen 1980a).

Table 14-2. Distribution of ceramic types from early and late contexts at LA 86744 (frequencies and column percentages)

Ceramic Type	Early Formative	Late Formative	Total
El Paso Brown rim	1 3.8	9 4.1	10
El Paso body	24 92.3	201 92.6	225
El Paso Polychrome	0 0.0	7 3.2	7
Unpainted white	1 3.8	0 0.0	1
Total	290	17	307

Another comparison involved the recording of average wall thickness. The average vessel thickness of the 279 plain brown ware sherds from LA 86774 was 5.8 mm. Interestingly, at 7.8 mm the average thickness was much greater for brown ware sherds from the lower component than for most other Mesilla phase sites (Whalen 1994a). Sherds from the upper component averaged 5.5 mm thick, which is similar to average thicknesses for known Mesilla phase sites but thicker than the average for Late Formative period sites (Whalen 1994a:88). Average wall thickness for the seven El Paso Polychrome sherds was 5.4 mm.

Surface finish on El Paso Brown sherds from later assemblages tends to be finer or more smoothed or polished than those associated with earlier phases (Whalen 1994a). Interiors and exteriors of El Paso Brown sherds from LA 86774 are dominated by smoothed or polished surfaces similar to those dominating later Mesilla phase assemblages. A higher ratio (72 percent) of the sherds from the lower component are unpolished than from the upper component (58.5 percent). This further indicates that sherds from the lower component could be associated with an earlier Mesilla phase occupation.

Unfortunately, the absence of well-dated intrusive types at this site limits the potential of cross-dating. Two brown ware sherds appear to exhibit heavily worn slips and could be from vessels originating in the Mimbres region. However, production of white-slipped brown wares in the Mimbres region was very long lived and extended from about A.D. 800 to 1200. The two obvious intrusive sherds represent unpainted white wares exhibiting some sherd temper and could be from the Mimbres or Southern Anasazi country.

In summary, characteristics of the brown ware pottery dominating LA 86774 indicate that despite the presence of a few painted sherds, plain brown wares from both the lower and upper components exhibit combinations of traits similar to those described for Early Formative sites. Despite the very small sample represented, examinations of both sherd thickness and surface polishing support an earlier (Mesilla phase) date for the lower component. Interestingly, if it were not for the seven painted sherds, the ceramic assemblage from the upper component could also have easily been assigned to the Mesilla phase. Furthermore, had it not been for two sherds exhibiting decorations in more than one color, that component would have been assigned to the Doña Ana phase.

For the later component, the presence of sherds from both El Paso Plain and El Paso Polychrome vessels could indicate an intermediate occupation during the Doña Ana or very early El Paso phase, when both plain and painted El Paso Brown Ware vessels were produced. Another possibility considered was that a mixture of sherds from a Mesilla phase occupation, such as that represented by the lower component, and a smaller El Paso phase component were represented. This possibility, however, was rejected based on stratigraphic position and relationships among artifacts. Interpretations from previous dating studies with similar combinations of types to those noted in this study vary considerably. For example, in many studies the co-occurrence of El Paso Rim and El Paso Polychrome and Bichrome sherds have been used to suggest a transitional Doña Ana phase occupation. Conversely, during a large survey of the Hueco Bolson, Whalen (1978) did not recognize this transitional phase. Instead he attributed assemblages exhibiting this combination of types to two distinct temporal components. Mauldin (1993) also placed all sites examined during the DIVAD project into the Mesilla or El Paso phase and classified sites previously assigned to the Doña Ana phase as mixed Mesilla and El Paso phase sites. However, the apparent association of El Paso Rim and El Paso Polychrome sherds in the upper component at LA 86774 and differences in characteristics of El Paso sherds from the two components seem to indicate the presence of an intermediate rather than mixed occupation. This suggests that changes in ceramic assemblages were very gradual and that the upper levels of LA 86774 were occupied sometime between the Mesilla phase and the later El Paso phase.

Ceramic Dating of LA 86780

A total of 17 sherds was recovered during the excavation of LA 86780. Ten sherds exhibit local temper and pastes along with a plain corrugated polished exterior surface similar to those seen in Mimbres Corrugated. All of these sherds are from a single vessel. In addition, four of the sherds classified as Plain Brown Body clearly were also from this corrugated vessel. Other sherds from this site include two El Paso Body sherds and one El Paso Rim sherd, derived from at least two vessels. While very low frequencies of similar textured wares with local temper and pastes have occasionally been identified, dates usually have not been assigned to this type given difficulties associated with their identification (Mills 1988). Given the association of Mimbres style pottery, an eleventh or twelfth century date (late Mesilla or early Doña Ana phase) is suggested. The ceramic-based dating assignment of these contexts is contradicted by the absolute dates, which indicate Middle and Late Archaic occupations. This suggests that the sherds were associated with higher strata that were mechanically removed before excavation and could have reached these levels through natural or mechanical disturbance.

Ceramic Patterns

Despite an emphasis on the use of ceramic data to date sites and components, the analysis of these sherds also provides information on the production, exchange, and use of vessels, as well as postdepositional processes. Since LA 86780 is represented by an extremely small ceramic sample probably belonging to three vessels, examinations of various trends were limited to patterns noted at LA 86774.

Resource Use and Production Technology

Analysis of pastes and tempers associated with El Paso Brown Ware types from all contexts indicate the use of very similar clays and tempers. Temper in all brown ware sherds consists of similar looking angular fragments, indicating the use of similar sources. While petrographic analysis (Hill, this volume) indicates that all brown ware sherds examined were tempered using crushed granite, variation in the degree of weathering of the feldspars was observed. This variation probably represents the use of at least two major paste composition groups, possibly reflecting distinctive source areas.

In order to identify potential sources of ceramics, samples of clay from five alluvial deposits and 35 sherds were fired to the same standardized oxidizing conditions. Four of the alluvial samples were from deposits filling an abandoned channel along the Rio Grande near Ysleta, Texas; the fifth was collected at the edge of La Mesa in the Rio Grande Valley near El Paso. All clay samples and El Brown Ware sherds fired to a very narrow range of dark red colors (Munsell readings of 2.5YR 4/6 and 1.5YR 3/6), indicating that alluvial clays were probably used to manufacture these vessels. The only sample that did not fire to this color range was from an intrusive white ware sherd which fired to a buff color, which further indicates that this type was not locally produced. While the clay sample from La Mesa was too small to submit for petrographic analysis, samples from near Ysleta were examined and did not resemble the paste of any of the sherds from our sites (see Hill, this volume).

While most of the El Paso Brown Ware sherds examined are relatively soft, paste characteristics indicate they were well-fired at a relatively high temperature or that the clays mature (vitrify) at relatively low temperatures. Fired clay samples were also relatively soft. Since refiring studies indicate that similar high-iron clays were used in the production of all El Paso Brown Wares, an examination of paste cross section may provide clues concerning the firing technology associated with this pottery. Such clays fired in a reducing atmosphere should exhibit dark gray to black profiles, while firing in an oxidizing atmosphere should result in reddish or brown colors. Table 14-3 shows that a combination of cross-section profiles are represented. A slight majority of the brown ware sherds exhibit brownish or reddish exteriors with a distinct dark gray to black core. About a third exhibit a dark gray to black profile, and the remaining exhibit a red color throughout the cross section. These cross sections indicate that most vessels were initially exposed to a reducing atmosphere but were oxidized during the later part of the firing.

Table 14-3. Exterior surface manipulation, LA 86774 (frequencies and row percentages)

Type	Reddish or Brown	Reddish with Distinct Core	Dark Gray or Black	White or Gray	Total
El Paso body	29 10.8	148 55.0	92 34.2	0 0.0	269
El Paso Brown rim	0 0.0	2 20.0	8 80.0	0 0.0	10
White-slipped brown	0 0.0	2 100.0	0 0.0	0 0.0	2
El Paso Polychrome	0 0.0	7 100.0	0 0.0	0 0.0	7
Unpainted white	0 0.0	0 0.0	0 0.0	2 100.0	2
Total	29	159	100	2	290

Functional Trends

Data concerning the relative frequency of pottery along with various characteristics may provide important information concerning functional trends. If the deposition of lithic materials occurred at a consistent rate, ratios of sherds to chipped stone artifacts may provide information concerning the relative use and breakage rates of ceramics. Previous comparisons of overall ceramic to chipped stone ratios in the northern Mogollon region indicate an increase in the overall frequency that may be associated with increased sedentism (Hayden and Wilson 1994). An examination of ceramic to chipped stone weight ratios from the Mockingbird site does indicate an increase in the frequency of sherds to chipped stone. For the lower component this comparison creates a score of 0.33, indicating that the total weight of sherds is about a third that of the chipped stone. This score is similar to but slightly lower than that of early pithouse sites in the Mogollon Highlands (Hayden and Wilson 1994). In contrast, similar comparisons in the upper component yielded a score of 1.8, which indicates that the total weight of sherds is almost twice that of the chipped stone. This ratio is between that noted for Pithouse and Pueblo period sites in the northern Mogollon region. This variation in ratios may indicate a significant increase in the utilization and breakage of vessels, even at seasonal sites.

Table 14-4. Interior surface manipulation, LA 86774 (frequencies and row percentages)

Type	Missing	Plain Smoothed	Plain Polished	Smooth Striations	Highly Smoothed	White Slipped	Total
El Paso Brown rim	0 0.0	9 90.0	0 0.0	0 0.0	1 10.0	0 0.0	10
El Paso Brown body	3 1.1	189 70.3	28 10.4	3 1.1	46 17.1	0 0.0	269
White-slipped brown	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	2
El Paso Polychrome	0 0..0	7 100.0	0 0.0	0 0.0	0 0.0	0 0.0	7
Unslipped, unpainted	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	2
Total	3	205	30	3	47	2	290

Distributions of forms and decorations may provide information concerning the use or function of these vessels. In many areas of the Southwest, combinations of sherd shape and location of polishing or painted decorations provide clues concerning associated vessel forms (Wilson and Blinman 1995). For example, in most Southwestern traditions, jar body sherds can be identified by the presence of decorations or polishing on the exterior surface only, while bowl sherds are recognized by decoration or polishing on the interior. Unfortunately, this does not appear to be as useful for Jornada assemblages, particular those generally lacking painted decorations. An examination of the El Paso Brown Rim sherds from LA 86774 indicates that there was often no association between vessel shape and the presence or location of polishing. Therefore, no attempt was made to recognize various vessel forms based on the presence or location of polish, although information concerning this attribute is reflected in the categories used and illustrated in Tables 14-4, 14-5, and 14-6. Attempts to recognize specific vessel forms were limited to rim and jar neck sherds exhibiting shapes characteristic of a particular form. The fact that most (90.6 percent) represent body sherds limits the functional inferences that can be made. The small number of rim sherds indicate a variety of forms are represented, including bowls, seed jars, and necked jars with varying diameters. This indicates that despite their lack of decoration, El Paso Brown Ware vessels appear to have been used for a wide range of activities, including cooking, storage, and serving.

Table 14-5. Exterior surface manipulation, LA 86774 (frequencies and row percentages)

Type	Missing	Plain Smoothed	Plain Polish	Polished and Striated	Highly Smoothed	Total
El Paso Brown	11 4.1	155 57.6	23 8.6	1 0.4	79 29.4	269
El Paso rim	0 0.0	9 90.0	0 0.0	0 0.0	1 10.0	10
White-slipped brown	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	2
El Paso Polychrome	0 0.0	0 0.0	7 100.0	0 0.0	0 0.0	7
Unpainted white	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0	2
Total	11	164	32	1	82	290

While most attention about the conservative nature of brown ware technology in the Jornada region has usually focused on chronological concerns, the apparent lack of any significant change in surface forms over many centuries may also have important functional implications. El Paso Brown Ware ceramic assemblages exhibit characteristics similar to the earliest pottery produced in the Mogollon Highlands, Hohokam, and Anasazi regions. Like El Paso Brown wares, ceramics associated with the earliest Southwestern occupations tend to be relatively rare, and the earliest pottery from these regions represents undecorated polished brown wares produced with high-iron alluvial clays and often exhibiting a dark paste (Whittlesey et al. 1994; Wilson and Blinman 1994). A wide range of forms are associated with these early brown wares, including bowls, seed jars, and necked jars. Such ceramics are often associated with groups that practiced agriculture but remained fairly mobile and dependent on wild food sources. Characteristics of ceramics produced in many regions of the Southwest changed significantly by the beginning of the seventh century, when both painted and textured decorations along with ware distinctions become more prevalent. Such changes seem to correlate with increasingly sedentary lifestyles that may have resulted in increased specialized use, differentiation, and decoration of pottery vessels. For example, the increased distinction of decoration, paste, and form between utility and decorated wares may reflect increased reliance on specialized activities associated with sedentary agriculture, including the boiling and serving of corn, rather than the very generalized vessel assemblages associated with earlier mobile or seasonal strategies. The lack of such a shift in ceramics in much of the Jornada region may reflect the continuation of mobile or seasonal patterns of plant and game exploitation similar to those associated with earlier occupations elsewhere in the Southwest (Whalen 1994a).

Table 14-6. Basic form categories, LA 86774 (frequencies and row percentages)

Type	Indeterminate	Body Sherd, Both Sides Unpolished	Body Sherd, Both Sides Polished	Body Sherd, Interior Polished	Body Sherd, Exterior Polished	Jar Neck	Necked Jar Rim	Bowl Rim	Seed Jar Rim	Total
El Paso Brown body	13 4.9	215 79.9	15 5.6	10 3.7	7 2.6	6 2.2	1 0.4	2 0.7	0 0.0	269 92.8
El Paso rim	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	5 50.0	2 20.0	3 30.0	10 3.4
White-slipped brown	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 0.7
El Paso Polychrome	0 0.0	0 0.0	0 0.0	0 0.0	1 14.3	6 85.7	0 0.0	0 0.0	0 0.0	7 2.4
Unpainted white	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	0 0.0	2 0.7
Total	13	217	15	10	8	12	6	6	3	290

Other evidence of ceramic-related activities may be reflected in postfiring modification of sherds. Obvious evidence of postfiring modifications are one sherd with a drill hole and a shaped item with an incomplete hole in its center. Other sherds exhibit evidence of modification by natural postdepositional processes. This type of modification is reflected by 35 sherds (12.1 percent of the sherds from LA 86744) representing small shaped forms. Three additional sherds probably represent fragments of naturally shaped forms. The size, shape, and wear patterns of all these items were remarkably similar. They exhibited wear along the entire sherd edge, usually resulting in an oval to round shape, although squarish shapes with rounded edges were sometimes present. The surfaces as well as the sides of these artifacts often exhibit evidence of wear or abrasion. Most of these items are fairly uniform in size and usually measure between 13.3 to 27.6 mm in diameter and average about 20 mm. They are very similar to specimens found in significant frequencies at other sites in the area, which have been classified as modified sherds or scraping tools (Lehmer 1948; Hard 1983b), and I initially regarded them as tools. However, the high frequency of modified items and the general lack of similar tools in assemblages from other areas of the Southwest resulted in suspicion concerning the use of these items as tools. This suspicion was supported by microscopic examination of the worn edges, which showed the lack of directional abrasion and the types of grooves present on intentionally shaped sherds. It is likely, then, that these items were naturally shaped by sand and wind action, and their common occurrence in sites in this area reflects both the softness of the sherds and the weathering effects of high winds and shifting sand dunes. A fairly large amount (15.2 percent) of the sherds from the upper components exhibited such modifications, while they were absent in the lower components. This may indicate that the conditions for such modifications were more prevalent in upper levels of the dune.

Thus, while these shaped items do not appear to represent tools, they may provide important clues concerning postdepositional processes and contexts at LA 86774. Examination of the grids from which these modified sherds were recovered indicated that while they were spread over much of the site, they were mainly concentrated along grid lines 608N and 609N. The association of such a large number of naturally modified sherds probably indicates long exposure to weathering by wind and sand, and suggests that much of this site was exposed to erosion for long periods of time.

Conclusions

Detailed characterizations of the small sample of sherds recovered during excavations at the Santa Teresa Port-of-Entry provided important information concerning the dating of various contexts and associated trends. Despite the strong similarities of ceramics from all components examined during this study, a careful comparison of types and attributes for sherds from the lower and upper contexts of LA 86774 indicates the presence of at least two distinct temporal components. The lower component appears to date to the Mesilla phase, while the later component dates to the Doña Ana or early El Paso phase. The few sherds from LA 86780 probably reflect an occupation during the late Mesilla phase, though they were probably not associated with the features or other materials encountered at this site. Despite slight differences in the range of attributes noted in sherds from temporally distinct components, the strong similarities in pastes, technological, and surface attributes of the sherds examined reflect the long term use of similar resources, ceramic technologies, and vessel forms. The conservative nature of ceramic change in the Jornada area, including the general absence of surface texture and decorations, may ultimately reflect long-lived conservative mobile strategies influenced by the environment of this area.

PETROGRAPHIC ANALYSIS OF BROWN WARE SHERDS
FROM LA 86774 AND LA 86780

David V. Hill

Petrographic analysis of a sample of brown ware ceramics from LA 86774 and LA 86780 was conducted. Twenty-one sherds of undifferentiated El Paso Brown Ware and one sherd of El Paso Polychrome were examined from LA 86774. Two sherds of undifferentiated El Paso Brown Ware and one sherd of Mimbres Corrugated constituted the petrographic sample from LA 86780. In addition, four samples of clay recovered from an abandoned river channel located in the lower El Paso Valley near Ysleta, Texas, were subjected to analysis.

Results of Analysis

LA 86774

Sample 19-1: El Paso Brown. The paste of this sherd is reddish brown and birefringent. The paste contains approximately 20 percent very fine to medium subangular to rounded quartz or altered feldspar grains. A few black opaque inclusions were also observed. The paste of this sherd was tempered using crushed alkali granite porphyry. Rock fragments and isolated mineral grains range from coarse to very coarse and constitute about 15 percent of the paste. The alkali feldspars range in appearance from fresh to slightly altered. Some micrographic intergrowth of quartz and alkali feldspar were observed.

Sample 21-1: El Paso Brown. The paste and temper of this sample strongly resemble that of the previous sample. The major difference between the two is that in Sample 21-1 the alkali feldspars display patch and ribbon-type microperthritic intergrowths of albite more commonly than in Sample 19-1.

Sample 45-1: El Paso Brown. The paste of this sherd is an opaque dark brown and contains in excess of 30 percent very fine to fine subrounded quartz and altered feldspar grains. The sample was tempered using a crushed alkali granite porphyry. The feldspars appear fresh and resemble those observed in the previous two specimens.

Sample 77-1: El Paso Brown. The paste color and granite temper of this specimen closely resemble those of Specimens 19-1 and 21-1. A single grain of mica schist was observed in the present specimen.

Sample 100-1: El Paso Brown. The paste of this sherd is a dark reddish brown and contains about 10 percent subangular to subrounded quartz and feldspar grains. The paste was tempered using a crushed granite porphyry. The feldspars are heavily kaolinized, although some Carlsbad and microcline twinning were observed in a few of the less altered specimens.

Sample 181-1: El Paso Brown. The paste color and granitic temper closely resembles that of the previous sample.

Sample 265-1: El Paso Brown. The color of this paste is a reddish brown, and it contains approximately 15 percent very fine to fine subrounded to rounded quartz and altered feldspar grains. The sherd was tempered using crushed alkali granite porphyry. The granite in this specimen contained trace amounts of brown biotite and green-brown hornblende.

Sample 329-1: El Paso Brown. The paste and color of this sherd closely resemble those observed in Sample 19-1.

Sample 336-1: El Paso Brown. The reddish brown sandy paste and granite porphyry temper of this sherd strongly resemble those observed in Sample 19-1.

Sample 372-1: El Paso Brown. The paste and temper of this specimen closely resemble those observed in Sample 19-1.

Sample 380-2: El Paso Brown. The paste and temper of this specimen closely resemble those observed in Sample 19-1.

Sample 412-1: El Paso Brown. The paste and granite temper of this sherd resemble those of Sample 19-1. However, the present specimen contains slightly more reddish brown biotite than observed in Sample 19-1.

Sample 418-1: El Paso Brown. The paste of this sherd is an opaque black mottled with a lighter brown. The paste contains approximately 15 percent very fine to fine and from subangular to subrounded quartz and altered feldspar grains. The paste is tempered using crushed granite porphyry. The feldspars range from slightly clouded to altered to opaque.

Sample 447-1: El Paso Brown. The paste of this sherd is a reddish brown and slightly briefrengent. The paste is tempered using a crushed equigranular (?) granite. The particle size of this material is continuous from medium to very coarse-grained and constitutes about 30 percent of the ceramic paste. The finer particles observed in the paste may also represent natural inclusions in the source of the ceramic clay. A few rounded black opaque coarse inclusions were also present. The alkali feldspars appear fresh to slightly altered. The most distinguishing feature of this sherd is that brown biotite constitutes approximately 5 percent of the ceramic paste and was also present in the source of the ceramic clay.

Sample 456-5: El Paso Polychrome. The paste and granite temper of this sherd resemble those of Sample 19-1.

Sample 493-5: El Paso Brown. The paste and granite temper of this sherd strongly resemble those of Sample 19-1.

Sample 494-2: El Paso Brown. The paste and granite temper of this sherd strongly resemble those of Sample 19-1.

Sample 556-1: El Paso Brown. The paste and granite temper of this sherd resembles those of Sample 418-1.

Sample 574-1: El Paso Brown. The paste and granite temper of this sherd strongly resemble those of Sample 19-1.

Sample 577-2: El Paso Brown. The paste of this sherd is an opaque black. Very fine to fine subrounded quartz and altered feldspar constitute approximately 30 percent of the ceramic paste. The paste is tempered using a porphyritic alkali granite. Some ribbon-type microperthritic intergrowths of albite are present within the fairly fresh alkali feldspar. A few microcline grains were present, and a few contained poikilitic quartz.

Sample 587-3: El Paso Brown. The paste and granite temper of this sherd strongly resemble those of Sample 577-2.

Sample 588-1: El Paso Brown. The paste and granite temper of this sherd resemble those of Sample 19-1. However, the present specimen also contains some microcline.

LA 86780

Sample 4-2: El Paso Brown. The paste and temper of this sherd resemble those of Sample 19-1 from LA 86774. However, the paste of this specimen contains approximately 20 percent very fine to fine subrounded quartz and altered feldspar inclusions. This material is likely to represent natural inclusions in the paste.

Sample 5-1: Mimbres Corrugated. The paste of this sherd is a black opaque color mottled with a slightly briefrengent dark brown. Very fine to fine rounded quartz and altered feldspar grains that constitute about 5 percent of the paste were observed. The paste was tempered using a crushed equigranular granite. The feldspars appear fresh, with some alteration to sassurite and clay minerals. Ribbon-type microperthritic intergrowths of albite were observed in some of the alkali feldspar grains. Plagioclase was present and also appeared fresh.

Sample 575-1: El Paso Brown. The paste and granite temper of this sherd strongly resemble those of Sample 4-2.

Clay Samples from 41EP3625

The four clay samples did not resemble the paste of any of the sherds. The clay is a bright red and contains very fine to fine rounded to subangular grains of quartz, alkali feldspar, and plagioclase that make up less than 10 percent of the clay matrix.

Discussion

Two major paste compositional groups were recognized during the course of this analysis. While all of the sherds examined from LA 86774 and LA 86780 were tempered using crushed granite, considerable variation in the degree of weathering of the feldspars was observed.

Samples 91-1, 21-1, 45-1, 77-1, 265-1, 329-1, 336-1, 375-1, 380-2, 412-1, 456-5, 493-5, 494-2, 574-1, and 588-1 from LA 86774, and 4-2 and 575-1 from LA 86780 contain alkali feldspars with a fresh appearance. The alkali feldspars in this group also display ribbon-like microperthritic intergrowths of albite. Some of the feldspar grains also display granophyric texture, that is, the intergrowth of alkali feldspar and quartz. Quartz grains displayed a slightly undulose extinction. All of the sherds contained some reddish brown biotite. However, Sample 447-1 contains almost 5 percent brown biotite in the paste. Brown hornblende was also observed, but only in trace amounts, except in Sample 265-1, which contained more hornblende than any other specimen. Hornblende still constituted less than 1 percent of the added ceramic temper in Sample 265-1.

A smaller number of sherds were tempered using a granite in which the feldspars displayed a greater degree of alteration. This group of sherds included Samples 100-1, 181-1, 418-1, 556-1, and 447-1 from LA 86774, and 5-1 from LA 86780. The nearest source of granite to the Santa Teresa area is the Franklin Mountains, some 24 km to the east. Two granite producing formations are present in the Franklins: an unnamed granite porphyry and the Red Bluff Granite complex. The unnamed granite porphyry was emplaced earlier than the Red Bluff Granite complex. The Red Bluff Granite complex occurs primarily on the west side of the Franklins. It is highly variable, though the feldspars usually appear fresh with little alteration. This granite is usually massive and equigranular but also contains a zone of porphyritic alkali granite. Another facies of the Red Bluff Granite contains abundant brown biotite (Ray 1982). It is not unlikely that the sherds containing the alkali feldspar grains that display little weathering were produced using temper derived from the Red Bluff Granite complex.

The feldspars within the unnamed granite porphyry have been kaolinized, masking most of the twinning striations. Minerals present within the granite porphyry include quartz and, in minor quantities, chlorite, sassurite, biotite, muscovite, and hornblende (Deen 1974). The major area of outcrop lies on the east side of the Franklin Mountains. Brown ware sherds tempered with granite porphyry and temper derived from the Red Bluff Granite complex have been reported throughout the Jornada Mogollon cultural sequence on the eastern side of the Franklin Mountains (Hill 1988a, 1988b).

Sample 5-1 from LA 86780 represents an example of indented corrugated ware. The paste of this sherd is characterized by a sandy dark opaque paste containing approximately 35 percent crushed granite, with fragments ranging from coarse to very coarse. Crushed granite has been observed as the predominant ceramic temper in corrugated vessels from the Mimbres Valley (Rugge 1976). The general similarity of the paste and temper of this specimen to the granite porphyry tempered specimens suggests that this vessel was produced using locally available materials. Additional types of analysis would be necessary along with comparison of Mimbres Corrugated sherds from the Mimbres Valley to see whether this sherd could have been produced in the El Paso area or the Mimbres Valley.

The clay samples do strongly resemble the paste of some of the Historic period native-made brown wares produced in the lower El Paso Valley from sometime in the early seventeenth century to the late nineteenth century (Hill 1990). Limited ethnographic information based on interviews with Tigua potters from Ysleta, Texas, indicated that utility vessels were made using clays derived from terrace deposits along the Rio Grande and that no additional temper was added (Hedrick 1971).

BOTANICAL REMAINS FROM ARCHAIC TO FORMATIVE PERIOD SITES IN THE MESILLA BOLSON

Mollie S. Toll and Pamela McBride

Flotation samples from two sites in the southeast corner of Doña Ana County provide some insight into the record of plant utilization by prehistoric populations living in the Chihuahuan desert scrub zone of the Mesilla Bolson. Floral data derive from 37 samples taken from structures and features dating to the Middle and Late Archaic periods (LA 86780) and the Formative period (LA 86774).

The Mesilla Bolson is an intermontane lowland basin in extreme south-central New Mexico. This area is bordered on the east and west by mountains (the Organ and Franklin Mountains to the east and the Sierra de Las Uvas and the Potrillo Mountains to the west). The floodplain of the Rio Grande widens within the basin to form the Mesilla Valley, a fertile bottomland. O'Laughlin (1980) describes the highly variable terrain on the western edge of the Rio Grande floodplain as the West Mesa. Today, this area is a northern finger of the (largely Mexican) Chihuahuan desert scrub zone. The extent of this vegetation zone has expanded considerably due to post-A.D. 1850 grazing pressure on plains-mesa and desert grasslands (Donart 1984).

Two vegetation communities are discernible (Nials 1988). Coppice dunes form around mesquite (*Prosopis*), resulting in barren interdunal areas. Additional ground cover taxa include yucca (*Yucca*), broom-dalea (*Dalea scoparium*), saltbush (*Atriplex*), a small sagebrush (*Artemisia*), creosote (*Larrea*), Mormon tea (*Ephedra*), grasses (Gramineae), and snakeweed (*Gutierrezia*). Vegetation occurs in greater density and diversity on aggrading parabolic dunes. Soaptree yucca dominates here, accompanied by many of the same taxa mentioned above, plus prickly pear and several annuals.

There is widespread agreement that the area's prehistoric vegetation differed from what can be seen today. Territorial survey records of the nineteenth century describe grama grass–dominated mesas along the southern reaches of the Rio Grande (York and Dick-Peddie 1969). Dick-Peddie (1993:132) discusses the possibility that presence of yucca and fluff grass and absence of tarbush may indicate recent succession, providing more arguments for prehistoric presence of grassland in the Santa Teresa area.

Previous research conducted in the Tularosa Basin, the Hueco Bolson, and the Mesilla Bolson has resulted in the recognition of land use and subsistence patterns common to all three intermontane basins. This broader area serves as a reasonable basis for discussion and comparison. Archaic settlement includes sites in various topographic situations presumed to reflect seasonal procurement ventures such as collecting agave hearts in the mountain foothills or gathering mesquite and annual seed plants in the lower basin (Brethauer 1978; Carmichael 1981). To date, there is little direct evidence of these postulated subsistence activities outside of cave sites (Cosgrove 1947; O'Laughlin 1977b) and O'Laughlin's (1980) studies at Keystone

Dam Site 33 (possibly a longer-term winter camp), where possible carbonized yucca or agave carpel fragments were recovered with charcoal, and charred seeds included mesquite, two cacti, sedge, and several edible weeds. In particular, we lack evidence of sequestered species at the smaller sites to indicate species-specific collection (unhandily, the small sites are precisely those where preservation tends to be poorest and recovery of perishables most difficult).

In the ensuing Formative period, Mesilla phase settlement apparently continues with a general pattern of high residential mobility, and some aggregation and longer-term residency in winter villages in the Rio Grande corridor and along side drainages. Smaller foraging or logistical camps continue to appear in the same variety of topographic settings, presumably as staging grounds for gathering and processing of specific plant products during various intervals of the seasonal round. Archaeobotanical analyses at many of the limited-activity sites of this period have been confounded by little (Donaldson and Toll 1981a; M. Toll 1983, 1987) or no (Scott 1985; M. Toll 1986, 1995) cultural plant remains other than wood charcoal to document what economic enterprises actually took place at these sites. Two sites from this time period had exceptional preservation of plant remains. Samples from Turquoise Ridge (on the edge of the Hueco Bolson; Whalen 1994a) and the Wind Canyon site (on the eastern slope of the Eagle Mountains, 160 km southeast of El Paso; Bohrer 1994) document the use of a variety of summer- to fall-ripening annuals, perennials, and grasses as well as agricultural crops. Cactus spines and agave/yucca and agave fiber were three of the fortuitously preserved plant remains from this time period at Wind Canyon offering evidence of specialized plant collection and processing.

Little is actually documented from the succeeding Doña Ana phase. Though characterized by Lehmer (1948) as a transitional period with surface adobe structures in association with pit structures, and with increased settlement aggregation accompanying greater subsistence focus on agriculture, there are few archaeological cases available to verify these descriptions. Only two sites have been well documented from this phase. There is evidence that agriculture was practiced at Meyer's Pithouse Village (no botanical analyses per se, but beans and corn noted as present; Scarborough 1986), but there is no botanical information to accompany pit structures at Hueco Tanks near El Paso (Kegley 1982).

Finally, the El Paso phase is considered to be a time of increased agricultural dependence, when populations were living in adobe pueblos, largely clustered along the Rio Grande or at the base of alluvial fans on the margins of the basins. Small camps occur in all environmental zones and have been interpreted (as in previous time periods) as loci for specialized plant collection forays. Archaeobotanical analyses from this time period indicate the cultivation of corn, beans, and squash (Ford 1977; O'Laughlin 1977b) as well as the continued exploitation of leaf succulents (Bohrer 1994; O'Laughlin 1977b).

Table 15-1. Flotation results for the Santa Teresa site

Time period	Middle Archaic		Late Archaic								
Feature group	EA-8		EA-5				EA-4				
Feature	7	14	2	9		22	3		4	24	
Feature description	oval hearth	oval hearth	oval hearth	circular hearth/ roasting pit		bilobed hearth	bowling pin-shaped hearth		bilobed hearth/ roasting pit	irregularly shaped hearth	
Sample type	scan	full	full	full	scan	full	full	scan	full	full	scan
Soil volume	2.5	3.6	3.0	2.0	2.3	1.9	1.5	2.5	3.0	2.2	1.0
Cultural remains											
Annuals											
Helianthus											
Unidentified seed											
Grasses											
Sporobolus	+										
Total	+										
Noncultural remains											
Annuals											
Amaranthus											
Boerhavia											
Compositae									0.3		
Euphorbia			0.7	34.5	+	0.5	1.3	+	35.0	2.3	+
Helianthus			0.3						1.3		
Ipomoea									0.3		
Malvaceae											
Unid. seed											
Unknown 9095				-	+						
Unknown 9170									0.6		
Grasses											
Cenchrus		0.6	0.3						6.3	0.5	-
Sporobolus									3.0		
Totals	-	0.6	1.3	34.5	-	0.5	1.3	-	46.8	2.8	-

Table 15-1 (continued). Flotation results for the Santa Teresa site

Time period	Late Archaic							Unknown	
Feature group	EA-1							Isolated Features	
Feature	5	18	19	20		21		10	23
Feature description	oval hearth/ roasting pit	circular hearth	irregular lobed hearth	oval lobed hearth		circular hearth/ roasting pit		oval hearth	oval, lobed probable hearth
Sample type	full	full	full	full	scan	full	scan	full	full
Soil volume	1.7	1.2	1.2	2.2	2.2	3.0	2.5	1.7	2.3
Cultural remains Annuals									
Helianthus				-	+				
Unid. seed			1.7						
Grasses									
Sporobolus									
Total			1.7						
Noncultural remains Annuals									
Amaranthus				0.5	-				
Boerhavia				0.5	-				
Compositae		0.8							
Euphorbia	6.5	0.8	1.7	44.5	++	-	+	0.6	2.6
Helianthus	0.6								
Ipomoea									
Malvaceae	0.6								
Unid. seed	1.2								0.4
Unknown 9095	2.4								2.6
Unknown 9170									
Grasses									
Cenchrus	0.6	0.8		0.5	-	0.3	-		
Sporobolus									
Total	11.8	0.24	3.4	46.0	-	0.3	-	0.6	5.6

Full-sort samples: numbers=standardized number of seeds/liter of original soil sample.
Scan samples: + = 1 to 10 seeds; ++ = 11 to 25 seeds.

Results

Santa Teresa Site (LA 86780)

The two hearths dating to the Middle Archaic (EA-8) yielded charred dropseed grass seeds and the uncharred bristled burrs of sandbur (Table 15-1). Dropseed's myriad tiny seeds were an important prehistoric plant resource harvestable from July through August. The uncharred burrs of sandbur are modern contaminants from a grass that prefers the contemporary sand dune habitat at the Santa Teresa site.

Three residential groups of Late Archaic features were sampled. Samples from EA-1 were the only ones that yielded any charred plant remains. Feature 19, an irregularly shaped lobed hearth, produced charred unidentified seeds, and Feature 20, an oval lobed hearth, yielded charred sunflower seeds. With such a paucity of remains it is unfortunate that the condition of seeds from Feature 19 precluded identification. Sunflowers are disturbed-ground annuals growing today around playa margins. Their high-oil-content seeds generally mature in August and September and could have been a valuable resource. Uncharred seeds recovered from flotation samples included spurge, sunflower family, two different unknowns, dropseed, sandbur, sunflower, morning glory, amaranth, mallow family, and spiderling, all of which probably represent modern contaminants. Mesquite charcoal (Table 15-2) was consistently recovered from thermal features of Middle and Late Archaic periods. A single instance of unidentified nonconifer charcoal was noted in Feature 17 (EA-1).

Table 15-2. Species composition of wood charcoal for the Santa Teresa site (weight in grams, row percentages)

Taxa	Feature 4 Hearth/ Roasting Pit	Feature 7 Hearth	Feature 9 Hearth/ Roasting Pit	Feature 14 Hearth	Feature 17 Hearth
Unidentified, probably mesquite	0.04 100.0	0.08 100.0	0.01 100.0	0.03 100.0	0 0.0
Unidentified	0 0.0	0 0.0	0 0.0	0 0.0	0.01 100.0
Total	0.04 100.0	0.08 100.0	0.01 100.0	0.03 100.0	0.01 100.0

Two isolated hearths (Features 10 and 23) did not contain enough organic material for radiocarbon dating. Only noncultural seed remains were present, including spurge, an unidentified seed, and an unknown.

Mockingbird Site (LA 86774)

Three hearths associated with the Mesilla phase were sampled at LA 86774 (Table 15-3). The scan sample analyzed from Feature 7 hearth fill contained charred purslane seeds.

Table 15-3. Flotation results for the Mockingbird site

Time period	Early Formative		Late Formative										Formative		
Feature	7		Pit Structure 1	Pit Structure 1	Pit Structure 1	1		2		10		11	3	8	
Context	hearth fill		fill, Level 5	fill, Level 6	floor contact	fill, hearth west of Pit Structure 1		fill, hearth west of Pit Structure 1		fill, hearth east of Pit Structure 1		fill, heating pit on Pit Structure 1 floor	hearth fill	hearth fill	
Sample type	full	scan	full	full	scan	full	scan	full	scan	full	scan	full	scan	full	scan
Soil volume	11.3	8.8	0.67	5.4	2.3	3.9	2.8	3.4	2.0	6.9	5.9	3.3	2.8	11.3	15.0
Cultural Annuals															
Helianthus						4.6	+							0.1	+
Portulaca	-	+		-	+					0.3	-				
Unid. seed						0.7	-			0.4	-	-	+	0.44	-
Grasses															
Sporobolus				0.9	+	-	+	0.6	-					3.3	++
Total	-	-		0.9	-	17.6	-	0.6	-	0.7	-	-	-	3.84	+
Non-cultural Annuals															
Amaranthus	0.2	-												-	+
Compositae								-	+						
Euphorbia	0.4	+	1.1	0.7	-	4.4	+	1.2	+	0.3	+	0.6	-	5.9	+
Helianthus	-	+						7.9	+					0.6	+
Paperveraceae	0.09	-													
Portulaca								0.6	-						
Grasses															
Sporobolus	0.2	+	1.1					0.3	-					-	+
Unid. Seed	-	+						-	+						
Total	0.89	-	2.2	1.6	-	22.0	-	10.6	-	1.0	-	0.6	-	10.34	-

Full-sort samples: numbers = standardized number of seeds/liter of original soil sample.
Scan samples: + = 1 to 10 seeds; ++ = 11 to 25 seeds.

Purslane produces tart, succulent leaves and stems, edible from June to September, and seeds which mature in August and September. Neither the preparation method (boiling as a potherb) or the fleshy nature of the leaves allow for preservation, so that only seeds are expected to survive as a record of possible multiseason use. The full-sort and scan samples both yielded modern uncharred seeds, including amaranth, poppy family, spurge, sunflower, and dropseed. The Feature 3 hearth yielded only one unidentified charred seed. Feature 8 was more productive, yielding charred sunflower and dropseed seeds. Uncharred modern amaranth, spurge, dropseed, and sunflower seeds were also recovered from Feature 8.

One shallow pit structure and four features were sampled from early Late Formative contexts at LA 86774. Pit Structure 1 and Feature 1 and 2 hearth samples all produced charred dropseed seeds. Feature 10 (hearth) and Pit Structure 1 samples yielded charred purslane seeds, while charred sunflower seeds were recovered from Feature 1 samples. The rock-filled heating pit on the pit structure floor did not produce any charred plant remains. Uncharred modern seeds recovered from Late Formative samples included spurge, dropseed, sunflower, poppy family, purslane, and sunflower family. Interestingly, the sample analyzed from the pit structure floor did *not* contain any uncharred seeds.

Charcoal was more abundant in LA 86774 proveniences (Table 15-4), probably providing a more accurate picture of wood selection than the tiny samples available from LA 86780. Charcoal in fill and thermal features was again heavily dominated by mesquite (88 to 99.5 percent; Table 15-4). Saltbush charcoal (less than 2 percent) was restricted to Feature 7, and undetermined nonconifer charcoal accounted for 0.5 to nearly 10 percent.

Table 15-4. Species composition of wood charcoal for the Mockingbird site (weight in grams, row percentages)

Taxa	Feature 2 Stratum 5	Structure 1 Stratum 3	Structure 1 Stratum 7	Feature 7 Stratum 10
Prosopis (mesquite)	2.01 96.2	6.49 98.0	6.27 99.5	1.98 88.4
Atriplex (saltbush)	0 0.0	0 0.0	0 0.0	0.04 1.8
Undetermined nonconifer	0.08 3.8	0.13 2.0	0.03 0.5	0.22 9.8
Total	2.09 100.0	6.62 100.0	6.30 100.0	2.24 100.0

Discussion: Evidence of Prehistoric Plant Use in South-Central New Mexico

Thermal Features as Informative Contexts for Plant-Processing Methods

Recovery of perennial plant species presents a complex interpretive problem for sites of the Mesilla Bolson, Hueco Bolson, and Tularosa Basin. Ethnographic studies from the historic era point to a heavy focus on concentrated perennial resources such as leaf succulents, cacti, and mesquite (Basehart 1974; Bell and Castetter 1937, 1941; Castetter and Opler 1936; Castetter et al. 1938). Previous discussions of site function and subsistence strategies have centered on defining small sites consisting primarily of thermal features containing burned rock as special processing camps. Many studies have concluded that small burned rock hearths as well as considerably larger burned rock features from sites excavated in the foothills and basins of south-central New Mexico and northern Texas were predominately used to process leaf succulents (Carmichael 1985a; Gasser 1983; O'Laughlin 1980; Seaman et al. 1987). Interpretations of feature use are based on feature distributions, presence and quantity of burned rock, and distributions of leaf succulents today (O'Laughlin 1979, 1980; Seaman et al. 1987). However, very little direct archaeobotanical evidence exists to reinforce these interpretations. Sites where agave remains have been recovered are in the foothills or valley margins, where agave is easily accessible. Oxalic acid is a component of agave and causes contact dermatitis, providing motivation for processing the plant as close to the source as possible (Buskirk 1986:170; Franceschi and Horner 1980; Johns 1990; Kearney and Peebles 1964:193; Niethammer 1974:4). Buskirk notes that each agave crown can weigh as much as 9.1 kg. Because it was common practice to roast 40 or more crowns at a time, their weight could also have been a compelling factor in the location of roasting pits.

With only one questionable yucca or agave carpel as evidence for the possible processing of leaf succulents during the Archaic period at Keystone Dam Site 33, O'Laughlin (1980:93) still states that the primary function of small burned rock hearths at the site was to "bake leaf succulents such as soap-tree yucca, lechuguilla, and sotol." Evidence of exploitation of other economic plants at this site comes in the form of carbonized seeds of two species of cacti, sedge, and several edible weeds. While it is possible that leaf succulents were processed at Site 33 during the Archaic, it seems more accurate to assume that plant processing included a variety of species.

Plant Utilization over Time

Locations of sites investigated in southern New Mexico and northern Texas for all time periods indicate that a variety of habitats were exploited (Tables 15-5, 15-6, and 15-7). Prehistoric populations living in an environment which is cyclically very dry and very hot might reasonably choose a varying and flexible economic strategy, growing domesticates and journeying to the nearby mountain foothills and higher elevation basins for exploitable resources (see Carmichael 1981, 1986b).

Plant remains recovered from the Santa Teresa sites are compared in Table 15-5 with other sites from the Archaic in the El Paso region, the Tularosa Basin, and the Mesilla Bolson. These archaeobotanical remains reflect the geographic locations of the sites. The richest array of economic plant remains was found at the Keystone Dam site and Fresnal Shelter. Keystone Dam is situated on an alluvial terrace east of the Rio Grande and west of the Franklin Mountains, giving site occupants access to both riverine and montane plant resources. Fresnal

Table 15-5. Charred remains of economic plant taxa at Archaic period and Archaic or Early Mesilla phase sites of the Tularosa Basin and the El Paso region

Taxa	Cox Ranch[1]	Distributional Survey[2]	Doña Ana County Fairgrounds[3]	Fresnal Shelter[4]	Keystone Dam[5]	Santa Teresa Sites
Domesticates						
Beans				+		
Corn				+		
Perennials						
Agave sp.				+		
Bulrush					+	
Coyote gourd				+		
Dock					+	
Four-o'clock				+ root pulp		
Four-wing saltbush				+	+	
Juniper				+		
Lily family		+stalk or pod				
Mesquite				+		
Milkvetch		+?				
Piñon				+		
Prickly pear				+	+	
Squawbush				+		
Tornillo					+	
Turk's cap				+	+	
Yucca		+pod		+	+ possible yucca/agave carpel	
Grasses						
Dropseed		+		+		+
Grass family		+			+	
Love grass					+	
New Mexico feathergrass				+		
Panic grass				+		
Annuals						
Amaranth		+		+		
Cheno-am					+	
Goosefoot	+			+		
Purslane	+	+	+		+	+

Taxa	Cox Ranch[1]	Distributional Survey[2]	Doña Ana County Fairgrounds[3]	Fresnal Shelter[4]	Keystone Dam[5]	Santa Teresa Sites
Smartweed					+	
Sunflower						+
Total taxa	2	7	1	18	12	3

[1] roasting pits, small shelter, hearths (LA 66186, LA 67706, LA 67737; Dean 1994)
[2] pits, pit structures (Unit 45SE, Unit 48NW; O'Laughlin 1988).
[3] pits, small burned rock hearths, pit and dump complexes (Site 030-3895; Dean 1987)
[4] pits, natural strata near rear wall of shelter (Bohrer 1981)
[5] houses, burned rock hearths (Site 33, Zone 4; O'Laughlin 1980)

Table 15-6. Charred remains of economic plant taxa at Mesilla phase sites of the El Paso region.

Site Locations	Basin						Foothills	Valley Margin
Taxa	White Sands[1]	Sunland Park[2]	Fort Bliss 4:84 M[3]	Fort Bliss 3:739, 4:132[4]	Distributional Survey[5]	Mockingbird[6]	Wind Canyon[7]	Turquoise Ridge[8]
Perennials								
Mesquite	+	+		+				+
Hedgehog cactus	+	+		+			+	
Prickly pear	+	+		+			+	
Agave							+	
Yucca				+	+			+
Grasses								
Panic grass								
Dropseed	+					+		+
Weedy annuals								
Bugseed								+
Goosefoot	+			+ (cheno-ams)	+		+	+
Pigweed	+				+			
Purslane	+		+		+	+	+	+
Mallow	+							
Sunflower				+		+		+
Spurge					+			
Sumpweed							+	

Site Locations	Basin						Foothills	Valley Margin
Taxa	White Sands[1]	Sunland Park[2]	Fort Bliss 4:84 M[3]	Fort Bliss 3:739, 4:132[4]	Distributional Survey[5]	Mockingbird[6]	Wind Canyon[7]	Turquoise Ridge[8]
Tansy mustard								+
Carpetweed							+	
Evening primrose							+	
Cultivars								
Beans								+
Corn	+							+
Total taxa	9	3	1	6	5	3	8	10

[1] temporary procurement camp with hearth, fire-cracked rock scatters (Toll 1986b)
[2] campsite (Toll 1993)
[3] hamlet (Ford 1977)
[4] small village (3:739); medium village (4:132; Wetterstrom 1978)
[5] I-1, III-3SE, III-21NW (Scott and Toll 1987)
[6] three hearths
[7] burned rock, Feature 14 (A.D. 1020) (Bohrer 1994)
[8] Minnis and Goldborer (1991)

Table 15-7. Charred remains of economic plant taxa at Doña Ana and El Paso phase sites of the El Paso region

Taxa	Site 37[1]	Sites 288, 1029[2]	Site 4:162E[3]	Three Lakes Pueblo[4]	Wind Canyon[5]	Mockingbird
Domesticates						
Beans				+		
Corn		+ (poss.)		+		
Winter squash				+		
Perennials						
Agave				+?	+	
Agave/yucca					+	
Banana yucca					+	
Hedgehog cactus					+	
Juniper	+					
Locoweed					+	
Mesquite				+		
Prickly pear					+	
Sotol/beargrass					+	
Pitaya cactus			+			
Summer-cypress				+		
Turk's cap cactus			+			
Grasses						
Dropseed						+
Grass family		+				
Annuals						
Amaranth				+	+	
Bugseed				+ (poss.)		
Carpetweed					+	
Cheno-am		+				
Goosefoot				+	+	
Pectis type					+	
Purslane		+			+	+
Sumpweed					+	
Sunflower						+
Sunflower/goldeneye type					+	
Other						
Evening primrose					+	
Mexican buckeye				+		
Spurge					+	

Taxa	Site 37[1]	Sites 288, 1029[2]	Site 4:162E[3]	Three Lakes Pueblo[4]	Wind Canyon[5]	Mockingbird
Sedge					+	
Tepary bean				+		
Total taxa	1	4	2	11	17	3

[1] roasting features, ash stain, hearths, pit structures (Scott 1985)
[2] hearths (Wetterstrom 1980)
[3] hearths (Ford 1977)
[4] hearths (Ford 1977)
[5] central basin of ring midden (Bohrer 1994)

Shelter is in a limestone cliff overhang of Fresnal Canyon in the Sacramento Mountains. The remainder of the sites are situated in arid dunal basins, where resource availability is limited to grasses, weedy annuals, mesquite, and yucca. Purslane is the most widespread seed species recovered, occurring at all the sites except Fresnal Shelter (purslane may have been present in low frequencies; the list of taxa includes only those occurring in 80 percent of proveniences [Bohrer 1981a:Table 6]) and the Santa Teresa site. Prehistoric utilization of purslane in the El Paso area is neatly substantiated by an unusual recovery of a significant volume of these tiny seeds in a Chupadera Black-on-White jar (Phelps 1968). Exploitation of leaf succulents is documented by Camilli et al. (1988), at Fresnal Shelter, and possibly from Site 33 at Keystone Dam. Fresnal Shelter is the only site where agave was positively identified. Evidence for domesticated plant use during the Archaic is restricted to Fresnal Shelter. Bohrer (1981a:45) classifies corn as one of the "less commonly eaten foods" at the shelter, based on constancy and presence ratios of all plant remains recovered. During the Archaic, it would appear that depending on what environmental zone was under exploitation, grasses, annuals, and perennials (including leaf succulents) were all used to a greater or lesser degree, while domesticates played a minor role in the diet.

Table 15-6 compares plant remains recovered from Mesilla phase sites in the El Paso region with those from the Mockingbird site. Purslane seeds continue to be the most common plant remain recovered: samples from six of eight sites yielded purslane. Mesquite and cheno-ams were the second most widely recovered plant remains, in samples from five of the eight sites. Diverse plant assemblages are no longer restricted to sites in the foothills and valley margins but occur in all environmental settings listed in Table 15-6. Cultigens are present at a greater number of sites in basin and valley margin settings, possibly stemming from an increased emphasis on domesticated plants. The most diverse array of plant taxa was recovered from Turquoise Ridge and included corn and the only specimens of domesticated beans. Considering that Turquoise Ridge is on the edge of the Hueco Bolson, the best-watered area between the desert basin zone and the mountain zone, this diversity is not surprising. Evidence of the exploitation of leaf succulents is present at five of the eight sites, but positive identification of agave is limited to Wind Canyon.

Table 15-6 indicates a marked decrease in the diversity of perennial species with respect to the preceding Archaic era (Table 15-5). Sixteen perennial species were present at Archaic period sites. However, the majority of these were recovered from Fresnal Shelter, where protected conditions allowed for the preservation of plant material not usually encountered in open-air sites. The apparent decrease in the diversity of perennials during the Mesilla phase could in fact be an artifact of differential preservation. Fewer grass taxa were recovered from Mesilla phase sites, suggesting that grasses could have been exploited more during the Archaic than the early Formative.

Table 15-7 compares plant remains recovered from the Mockingbird site to those recovered from other Doña Ana or El Paso phase sites in the El Paso region. Domesticated plants may have increased in importance in the diet of Late Formative populations. Remains of domesticated plants were absent from the Late Formative components of the Mockingbird site but have been found at several other Formative period sites (Ford 1977; Wetterstrom 1980). Corn caches in storage pits were discovered by Scarborough (1985) at Anapra Pueblo near Sunland Park, and Brook (1966b:41) notes that 200 bushels of corn were excavated from a village about

64 km north of Hot Well Pueblo in El Paso. In the Late Formative, purslane persists as the most widely recovered plant remain. Wind Canyon had the most diverse plant remains with evidence for the exploitation of several leaf succulents and cacti. A wide array of annuals and perennials (nearly as many as during the Archaic), as well as three grass taxa, were utilized during the Late Formative.

Wood Utilization

Fuel wood selection at the Mockingbird and Santa Teresa sites centered on mesquite, as it does throughout the Mesilla Bolson, Hueco Bolson, and Tularosa Basin (Table 15-8). Significant quantities of *Larrea* were present at Keystone Dam, Site 4:162E, and Three Lakes Pueblo. The proportion of samples with mesquite wood remains at all these sites varies from 67 to 100 percent. Mesquite's admirable fuel qualities (it is a dense wood providing "a bed of hot, slow burning coals" [Ford 1977:200]) are surely responsible for the clear prehistoric preference for this fuel material, even in areas of the El Paso region where it is not particularly abundant today, such as the High Desert Zone on Fort Bliss (Ford 1977:200). The predominance of mesquite charcoal is also significant at sites in the lower elevation zones, where mesquite flourishes today in Chihuahuan Desert Scrub communities (Brown 1982), since the extent and density of mesquite has increased dramatically in this zone in the last hundred years (York and Dick-Peddie 1969). Greater abundance of mesquite in the archeological record than in the contemporary environment (Minnis and Toll 1991:397) points to the particular usefulness and desirability of this fuel type.

Table 15-8. Comparison of wood utilization by site, time period, and location in the El Paso region

Time Period	Archaic		Late Formative		
Site Locations	Basins	Valley Margins	Basins	Valley Margins	Foothills
Agave			E: 15%		H: 33%
Acacia					H: 33%
Artemisia			E: 8%		
Atriplex	A: +; B: 30%		E: 8%		
Chilopsis linearis		C: 6.2%			
Fallugia paradoxa		C: 6.2%			
Larrea tridentata		C: 18.7%	E: 23%		H: 50%
Lycium		C: 6.2%			
Populus fremontii		C: 12.5%			
Prosopis	A: dominant; D: 83%	C: 68.7%	E: 92%; F: 100%	G: dominant	H: 67%
Prosopis/Quercus	B: 90%				
Indeterminate nonconifer	D: 17%		F: 100%		

A: Distributional Survey; B: Doña Ana Fairgrounds; C: Keystone Dam; D: Santa Teresa/Mockingbird; E: Three Lakes Pueblo; F: Mockingbird; G: Site 37; H: 4:162E

Summary

Perhaps the principal attribute of note in the Mockingbird and Santa Teresa site assemblages is continuity of localized plant utilization over a considerable time span. Dropseed and sunflower were recovered from both sites in all time periods, while purslane was recovered from both Early and Late Formative contexts. The seeds of all three taxa usually mature in August or September, indicating a late summer to early fall occupation. However, caution should always be exercised when using archaeobotanical data to indicate seasonality of occupation. The absence of a plant in the archeological record does not necessarily mean it was not utilized in the past. Vagaries of preservation often prevent recovery, especially of rarely used taxa. Wood burned at the Mockingbird and Santa Teresa sites was almost exclusively mesquite, as is the case at most sites, of all ages, in the region. The Santa Teresa and Mockingbird sites could represent seasonal procurement camps among many visited by groups subsisting in a challenging environment, utilizing a varying and flexible economic strategy that involved growing domesticates and foraging for wild resources wherever and whenever possible.

INTENSIVE SYSTEMATIC MICROSCOPY OF POLLEN SAMPLES FROM THE MOCKINGBIRD SITE

Richard G. Holloway

Seven samples were submitted to the Castetter Laboratory for Ethnobotanical Studies at the University of New Mexico for pollen analysis. These samples were collected from a single pit structure at the Mockingbird site (LA 86774). Intensive Systematic Microscopy (ISM) was requested for these samples to ascertain the presence, if any, of cultivated plant materials.

Methods and Materials

Chemical extraction of pollen samples was conducted at the Palynology Laboratory at the Castetter Laboratory for Ethnobotanical Studies (CLES) using a procedure designed for semiarid Southwestern sediments. The method used specifically avoids such reagents as nitric acid, bleach, and potassium hydroxide, which have been demonstrated experimentally to be destructive to pollen grains (Holloway 1981).

From each pollen sample submitted, 25 g of soil were subsampled. Prior to chemical extraction, three tablets of concentrated *Lycopodium* spores (batch 710961, Department of Quaternary Geology, Lund, Sweden; 13,911 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 samples were treated overnight with 35 percent hydrochloric acid to remove carbonates and to release the *Lycopodium* spores from their matrix. After neutralizing the acid with distilled water, 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 250μ 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 overnight in cold 48 percent hydrofluoric acid to remove silicates. After completely neutralizing the acid with distilled water, the samples were treated with a 1 percent solution of tri-sodium phosphate (Na_3PO_4) and repeatedly washed 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.

Heavy density separation ensued using zinc chloride ($ZnCl_2$), with a specific gravity of 1.99 to 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 and treated with glacial acetic acid to remove any remaining water.

Acetolysis solution (acetic anhydride: concentrated sulfuric acid in 8:1 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.

The material was rinsed in methanol stained with safranin, rinsed twice with methanol, and transferred to 2 dram vials with tertiary butyl alcohol (TBA). The samples were mixed with a small quantity of silicone oil (1,000 cks) and allowed to stand overnight for evaporation of the TBA. The storage vials were capped and are permanently stored at CLES. The remaining soil samples were returned to the Office of Archaeological Studies at the Museum of New Mexico in Santa Fe.

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 either 400X or 1,000X oil immersion to obtain a positive identification to either 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. This was done to establish a baseline estimation of pollen concentration values and provide an estimate of the number of marker grains present per transect. The latter information was needed for later calculations. 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.

Total pollen concentration values were computed for all taxa. 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. Rare pollen types tend to constitute less than 1 percent of the total assemblage with this method. 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:

$$PC = \frac{K * \sum_p}{\sum_L * S}$$

Where:

PC = Pollen concentration
K = *Lycopodium* spores added
$\sum_p$ = Fossil pollen counted
$\sum_L$ = *Lycopodium* spores counted
S = Sediment weight

The following example should clarify this approach. Taxon X may be represented by a total of 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.

ISM utilizes a variation of the formula for computing pollen concentration values. After examining each slide, the mean number of marker grains per counted transect is determined. This number is multiplied by the total number of transects examined in order to obtain an estimate of the total number of marker grains present on the slide. Assuming that the first grain encountered on a second slide would be one of the target taxa, an estimated maximum concentration value for these target taxa is obtained. The fossil pollen counted is 1 due to the above assumption. The estimate of marker grains per slide is used for the number of marker grains counted. By substituting these values in the above formula, the estimated maximum concentration value is obtained. A second slide was examined if the estimated maximum concentration values obtained were in excess of 1 grain per gram. The marker grains were tabulated for the two consecutive transects to obtain an average value, and the total number of transects examined was also recorded. This must be done for each slide examined. The estimated maximum concentration was recalculated using the total number of marker grains present on two slides. After two slides had been examined, further examination was terminated upon consultation with the project director.

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 rock shelter, 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/g 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 also indicate restriction of 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 grains of different taxa degrade at variable rates (Holloway 1981, 1989). 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 (ca. 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. Most of these identifications conformed to existing levels of taxonomy with a few exceptions. For example, cheno-am is an artificial 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 and produce very large quantities of pollen. In many sediment samples from the American Southwest, this taxon often 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 2.5μ, while the low spine group have spines that are less than 2.5μ long (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. 80μ), 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 members of the Poaceae.

Clumps of four or more pollen grains (anther fragments) were tabulated as single grains to avoid skewing counts. Clumps of pollen grains (anther fragments) from archaeological contexts are interpreted as evidence for the presence of flowers at the sampling locale (Bohrer 1981b). This enables the analyst to infer possible 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. Pollen grains that lack identifiable characteristics can potentially be missed. 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). Only grains containing identifiable pollen characteristics were assigned to the indeterminate category, so spores were not counted as deteriorated pollen. 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.

Results and Discussion

Provenience data for all seven samples are provided in Table 16-1. Table 16-2 contains the raw pollen counts, and Table 16-3 contains pollen concentration values by taxa. The results of the ISM are presented in Table 16-4. All seven samples were taken from on or near the floor of Pit Structure 1 at the Mockingbird site. The pollen concentration values ranged from a high of 414 grains/g (FS-398) to a low of 81 grains/g (FS-401). *Pinus* and cheno-am concentration values were very low throughout. *Ephedra* (FS-391), Poaceae and *Ulmus* (FS-398), and high spine Asteraceae (FS-394) were all present in single samples. Low spine Asteraceae was common in low concentration values. A pollen grain which compared favorably to *Zea mays* was identified only in sample FS-420. This grain was badly preserved and broken, and it was not possible to positively identify it to this taxon.

Table 16-1. Provenience data for pollen samples from the Mockingbird site

Field Specimen No.	Grid	Stratum	Level	Provenience	CLES No.
FS-398	610N/590E	7	5	Pit Structure 1 floor	94434
FS-394	610N/591E	7	5	Pit Structure 1 floor	94435
FS-391	609N/590E	7	5	Pit Structure 1 floor	94436
FS-420	607N/590E	7	5	Pit Structure 1 floor	94437
FS-406	609N/589E	7	5	Pit Structure 1 floor	94438
FS-384	609N/591E	7	5	Pit Structure 1 floor	94439
FS-401	610N/589E	7	5	Pit Structure 1 floor	94440

The pollen concentration values from this structure are all very low and generally reflect those taxa which are more commonly preserved or more resistant to deterioration. The concentration values reflect an assemblage that has been severely weathered or deteriorated. The presence of *Ulmus* pollen in sample FS-398 is interesting. *Ulmus* is not native to New Mexico, and its presence on the floor of the pit structure is intriguing. The presence of this taxon was based on a single grain tabulated during the counts, which is responsible for its slightly

Table 16-2. Raw pollen counts for the Mockingbird site

CLES No.	*Pinus*	*Ulmus*	Poaceae	Cheno-am	Asteraceae (high spine)	Asteraceae (low spine)	*Ephedra*	Indeterminate	Marker	*Zea* scan
94434	14	1	2	1	-	3	-	10	125	
94435	1	-	-	1	5	2	-	1	81	
94436	2	-	-	4	-	-	1	6	76	
94437	3	-	-	4	-	2	-	3	132	1
94438	3	-	-	5	-	2	-	2	85	
94439	2	-	-	10	-	3	-	3	87	
94440	1	-	-	2	-	-	-	1	82	

Table 16-3. Pollen concentration values for samples from the Mockingbird site

CLES No.	*Pinus*	*Ulmus*	Poaceae	Cheno-am	Asteraceae (high spine)	Asteraceae (low spine)	*Ephedra*	Indeterminate	*Zea* scan
94434	187	13	27	13	0	40	0	134	0
94435	21	0	0	21	103	41	0	21	0
94436	44	0	0	88	0	0	22	132	0
94437	38	0	0	51	0	25	0	38	2
94438	59	0	0	98	0	39	0	39	0
94439	38	0	0	192	0	58	0	58	0
94440	20	0	0	41	0	0	0	20	0

Table 16-4. Results of intensive systematic microscopy for pollen samples from the Mockingbird site

CLES No.	Transects Counted	Total Transects	Pollen Sum	Concentration	Estimated Marker per Slide	Estimated Marker Slide 2	Estimated Maximum Concentration
94434	4	25	31	414	781.25	625	1.19
94435	2	24	10	206	972	377	1.24
94436	2	24	13	286	912	492	1.19
94437	4	24	12	152	792	575	1.22
94438	4	22	12	236	467.5	672	1.46
94439	4	24	18	345	522	689	1.38
94440	2	24	4	81	984	852	0.91

elevated concentration value. A single grain could have been incorporated into the sediments by any number of mechanisms. *Ulmus* is present in the area today, and this grain could represent modern contamination occurring during the excavation of the pit structure. Alternatively, it may represent long distance transport of either modern or prehistoric pollen. The condition of the grain was almost perfect, and I suspect this indicates some form of modern contamination.

Estimated maximum concentration values of target taxa were computed for all samples (Table 16-4) by the methodology described above. This analysis indicates that if target taxa are present, they occur in quantities below 1.46 grains/g, which is very low. The probability is high, therefore, that the target taxa are indeed absent from these samples. These data are based on an examination of two slides. In consultation with the project director, it was decided that no benefit would be obtained by further examination in order to reach a minimum of 1 grain/g. At this point, analysis was terminated. The examination of all samples revealed that if other types were present, they were in extremely low quantities.

The presence of a grain which is thought to be *Zea mays* suggests at least some cultivated material. The preservation of the grain was extremely poor, and a positive identification was not possible. The deteriorated condition of the grain suggests that it was not the result of modern contamination, though this remains a possibility.

Conclusions

The pollen concentration values reflect an extremely weathered or deteriorated assemblage. The results of the ISM study suggest that the target taxa were generally absent from the assemblage. In my opinion it is unlikely that cultivated plant materials were present in any quantity in this pit structure. The presence of a possible *Zea mays* grain does, however, suggest that this cultigen was present in the area.

PART 4: INTERPRETATION AND CONCLUSIONS

ANIMAL EXPLOITATION PATTERNS AND ZOOARCHAEOLOGICAL ANALYSIS OF THE SANTA TERESA PORT-OF-ENTRY SITES

Linda S. Mick-O'Hara

Faunal Exploitation in the Santa Teresa Region

The paucity of faunal remains from the Santa Teresa excavations prevents us from discussing the faunal subsistence strategies at the excavated sites in detail. However, the remains provide an inroad to a discussion of subsistence patterns during the periods represented by the sites under investigation. General subsistence trends are reviewed for each of the prehistoric periods identified in the Santa Teresa area in the cultural overview for this report. In discussing ideas about the faunal subsistence strategies used by the prehistoric populations that occupied and used this landscape, this general time frame will be followed. The faunal remains recovered are discussed in the context of the Late Formative period, to which that part of LA 86774 is assigned. Consideration of the Formative period also includes a discussion of the utilization of lagomorphs and seasonal transhumance patterns that may affect what we see archaeologically in the selection of faunal remains recovered from various Formative period sites. The pattern of lagomorph procurement and utilization is first clearly evident in Early Formative period sites but exists in various forms into the historic period of south central New Mexico. To establish a reasonable explanation of lagomorph use, a model is presented that takes into account several parameters that are equally as important as agricultural intensification when considering changes in faunal procurement patterns.

A Model of Lagomorph Use for the Southern Southwest

In the recent zooarchaeological literature of the Southwest, there has been an emphasis on the focal use of small mammals as an important aspect of the prehistoric diet (Mick-O'Hara n.d.; Szuter and Bayham 1988; Szuter 1991; Whalen 1994a). This focus, though numerous small species were used, was primarily on the use of lagomorphs. Concentration on small-animal use at archaeological sites in the Southwest was clearly present during the Archaic period and continued from that time. The terms *focus* or *concentration* do not suggest that large mammals were ignored, rather that patterns of mobility and the seasonal use of various environmental zones also selected for different animal procurement strategies. In lowland, more desert environs, collecting strategies included the use of technologies for the capture of small animals, while food procurement in more upland settings included technologies for the hunting of larger mammals. Certainly, there was small-animal procurement in the uplands and vice versa, but these activities were occasional rather than intentional pursuits.

The extensive and, at times, intensive use of lagomorphs in the southern Southwest seems to be most noteworthy during the Mesilla phase (Early Formative period), when the introduction and use of cultigens had already reached a level of importance in local subsistence strategies to warrant alterations in the timing of other aspects of their yearly subsistence cycle and overall mobility patterns. At some sites, lagomorphs comprise 80 to 90 percent of the faunal remains recovered (Bradley 1983; Hard 1983b; Mick-O'Hara n.d.; O'Laughlin 1980:95; Whalen 1994a).

The focus of some of the zooarchaeological writings on lagomorph hunting has resulted in further considerations regarding the proportion of cottontails to jackrabbits represented in an assemblage. Generally, an increase in jackrabbits has been equated directly with disruption of the landscape by agriculture (Whalen 1994a:120-126), and a lagomorph index has been developed to quantify these proportional changes in recovered faunal assemblages (Bayham and Hatch 1985). Given other cultural and natural factors affecting both procurement and preservation, this assumption seems rather simplistic, and the discussion that follows explains why other variables are equally and often more important in producing the lagomorph ratios noted in various archaeological assemblages throughout the southern Southwest.

Whalen (1978:72) characterized hunting as an important part of the subsistence strategy during the Mesilla phase, as I would suggest it was during all previous and subsequent periods. He suggests that hunting was restricted to small game, dominated by jackrabbit bone, as indicated by materials recovered from two pithouses at a small village excavated during the Turquoise Ridge project. Hard's (1983b:72) excavations at the Castner Range sites recovered fragmentary bone, and all identified specimens were either jackrabbit or cottontail. In Hard's analysis, cottontail remains outnumbered jackrabbit, and the entire assemblage was heavily fragmented. If cottontail is seen as the most desirable of the lagomorph species, decreases in the quantity of cottontail bone recovered would provide some indication of changes in local environment or procurement technology.

Lagomorphs are included in the small-mammal category because behaviorally they correspond well with most rodent species (Findley et al. 1975). Cottontails and jackrabbits do, however, exhibit different prey behavior and habitat preferences, thus responding in dissimilar ways to various procurement techniques and technologies. Cottontails prefer brushy undergrowth and overall thicker vegetational cover than do jackrabbits (Diersing and Wilson 1980). This vegetational cover provides excellent camouflage for cottontails hiding from predators while out of their burrows (Legler 1970). Cottontails behave as a "fright" species with regard to predators in their environment. They hide in the thick undercover and remain still even if the predator is in close proximity (Madsen 1974). Jackrabbits tend to be more numerous in more open environments, where vegetation is sparse (Erickson 1985; Legler 1970). They use their long back legs to extend their heads, or a least ears, above the plant cover, providing a greater range for hearing the movement of probable predators on the landscape. As a "flight" species, jackrabbits use their hearing to provide time for escape from potential predators (Palmer 1897; Erickson 1985). These habitat and behavioral differences make some procurement techniques better suited to hunting cottontail and others more appropriate for taking jackrabbits.

Animal Behavior and Procurement Techniques: The Lagomorph Case

Lagomorphs may be taken by techniques similar to those used for the procurement of other small animals. Underhill (1941:67-70; 1946:97-99) indicates that the Pueblo Indians used several techniques to hunt small animals. Rabbit drives were a communal activity associated with hunting ceremonies. This technique used large nets stretched across the landscape, people to set up and maintain these nets who had rabbit sticks or clubs to kill rabbits as they were caught in the netting, and "beaters," whose job it was to yell and beat together sticks or drums and chase rabbits toward the extended nets. The rabbit drive was, obviously, a highly organized communal activity which required preparation time and the gathering of allied individuals who then shared in the proceeds.

Most other techniques used to hunt small mammals involved only one or two individuals (Underhill 1946:68-69). They included individual hunting using rabbit sticks, in which a person carried a stick while traveling to and from agricultural fields and took small mammals on an encounter basis. The Pueblos also used a variety of traps to capture small mammals. The rabbit stick or any convenient club would then be used to kill the animals caught in these traps (Underhill 1946:69). The Pueblos also used bows and arrows to hunt smaller game, concentrating on those species that could be frightened out of their hiding places.

The Mojave tribe along the Colorado river hunted small mammals as they were forced from flooding fields in the spring, filling burrows with water to drown or force small animals out. They would then skewer them in their burrows or club them as they fled (Castetter and Bell 1951; Forde 1934). The Papago rammed long sticks with blunt or hooked ends into rodent holes and rabbit burrows, skewered the animals, and then pulled them out (Joseph et al. 1949; Underhill 1938; Castetter and Underhill 1935). Most small-animal procurement techniques using traps, clubs, poles, and bows could be accomplished by a single individual. The catch was consumed by that person or taken back to the family campsite. All of these hunting techniques use implements that could easily be carried from place to place by mobile groups or used by more sedentary populations. If these techniques are applicable to the past, they would influence the ratio of lagomorphs taken by Mesilla phase populations.

Of the above techniques, the rabbit drive would result in the highest animal return per event, though animals would be shared among a number of allied individuals or households. Any hunting technique that concentrates on driving small mammals that react to predators by flight would inevitably bias the species procured. Since among the lagomorphs, jackrabbits run to escape from predators, rabbit drives should favor the capture of jackrabbits over cottontails. With the numerous techniques requiring only a single individual, any animals taken would be cooked and consumed in the field or returned to the household or campsite to be included in the family's dietary fare. Hunting techniques used by a single or few individuals could either take species that flee from predators or hide from them, but lagomorphs, such as cottontails, which tend to freeze and hide when pursued, would be a considerably easier target for such techniques. Hunting techniques that focus on a single individual procuring food should produce a bias toward the capture of cottontails over jackrabbits, though both would be taken.

Zooarchaeological assemblages exhibiting a predominance of lagomorphs or other small mammals and the historic procurement techniques discussed above suggest that small-mammal procurement was an important strategy in the Southwest from early prehistoric times into the historic period. Bayham (1982), Szuter and Bayham (1989), and Szuter (1991) have noted this of their research in the Hohokam area. At several desert Hohokam sites, Szuter (1991) found that cottontails were most frequent at farmsteads, while jackrabbits were more frequent at village sites. Whalen (1994a:120-125), describing Bayham and Broughton's research for the Turquoise Ridge report, indicates that increase in jackrabbits over cottontails in that faunal assemblage resulted from hunting small mammals on a landscape degraded by intensified cultivation. This may be the case in the Hohokam area and in Szuter's (1991) example, but there is a danger in taking this simple explanation too far. Agriculture may provide sufficient environmental change to establish a landscape more preferable to jackrabbits than to cottontails in some desert areas, but several other factors may provide more plausible arguments for such a shift in lagomorph use, both at Turquoise Ridge and in the Santa Teresa area.

Factors Influencing Lagomorph Ratios in the Desert Southwest

Environmental and cultural factors that influence the ratio of cottontails to jackrabbits taken by a group vary with the geographical landscape. Environmental factors in the lowland desert Southwest include topography or relief on the landscape, vegetational cover, variation in seasonal and annual precipitation, and seasonal temperature variation. Cultural factors affecting the capture of various lagomorphs consist of use or intensification of agricultural techniques that change the overall amount of plant cover, use of various hunting techniques, area covered by individual and communal hunting, distribution and processing of animals captured, and disposal and preservation of remains. Any or all of these factors may be affecting the composition of the recovered faunal assemblage and thus, the ratio of lagomorphs. It is the use of differences in habitat preference, animal behavior, and ethnographic evidence on the use of hunting techniques that allow inference about the rates of occurrence of different species in the archaeological record.

The natural landscape in the Santa Teresa area is more suitable for jackrabbits than cottontails. As discussed earlier, open areas with little brushy undercover are preferred by jackrabbits, while areas with greater amounts of vegetation are preferred by cottontails (Findley et al. 1975). As agricultural practices change the landscape by clearing groundcover, the environment would become more suitable for jackrabbits than cottontails (Szuter and Bayham 1989). Precipitation changes from year to year can dramatically affect the vegetational pattern on the landscape (Dick-Peddie 1993:27-31). The reproductive cycles and population peaks as well as areal preferences of lagomorphs are influenced by these often subtle changes in the lowland desert Southwest. Cottontails reach peak populations when increased precipitation expands the overall vegetational cover, providing needed food and hiding places (Findley et al. 1975:86-89; Diersing and Wilson 1980). However, this increase may be mitigated by any increase in agriculture that would alter the vegetational cover. Seasonal temperature variation is more drastic in some years than in others and tends to affect vegetational cover in combination with variations in moisture (Dick-Peddie 1993:27-32). If winters are colder, and/or the relative moisture in an area is decreased, the reproduction and survival of cottontails and jackrabbits are affected. While an overall decrease in vegetational cover would favor jackrabbits, evidence of these environmental effects in the archaeological record would be seen more in the size of adult jackrabbits than in overall numbers recovered. In general, any environmental parameters that decrease vegetation increase the likelihood of taking jackrabbits, while increases in moisture and vegetation are favorable to cottontail populations, increasing the probability of capturing those taxa.

Cultural variables work with environmental parameters, resulting in what we see archaeologically in a faunal assemblage. Procurement techniques can be employed that optimize the capture of animals already favored by varying vegetational cover and precipitation regimes. As mentioned in the consideration of environmental factors, the use and intensification of agriculture in the desert Southwest should occur in years of higher overall precipitation, producing a landscape that would favor jackrabbits. Increased precipitation would also result in increased vegetational growth in zones around the farming areas, and cottontails would be favored in these zones. Under these conditions more animals, including more immature lagomorphs, would be available, and preferential capture would hinge on the hunting techniques employed and the breadth of the landscape covered during hunting. As discussed earlier, communal rabbit hunts, some bow and arrow strategies, and techniques conducive to frightening small game into flight would favor the capture of jackrabbits. The greater the area covered by a population, the more likely that cottontails would be encountered and captured using individual hunting techniques. Increased precipitation along with the use of individual hunting strategies would increase the procurement of cottontails with a wide age distribution.

Most small mammals, when taken in a communal drive or by an individual, are distributed as complete carcasses to single households for processing and consumption (Castetter and Underhill 1938; Underhill 1946). Processing and cooking methods differentially affect the survival rate of bone depending on the relative density of the elements involved (Binford and Bertram 1977; Lyman 1985, 1994). The processing of small mammals, including lagomorphs, often involves removal of the head and loose skin before cooking. Thus, crania and mandibles are discarded prior to cooking and should preserve better than postcranial remains exposed to roasting or boiling. Since lagomorph crania are more fragile than the thicker mandibles, the mandibles would be more frequent in deposits associated with populations using this processing technique.

Different cooking techniques may leave evidence of their use on bone surfaces. Roasting meat over an open fire can burn any exposed bone surfaces and discolor meat-covered bone during the cooking process. On recovered bone this should appear as dark or blackened articular surfaces where bone is exposed, and mottled light to dark brown diaphyses where fluids and grease from the meat and bone produce such patterning. Boiling of bone tends to reduce the surface of elements that are cooked continually for an extended period. Bone grease and some collagen are removed, and the surface becomes chalky to the touch and in appearance. Mechanisms of bone disposal and preservation greatly affect the extent to which these processes may be observed. Ground water erosion and leaching along with weathering from exposure can make such observations impractical, but, if evident, cooking processes are important in the study of human behavior. While weathering or other taphonomic factors preclude the observation of some processes, they provide evidence of the postdepositional environment in the site area (Lyman 1994). Thus, though one set of information may be unretrievable, another set becomes relevant to the site context.

The selective and intense use of lagomorphs as an essential part of the meat diet has to be distinguished from agricultural intensification. Yes, disruption of the landscape by agricultural fields would increase habitat for rabbits and would favor jackrabbits, but the dominance in archaeological assemblages can not be directly connected with agricultural intensification. A number of environmental parameters and possible cultural technological decisions must be evaluated so that an adequate argument about these occurrences can be mounted. The parameters presented here as a model of lagomorph use address environmental, cultural, and technological change that provides a sufficient explanation for the varied occurrence of lagomorphs in the zooarchaeological record of the southern Southwest. A review of what is currently understood of the faunal record through time in the desert Southwest can be used to show when the dietary focus on lagomorphs becomes an issue, and how the small amount of faunal materials from LA 86774 might fit in with the existing record.

Patterns of Animal Exploitation

The ways people captured and killed animals for food and the types of animals taken changed through time worldwide, as well as in the greater Southwest (see Jennings 1983 or Willey 1966 for a general review). The most general trend went from the utilization of a variety of megafauna to the use of domestic species in the Old World, and from the use of megafauna to the procurement of small mammals in much of the New World, including the Southwest. Exploitation of animals in the Santa Teresa region of south central New Mexico followed much the same pattern, and it is this pattern that will be approached here.

Paleoindian

The Paleoindian period in North America has been traditionally thought of as a time when nomadic populations hunted megafauna (Judge 1973), with the occasional smaller animal and plant thrown in to vary the monotonous meat diet (Jennings 1983). There are, however, a few sites dating to this time period that do not represent the typical "big game" subsistence pattern. These sites suggest that while the large-mammal kills are more archaeologically visible on the landscape (as per Upham 1988), greater variety existed in the subsistence strategies than what the bulk of the Paleoindian literature indicates. Desert playas and dune areas may have been used by early, principally nomadic populations for large-game procurement during the yearly monsoons, but encounter hunting of smaller mammals was probably also an important part of the pattern.

Archaic

The Archaic period throughout the greater Southwest appears to have been a time of the supreme generalist on many levels. The extent to which this was a result of the extinction of megafauna during the Paleoindian period or a subsistence change based on mobility changes from that of the Paleoindian populations remains unknown. The Hinds Cave deposits (Lord 1984; Williams-Dean 1978) showed a vast diversity in the subsistence materials gathered and used by the populations occupying the cave throughout the Archaic period. Zooarchaeological materials from the general cave deposits (Lord 1984) and those collected from the coprolite analysis (Williams-Dean 1978) show the use of a wide range of animals, though small-animal remains dominated both assemblages. The Archaic period in the southern Southwest exhibits a similar pattern of faunal exploitation. Small mammal remains dominate archaeological assemblages as they dominate the array of species found on the general landscape, but all animal resources seem to have been exploited when they were available, using a basic encounter strategy.

The faunal remains from Fresnal Shelter (Wimberly and Eidenbach 1981) show the use of large and small mammals during the sequence of occupation evident in those deposits. A preliminary report suggests there was a great continuity in subsistence pursuits throughout the Archaic use of Fresnal Shelter (Wimberly and Eidenbach 1981:21). The deer elements present in those deposits suggested that whole carcasses were returned there for processing, and butchering evidence indicated that carcasses were processed according to high and low meat utility units (Binford 1978). The consistency of the species and the butchering patterns found suggest that large-mammal exploitation was a regular part of the seasonal round of the Archaic populations that inhabited the shelter.

Bayham (1979) has suggested that Archaic patterns of animal exploitation emphasized the procurement of smaller mammals due to the lack of availability of larger mammals on the landscape. This conclusion was reached using an optimal diet model for the Archaic, which suggested that small mammals would be utilized only when there was a decrease in the availability of larger forms. A microecological model established by Winterhalder et al. (1988) suggests that the interrelationship between human populations, diet selection, and environmental parameters is much more complex than original optimal models indicate. This increased complexity is supported by the data from Fresnal Shelter, where a large variety of taxa were taken, but the focus was on large-mammal procurement in an environmental zone where large mammals were still readily available throughout the Archaic period.

Bayham's model may suit the patterns noted for the lowland desert Hohokam, but the use of this model for all Archaic populations simply does not address the variability and complex mobility and subsistence patterns used by Archaic populations throughout the greater Southwest. Animal exploitation patterns noted at Hinds Cave (Lord 1984) illustrate one extreme in the Archaic pattern, while deposits excavated at Fresnal Shelter show another part of the Archaic subsistence pattern. The use of primarily small mammals at one location and a focus on large game at another location, both with long Archaic occupational sequences, indicates that some Archaic populations practiced a seasonal mobility pattern similar to many ethnographic hunter-gatherers and marginal agriculturalists. Subsistence in more lowland desert environments depended on small-animal exploitation, while the focus in upland environments was on exploitation of the larger game available there throughout the Archaic period.

Mesilla Phase

The Mesilla phase has been defined as somewhat more sedentary than the Archaic period (Carmichael 1985c; Whalen 1994a). This is, however, only a difference in degree because mobility during the Mesilla phase was still clearly an essential part of the adaptation of those populations. The degree of mobility probably varied from season to season and year to year depending on local environmental parameters and, later in the phase, because of levels of agricultural investment. The level of mobility and agricultural dependence affected hunting patterns throughout the phase. There appears to have been a decrease in large-mammal utilization (Bradley 1983; Mick-O'Hara n.d.; Whalen 1994a) illustrated at a number of excavated sites in southern New Mexico, but given the Archaic example from Fresnal Shelter, this may be an artifact of the localities excavated more than an actual change in overall subsistence pattern. Changes in the intensity of small-mammal and especially lagomorph usage may indicate a change in subsistence strategy, at least seasonally, but we must also consider the effects of technology or environmental parameters on this body-size selection. Mesilla phase occupants seem to have used a subsistence strategy similar to that of their Archaic predecessors, with the contribution of cultigens increasing through the phase. The pattern of exploitation presented in the model for lagomorph use fits nicely into the Formative pattern, which is an extension of the Archaic pattern with an increased focus on a narrower range of species.

The faunal remains from Turquoise Ridge and the Alamogordo site (LA 457) (Mick-O'Hara n.d.) exhibit close to the same ratio of cottontail to jackrabbit, where jackrabbit remains were identified twice as frequently as cottontail remains. Though lagomorphs were not a large part of the Santa Teresa faunal assemblage, these sites may exhibit a pattern evident at numerous lowland Mesilla phase sites, but it must be kept in mind that greater variability in faunal utilization has been speculated for upland locales (O'Laughlin 1980). Bayham and Broughton's (Whalen 1994a:120-125) faunal analysis of the Turquoise Ridge site indicates that the increased use of jackrabbits over cottontails reflects degradation of the surrounding landscape by a population pursuing and intensifying an agricultural strategy. Turquoise Ridge is a larger site with a more complex history than what we know of LA 457, but degradation of the environment by agriculture during a phase in which residential mobility was substantial is a very small part of the reason for the lagomorph ratios seen at that site. The use of hunting techniques such as rabbit drives by larger more organized communities would change the lagomorph ratio by favoring jackrabbits. Decreases in precipitation would reduce plant growth and provide less vegetational cover resulting in an increase in habitat preferred by jackrabbits over cottontails. It is clearly a combination of factors that produced the faunal assemblages reported from Turquoise Ridge and other lowland Mesilla phase sites. The deer bone recovered from LA 86774 suggests at least some variation from this pattern.

Perhaps meat from larger mammals was occasionally transported from speculated upland sites to lowland basecamps as a result of a mobility and residential pattern similar to the Archaic pattern mentioned earlier. Binford (1978) talks about the butchering and transport of meat units by the Nunamiut and suggests that a pattern in butchering and transport exists that can be used in understanding large-mammal remains in archaeological sites. Using this pattern, low meat utility segments of a carcass (those with relatively little meat for the bone mass) should be consumed at or near the kill site, while high meat utility elements (those with the highest meat mass per bone unit) would be transported to residential or storage sites. If a whole hind limb was transported to LA 86774, it could account for the discard of the lower limb segment that was recovered during excavation. The occurrence of this large-mammal limb bone also indicates that hunting was not restricted to smaller taxa. The seasonal mobility and selective animal use apparent at the Archaic sites discussed was still a pattern frequently used by Early Formative populations.

Doña Ana and El Paso Phase

The Doña Ana and El Paso phases are often difficult to separate during survey and excavation. For the purposes of this discussion, they are combined as the Late Formative period and represent an intensification of patterns originating in the Archaic period and Mesilla phase. Distinguishing these phases would hold little value in understanding animal exploitation.

By the El Paso phase, agriculture had become an integral part of the subsistence regime (Bradley 1983; Foster et al. 1981; Whalen 1994a). The agricultural alteration of the landscape and the overall investment in cultigens as part of the subsistence strategy would have affected all parts of the subsistence regime. As discussed for the Mesilla phase, Bayham and Broughton (Whalen 1994a) suggest that agricultural alteration and degradation of the landscape should result in greater use of jackrabbits over cottontails, as noted in the Turquoise Ridge assemblage. I have suggested that a number of other factors, including environmental conditions and hunting techniques, play important roles in what we see as procurement ratios in the archaeological record. The La Cabrana faunal assemblage is an interesting case in point (Bradley 1983; Foster et al. 1981). Though this faunal assemblage contains a high percentage of lagomorphs, cottontails are significantly higher in NISP and MNI than jackrabbits, and the overall diversity of the small animals utilized suggests field hunting (Ford 1984; Linares 1976) and the use of hunting techniques and technology aimed at the capture of small animals. This example of El Paso phase subsistence suggests that even with the use of more intensive agricultural strategies, the ratio of animals procured may be more a result of hunting technique combined with environmental parameters than a result of the landscape alteration of agricultural intensification. Agricultural pursuits alter a section of the landscape and would alter the species occupying that area, but the remainder of the hunting area, along with the fields, may produce a different ratio of cottontails to jackrabbits as environmental parameters and hunting techniques vary.

Excavations at La Cabrana also recovered over 5,000 fish bone fragments, making fish remains approximately equal to those of lagomorphs and other small mammals at the site. The Manso, an ethnographically recorded group who are usually considered to be descendants of the El Paso phase population (Beckett and Corbett 1992), are said to have used fish regularly in their diet. The amount of fish bone recovered at La Cabrana suggests that this was not a recent addition to the diet, but a well-established part of the subsistence system. Lagomorph use was an extremely important part of the subsistence strategy during the El Paso phase, but agricultural intensification did not always result in the same or similar animal exploitation patterns. The hunting technology used, the extent of investment in agriculture, and other elements of the natural environment all contribute to the faunal assemblages recovered from El Paso phase sites. These assemblages are the result of exploitation of the local environment filtered through numerous cultural factors rather than a reflection of simple degradation of the environment by agricultural pursuits.

Conclusions

The patterns seen in faunal assemblages from Paleoindian times through the Late Formative period provide a general outline for patterns of animal exploitation in the southern

Jornada region, but we must not let these observations limit our ideas concerning the diversity of subsistence patterns and animal exploitation. The archaeological visibility of some early sites has biased our views on both Paleoindian and Archaic faunal use. Samples from the Mesilla phase are dominated by lagomorph remains, but other small mammals and some large game were also exploited. The issue of the increasing proportion of jackrabbits to cottontails in some faunal assemblages is clearly not as simple as an environment changed by agriculture, especially during the Mesilla phase, when mobility was still an essential part of the population's adaptation to environmental change and subsistence needs. Changes in hunting techniques along with other environmental variation may have produced the changing lagomorph ratios seen during the Early and Late Formative periods. The La Cabrana, Turquoise Ridge, and Keystone Dam sites exhibit assemblages with numerous lagomorph remains in varying species proportions, but it is the variety of the other remains present that show the adaptation of each population to the local environment. Cultural, environmental, and technical parameters effect the selection of small mammals, including specific lagomorph species, to be used in the successful adaptation of these southern desert populations.

THE STRUCTURE OF ARCHAEOLOGICAL REMAINS AT THE SANTA TERESA SITE (LA 86780)

James L. Moore

It is necessary to examine site structure in some detail to understand the nature of archaeological remains at the Santa Teresa site. The goals of this study are to define zones related to discrete occupations, compare and contrast the structure of those occupations, and determine how they are related to local geomorphology. This will be done by examining the distribution of chipped stone artifacts, selected material types, and burned rock in relation to features and excavation areas. Other pertinent data will be presented when needed. In the following discussion, analytic units include excavated grids and zones around them (within 1 or 2 m). EA-11 was a small trench (three grids) placed in a sand hummock to determine whether buried deposits were present. Since this analytic unit contained no artifacts or features, it is dropped from further consideration.

Distribution of Cultural Materials across the Site

The contour plots presented in this discussion were created using SURFER (version 4.15, Golden Software, Inc., 1990). At times it is necessary to exaggerate contours to clarify artifact distributions. Information on minimum contours and contour intervals are provided for each plot. Figures 18-1 and 18-2 suggest an interesting distribution of artifacts for the site as a whole. While these plots include both surface and subsurface data and are somewhat skewed by the latter, they suggest that chipped stone artifacts concentrated in the south-central part of the site, while burned rock was mostly restricted to the north part. In particular, chipped stone artifacts were concentrated in and around EA-1, EA-2, EA-3, and EA-8. Burned rock was concentrated in and around EA-1, EA-4, and EA-5, with smaller clusters around EA-3 and EA-7. Rather than suggesting functional differentiation between diverse parts of the site, this distribution is probably related to the intensity of various occupations. Areas that contained the largest numbers of chipped stone artifacts and burned rock were probably occupied longer than other zones.

This distribution suggests that while there are similarities between analytic units, there are also important differences. Only EA-1 contained large amounts of both chipped stone artifacts and burned rock. EA-3 was relatively similar and contained many chipped stone artifacts but only a small concentration of burned rock. Other analytic units are distinguished by clusters of only one artifact class or the presence of features with few associated artifacts.

The distribution of burned rock by analytic unit is shown in Table 18-1. The surface artifact category comprises materials collected outside analytic units and is not considered in this discussion; it is only shown so that complete assemblages are represented. The vast majority of burned rock was found in three analytic units--EA-1, EA-4, and EA-5--which contained between 17 and 38 percent of this assemblage each. Since EA-3 contained nearly 10 percent of the burned rock, it should perhaps also be included with these areas. Except for EA-10, which had no burned

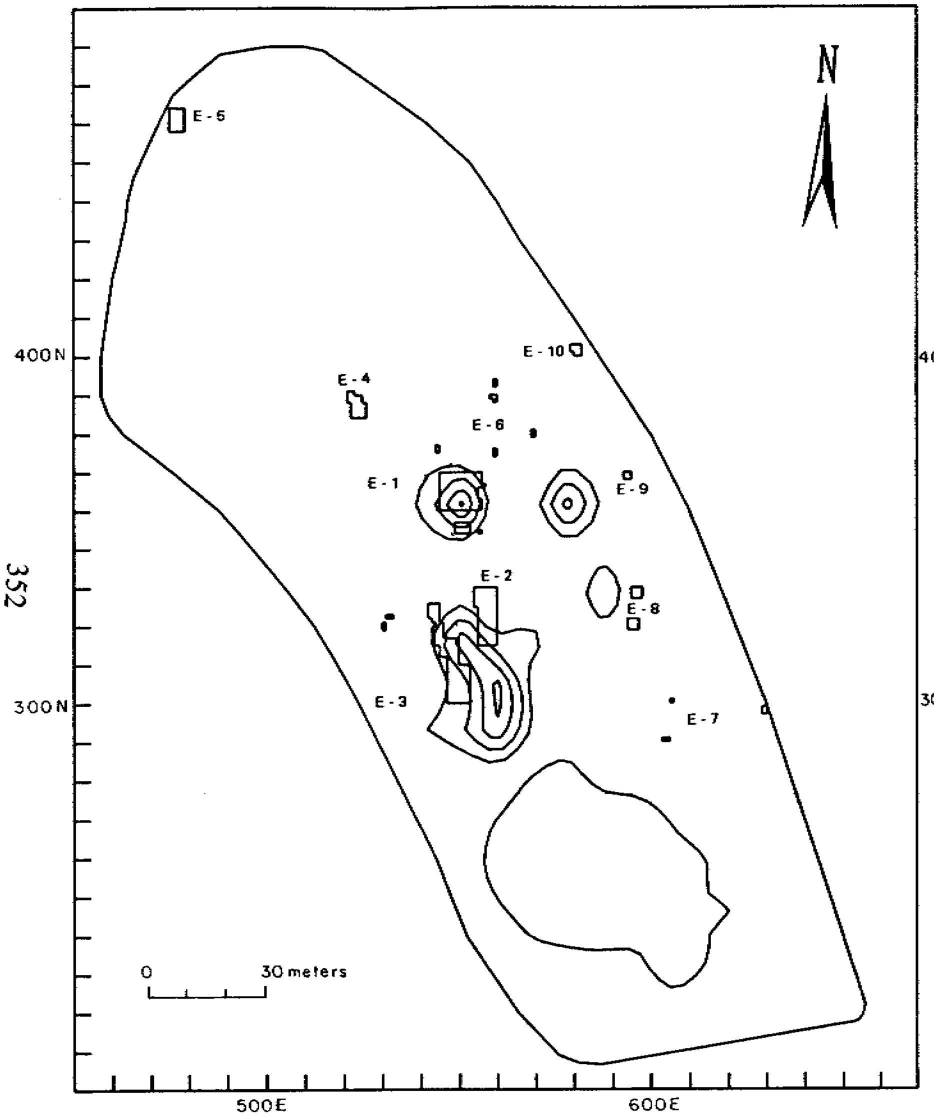

Figure 18-1. Distribution of all chipped stone artifacts at the Santa Teresa site; minimum contour = 1, contour interval = .5.

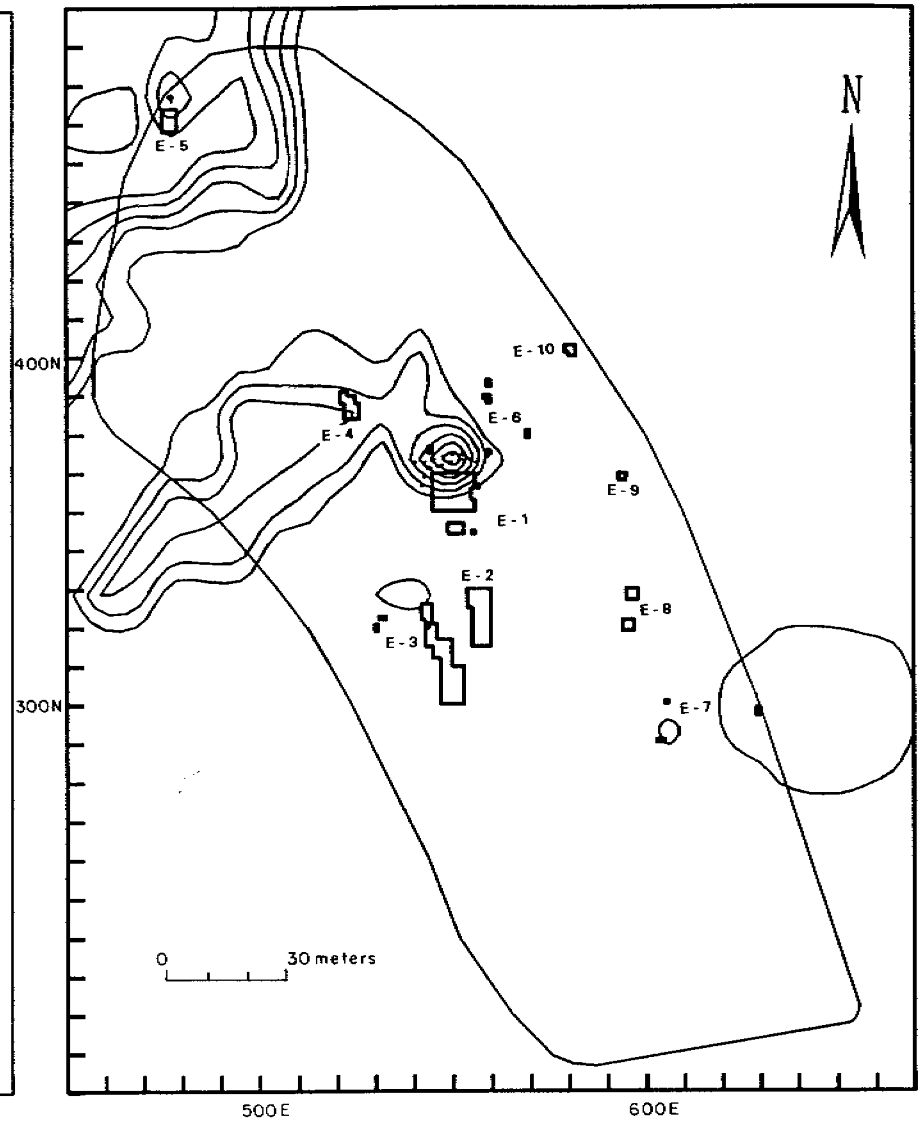

Figure 18-2. Distribution of burned rock at the Santa Teresa site; minimum contour = 1, contour interval = 3.

rock, other analytic units contained less than 4 percent of this assemblage each. Fragments of ground stone tools comprised small percentages of burned rock assemblages in six analytic areas. These artifacts probably represent tools collected from earlier sites and recycled as thermal elements.

Table 18-1. Distribution of burned and fire-cracked rock by analytic unit (frequencies and row percentages)

Provenience	Burned Ground Stone	Burned Rock	Totals
EA-1	9 2.8	308 97.2	317 38.1
EA-2	2 8.7	21 91.3	23 2.8
EA-3	13 16.3	67 83.8	80 9.6
EA-4	3 1.6	180 98.4	183 22.0
EA-5	11 7.7	131 92.3	142 17.1
EA-6	0 0.0	1 100.0	1 0.1
EA-7	2 6.9	27 93.1	29 3.5
EA-8	0 0.0	6 100.0	6 0.7
EA-9	0 0.0	3 100.0	3 0.4
Surface	13 27.7	34 72.3	47 5.7
Totals Percent	53 6.4	778 93.6	831 100.0

Table 18-2 shows the distribution of chipped stone artifacts by analytic area. Again, the surface artifact category includes materials recovered outside analytic areas and is shown only so that the entire assemblage is presented. No chipped stone artifacts were found in or around EA-9 or EA-10. EA-1 and EA-3 contained the largest numbers of artifacts, in both cases around 30 percent of the total. Nearly 10 percent of the assemblage was recovered from EA-2, while the remaining areas contained few chipped stone artifacts. Tabular fragments were found in only one area and probably represent ground stone tools that were recycled as cores. While angular debris and core flakes were recovered from all analytic units that contained chipped stone artifacts, biface flakes were found in only three, and multiple biface flakes occurred only in EA-1. Cores were recovered from five assemblages, cobble tools from one, and bifacial tools from two.

Table 18-2. Distribution of chipped stone artifacts by analytic unit (frequencies and row percentages)

Provenience	Tabular Fragments	Angular Debris	Core Flakes	Biface Flakes	Cores	Cobble Tools	Bifaces	Totals
EA-1	0 0.0	56 21.5	198 75.9	4 1.5	3 1.1	0 0.0	0 0.0	261 28.9
EA-2	0 0.0	21 27.6	54 71.1	0 0.0	1 1.3	0 0.0	0 0.0	76 8.4
EA-3	2 0.7	84 29.4	195 68.2	1 0.3	3 1.0	0 0.0	1 0.3	286 31.7
EA-4	0 0.0	1 33.3	2 66.7	0 0.0	0 0.0	0 0.0	0 0.0	3 0.3
EA-5	0 0.0	0 0.0	5 83.3	0 0.0	0 0.0	1 16.7	0 0.0	6 0.7
EA-6	0 0.0	1 14.3	4 57.1	1 14.3	1 14.3	0 0.0	0 0.0	7 0.8
EA-7	0 0.0	1 16.7	3 50.0	0 0.0	1 16.7	0 0.0	1 16.7	6 0.7
EA-8	0 0.0	7 23.3	23 76.7	0 0.0	0 0.0	0 0.0	0 0.0	30 3.3
Surface	1 0.4	47 20.7	158 69.6	3 1.3	11 4.8	2 0.9	5 2.2	227 25.2
Totals Percent	3 0.3	218 24.2	642 71.2	9 1.0	20 2.2	3 0.3	7 0.8	902 100.0

When combined with the plots presented in Fig. 18-1 and 18-2, these data suggest there are indeed important differences between analytic units. While some differences could be due to variation in the size of excavated areas, this is unlikely. Excavation concentrated on features and clusters of surface artifacts. Some excavation areas were large because they contained numerous features and extensive artifact clusters, while others were small because few features or artifacts were present. Thus, excavation area size is related to the patterning of cultural materials, and differences in assemblage sizes are real and not a product of the extent of the area examined. Each analytic area is examined individually to more fully illustrate these differences.

Distribution of Cultural Materials in Analytic Units

Excavation Area 1

Figures 18-3 and 18-4 show that the distributions of chipped stone artifacts and burned rock in EA-1 were quite different. Chipped stone artifacts clustered to the south and southeast of the hearths in Subarea 1, while burned rock concentrated to the northwest of those features.

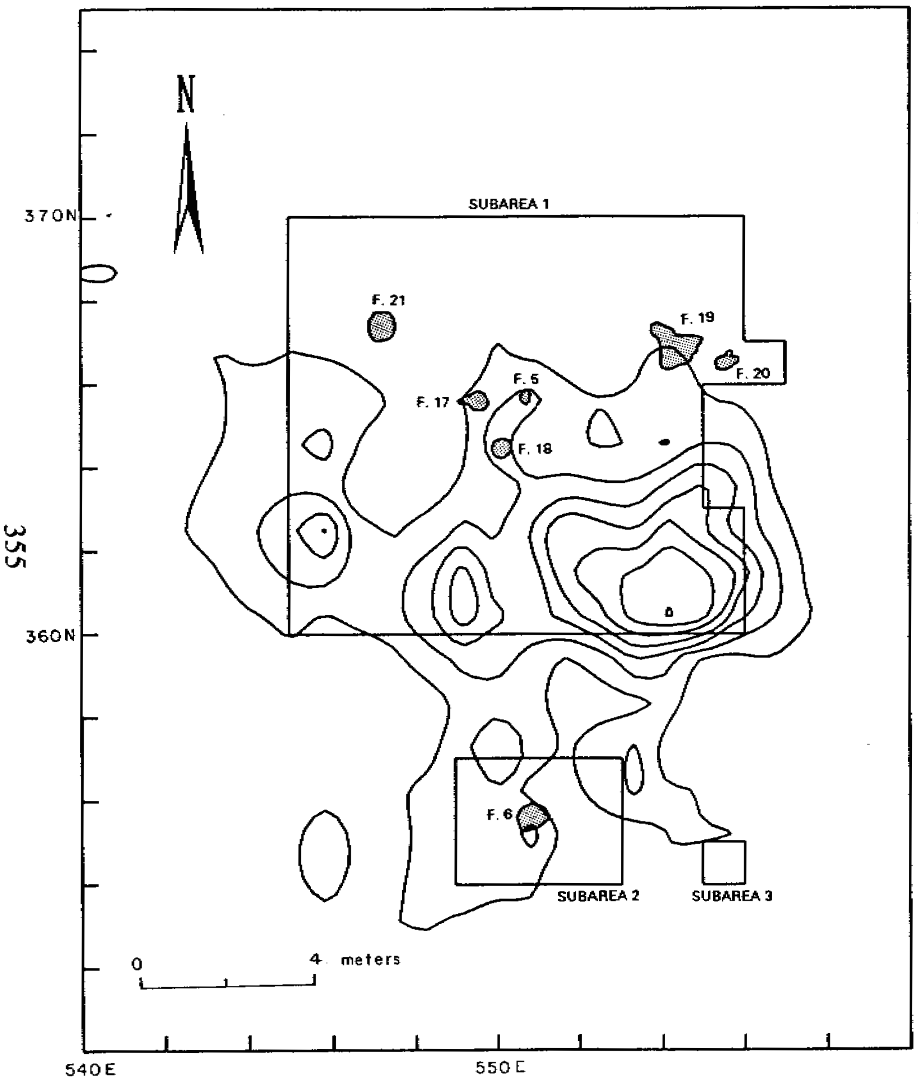

Figure 18-3. Distribution of chipped stone artifacts in EA-1 at the Santa Teresa site; minimum contour = 1, contour interval = 1.

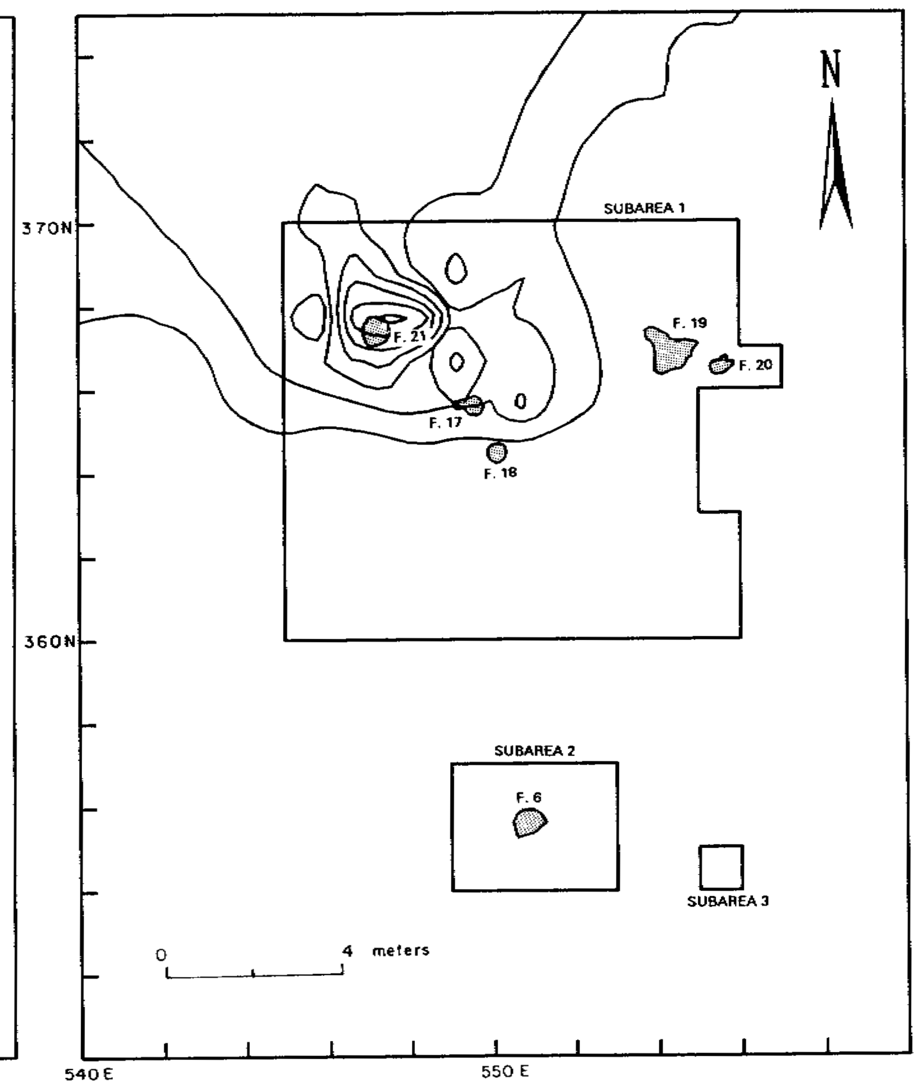

Figure 18-4. Distribution of burned rock in EA-1 at the Santa Teresa site; minimum contour = 1, contour interval = 10.

Several hearths appear to have been grouped. Features 5, 17, and 18 were within a few meters of one another, and Features 19 and 20 were also close together. Feature 21 was near the first group but somewhat separated from them. Only Feature 6 had no close association with other hearths. Groups of hearths might represent multiple uses of certain areas at different times, each feature representing a separate use. It is also possible that hearths were abandoned and replaced by nearby features during lengthy occupations because areas around them were cluttered with debris, there was a shift in wind direction, or people simply didn't want to use them any more. Finally, some hearths could have been used for specialized purposes like stone boiling, roasting, or heating. If so, the presence of multiple hearths might indicate the performance of different tasks in an area.

If the collection of hearths in EA-1 represents a series of discrete occupations over a long period, several associated and overlapping activity areas should also be present. As Figure 18-3 illustrates, this type of distribution does not occur. There was a distinct clustering of chipped stone artifacts in the southeast corner of Subarea 1, with smaller peaks to the west of this area and around Feature 6. However, these are very minor peaks, containing highs of only three to five artifacts.

Only two general material categories contained enough specimens for plotting. Chertic materials (Fig. 18-5) were mostly reduced in the southern part of Subarea 1, with small peaks across the south part of that zone. Aphanitic rhyolites (Fig. 18-6) were primarily reduced in the southeast corner of Subarea 1.

While distributions of chertic materials and aphanitic rhyolites varied somewhat, they clustered in the same area. It is unlikely that several discrete occupations over many years would position their hearths and reduction areas so consistently. If the debris of previous occupations was covered by sand, one would expect earlier hearths to be overlain and surrounded by debris from later occupations. At the very least, this degree of consistency in artifact distribution should not occur. If debris from earlier occupations was visible on the surface, those areas should have been avoided by later occupants. When reoccupying sites, hunter-gatherers avoid areas that contain debris from previous uses, tending instead to place their camps in adjacent zones that are not cluttered with debris (Vierra 1985; Yellen 1976). Hearths should not be clustered, and each occupation should leave behind separate groups of features and work areas. This type of distribution seems to distinguish the site as a whole but cannot be applied to EA-1.

Thus, neither possibility seems plausible. The distribution of artifacts is too consistent to accept the idea that debris from earlier occupations was completely concealed by a layer of sand. Indeed, this is very unlikely, since the hearths occurred at similar elevations (Table 18-3). Reoccupation of areas with visible debris is inconsistent with ethnographic examples of hunter-gatherer behavior. Such areas are traditionally avoided rather than reused. Thus, it is likely that the features and artifacts in EA-1 reflect a single occupation.

Only Feature 17 was dated in this unit (Beta-80961). The date was calibrated, and at the second standard deviation two ranges of equal probability were provided: 330 to 330 B.C., and 205 B.C. to A.D. 65. This suggests a Late Archaic affiliation for this cluster of features and artifacts.

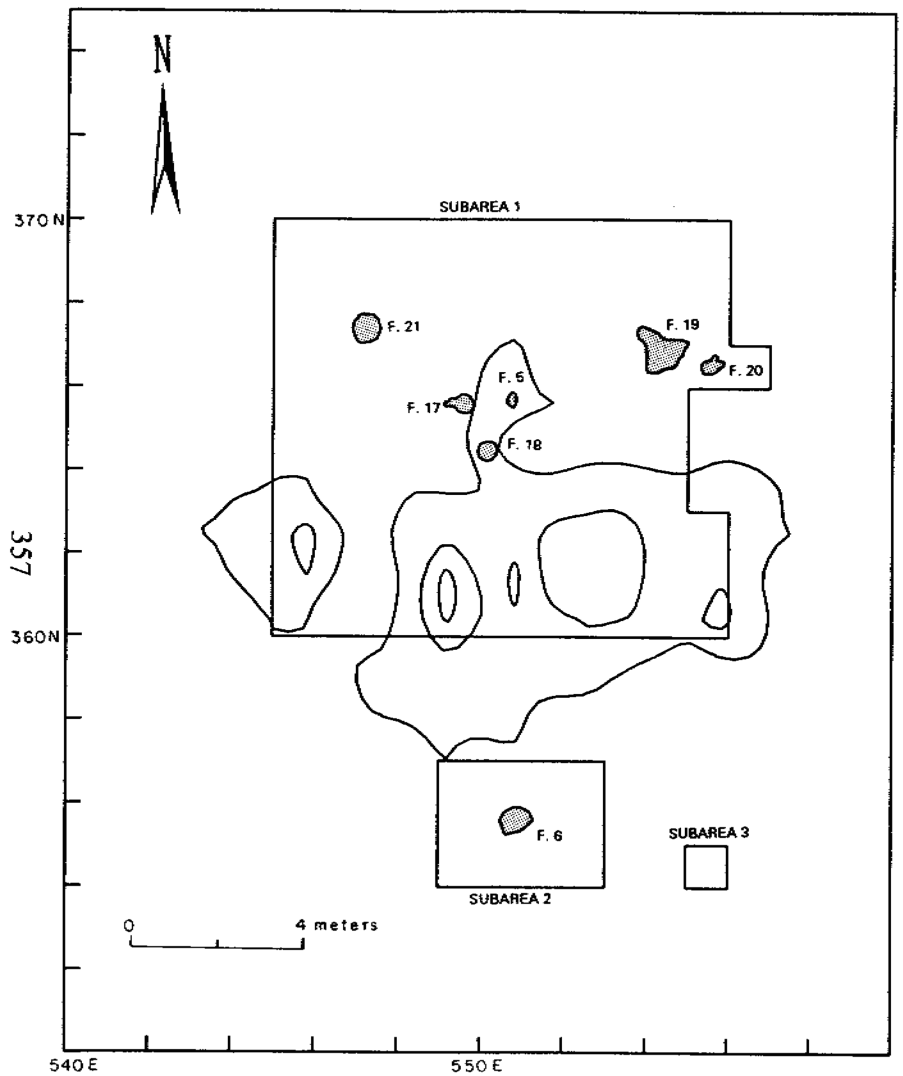

Figure 18-5. Distribution of chertic materials in EA-1 at the Santa Teresa site; minimum contour = 1, contour interval = 1.

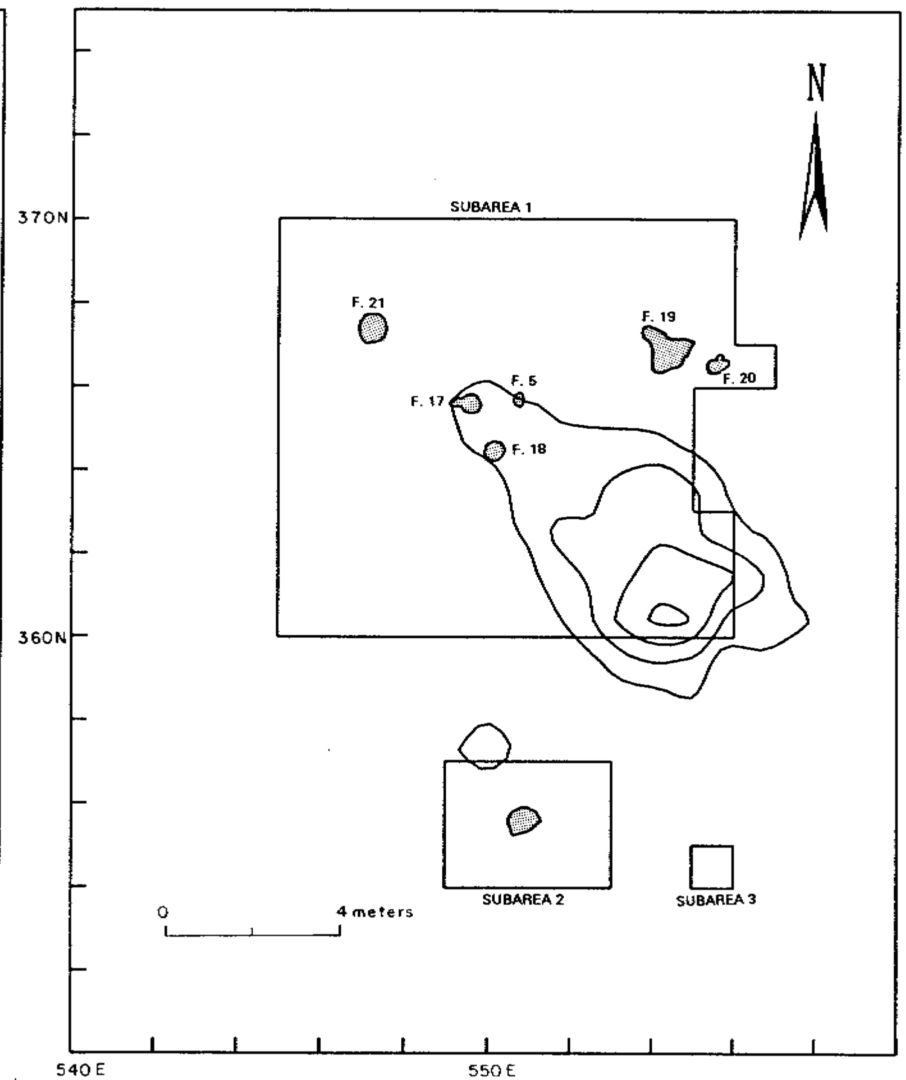

Figure 18-6. Distribution of aphanitic rhyolites in EA-1 at the Santa Teresa site; minimum contour = 1, contour interval = 1.

Table 18-3. Top and bottom elevations below datum for hearths in EA-1

Feature	Elevation at Top of Feature	Elevation at Bottom of Feature
5	12.80	12.92
6	12.86	12.97
17	12.85	12.94
18	12.87	12.94
19	12.85	12.92
20	12.86	12.92
21	12.87	13.00

Excavation Area 2

Figures 18-7 and 18-8 illustrate distributions of chipped stone artifacts and burned rock in EA-2. Chipped stone artifacts clustered in two areas (Fig. 18-7), one in the southeast part of the unit, and the other in the north-central part. Though no hearths were found in this unit, there was a distinct clustering of burned rock in the east-central section (Fig. 18-8). For reasons discussed later, burned rock appears to have been discarded near features rather than in discrete middens. Thus, a hearth may have existed near grid 332N/560E, as evidenced by the small concentration of burned rock centered there.

The distribution of chipped stone artifacts and burned rock in EA-2 suggest that these remains may represent a discrete occupation. Chertic materials and aphanitic rhyolites had a relatively similar distribution, with highs occurring in approximately the same locations (Figs. 18-9 and 18-10). However, cherts were considerably more common than aphanitic rhyolites. Concentrations in the southwest corner of Figure 18-9 represent spillover from EA-3. The separation between those areas was artificial, created by a chain-link fence that ran the length of the site. Thus, it is possible that EA-2 and EA-3 were more closely related than this discussion suggests.

While EA-2 contained only small amounts of chipped stone artifacts and burned rock, the patterning of deposits suggests it represents an occupational area rather than a discard or work zone. The centers of distribution for those classes of artifacts were spatially distinct, with a small degree of overlap. This pattern is similar to that of EA-1, where the clustering of chipped stone artifacts and burned rock were also spatially distinct. No temporally diagnostic artifacts or materials were recovered from this unit, so there is no way to directly date these materials.

Excavation Area 3

Figures 18-11 and 18-12 show the distribution of chipped stone artifacts and burned rock in EA-3. As in EA-1 and EA-2, there are differences in the distributions of these artifact classes.

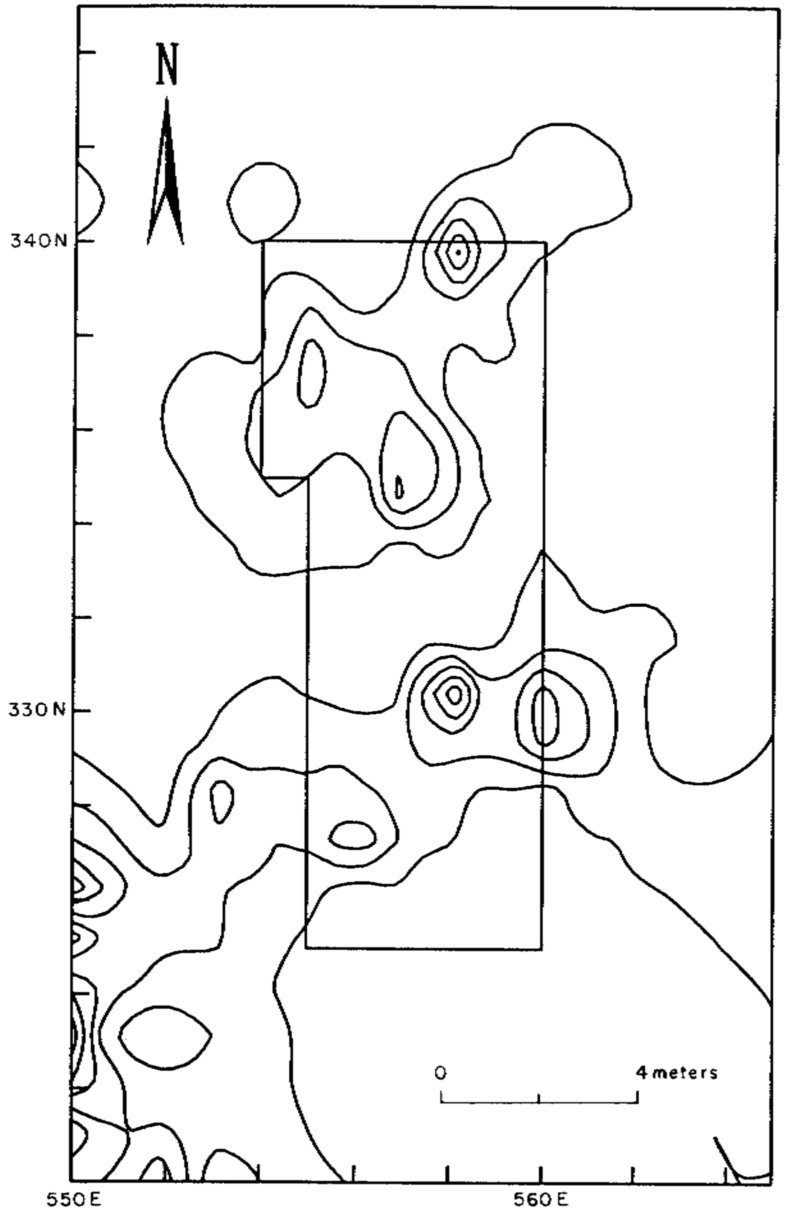

Figure 18-7. Distribution of chipped stone artifacts in EA-2 at the Santa Teresa site; minimum contour = 1, contour interval = .5.

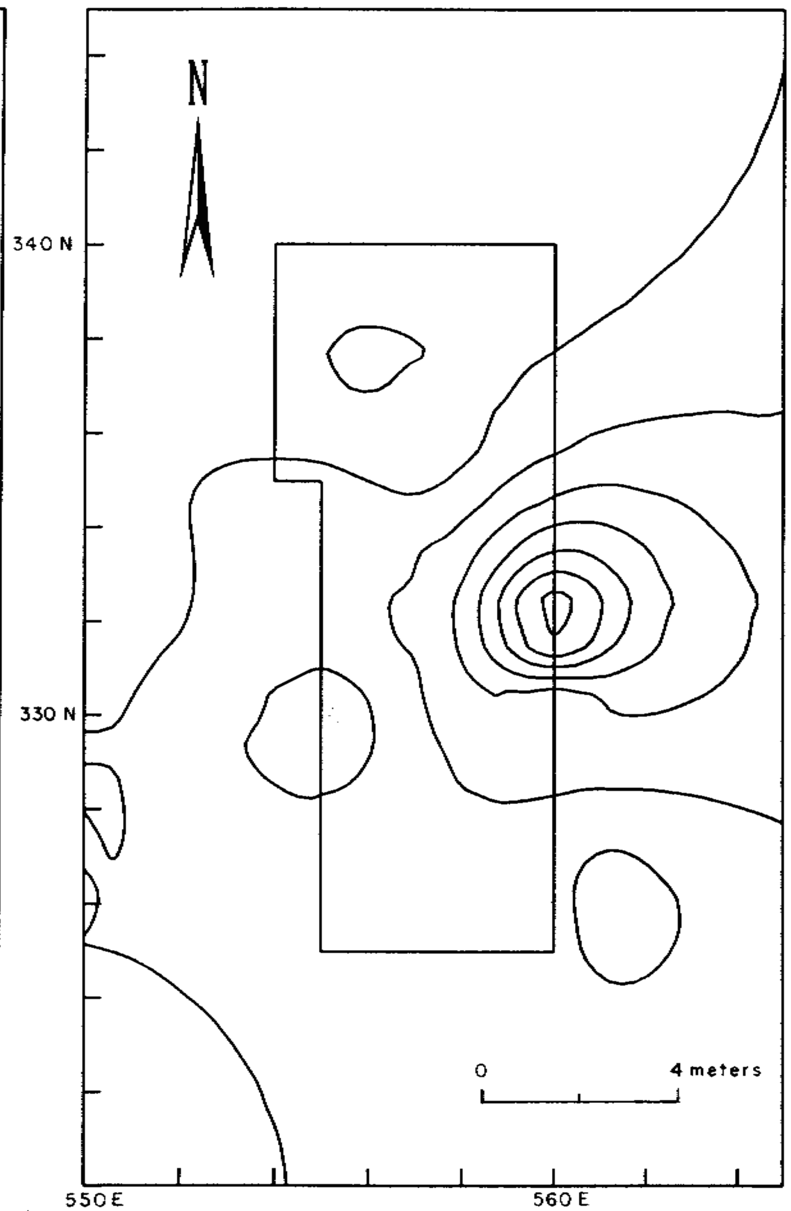

Figure 18-8. Distribution of burned rock in EA-2 at the Santa Teresa site; minimum contour = 1, contour interval = .5.

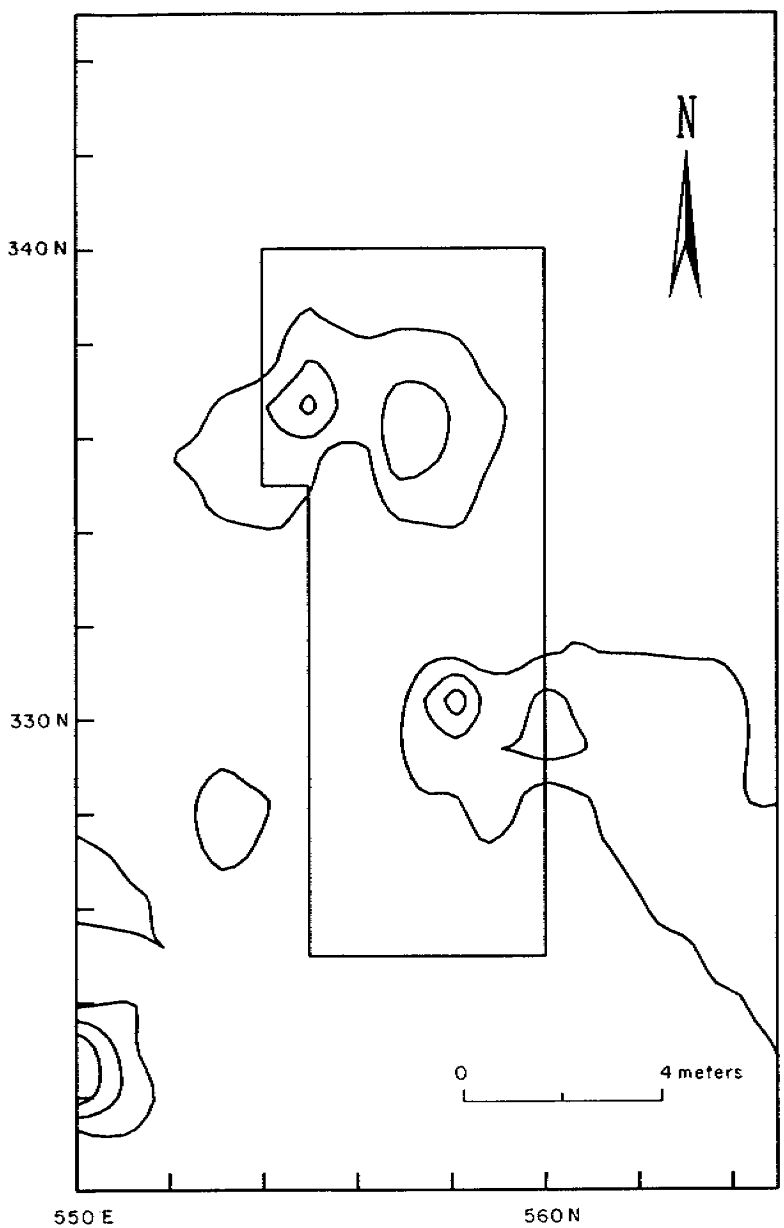

Figure 18-9. Distribution of chertic materials in EA-2 at the Santa Teresa site; minimum contour = 1, contour interval = .5.

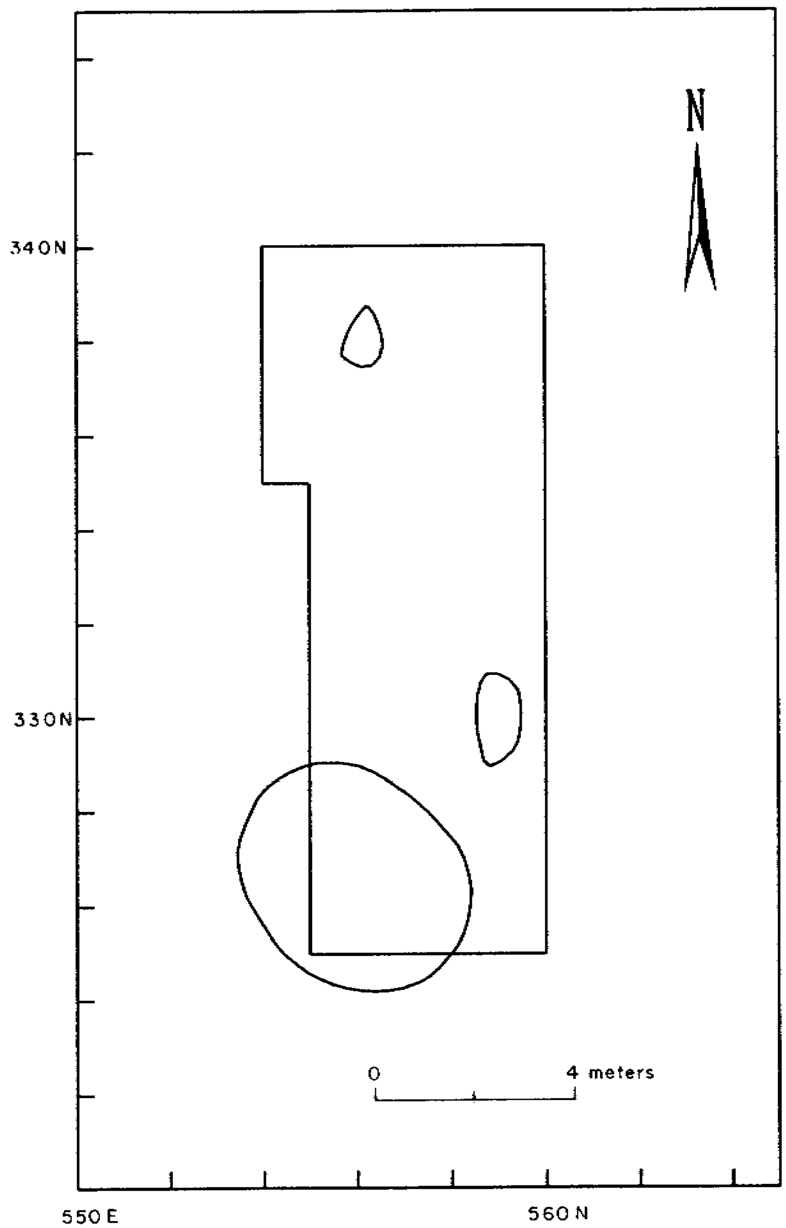

Figure 18-10. Distribution of aphanitic rhyolites in EA-2 at the Santa Teresa site; minimum contour = 1, contour interval = .5.

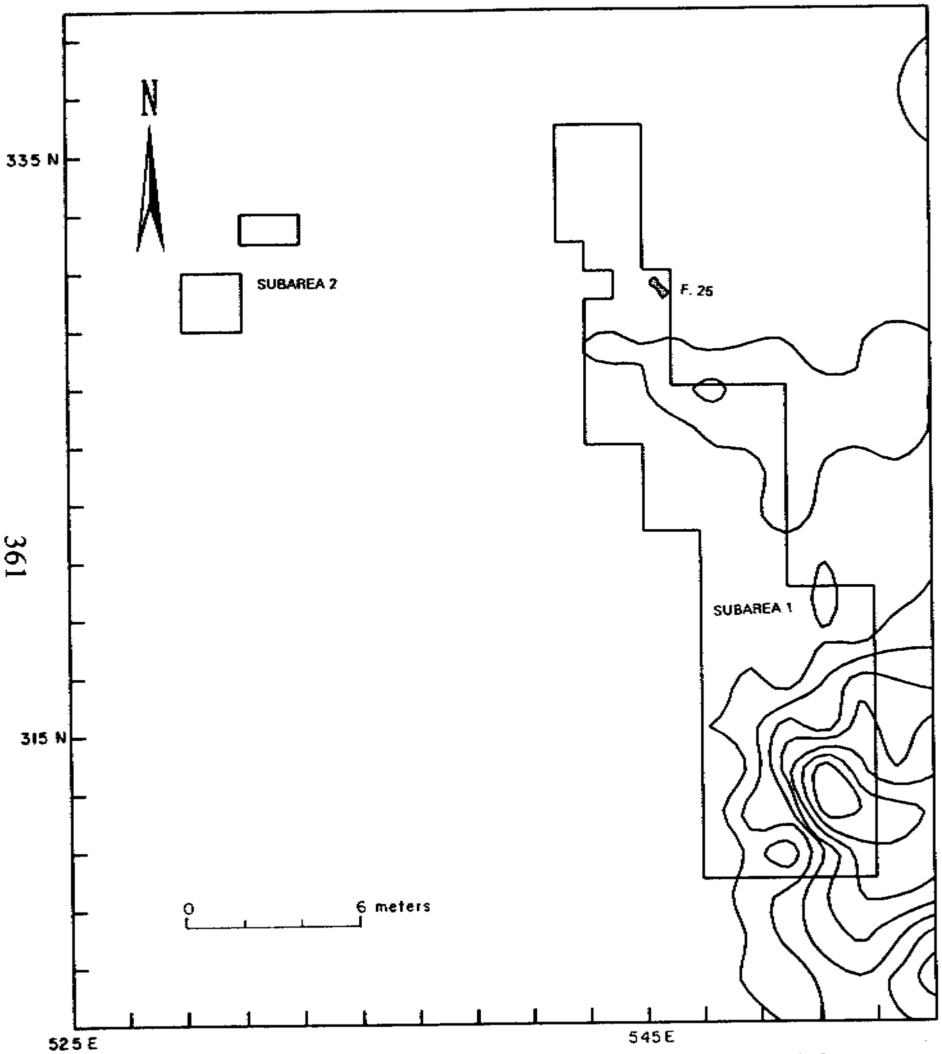

Figure 18-11. Distribution of chipped stone artifacts in EA-3 at the Santa Teresa site; minimum contour = 1, contour interval = 1.

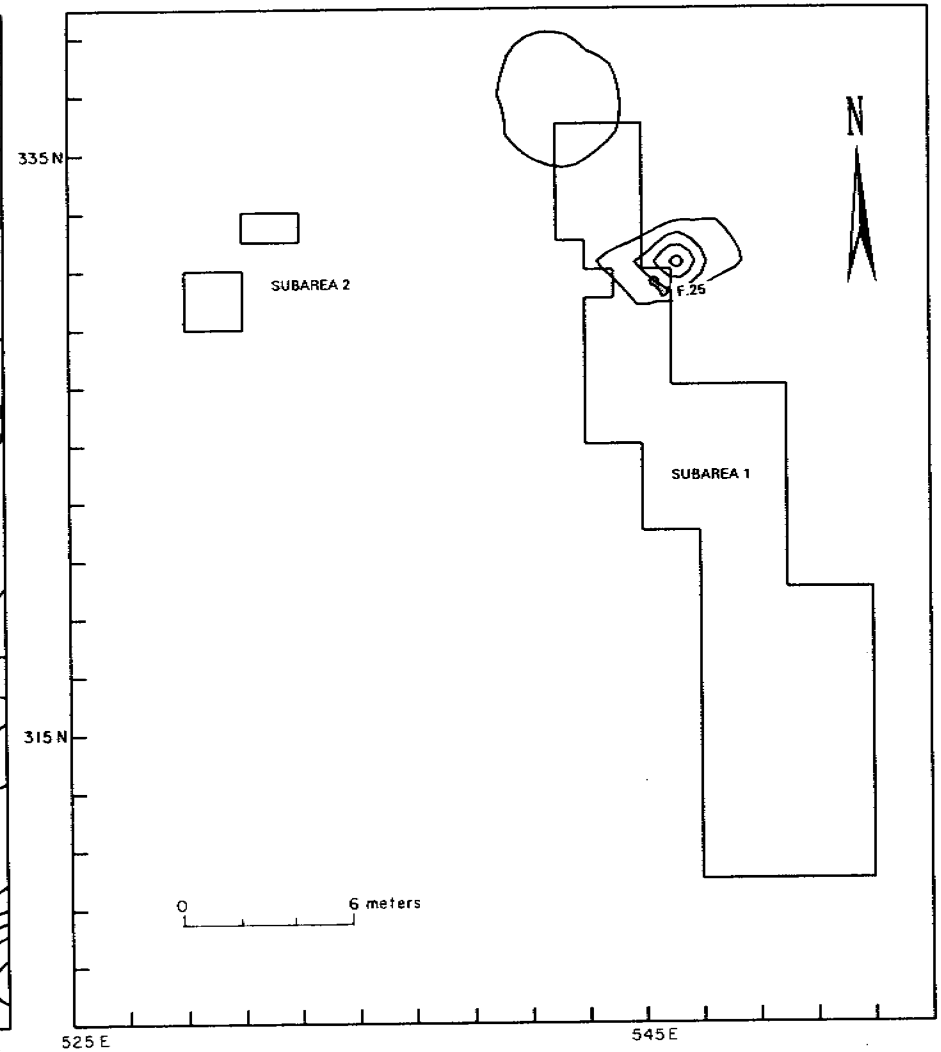

Figure 18-12. Distribution of burned rock in EA-3 at the Santa Teresa site; minimum contour = 1, contour interval = 4.

Two clusters of chipped stone artifacts are visible, a very small one south of Feature 25 and a much larger concentration in the southern part of Subarea 1. Burned rock clustered in and around Feature 25 and to the north of that hearth.

Distributions of chertic materials and aphanitic rhyolites are shown in Figures 18-13 and 18-14. These materials occur in very similar patterns. Chertic materials clustered in two zones, one directly south of Feature 25 and another in the southeast part of Subarea 1. Aphanitic rhyolites mainly clustered just northwest of the center of distribution for chertic materials.

Thus, EA-3 may represent the remains of more than one occupation. No temporally diagnostic artifacts or dateable materials were found in this unit, so there is no way to directly date these materials. The possibility that EA-2 and EA-3 were related has already been mentioned. In addition, the general similarity of these analytic units to EA-1 suggests that all three could be related, though there was a distinct break between EA-1 and EA-2/EA-3. In order to explore this possibility, these units are compared in the next section.

Comparison of Excavation Areas 1, 2, and 3

EA-1, EA-2, and EA-3 were in the central part of the site and contained most of the chipped stone assemblage as well as much of the burned rock. Figure 18-15 shows the distribution of all chipped stone artifacts in this part of the site and suggests that EA-2 was simply an outlying part of the artifact concentration centered on EA-3. EA-1 appears to be completely separated from the other analytic units. However, distortion was undoubtedly introduced into this plot by combining surface and subsurface assemblages, since there is no subsurface data for intervening grids. Only surface artifacts are considered in Figure 18-16. The few very small clusters that occur probably represent isolated artifacts. The same general clusters occur in this plot, but EA-2 and EA-3 no longer seem to be part of the same large cluster. Thus, there probably was some distortion in Figure 18-15, and those contours cannot be completely trusted. Some contours probably cross EA-2 and EA-3 because of their close proximity, and do not cross EA-1 because it is much farther away.

The distribution of burned rock in the central part of the site is shown in Figure 18-17. Two general clusters are visible, one comprising the northwest quarter of EA-1 and the second occurring around and north of Feature 25 in EA-3. At this level of analysis there are no clusters of burned rock in EA-2. When compared with Figure 18-15, the differential distribution of chipped stone artifacts and burned rock is quite visible, again suggesting that the activities which used these materials were spatially separate.

Distributions of chertic materials and aphanitic rhyolites are shown in Figures 18-18 and 18-19. These distributions were generally similar, suggesting those materials were mostly reduced in the southeast corner of EA-1, Subarea 1, and the southeast corner of EA-3, Subarea 1. Only one piece of chert was found in the north part of EA-2, and aphanitic rhyolites were so evenly spread that no clusters were plotted. Table 18-4 illustrates percentages of material categories for these assemblages. In general, they are fairly similar. Cherts were the most common materials in EA-2 and EA-3, and aphanitic rhyolites were the second most abundant. This order was reversed

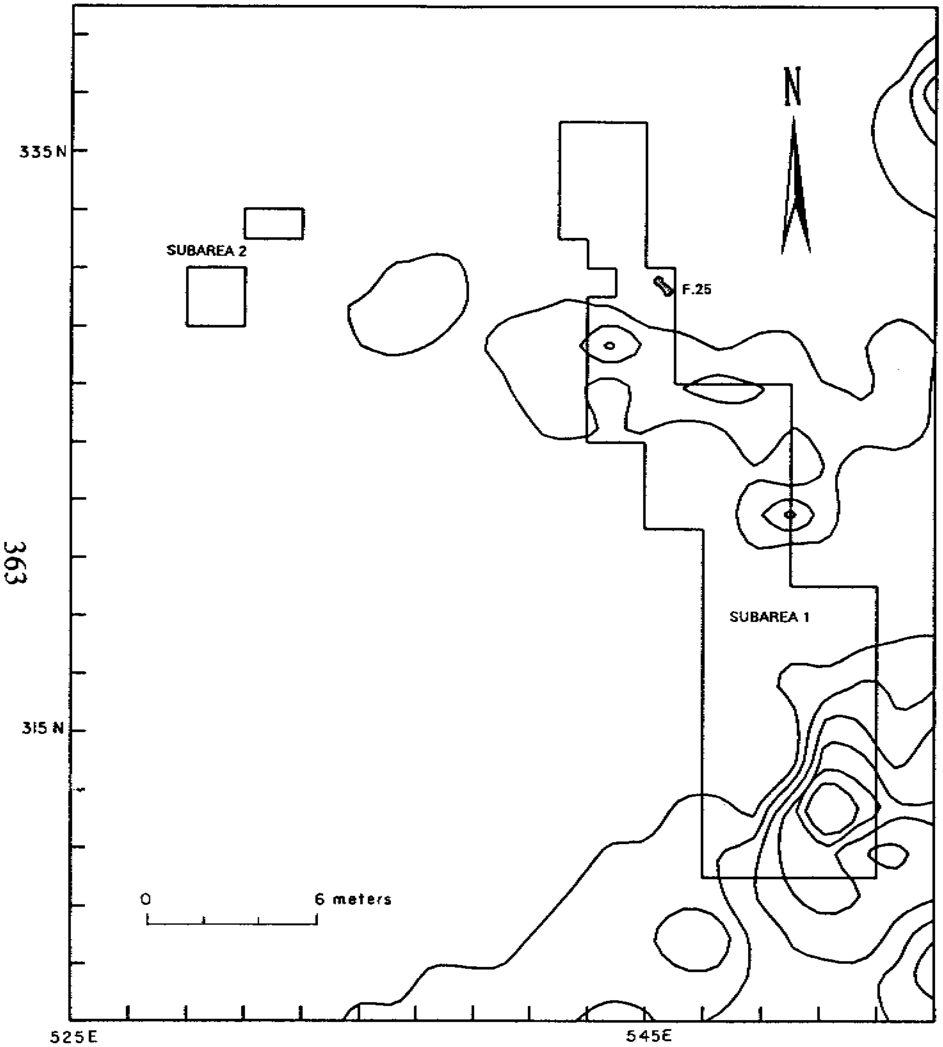

Figure 18-13. Distribution of chertic materials in EA-3 at the Santa Teresa site; minimum contour = 1, contour interval = .5.

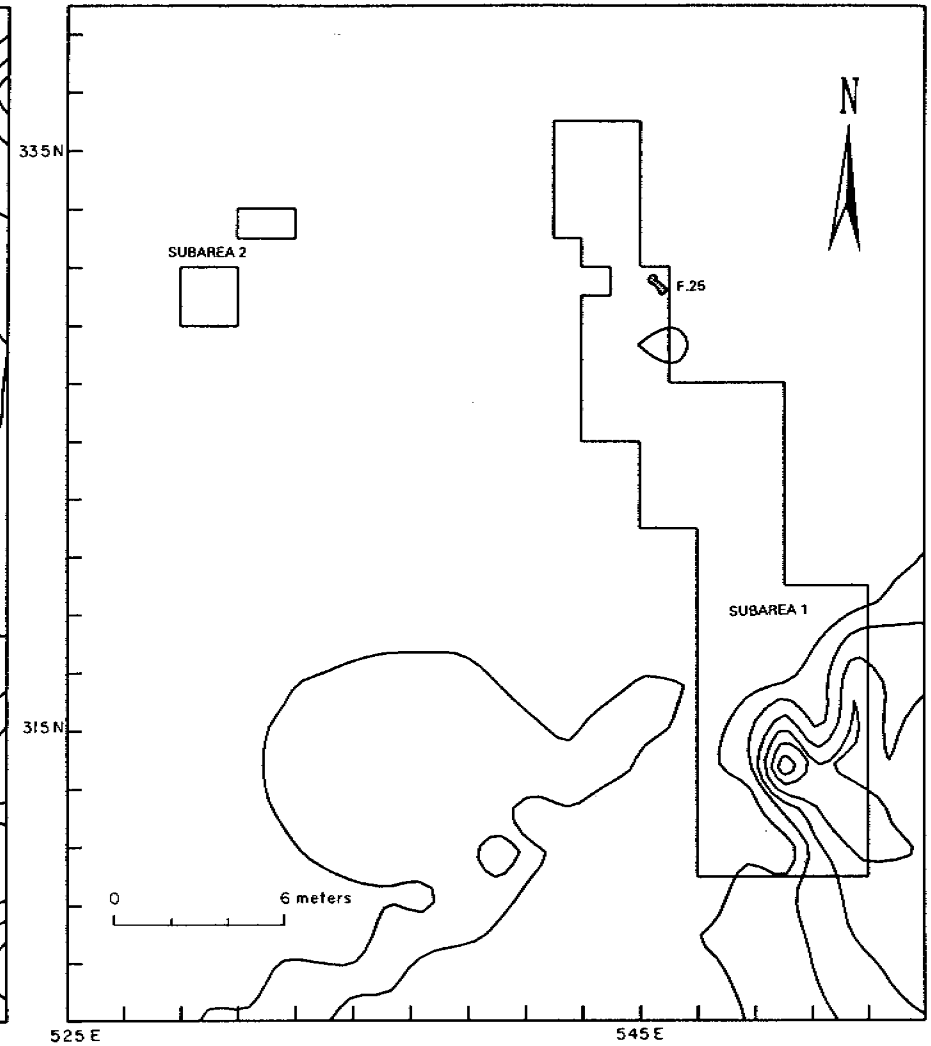

Figure 18-14. Distribution of aphanitic rhyolites in EA-3 at the Santa Teresa site; minimum contour = 1, contour interval = .5.

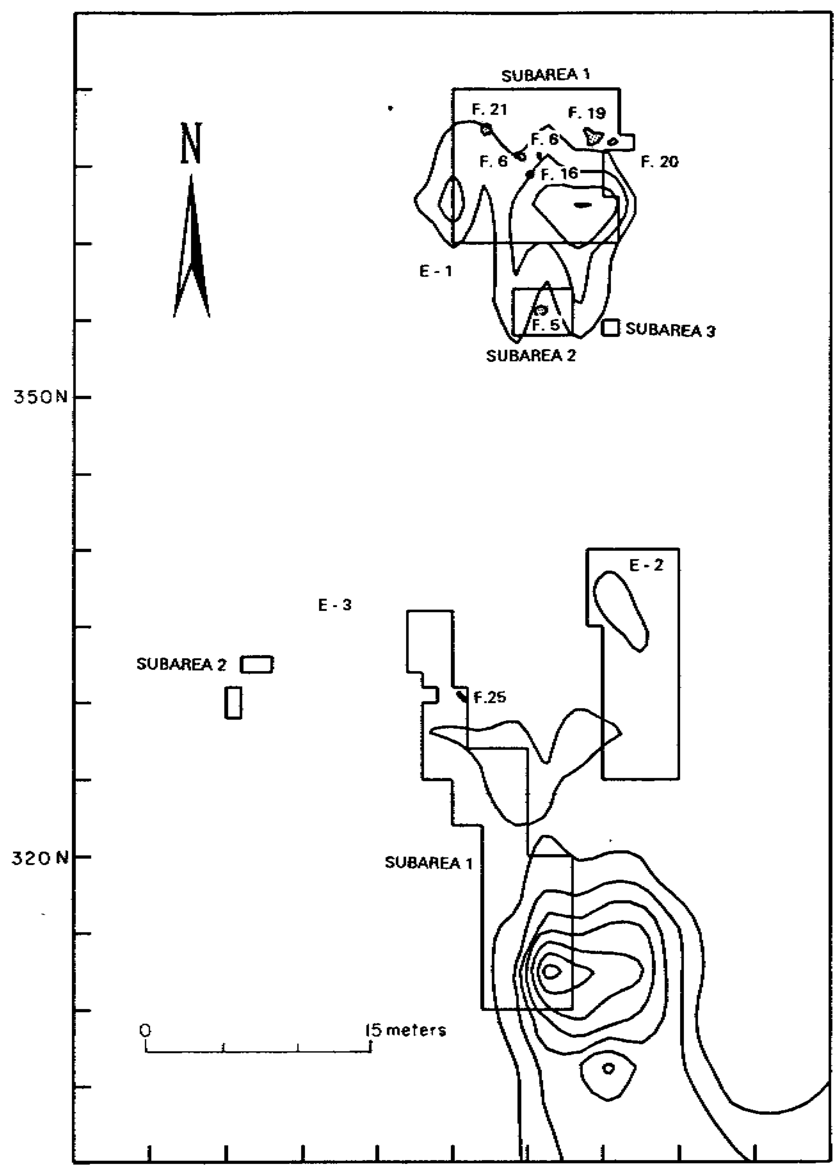

Figure 18-15. Distribution of chipped stone artifacts in the central part of the Santa Teresa site; minimum contour = 1, contour interval = 1.

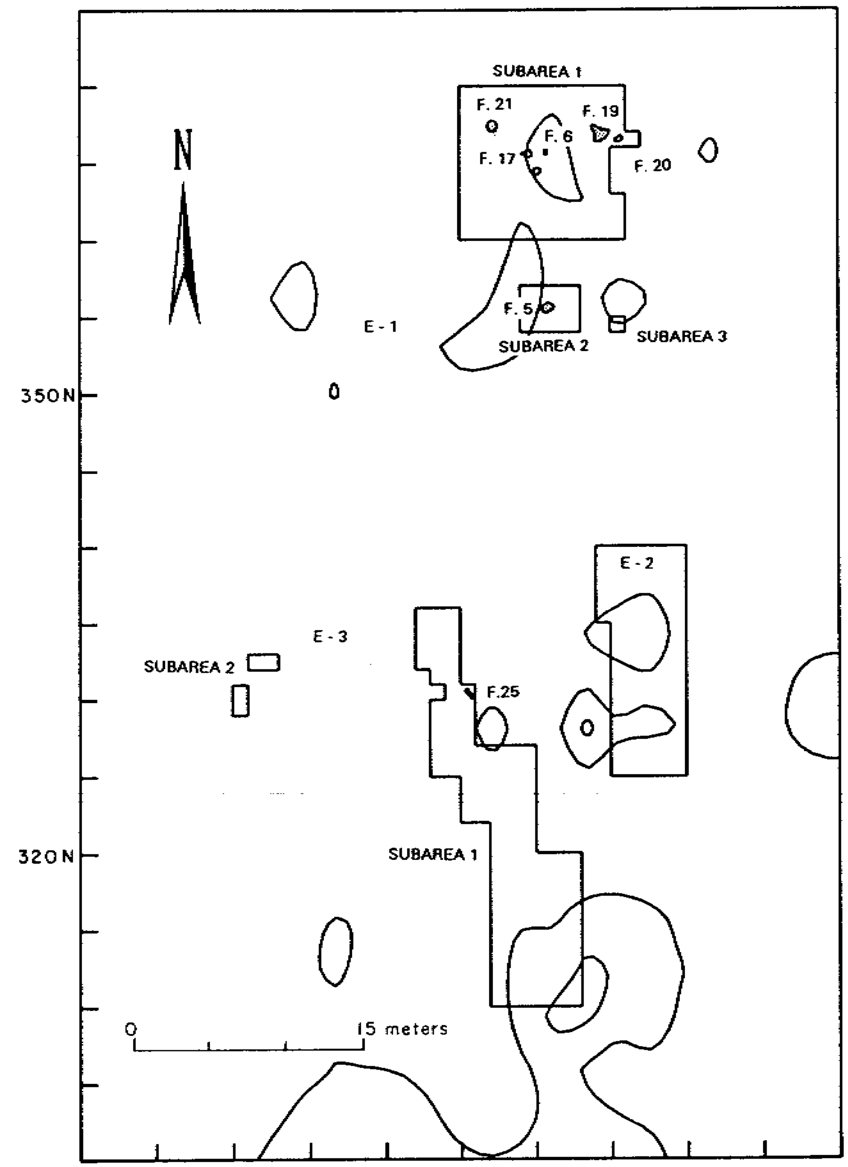

Figure 18-16. Distribution of surface chipped stone artifacts in the central part of the Santa Teresa site; minimum contour 1 = .5, contour interval = 1.

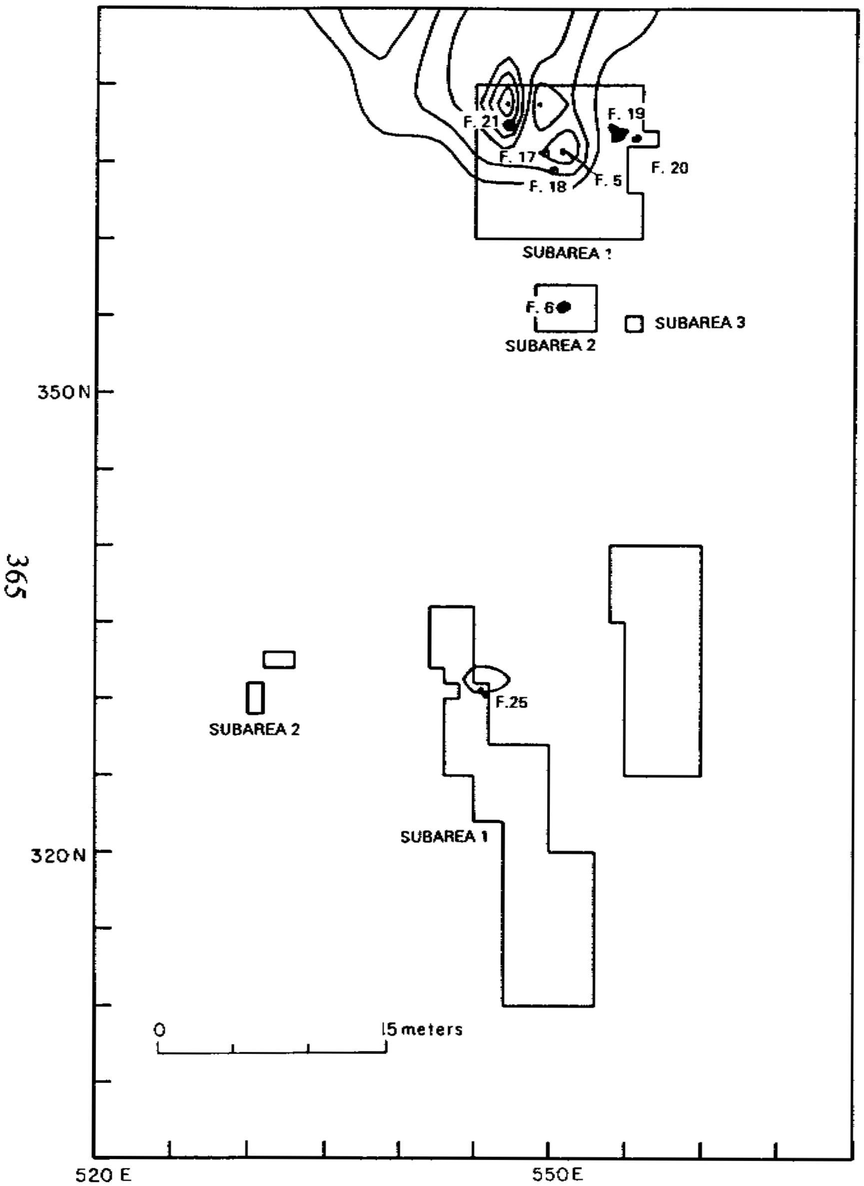

Figure 18-17. Distribution of burned rock in the central part of the Santa Teresa site; minimum contour = 1, contour interval = 7.

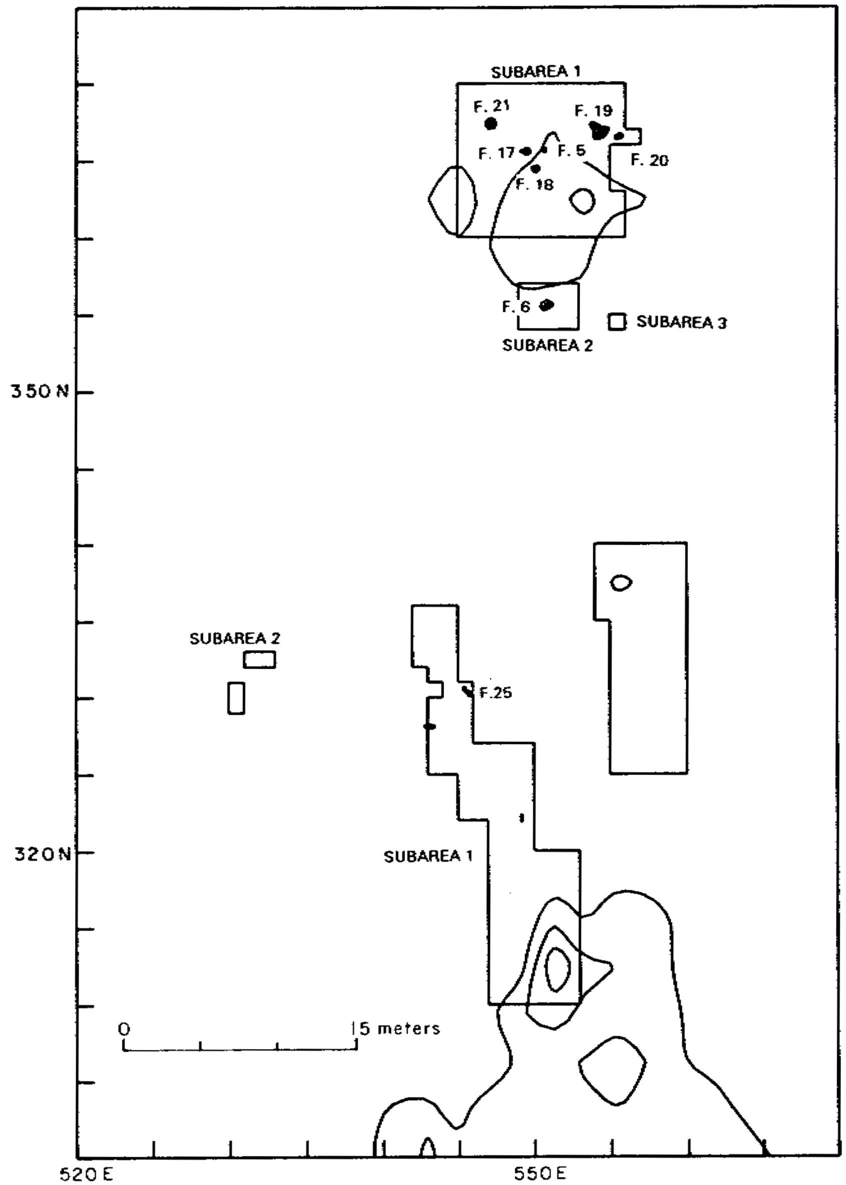

Figure 18-18. Distribution of chertic materials in the central part of the Santa Teresa site; minimum contour = 1, contour interval = 1.

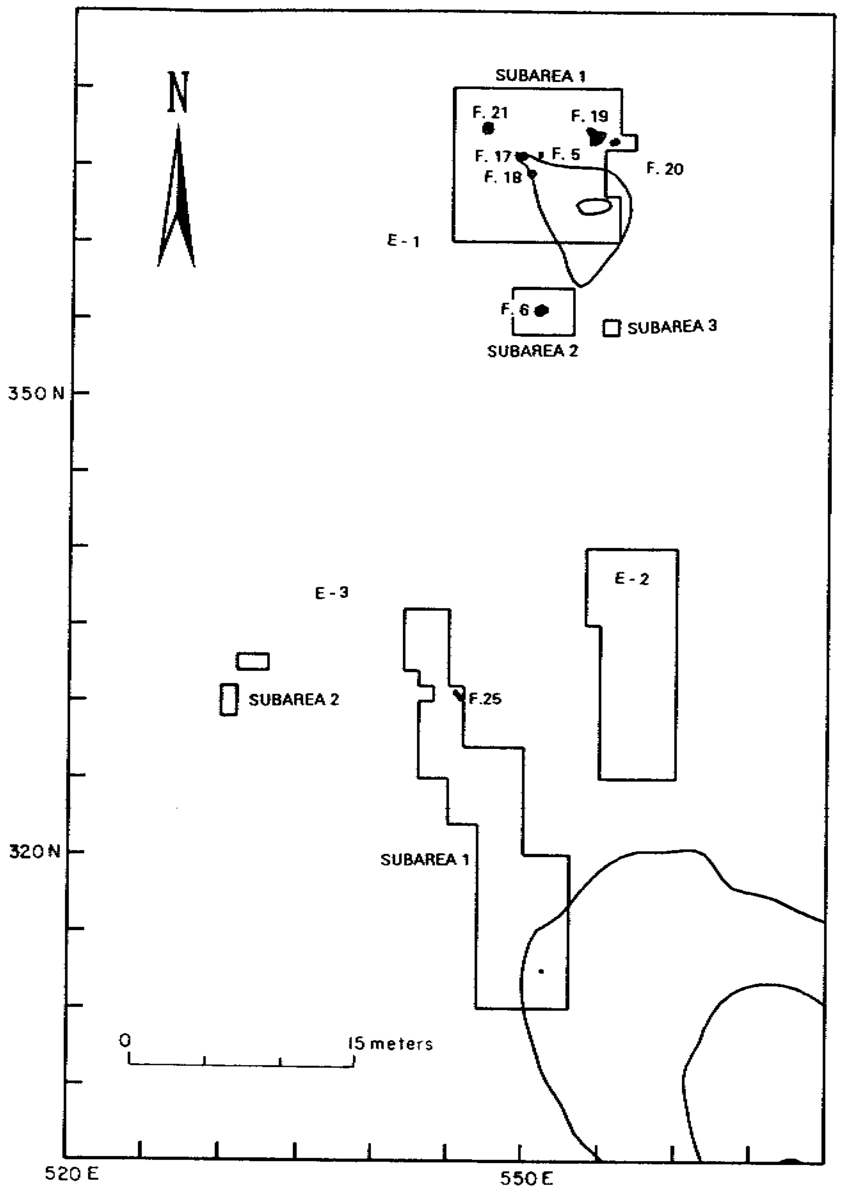

Figure 18-19. Distribution of aphanitic rhyolites in the central part of the Santa Teresa site; minimum contour = 1, contour interval = 1.

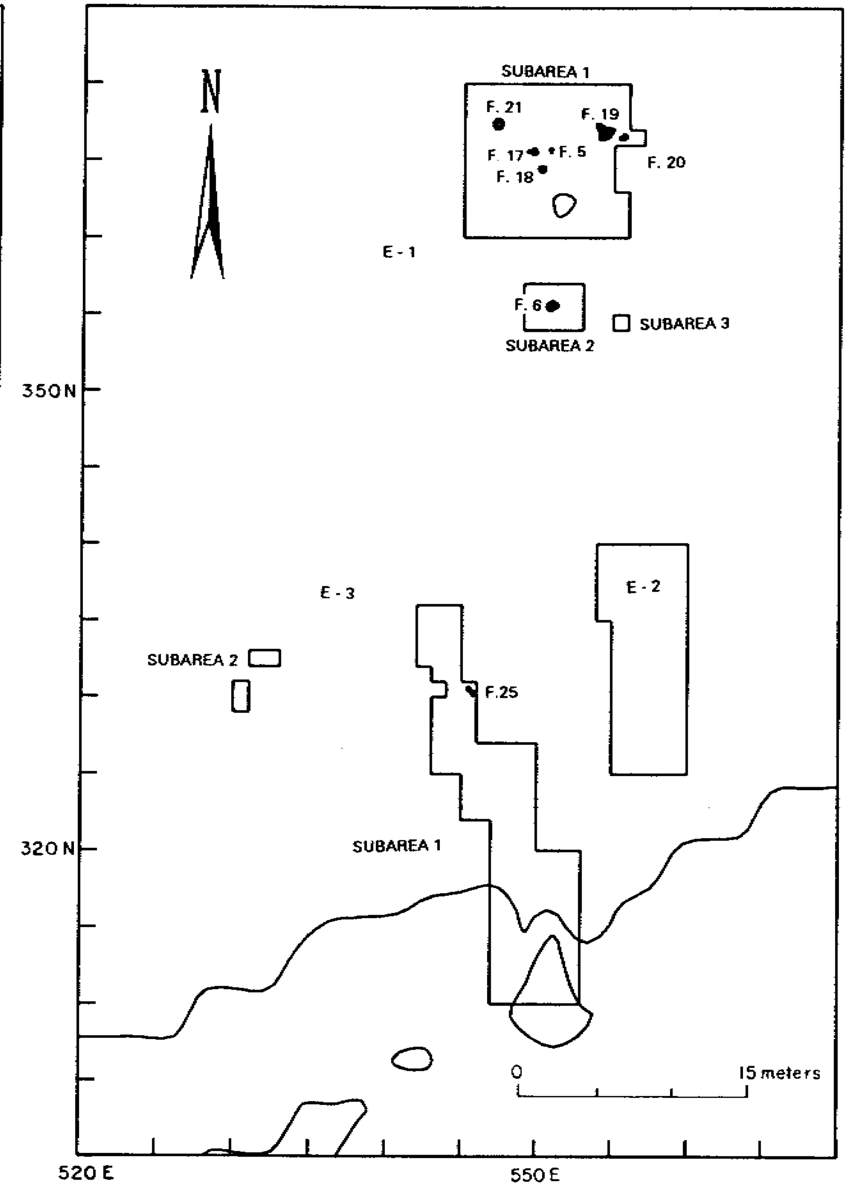

Figure 18-20. Distribution of aphanitic rhyolite Variety 360 in the central part of the Santa Teresa site; minimum contour = .5, contour interval = .4.

in EA-1. Coarse-grained rhyolites were moderately common in all three assemblages, while other materials were rare or absent. These assemblages were fairly similar, and they may be related. It may be possible to further evaluate this potential by examining specific material varieties.

Table 18-4. Comparison of material category makeup of Excavation Areas 1, 2, and 3 (column percentages)

Material Type	EA-1	EA-2	EA-3
Cherts	37.6	59.2	45.8
Chalcedonies	5.0	1.3	1.4
Silicified woods	1.2	0.0	1.4
Obsidian	0.0	1.3	0.0
Undifferentiated igneous	0.0	1.3	0.7
Rhyolites	7.7	7.9	9.9
Aphanitic rhyolites	42.5	21.1	27.5
Silicified limestone	2.3	4.0	2.8
Siltstone	0.0	0.0	0.7
Undifferentiated metamorphic	0.8	1.3	0.7
Quartz arenite	0.0	0.0	0.7

The chert and aphanitic rhyolite categories each contained a series of materials that were separated during analysis. Two varieties in particular suggest that EA-1 and EA-3 were closely related, while EA-2 may represent a separate occupation. Aphanitic rhyolite Varieties 360 and 361 occurred across the site, but were mostly found in EA-1 and EA-3, as shown in Table 18-5 and Figures 18-20 and 18-21. Only a few examples of these materials were recovered from EA-2. Silicified limestone Variety 412 occurred only in these three analytic units (other than two examples found elsewhere on the surface). However, while six examples were found in EA-1 and eight in EA-3, only one was recovered from EA-2. Three examples of a mottled brown chert (Variety 32) were found at the site, occurring only in EA-1 and EA-3. Similarly, two examples of a mottled gray chert (Variety 35) were found, one each in EA-1 and EA-3. Only three pieces of silicified wood Variety 103 were recovered, one each in EA-1 and EA-3, and one from elsewhere on the surface.

Thus, all three analytic units in the central part of the site may not have been closely related. EA-1 and EA-3 each contained large amounts of two varieties of aphanitic rhyolite, and most specimens of several other rare materials. EA-2 differed from those assemblages, containing few pieces of those varieties of aphanitic rhyolites and a silicified limestone, and none of the other materials. At this more specific level, the EA-1 and EA-3 assemblages were similar in composition, while EA-2 was different. This suggests that EA-1 and EA-3 represent the same site occupation.

Table 18-5. Distribution of aphanitic rhyolite Varieties 360 and 361 (frequencies)

Provenience	Variety 360	Variety 361
EA-1	33	63
EA-2	1	7
EA-3	29	43
EA-5	0	1
EA-7	2	1
EA-8	1	7
Surface	26	30

Table 18-6. Top and bottom elevations below datum for hearths in EA-4

Feature	Elevation at Top of Feature	Elevation at Bottom of Feature
3	12.75	12.80
4	12.72	12.75
24	12.73	12.81

Where EA-2 fits into this picture is difficult to determine. The presence of a few examples of materials that were common in EA-1 and EA-3 may suggest a close relationship with those areas. Conversely, it could also indicate the recycling of debitage from earlier occupational zones. While the latter is probably more likely, neither can be ruled out.

Excavation Area 4

Since only three chipped stone artifacts were found in EA-4, no contour plots could be constructed. In contrast, burned rock was quite common, and its distribution is shown in Figure 18-22. Most of the burned rock clustered in and around Feature 4, with a much smaller high occurring to the north of Features 3 and 24. Top and bottom elevations for the hearths in this area are shown in Table 18-6. Elevation ranges were quite similar for all three hearths, particularly their upper depths. Similarities between measurements suggest that these hearths were in some way related and were perhaps used sequentially or for different purposes during a single occupation. This is discussed in more detail later. Only Feature 4 was dated (Beta-80965). The date was calibrated, and at the second standard deviation provides a range of 405 to 180 B.C., suggesting a Late Archaic affiliation for this cluster of features.

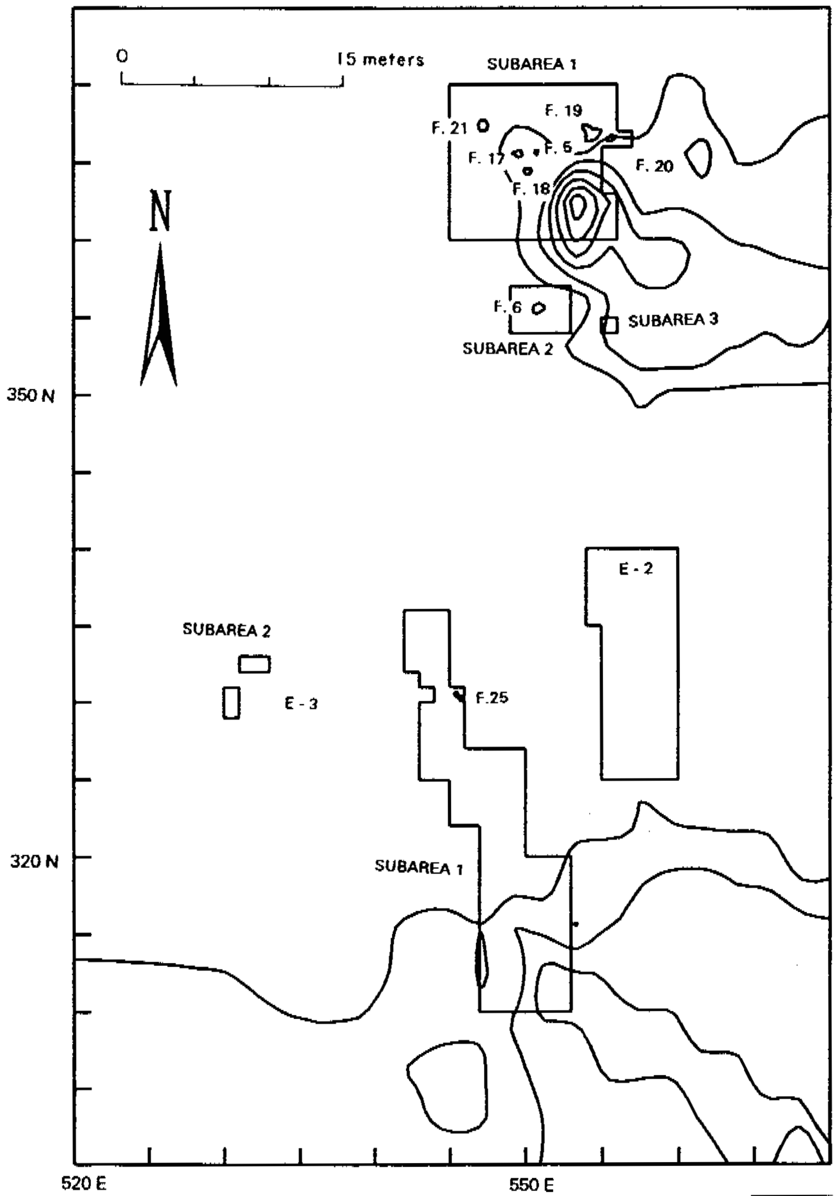

Figure 18-21. Distribution of aphanitic rhyolite Variety 361 in the central part of the Santa Teresa site; minimum contour = .5, contour interval = .4.

Excavation Area 5

Since only six chipped stone artifacts were found in EA-5, no contour plots could be constructed. Like EA-4, burned rock was common, and its distribution is shown in Figure 18-23. Most burned rock clustered in and around Feature 9, with a few pieces occurring to the south and southeast of that hearth. Feature 2 is also near this high but is probably unassociated since it contained only one piece of burned rock. No burned rock was found in Feature 22.Top and bottom elevations for the hearths in this area are shown in Table 18-7. Elevation ranges were quite similar for all three hearths, particularly their upper depths. These similarities suggest that the hearths in this analytic unit were related and were perhaps used sequentially or for different purposes. Only Feature 9 was dated (Beta-80963). The date was calibrated and at the second standard deviation provides two ranges of equal probability: 760 to 635 B.C., and 560 to 380 B.C. This suggests a Late Archaic affiliation for these features and artifacts.

Excavation Area 6

Unlike other excavation areas at the Santa Teresa site, EA-6 contained no visible features and was used to examine five low-level anomalies that were identified in this area during the magnetometer survey. Excavation encountered no subsurface cultural features or deposits. Since this part of the site contained only seven chipped stone artifacts and one piece of burned rock, no contouring was possible. No temporally sensitive artifacts or other materials were recovered from this area, so no date was assigned.

Table 18-7. Top and bottom elevations below datum for hearths in EA-5

Feature	Elevation at Top of Feature	Elevation at Bottom of Feature
2	13.03	13.23
9	13.05	13.13
22	13.04	13.12

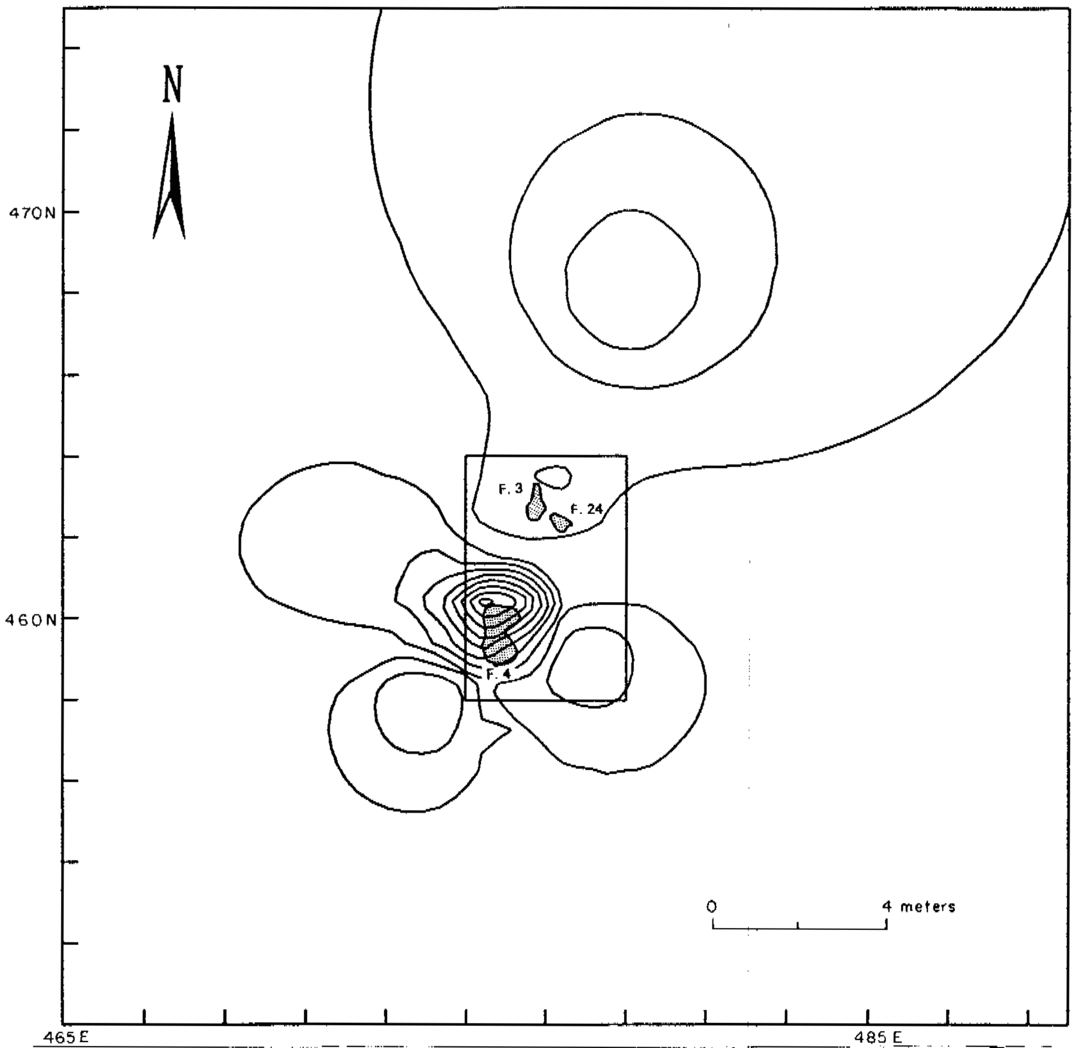

Figure 18-22. Distribution of burned rock in EA-4 at the Santa Teresa site; minimum contour = 1, contour interval = 5.

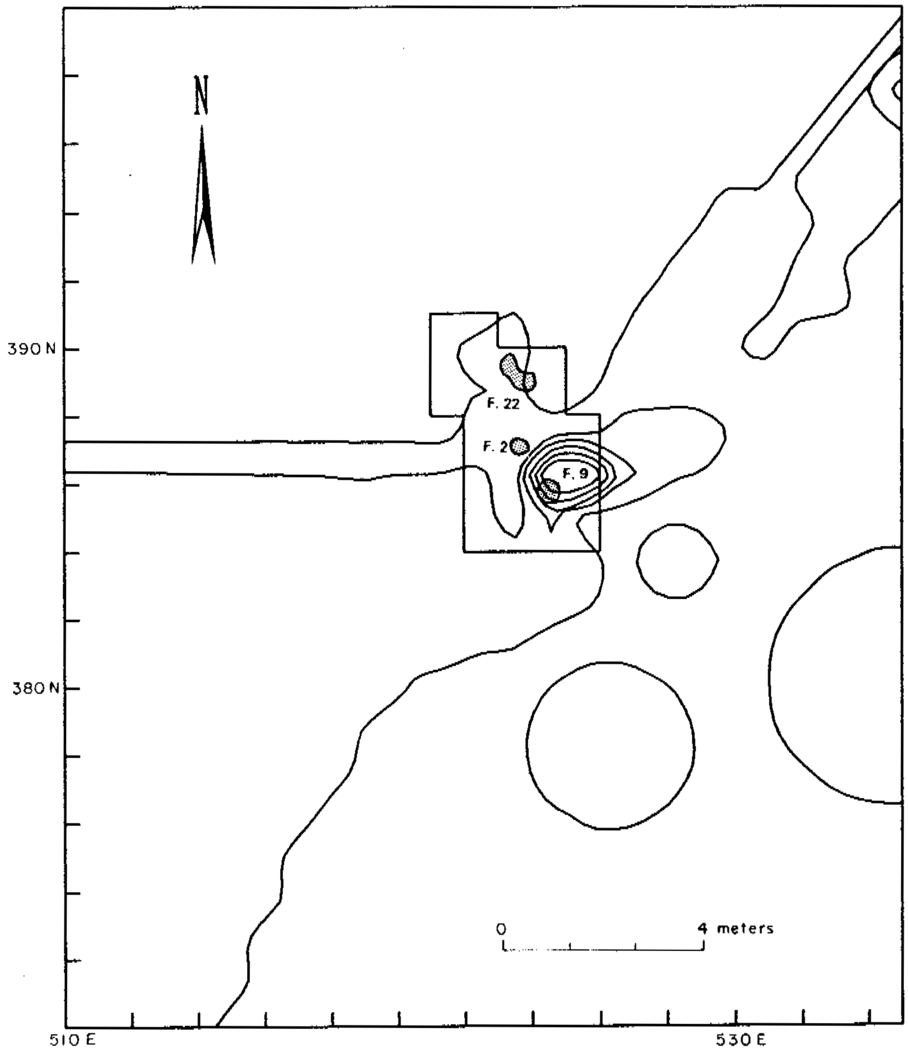

Figure 18-23. Distribution of burned rock in EA-5 at the Santa Teresa site; minimum contour = 1, contour interval = 5.

Excavation Area 7

Since only six chipped stone artifacts were found in EA-7, no contour plots could be constructed. In contrast, burned rock was rather common, and the distribution of this artifact class is shown in Figure 18-24. All three features in this area were clusters of burned rock. Consequently, most burned rock clustered in and around Features 8 and 11, with a smaller high northwest of Feature 16.

Just exactly what these materials represent is unclear. The clusters of burned rock defined as features may be the remains of deflated hearths, though no associated charcoal stains were found. They could also be collections of discarded materials. However, if this area was a discard zone it is strange that more chipped stone artifacts were not found there. These features probably represent one or more very short-term uses of this general area, in which few artifacts were discarded and little chipped stone reduction occurred. Unfortunately, the lack of associated charcoal stains makes it impossible to determine whether the features were in any way affiliated, since the depths at which they occurred could as easily reflect deflation as the original locus of deposition. No temporally diagnostic materials were recovered from this area, so no dates can be assigned.

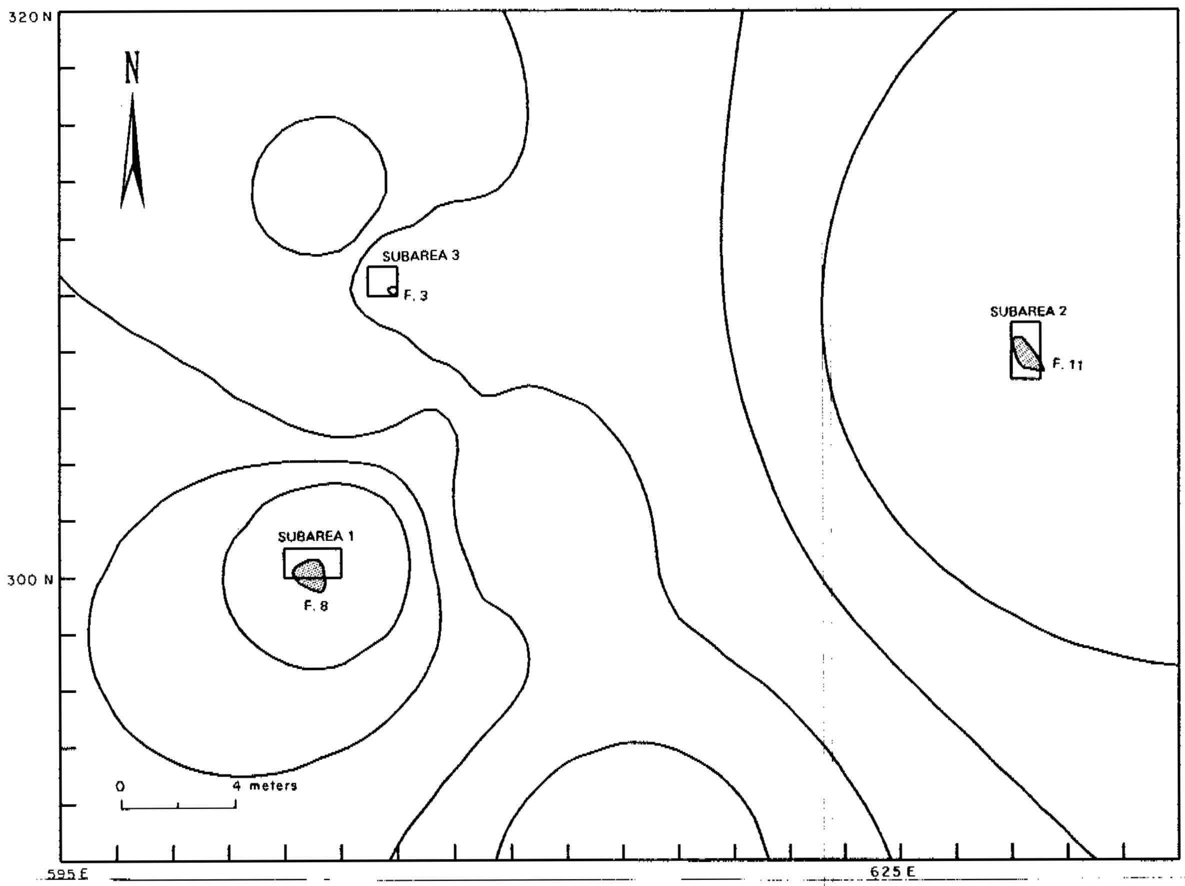

Figure 18-24. Distribution of burned rock in EA-7 at the Santa Teresa site; minimum contour = 1, contour interval = 1.

Excavation Area 8

Figures 18-25 and 18-26 show the distribution of chipped stone artifacts and burned rock in EA-8. As elsewhere on the site, these artifact classes were distributed differently. Chipped stone artifacts clustered to the west of Feature 14 and north of Feature 7, while burned rock clustered to the east of Feature 7. Top and bottom depths for these hearths are shown in Table 18-8. Depth ranges were very similar, suggesting these hearths were related and perhaps used sequentially or for different purposes. Both features were dated, and dates were calibrated (Beta-80962 and Beta 80964). At the second standard deviation, Feature 7 dated between 2910 and 2595 B.C., and Feature 14 between 2910 and 2590 B.C. The similarity of these dates suggest that both were fueled with wood from the same source, probably a nearby mesquite hummock. A Middle Archaic affiliation is indicated, and it is likely that both hearths were used during a single occupation.

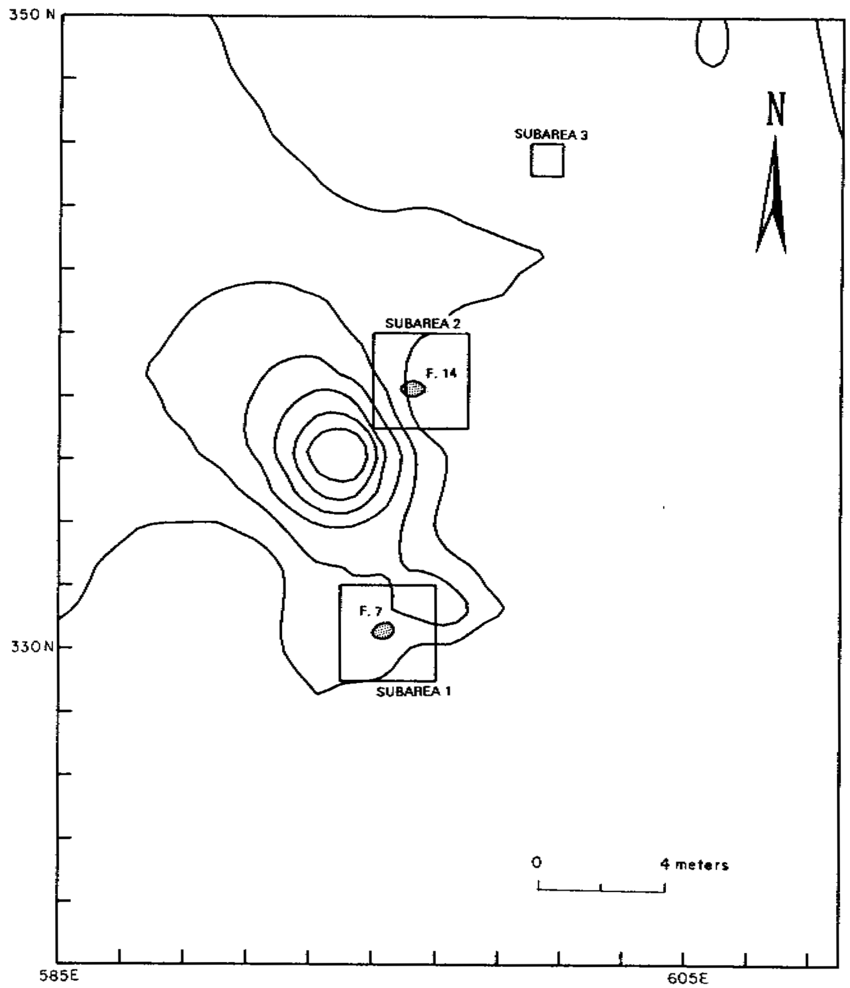

Figure 18-25. Distribution of chipped stone artifacts in EA-8 at the Santa Teresa site; minimum contour = 1, contour interval = .5.

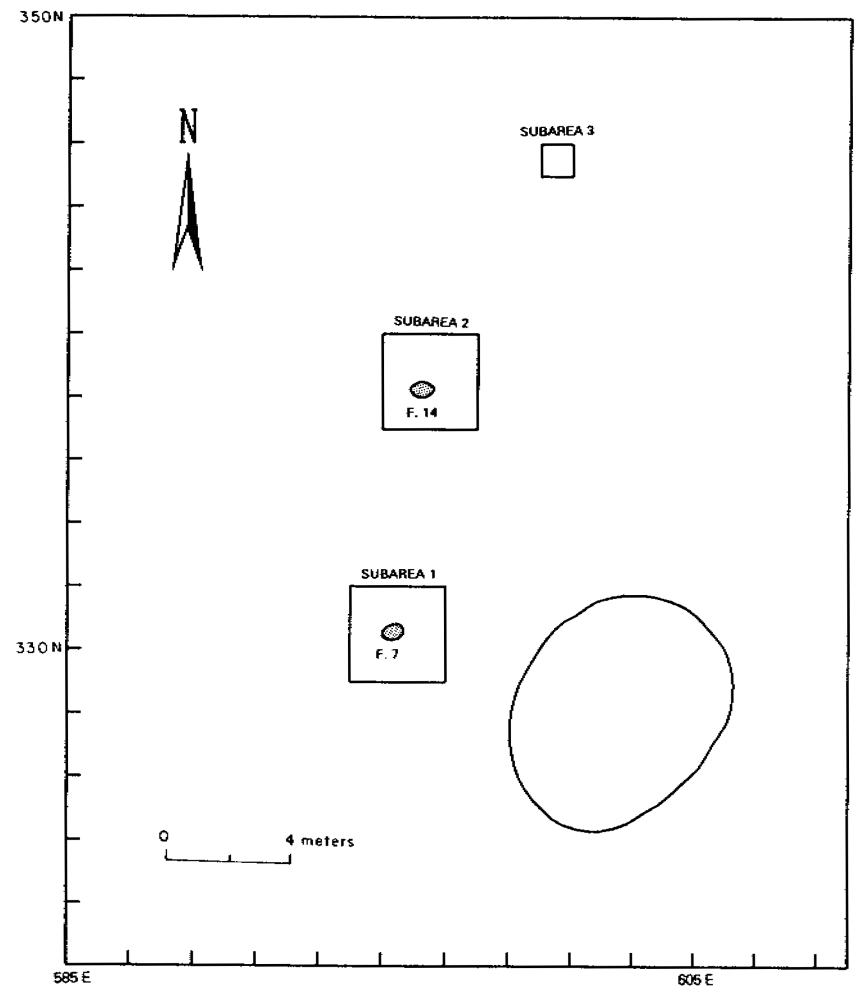

Figure 18-26. Distribution of burned rock in EA-8 at the Santa Teresa site; minimum contour = 1, contour interval = .5.

Table 18-8. Top and bottom elevations below datum for hearths in EA-8

Feature	Elevation at Top of Feature	Elevation at Bottom of Feature
7	12.97	13.05
14	13.00	13.05

Excavation Areas 9 and 10

These analytic units contained few artifacts or features. EA-9 contained no chipped stone artifacts and only three pieces of burned rock, while no artifacts were found in EA-10. Thus, it was not possible to produce contour plots for these analytic units, and no dates are available from the features.

Discussion

Little information is available from four of the ten analytic units discussed in this chapter. Three other units contained few chipped stone artifacts, though hearths and burned rock were present. While this distribution places limitations on our ability to analyze site structure, it should be possible to draw some tentative conclusions. The distribution of cultural materials has been discussed for each analytic unit, when possible, and some comparisons have already been made. We must now compare all analytic units to determine whether multiple occupations are indicated. In particular, the variety and distribution of hearths must be examined to determine whether they represent general purpose features or had special functions.

Hearths as Artifacts

While hearths are typically classified as features indicative of certain cultural activities, they can also be considered artifacts of human behavior. As such, characteristics of construction, content, and association can be compared and contrasted to help understand how they functioned.

Seventeen hearths were excavated at the Santa Teresa site. Table 18-9 shows hearth attributes, including maximum depth, approximate size, shape, and burned rock content. All of the hearths were simple excavations into sand; there was no evidence for any stone or clay linings. Depths ranged between 3 and 18 cm, so no hearth was particularly deep. Five basic shape categories were defined: oval, circular, bowling pin, bilobed, and irregular. Oval was the most common shape, with eight examples. Three hearths were circular and along with the oval category had probably retained their original shapes and were not distorted by bioturbation. Some distortion may be possible in other shape categories.

It is possible that the bilobed, bowling pin, and irregular hearths were disturbed by cultural or natural processes. Two bilobed hearths were found. The southern lobe of Feature 4 seemed to be the most intact part of this hearth, and the northern lobe contained a shallow stain and mostly surficial burned rock. This lobe may have contained materials cleaned from the main hearth pit, represented by the southern lobe. Thus, this feature probably should be reclassified as oval. The same cannot be said of Feature 22, which contained no burned rock or evidence that one lobe represented materials cleaned from the other. This feature may actually be made up of two hearths, one intrusive into the other. Whether they were built during one occupation or represent two uses of the same area is impossible to determine, but the former is probably more likely.

Table 18-9. Shape and depth data for hearths at the Santa Teresa site (burned rock weight in parentheses)

Feature	Depth (cm)	Size (sq m)	Shape	Burned Rock
2	18	.28	oval	1 (1.3 g)
3	5	.44	bowling pin	-
4	11	1.33	bilobed	124 (3083.6 g)
5	12	.10	oval	14 (612.7 g)
6	12	.74	irregular oval	-
7	6	.35	oval	1 (77.1 g)
9	14	.52	circular	55 (1136.8 g)
10	8	1.09	oval	-
14	9	.39	oval	1 (18.6 g)
17	10	.41	bowling pin	-
18	3	.25	circular	-
19	10	1.46	irregular, lobed	-
20	6	.28	oval, lobed	-
21	12	.49	circular	93 (4840.9 g)
22	8	.74	bilobed	-
23	10	.98	oval, lobed	
24	8	.17	irregular	-

Two hearths were shaped like bowling pins (Features 2 and 17), with an oval-shaped main basins and narrower extensions on ends. No evidence of rodent or root disturbance were noted in these features, and there were no signs of cultural alteration. Thus, these shapes appear to have been intentional. Feature 19 was categorized as irregular in shape, yet in some ways it resembles the bowling pin–shaped hearths. However, some evidence of bioturbation was noted in this feature, indicating that its shape was distorted. Feature 24 was also classified as irregular, mostly because it was distorted by a narrow lobe on the east side. However, when examined in cross section (see Fig. 9-12), the lobe was very shallow (1 to 2 cm). With the lobe eliminated, Feature 24 is essentially oval. The lobe on this hearth could represent spillover from the interior, or it could have had a similar function to lobes on other hearths.

Thus, hearths seem to occur in three basic shapes: oval (10), circular (3), and bowling pin (2). The original shapes of two hearths could not be determined due to distortion. While the bowling pin hearths might seem aberrant, it should be noted that three oval hearths (including Feature 24) contained similar lobes. A considerable amount of disturbance was noted in the lobe on Feature 23, but such was not the case with Features 20 or 24. Thus, up to four hearths contained definite extensions. Further analysis may help show whether they were functional parts of the hearths.

The various attributes of each shape category are compared in Table 18-10. Mean depths of oval and circular hearths are quite similar, while bowling pin hearths were slightly shallower. Of course, there were only two examples of the latter, so sample error could be responsible for this difference. Mean sizes of circular and bowling pin hearths were almost identical, while oval hearths were slightly larger. Perhaps the most significant difference between shape categories is in burned rock inclusions. Neither of the bowling pin hearths contained burned rock, while half to two-thirds of the other categories did. However, breaking hearths down by shape resulted in the definition of no consistent differences. Perhaps general hearth shape was less important functionally than other aspects.

Table 18-10. Comparison of hearth shape categories for the Santa Teresa site (disturbed features eliminated from consideration)

Shape	Mean Depth (cm)	Mean Size (sq m)	Percent Containing Burned Rock
Oval	10.0	.57	50.0
Circular	9.7	.42	66.7
Bowling Pin	7.5	.43	0.0

Hearth depth may be a more important functional determinant. Considering 10 cm to be the break between shallow and deep hearths, some important distinctions can be discerned. Only 2 of 11 hearths that were 10 cm or less in depth contained burned rock. In both cases only one piece of burned rock was recovered, suggesting that its presence may be unrelated to the function of these features. In contrast, 5 of 6 hearths that were deeper than 10 cm contained burned rock. Only one fragment was found in Feature 2, and again may have been an accidental inclusion. However, between 14 and 124 pieces of burned rock were found in the other four hearths, suggesting that it was functionally related to the features in which it was found. All four hearths with extensions (bowling pin and lobed) were 10 cm or less in depth, while none of the deeper hearths had extensions. Overall, the deeper hearths were somewhat larger, averaging 0.58 sq m, compared to 0.48 sq m for the shallow hearths. However, by eliminating the two disturbed features and correcting the size of Feature 4 to include only the deeper lobe, this situation is reversed: deeper hearths averaged 0.38 sq m, while the mean size of shallow hearths is unchanged.

Considering hearth depth and related characteristics, four general categories can be defined: shallow hearths, shallow hearths with extensions, deep hearths, and deep hearths containing burned rock. How are these categories distributed across the site? Seven hearths were found in EA-1 and can be divided into two clusters and two isolated features. One cluster contained Features 5, 17, and 18. Each of these hearths falls into a separate category: Feature 5 was comparatively deep and contained burned rock, Feature 17 had an extension, and Feature 18 was shallow. The second cluster contains Features 19 and 20. The shape of the former was unfortunately distorted, while the latter contained an extension. Of the isolated hearths, Feature 6 was comparatively deep and contained no burned rock. Feature 21, in contrast, was deep and contained the largest amount of burned rock at the site, by weight. Thus, this analytic unit contained all four categories of hearths. In addition, as illustrated in Figure 9-2, there were numerous small stains around several hearths as well as elsewhere in Subareas 1 and 2. The number of hearths, range of functional categories represented, similarity of feature elevations, and occurrence of numerous other stains suggest that this analytic unit represents a single comparatively lengthy occupation.

Three hearths were excavated in EA-4, and some functional distinctions are also evident there. Feature 3 was shallow and had an extension. Feature 4 was comparatively deep and contained a large amount of burned rock. Feature 24 was shallow and may have had an extension, though that part of the hearth could also represent spillover from the interior. The shape and extremely shallow nature of this lobe suggest it was not an intentionally constructed part of the feature. If this is correct, each hearth in this unit is morphologically distinct.

Three to four hearths were found in EA-5. Feature 2 was comparatively deep and contained a single piece of burned rock that was probably unrelated to its use. Feature 9 was also comparatively deep and contained a moderate amount of burned rock. Feature 22 was apparently distorted and may represent two overlapping hearths. Whether or not this disturbance was cultural, it seems to fall into the shallow hearth category and lacks any extension. Thus, each hearth in this cluster is also morphologically distinct.

The last cluster of hearths is represented by two features in EA-8. Features 7 and 14 both fall into the category of shallow hearths, and both contained a single fragment of burned rock that may or may not be related to their use. However, a small cluster of burned rock southeast of Feature 7 suggests they probably were. If so, these features are functionally distinct from other shallow hearths at the site. It may be significant that they dated to the Middle Archaic, while all others appear to have been used during the Late Archaic.

The presence in several analytic units of multiple hearths that represent a variety of morphological types has important implications. Rather than evidence of repeated overlapping occupations occurring over a number of years, clusters of hearths instead appear to represent discrete occupational areas related to single uses. At least four morphological categories are represented among the hearths in EA-1 and probably represent several functional types. While some hearths seem to replicate the functions of others, this is probably indicative of length of stay rather than multiple uses. If several different occupations were represented in this unit or there was more than one occupying group, we would expect to see multiple activity areas. This is not the case. Only one area seems to have been used for chipped stone reduction, and most hearths are around the edge of that area. As seen in Figure 18-3, the zone in which chipped stone artifacts clustered overlaps the group of hearths that includes Features 5, 17, and 18. This group includes a shallow hearth with extension, a comparatively deep hearth containing burned rock, and a shallow hearth without an extension. It is interesting that Features 19, 20, and 21 replicate these types. Perhaps the zone around Features 5, 17, and 18 became cluttered with debris and they were replaced by other hearths, further away from the main activity area. Chipped stone artifacts may simply be the only materials discarded in this area that have been preserved. If bone scraps, wood shavings, and plant debris were also discarded there, the amount of trash would be considerably increased. Unfortunately, preservation at the site was very poor, and there was no evidence of such materials.

The situation is less complicated in the other analytic units that contain multiple hearths. Each of the hearths in EA-4 and EA-5 were morphologically and probably functionally distinct, and appear to represent a suite of activities. There were two shallow hearths in EA-8, each containing a small amount of burned rock with a larger discard area situated near the features. While deflation or mechanical disturbance could explain this discrepancy, it is more likely related to a different pattern of site use.

Hearth Functions

Several types of hearths were defined at the Santa Teresa site, and we have assumed that these categories were functionally distinct. Information on feature content may support this assumption. With the exception of features represented by clusters of burned rock, hearths contained a relatively homogenous fill of charcoal-stained sand. Very little charcoal was recovered, either during excavation or by flotation, and macrobotanical specimens were even rarer. However, a few specimens were found and are shown in Table 18-11. It is interesting that burned seeds were only found in shallow hearths, and two had extensions on one side. Unfortunately, the generally bad preservation of botanical materials renders these data suspect. Had wood charcoal been well preserved and this type of distribution found, some significance might be ascribed to it. Unfortunately, this was not the case. Wood charcoal was also badly preserved, and only tiny specimens were obtained for AMS dating. Thus, this distribution may simply represent the luck of the draw. Still, it is tempting to suggest that the presence of seeds in hearths with extensions is evidence of cooking. While botanical data can not be used to back this view, it is possible that the shallow extensions represent some type of specialized cooking feature.

Burned rock was recovered from several hearths and may be indicative of function. Experiments conducted by Duncan and Doleman (1991) suggest that different uses can produce specific break patterns. Irregular and blocky breaks seem related to use in stone boiling, while straight or curved breaks may be more indicative of hearth stone (or roasting) use. While tentative, these experiments suggest that it might be possible to examine hearth function through the types of breaks found on associated burned rock. However, it should be noted that Gerow (1994) examined burned rock from numerous archaeological features in south-central New

Mexico and disagrees with their conclusions. She feels that only curved breaks are diagnostic and that blocky breaks were caused by both stone boiling and roasting. These conclusions were not based on experimentation, so it is difficult to assess their validity.

Table 18-11. Macrobotanical specimens from hearths at the Santa Teresa site

Feature	Hearth Type	Date	Burned Seeds
7	shallow with burned rock	Middle Archaic	*Sporobolus* sp.
19	shallow with extension	Late Archaic	unknown type
20	shallow with extension	Late Archaic	*Helianthus* sp.

Table 18-12 provides information on burned rock breakage patterns for each feature that contains this artifact category (burned caliche is dropped from consideration). In most cases, only a small percentage of burned rock in hearths had definable breakage patterns. However, when break types could be determined they were overwhelmingly angular rather than straight or curved. This pattern occurs throughout the site, and small percentages of fragments with straight or curved breaks occurred only in EA-1 and EA-3. While rather problematic because of the high percentage of undefinable breaks, these data nonetheless suggest that stone boiling may have been the dominant activity in which hearth stones were used, providing the results of preliminary experiments are accurate.

Table 18-12. Breakage patterns for burned rock other than caliche from hearths at the Santa Teresa site (percentages in parentheses)

Feature	Number of Fragments	Angular Break	Straight or Curved Break	Indeterminate Break Type
2	1	-	-	1 (100.0)
4	93	6 (6.5)	-	87 (93.5)
5	2	2 (100.0)	-	-
9	37	13 (35.1)	2 (5.4)	22 (59.5)
14	1	-	-	1 (100.0)
21	74	19 ((25.7)	1 (1.4)	54 (73.0)

Analysis of these admittedly meager data suggest that shallow hearths, particularly those with extensions, were used for cooking, while deeper hearths with large amounts of associated burned rock may have been used to heat elements for stone boiling. Other hearths that contain no specific evidence of function could have also been used for cooking, heating, or both. The only possible exceptions to this are Features 7 and 14 in EA-8, which were shallow and contained small amounts of burned rock. Only six pieces of burned rock were found in this part of the site, including fragments recovered from hearths. Thus, while some stone cooking may have occurred there, it does not seem to have been a major activity.

Evidence of Seasonality

The only evidence for season of use is available from the scanty macrobotanical data presented earlier. Assuming that these materials were collected and consumed while the site was occupied and do not represent stored foods, the two identifiable seed types suggest a late summer to early fall occupation. One seed each was associated with components dating to the Middle and Late Archaic periods, suggesting long-term consistency in the season of occupation. As Hard's (1983a) model of Mesilla phase settlement and subsistence suggests, late summer is the season when the inner basins were useable. Rainfall accelerates plant growth at that time, many annuals ripen, rabbit populations peak, and water is often available in playas. Thus, use of the desert basins is expected to have occurred during the late summer to early fall in years with enough rainfall. The few data concerning seasonality from the Santa Teresa site suggest that the same pattern was followed during the Archaic.

Occupational Dates and Geomorphology

Questions have been raised concerning the relationship of feature and artifact clusters and geomorphological processes at the Santa Teresa site. Unfortunately, examination of the parabolic dune upon which the site is situated found no microstratigraphy that could be used to compare analytic units. Only a single massive layer of sand was found. Thus, we must rely on the few dates that were obtained and the elevations of associated materials.

Dating information and elevations for analytic units and dated features are presented in Table 18-13. As can be seen, there is no good correspondence between elevations and dates. EA-8, which dates to the Middle Archaic, occurred at nearly the same depth as EA-5, which had a Late Archaic date. Similarly, EA-4 dates a little earlier than EA-1 but was at a slightly higher elevation. Thus, it appears that the prehistoric dune surface was undulating. While the surface depth of EA-2 was lower than that of EA-1, and that of EA-3 was even lower, little meaning can be ascribed to this because of the mechanical disturbance that uncovered these deposits. Lacking dates for EA-2 and EA-3, it is nearly impossible to relate them to other occupational areas by elevation data alone. In general, while older occupational areas occur at lower elevations than more recent ones, the oldest and youngest occupations are separated by only about 22 cm.

While we suggested earlier that EA-1 and EA-3 seem related based on comparison of specific material varieties, too few temporal data exist to allow us to address that question in greater detail. Dissimilarities between chipped stone assemblages from EA-2 and EA-1/EA-3 suggest those units were not related. EA-2 was considered a later use of the area, which spatially overlapped earlier occupations in other analytic units. Once again, this supposition cannot be supported with temporal or elevation data. Thus, it is impossible to determine the exact relation between these analytic units, as well as others, like EA-7, EA-9, and EA-10, which lack dates and comparable assemblages.

Table 18-13. Temporal and elevation information for analytic units at the Santa Teresa site (oldest to youngest dates)

Analytic Unit	Dated Hearth	Date	Upper Elevation of Dated Hearth(s)	Average Surface Elevation of Area
EA-8	Feature 7	2910-2595 B.C.	12.97	12.97
	Feature 14	2910-2590 B.C.	13.00	12.97
EA-5	Feature 9	760-635 B.C. or 560-380 B.C.	13.05	12.98
EA-4	Feature 4	405-180 B.C.	12.72	12.68
EA-1	Feature 17	205 B.C.-A.D. 65	12.85	12.75

Conclusions

It is likely that at least four separate occupational episodes were represented at the Santa Teresa site. A short-term use during the Middle Archaic is suggested by features and artifacts in EA-8. Dates for the two hearths in that unit are almost identical, and they were undoubtedly used during a single occupation. Few artifacts were recovered from that part of the site, suggesting that the occupation was brief.

Up to three Late Archaic occupations seem indicated by discrete clusters of hearths and associated artifacts: EA-1, EA-4, and EA-5. Each of these contains three or more hearths that appear to be morphologically and functionally distinct. It was impossible to determine whether these units represented sequential occupations over a number of years or zones used by a band containing several domestic groups during a single occupational episode. However, the structure of remains in EA-1 suggests that part of the site was used for a much longer period than EA-4 or EA-5, neither of which contained many artifacts other than burned rock. Thus, it is unlikely that all three units were used during a single occupation and instead represent multiple uses of adjacent areas over a number of years.

EA-2 and EA-3 are a little more difficult to fit into this picture. The similarity of remains in EA-3 to those in EA-1 may indicate a relationship between those units. If so, that occupation was certainly the most substantial use of the site. EA-2 may represent a later occupation or could also be related to EA-1 and EA-3. There simply are not enough data to allow resolution of this problem.

While this discussion has raised more questions than it has answered, it did allow us to address a question raised in the site description chapter concerning the possible relationship between the few sherds recovered from EA-3 and the other remains found there. As our analysis suggests, the chipped stone assemblage from EA-3 is quite similar to that of EA-1, suggesting a close relationship between those analytic units. EA-1 dates solidly to the Late Archaic. The sherds in EA-3 were mostly found to the north and west of the main cluster of chipped stone artifacts and west of the main cluster of burned rock. They were spatially and almost certainly temporally distinct from the rest of the assemblage in this area and probably represent an intrusive vessel that was shattered and scattered by earth-moving activities.

In summary, the Santa Teresa site represents a locale that was used on several occasions during the Middle and Late Archaic periods. Most occupations seem to have been during the later period, and with at least one exception, they were rather brief. Though no structures were found, the presence of several clusters containing a variety hearths suggests a residential function. Any shelters that were constructed were probably unsubstantial and did not burn, leaving no definable remains behind. A minimum of one Middle Archaic (EA-8) and three Late Archaic (EA-1 and EA-3, EA-4, and EA-5) uses are indicated by our data, and it is possible that at least one other occupation is represented by the sparse remains found in EA-2. While only meager evidence of seasonality was recovered, this site appears to have been used during the late summer to early fall, when food resources were most abundant and monsoon rains would have made use of the desert basins possible.

THE STRUCTURE OF ARCHAEOLOGICAL REMAINS AT THE MOCKINGBIRD SITE (LA 86774)

James L. Moore

To understand how the Mockingbird site fit into the settlement system of which it was part, it is necessary to examine the spatial distribution of artifacts in some detail. In particular, we must compare and contrast parts of the site that may reflect individual episodes of occupation. Though only one structure was found, it is possible that more were once present. Pit Structure 1 may simply have been the only structure that burned, and thus was the only one defined. At least two other activity or discard zones were identified, but it is uncertain whether they were related to Pit Structure 1 or represent discrete occupation zones, perhaps used at widely different times. Hopefully, analysis of the patterning of cultural remains will allow us to address this question. The goals of this study are to define zones related to various occupations, compare and contrast the nature of those occupations, and determine how they are related to local geomorphology. To do this we will examine the distribution of chipped stone artifacts, selected material categories, and burned rock in relation to features and excavation areas. Other pertinent data are presented as needed.

Distribution of Cultural Materials across the Site

The surface distribution of sherds, chipped stone artifacts, and burned rock by subarea is shown in Table 19-1. Only two excavation areas exhibited artifacts on the surface, though their numbers were rather small. Of the areas excavated during data recovery, only EA-2, Subarea 4, was selected for detailed examination because it contained a surface concentration of artifacts. Table 19-2 illustrates the distribution of surface and subsurface artifacts for each excavation area that contained cultural materials. EA-1, Subarea 1, contained by far the largest number of artifacts in every category. The only other areas that contained relatively large numbers of artifacts were EA-2, Subareas 3 and 4. In only one other case (EA-2, Subarea 5) were artifacts from all three categories recovered.

Table 19-1. Surface distribution of artifacts by subarea at the Mockingbird site (frequencies and column percentages)

Provenience	Sherds	Chipped Stone	Burned Rock
EA-1, Subarea 1	6 13.3	9 5.6	2 7.4
EA-2, Subarea 4	3 6.7	3 1.9	0 0.0
Other areas	36 80.0	148 92.5	25 92.6
Totals	45	160	27

Table 19-2. Distribution of surface and subsurface artifacts by subarea at the Mockingbird site (frequencies and column percentages)

Provenience	Sherds	Chipped Stone	Burned Rock
EA-1, Subarea 1	218 74.9	175 37.9	267 77.8
EA-1, Subarea 2	1 0.3	2 0.4	0 0.0
EA-1, Subarea 3	0 0.0	0 0.0	2 0.6
EA-1, Subarea 4	0 0.0	1 0.2	0 0.0
EA-2, Subarea 1	0 0.0	10 2.2	0 0.0
EA-2, Subarea 2	2 0.7	5 1.1	0 0.0
EA-2, Subarea 3	4 1.4	22 4.8	32 9.3
EA-2, Subarea 4	20 6.9	55 11.9	9 2.6
EA-2, Subarea 5	1 0.3	1 0.2	1 0.3
EA-2, Subarea 6	0 0.0	0 0.0	0 0.0
EA-2, Subarea 7	0 0.0	0 0.0	0 0.0
Other areas	45 15.5	191 41.3	32 9.4
Totals	291	462	343

A variety of sizes is represented among the array of excavation areas. To account for this and determine whether any areas contained atypical concentrations of cultural materials, Table 19-3 was constructed. Only four areas contained concentrations greater than three artifacts per sq m. Sample error may account for this concentration level in EA-2, Subarea 1, since only one grid was excavated there. The highest concentration was in EA-1, Subarea 1, as might be expected. The second highest was in EA-2, Subarea 4, and the third was in EA-2, Subarea 3. While both EA-1, Subarea 1, and EA-2, Subarea 3, contained multiple features, EA-2, Subarea 4, had none. The only other zone that contained features was EA-2, Subarea 5, which also had a very low artifact concentration level.

There appears to be only a moderate correlation between areas of high artifact concentration and features. Only 75 percent of the excavation areas that contained features also contained high concentrations of artifacts, and only 66.7 percent of the areas with high artifact concentrations (EA-2, Subarea 1, eliminated) also contained features. Thus, zones around features may not have always served as activity loci.

Table 19-3. Concentration levels of artifacts for all excavation areas at the Mockingbird site

Provenience	Number of Artifacts	Size (sq m)	Average Number of Artifacts per sq m
EA-1, Subarea 1	660	151	4.37
EA-1, Subarea 2	3	1	3.00
EA-1, Subarea 3	2	5	0.40
EA-1, Subarea 4	1	1	1.00
EA-2, Subarea 1	10	8	1.25
EA-2, Subarea 2	7	8	0.88
EA-2, Subarea 3	58	19	3.05
EA-2, Subarea 4	84	25	3.36
EA-2, Subarea 5	3	8	0.38
EA-2, Subarea 6	0	4	0.00
EA-2, Subarea 7	0	1	0.00

The distribution of chipped stone materials can be used to compare individual excavation areas. This is shown in Table 19-4. Only three of eight excavation areas contained relatively large numbers of chipped stone artifacts (EA-1, Subarea 1; EA-2, Subarea 3; and EA-2, Subarea 4). Over half of the chipped stone artifacts were in the general artifact scatter and were not associated with specific study areas. Most general material categories that are represented by multiple artifacts occur in more than one excavation area. However, distributions of several specific varieties are more restricted. With the exception of one artifact in the general scatter, Pedernal chert was only found in EA-1, Subarea 1, and EA-2, Subarea 3. Other specific varieties of chert occurred in only one excavation area apiece, except for a variety of whitish chert that was found in three subareas as well as the general artifact scatter.

Several specific varieties of aphanitic rhyolite were also identified. Varieties 2 and 6 were found in EA-1, Subarea 1; EA-2, Subarea 3; and the general artifact scatter. Variety 5 only occurred in EA-2, Subarea 4, and Variety 3 was found in EA-1, Subarea 1; EA-2, Subareas 1, 3, and 4; and the general scatter. Varieties 1 and 7 occurred only in the general artifact scatter. Silicified limestone occurred in EA-1, Subarea 1, and EA-2, Subarea 4. Undifferentiated metamorphic variety 1 was found in EA-1, Subarea 1, and the general scatter. Other than a few specimens in the general scatter, quartz arenite Variety 1 occurred primarily in EA-1, Subarea 1, with a few examples in EA-2, Subarea 4. Variety 2 of this category occurred in EA-1, Subarea 1, and EA-2, Subarea 3, as well as the general scatter. Variety 3 occurred in EA-1, Subarea 1; EA-2, Subareas 3 and 4; and the general scatter.

Table 19-4. Distribution of chipped stone artifact materials by excavation area at the Mockingbird site

Material	EA-1, SA-1	EA-1, SA-2	EA-1, SA-4	EA-2, SA-1	EA-2, SA-2	EA-2, SA-3	EA-2, SA-4	EA-2, SA-5	Other Areas	Totals
Chert (generic)	24 49.0	1 2.0	0 0.0	1 2.0	0 0.0	0 0.0	5 10.2	0 0.0	18 36.7	49 10.6
Pedernal chert	5 55.6	0 0.0	0 0.0	0 0.0	0 0.0	3 33.3	0 0.0	0 0.0	1 11.1	9 1.9
Rancheria chert	2 10.0	1 5.0	0 0.0	1 5.0	1 5.0	1 5.0	3 15.0	1 5.0	10 50.0	20 4.3
Chert, pink	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 0.4
Chert, brown, porous	3 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 0.6
Chert, gray with voids	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 100.0	0 0.0	0 0.0	3 0.6
Chert, whitish	1 20.0	0 0.0	1 20.0	0 0.0	1 20.0	0 0.0	0 0.0	0 0.0	2 40.0	5 1.1
Silicified wood	2 66.7	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 33.3	3 0.6
Obsidian	1 25.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 25.0	0 0.0	2 50.0	4 0.9
Undifferentiated igneous	1 16.7	0 0.0	0 0.0	0 0.0	0 0.0	1 16.7	1 16.7	0 0.0	3 50.0	6 1.3
Basalt	4 66.7	0 0.0	0 0.0	0 0.0	0 0.0	1 16.7	0 0.0	0 0.0	1 16.7	6 1.3
Vesicular basalt	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.2
Rhyolite, red	4 50.0	0 0.0	0 0.0	0 0.0	0 0.0	1 12.5	0 0.0	0 0.0	3 37.5	8 1.7
Rhyolite, gray	6 54.5	0 0.0	0 0.0	1 9.1	0 0.0	1 9.1	1 9.1	0 0.0	2 18.2	11 2.4
Thunderbird rhyolite	64 54.7	0 0.0	0 0.0	2 1.7	0 0.0	4 3.4	14 12.0	0 0.0	33 28.2	117 25.3
Rhyolite, siliceous	4 8.9	0 0.0	0 0.0	4 8.9	3 6.7	0 0.0	6 13.3	0 0.0	28 62.2	45 9.7
Rhyolite, flow-banded	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	2 0.4
Aphanitic rhyolite, red	3 37.5	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	5 62.5	8 1.7

Material	EA-1, SA-1	EA-1, SA-2	EA-1, SA-4	EA-2, SA-1	EA-2, SA-2	EA-2, SA-3	EA-2, SA-4	EA-2, SA-5	Other Areas	Totals
Aphanitic rhyolite, gray	4 57.1	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 42.9	7 1.5
Aphanitic rhyolite, dark gray	1 100	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.2
Aphanitic rhyolite, Variety 1	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	4 100.0	4 0.9
Aphanitic rhyolite, Variety 2	3 11.5	0 0.0	0 0.0	0 0.0	0 0.0	1 3.8	5 19.2	0 0.0	17 65.4	26 5.6
Aphanitic rhyolite, Variety 3	5 10.0	0 0.0	0 0.0	1 2.0	0 0.0	1 2.0	8 16.0	0 0.0	35 70.0	50 10.8
Aphanitic rhyolite, Variety 5	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 33.3	0 0.0	2 66.7	3 0.6
Aphanitic rhyolite, Variety 6	1 33.3	0 0.0	0 0.0	0 0.0	0 0.0	1 33.3	0 0.0	0 0.0	1 33.3	3 0.6
Aphanitic rhyolite, Variety 7	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0	2 0.4
Silicified limestone, Variety 2	1 33.3	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 66.7	0 0.0	0 0.0	3 0.6
Sandstone	1 33.3	0 0.0	0 0.0	0 0.0	0 0.0	1 33.3	1 33.3	0 0.0	0 0.0	3 0.6
Silicified sandstone	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 0.2
Siltstone	3 60.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 40.0	5 1.1
Undifferentiated metamorphic	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.2
Metamorphic unknown, Variety 1	2 66.7	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 33.3	3 0.6
Quartzite	3 50.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 50.0	6 1.3
Metaquartzite, Variety 2	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 0.2
Quartz arenite	3 75.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 25.0	4 0.9
Quartz arenite, Variety 1	14 73.7	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	3 15.8	0 0.0	2 10.5	19 4.1
Quartz arenite, Variety 2	3 33.3	0 0.0	0 0.0	0 0.0	0 0.0	4 44.4	0 0.0	0 0.0	2 22.2	9 1.9

Material	EA-1, SA-1	EA-1, SA-2	EA-1, SA-4	EA-2, SA-1	EA-2, SA-2	EA-2, SA-3	EA-2, SA-4	EA-2, SA-5	Other Areas	Totals
Quartz arenite, Variety 3	4 44.4	0 0.0	0 0.0	0 0.0	0 0.0	1 11.1	1 11.1	0 0.0	3 33.3	9 1.9
Totals Percent	176 38.1	2 0.4	1 0.2	10 2.2	5 1.1	22 4.8	55 11.9	1 0.2	190 41.1	462 100.0

While specific varieties of chert other than Pedernal and Rancheria probably represent individual cores, the same conclusion cannot be made for specific varieties of other materials. Similarities in the distributions of several specific material varieties suggest there may be some relationship between EA-1, Subarea 1; EA-2, Subarea 3; and EA-2, Subarea 4.

Artifact Distribution Plots

Contour plots presented in this discussion were created using SURFER (version 4.15, Golden Software, Inc., 1990). At times it is necessary to exaggerate contours to clarify artifact distributions. Information on minimum contours and contour intervals are provided for each plot. Figure 19-1 shows the surface distribution of chipped stone artifacts. Three areas contained surface concentrations of chipped stone artifacts: the north part of EA-1, Subarea 1; EA-2, Subareas 1, 2, 5, 6, and 7; and Backhoe Trench 20. Since no intact subsurface cultural features or deposits were found in the latter, little effort was expended there, while the other areas were investigated in detail. The distribution of surface sherds, shown in Figure 19-2, is considerably different from that of the chipped stone. Pottery was most common in a strip that ran through the east end of the site, around EA-2, Subarea 4, and around EA-2, Subareas 3 and 5. Thus, there is only a slight overlap in the surface distributions of these artifact classes.

Subsurface ceramic and chipped stone artifacts pattern somewhat differently (Figs. 19-3 and 19-4). The densest cluster of subsurface chipped stone artifacts was in the east part of EA-2, with three smaller peaks in EA-1. Conversely, most subsurface sherds were in the east part of the site, particularly in EA-1, with a much smaller peak in EA-2, Subarea 4. This pattern is much different from that of the surface artifacts, and the distribution of that assemblage clearly did not correctly predict the patterning of subsurface artifacts.

Figs. 19-5 through 19-7 illustrate the distributions of various categories of hearth stones. Because the numbers of specimens falling into these categories were rather low, surface and subsurface materials are combined in these plots. Burned rock clustered in two areas, the eastern part of EA-1, Subarea 1, and around EA-2, Subarea 3. The former cluster reflects Feature 11, a rock-filled heating pit. Burned ground stone artifacts were distributed rather similarly, though it was necessary to exaggerate the contours of this category in Figure 19-6 because few examples were recovered. The main difference between these plots is in EA-2, Subarea 3, where burned rock clustered to the north and burned ground stone artifacts to the south of that excavation area. When combined (Fig. 19-7), the distribution is nearly identical to that of the burned rock, which is no surprise since that category dominates the combined assemblage.

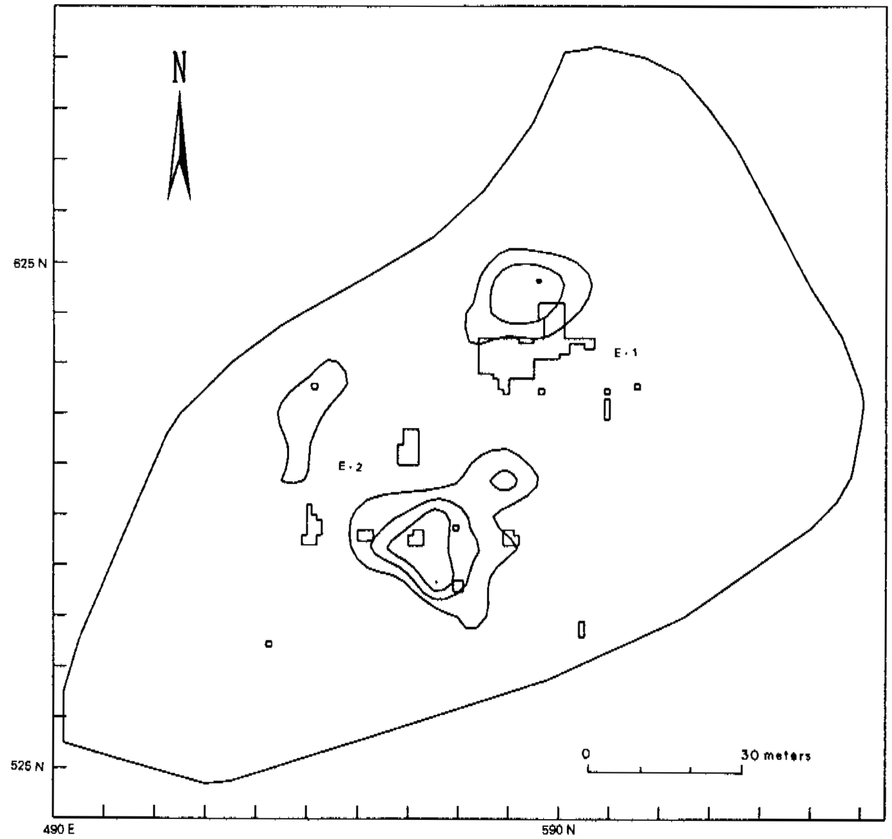

Figure 19-1. Distribution of surface chipped stone artifacts at the Mockingbird site; minimum contour = 1, contour interval = .2.

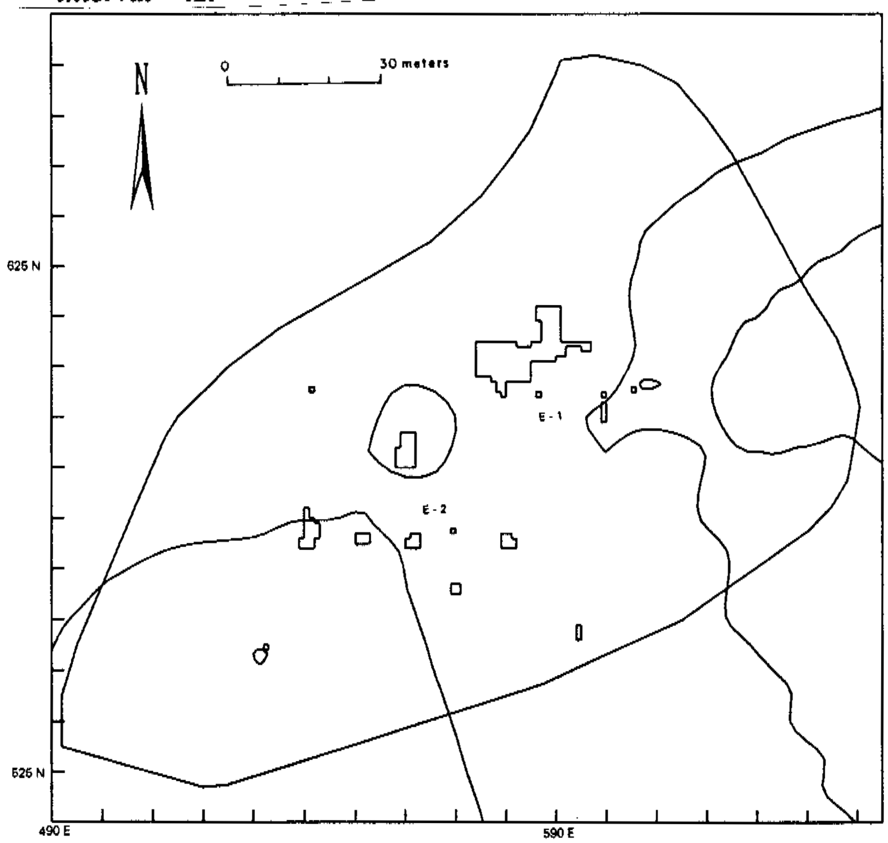

Figure 19-2. Distribution of surface ceramic artifacts at the Mockingbird site; minimum contour = 1, contour interval = .2.

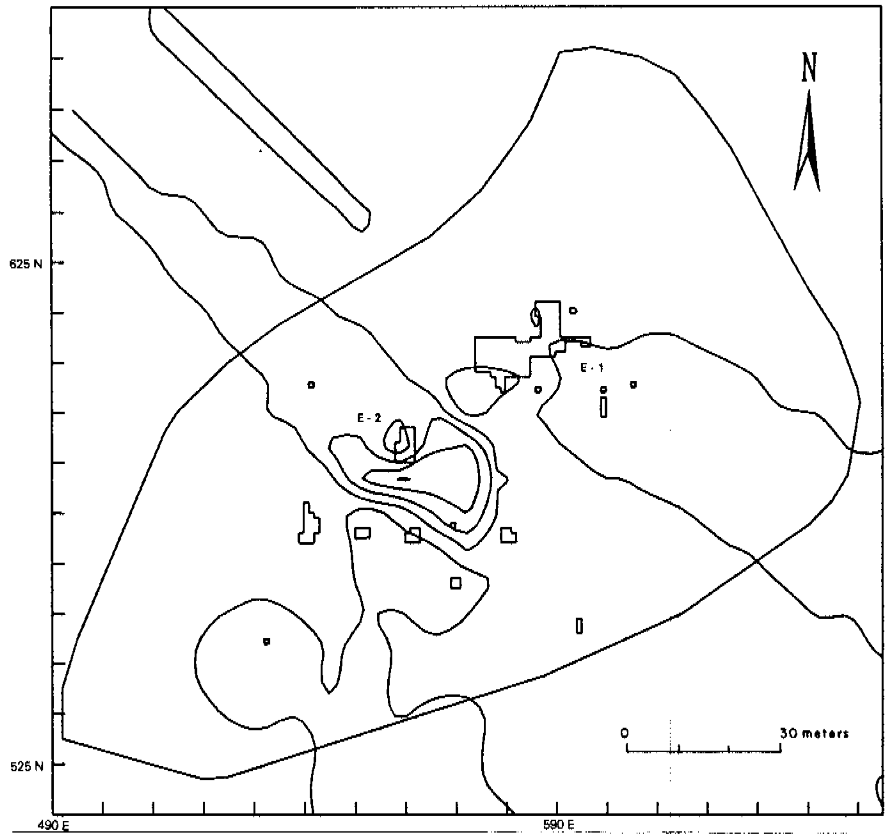

Figure 19-3. Distribution of subsurface chipped stone artifacts at the Mockingbird site; minimum contour = 1, contour interval = 1.

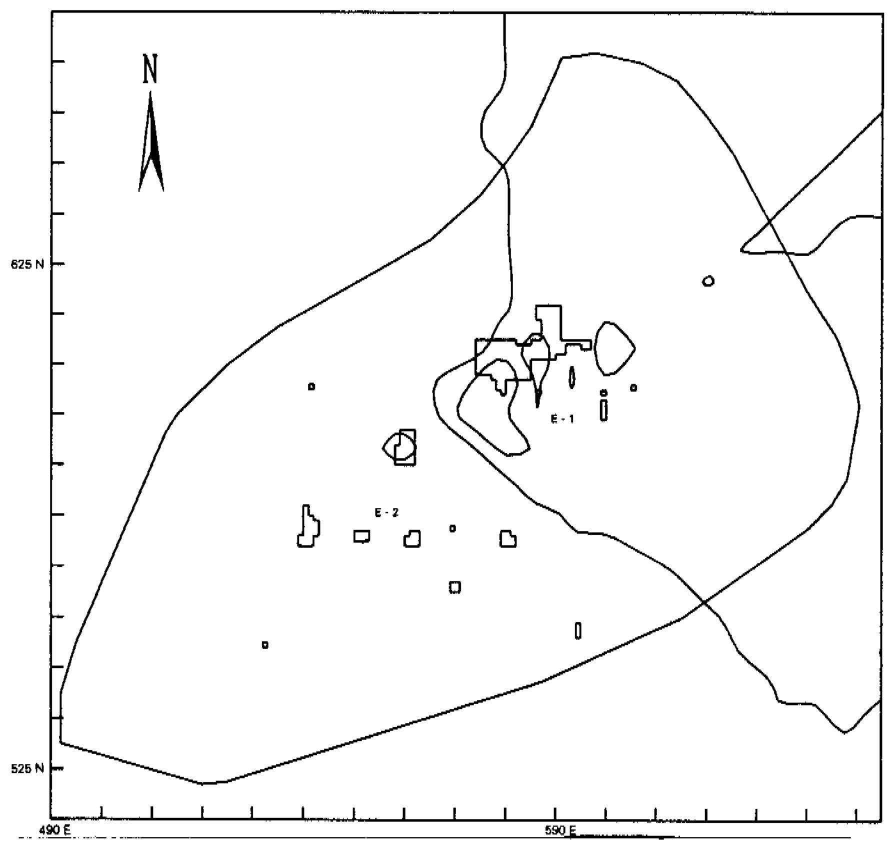

Figure 19-4. Distribution of subsurface ceramic artifacts at the Mockingbird site; minimum contour = 1, contour interval = 1.

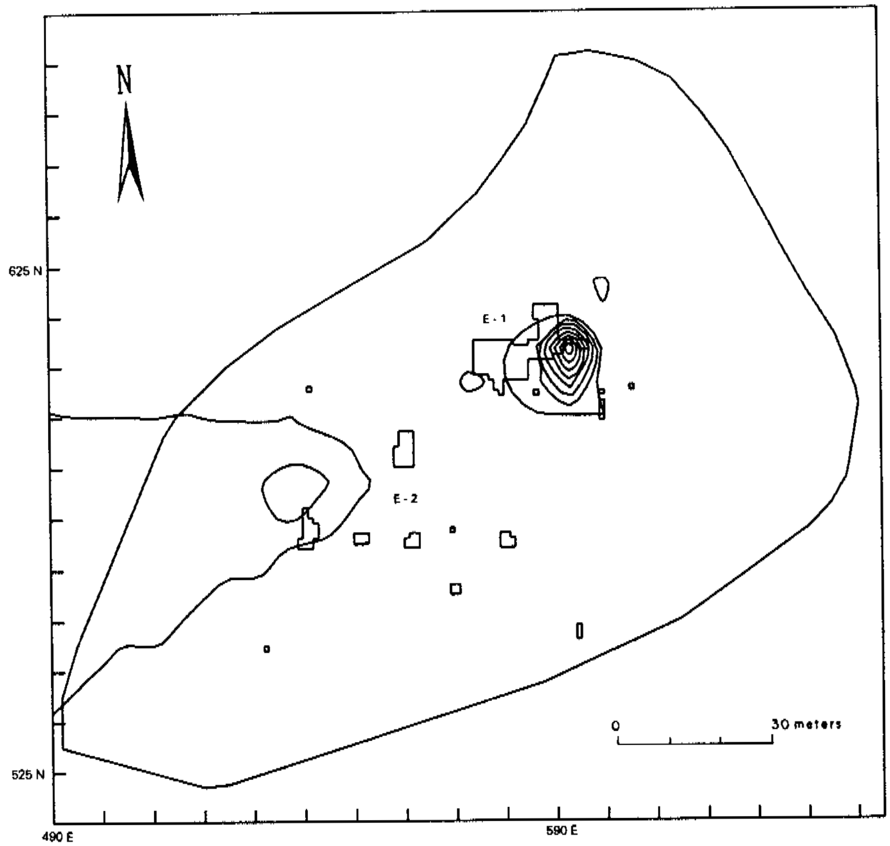

Figure 19-5. Distribution of burned rock at the Mockingbird site; minimum contour = 1, contour interval = 1.

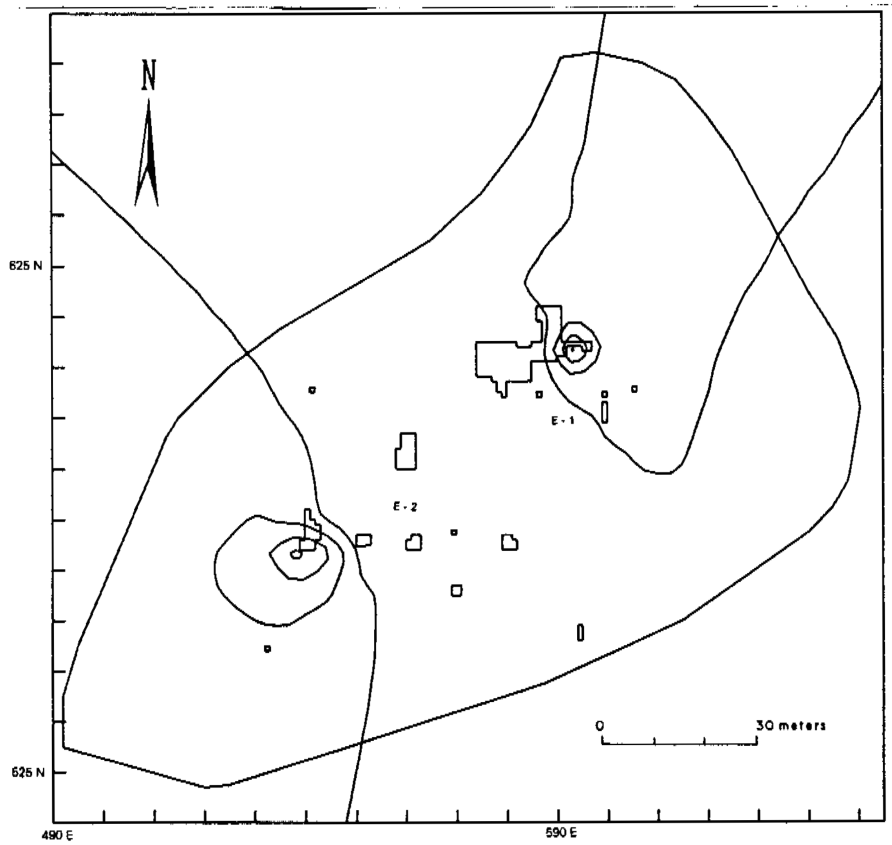

Figure 19-6. Distribution of burned ground stone artifacts at the Mockingbird site; minimum contour = 1, contour interval = 1.

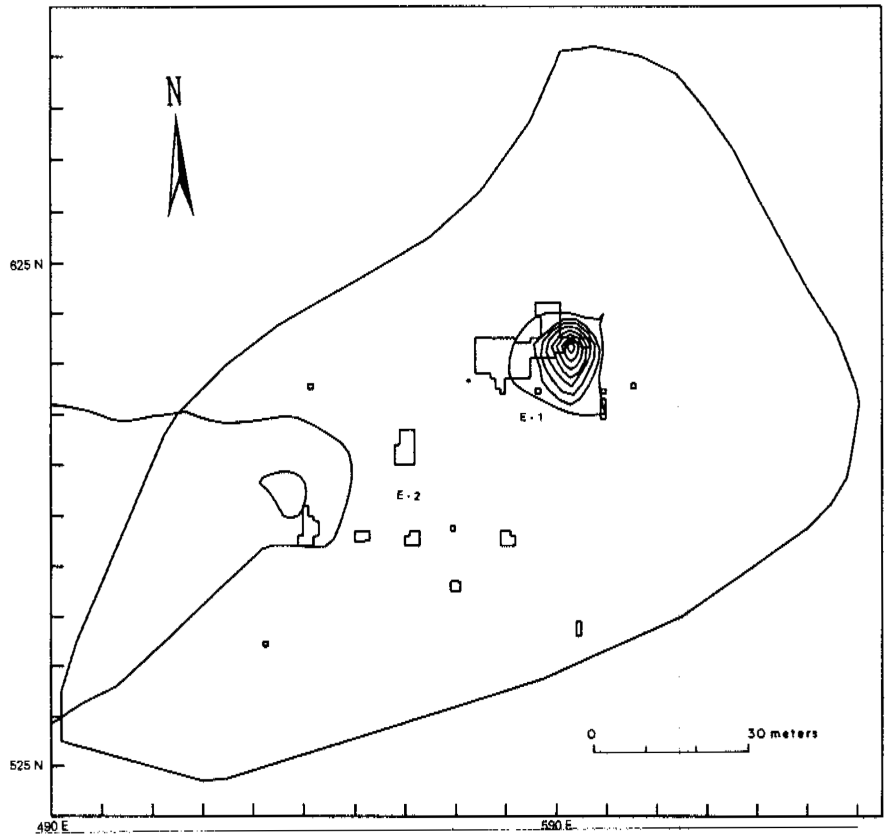

Figure 19-7. Distribution of burned rock and burned ground stone artifacts at the Mockingbird site; minimum contour = 1, contour interval = 1.

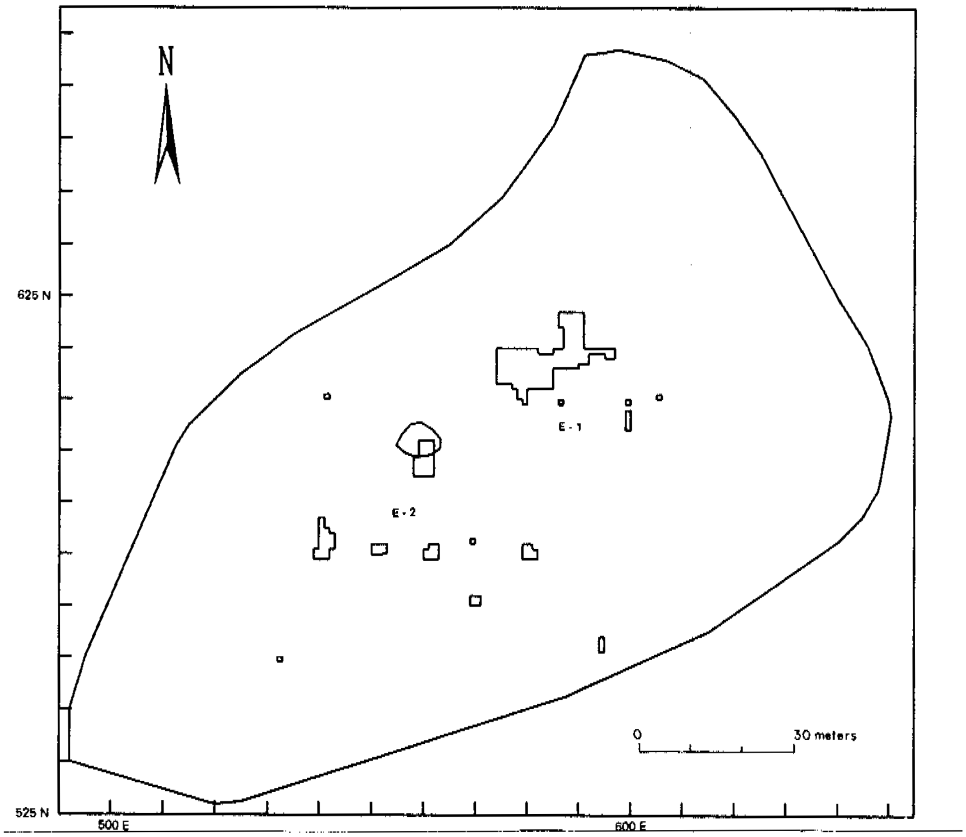

Figure 19-8. Distribution of chertic materials at the Mockingbird site; minimum contour = 1, contour interval = .5.

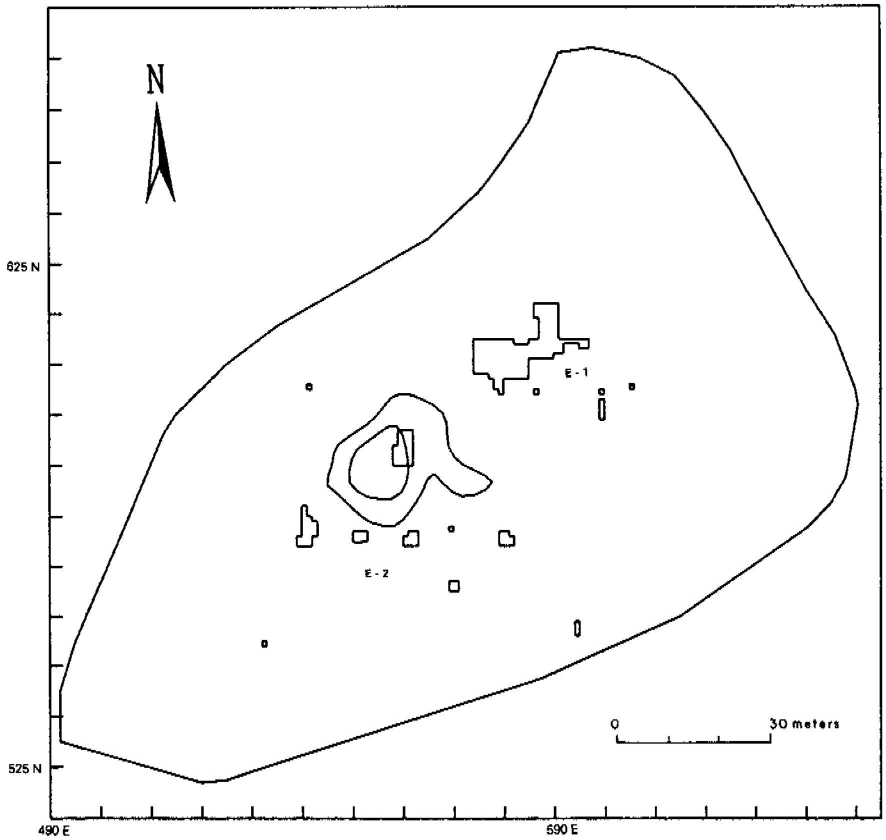

Figure 19-9. Distribution of aphanitic rhyolites at the Mockingbird site; minimum contour = 1, contour interval = .5.

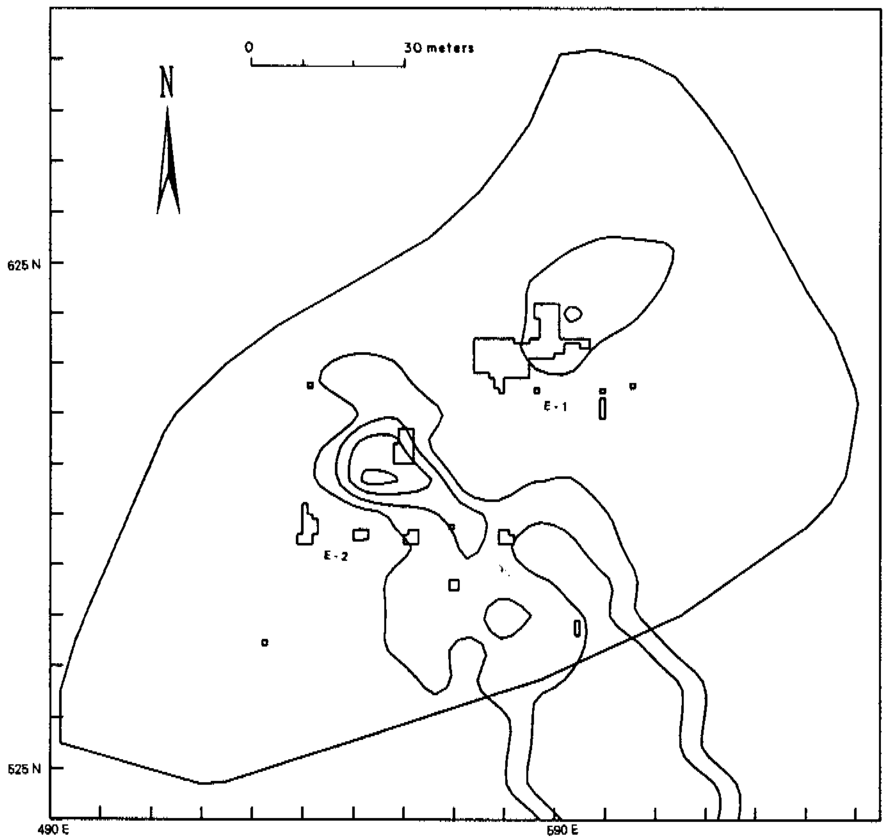

Figure 19-10. Distribution of coarse igneous materials at the Mockingbird site; minimum contour = 1, contour interval = .5.

Chipped stone artifacts were divided into five general categories: chertic materials (cherts and silicified woods), aphanitic rhyolites, coarse igneous materials (rhyolites, basalts, and undifferentiated igneous rocks), sedimentary materials (sandstone, siltstone, silicified limestone, and silicified sandstone), and metamorphic materials (quartzite, metaquartzite, undifferentiated metamorphic materials, and quartz arenite). The only material that is not included in these categories is obsidian. The distributions of these material categories are show in Figures 19-8 through 19-11. Chertic materials clustered in EA-2, Subarea 4, as did aphanitic rhyolites. Coarse igneous materials clustered in the east half of EA-1, Subarea 1, and in most of EA-2, particularly Subarea 4. Sedimentary materials clustered in EA-2, particularly around Subareas 3 and 5. Unfortunately, not enough metamorphic materials were recovered to allow that category to be meaningfully plotted.

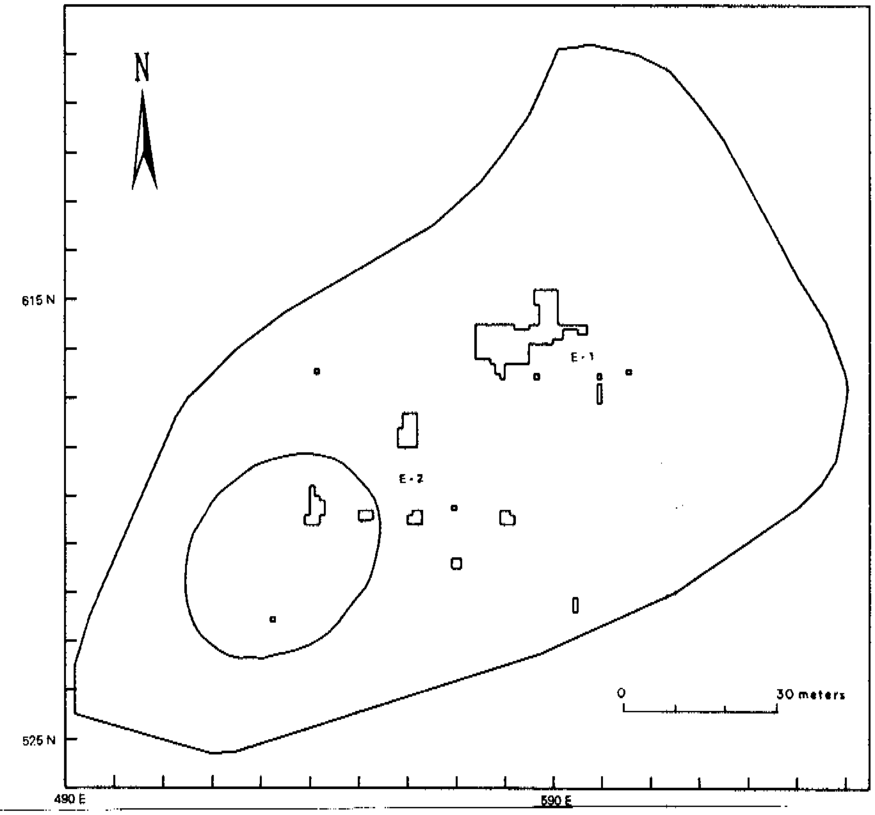

Figure 19-11. Distribution of sedimentary materials at the Mockingbird site; minimum contour = 1, contour interval = 1.

These plots show there are both similarities and differences between EA-1 and EA-2. Chertic and coarse igneous materials were commonly used in both parts of the site. However, aphanitic rhyolites and sedimentary materials were mostly confined to EA-2. Thus, differences in material type selection can be seen between northern and southern parts of the site. It is now necessary to examine each area separately to see if these differences hold up under closer scrutiny.

Excavation Area 1

EA-1 contained the only structure found at the site. The array of associated features included three extramural hearths and a heating pit inside the pit structure. Four areas were investigated in this part of the site, but Subarea 1 was the largest area of investigation. Most artifact categories cluster in that area, which seems to represent one of the main zones of cultural use at the site. Both surface and subsurface artifacts are included in the plots presented for the following discussion.

As Figure 19-12 shows, chipped stone artifacts clustered in two zones, the west part of Subarea 1 around Features 1 and 2, and north of Pit Structure 1 in the same subarea. These clusters seem to represent discrete zones of reduction. While only one real cluster is visible in the latter area, the former contains three, all to the south and southwest of hearths. Each cluster contains a wide variety of materials, including several identifiable varieties that overlap between two or three areas. Thus, these clusters do not represent discrete reduction events, but instead seem to be evidence for a series of reduction episodes involving many materials. The clustering may indicate that certain zones were consistently used for reduction or that the apparently discrete clusters represent discard zones. Similarly, the cluster of chipped stone artifacts north of Pit Structure 1 contained a rather wide variety of materials, including several identified types that overlap with those found in the three western clusters.

Pottery had a significantly different distribution from that of chipped stone artifacts, as shown by Figure 19-13. Sherds were mostly concentrated in and around Pit Structure 1 and in the southwest part of EA-1. These clusters barely overlap those defined for the chipped stone artifacts, suggesting that artifact clusters represent activity areas rather than trash disposal zones. In turn, it appears that the activities in which these classes of artifacts were used were spatially distinct.

Figure 19-14 shows the distribution of burned ground stone artifacts. These materials cluster in two areas, in and directly west of Feature 2 and northeast of Pit Structure 1. The distribution of burned rock is shown in Figure 19-15. Most of this material clustered in and around Feature 11, the probable heating pit in Pit Structure 1. When both data sets are combined, the distribution remains essentially the same as that shown in Figure 19-15. However, the large amount of burned rock in Feature 11 may be obscuring other patterns in this part of the site. To determine whether this is the case, burned rock from Feature 11 was dropped from consideration, and Figure 19-16 was plotted. Outside of Feature 11, burned rock clustered in several areas, particularly south of Feature 1 and within and south of Pit Structure 1. Much smaller clusters occurred south of Feature 2 and east of Feature 10.

Figure 19-17 combines distributions of burned rock and ground stone artifacts, again with materials from Feature 11 eliminated. Patterning here is fairly distinct, with burned rock clustering south of Feature 1 and within and to the south of Pit Structure 1. A lighter concentration can be seen to the south of Feature 2.

Figures 19-18 through 19-21 illustrate distributions of various materials. Too few specimens of metamorphic materials occurred for that category to be plotted. Each category

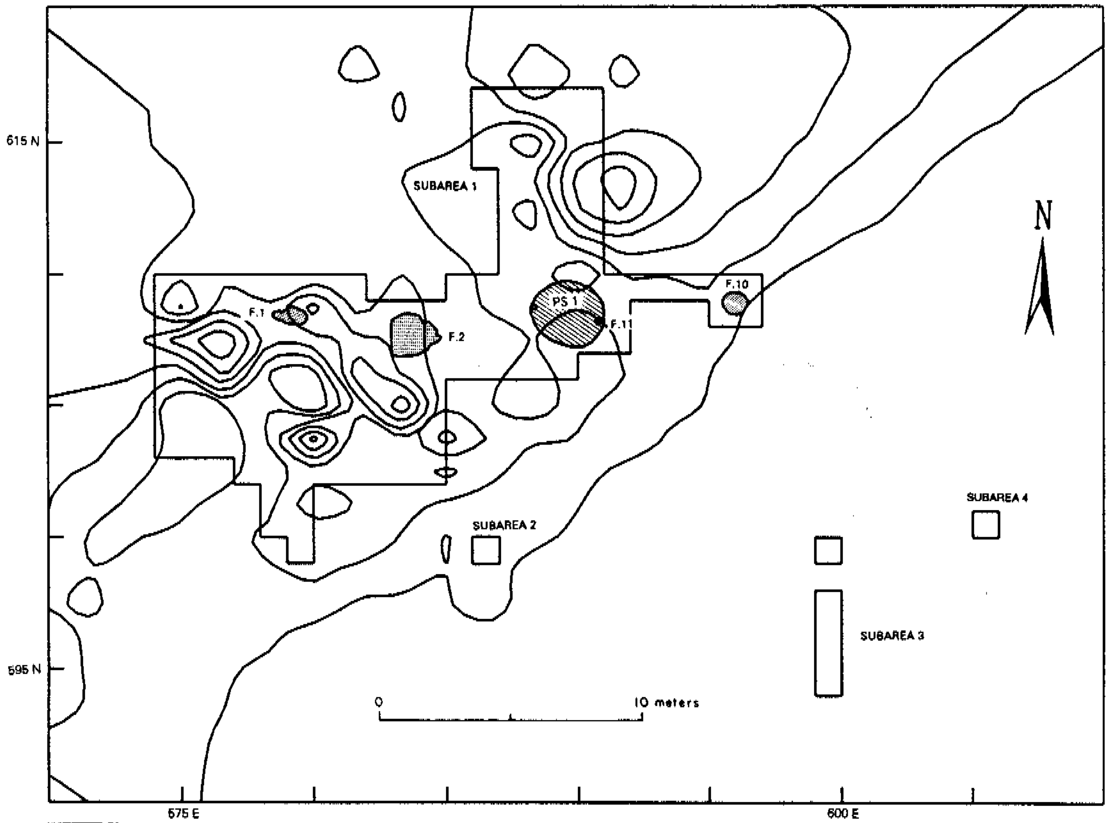

Figure 19-12. Distribution of chipped stone artifacts in EA-1 at the Mockingbird site; minimum contour = 1, contour interval = .5.

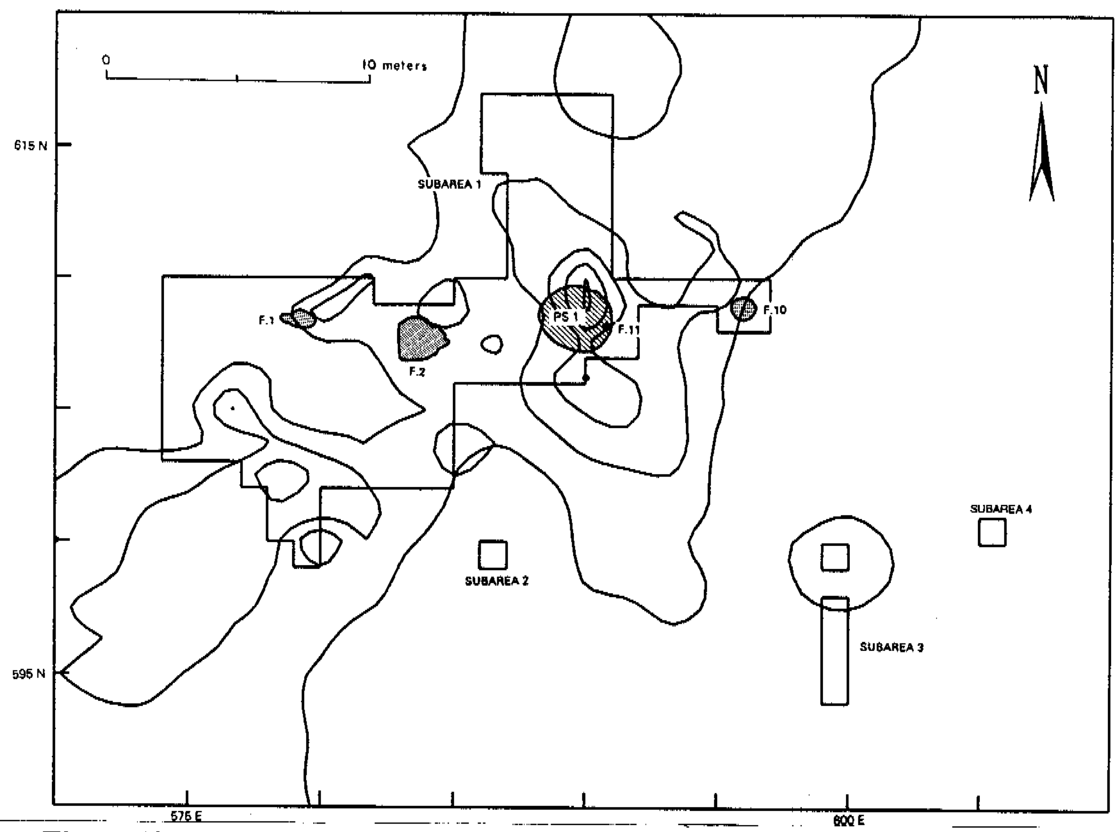

Figure 19-13. Distribution of ceramic artifacts in EA-1 at the Mockingbird site; minimum contour = 1, contour interval = 1.

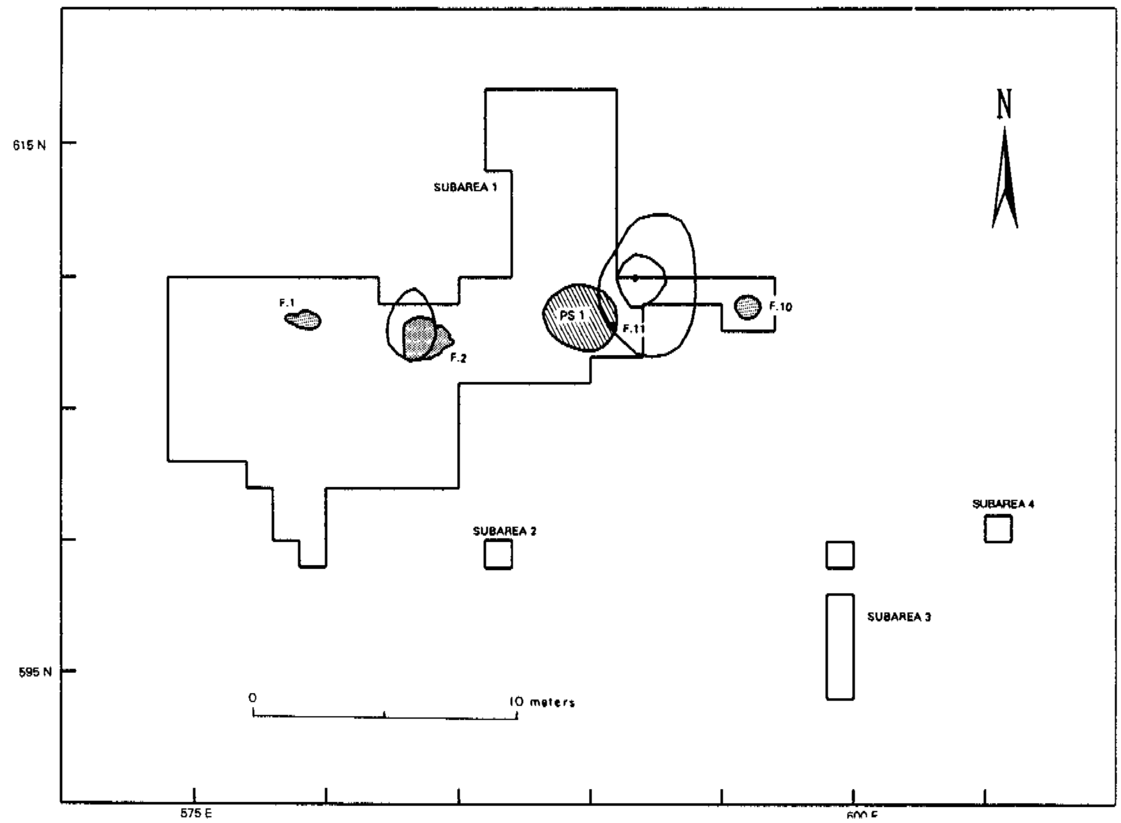

Figure 19-14. Distribution of burned ground stone artifacts in EA-1 at the Mockingbird site; minimum contour = 1, contour interval = .3.

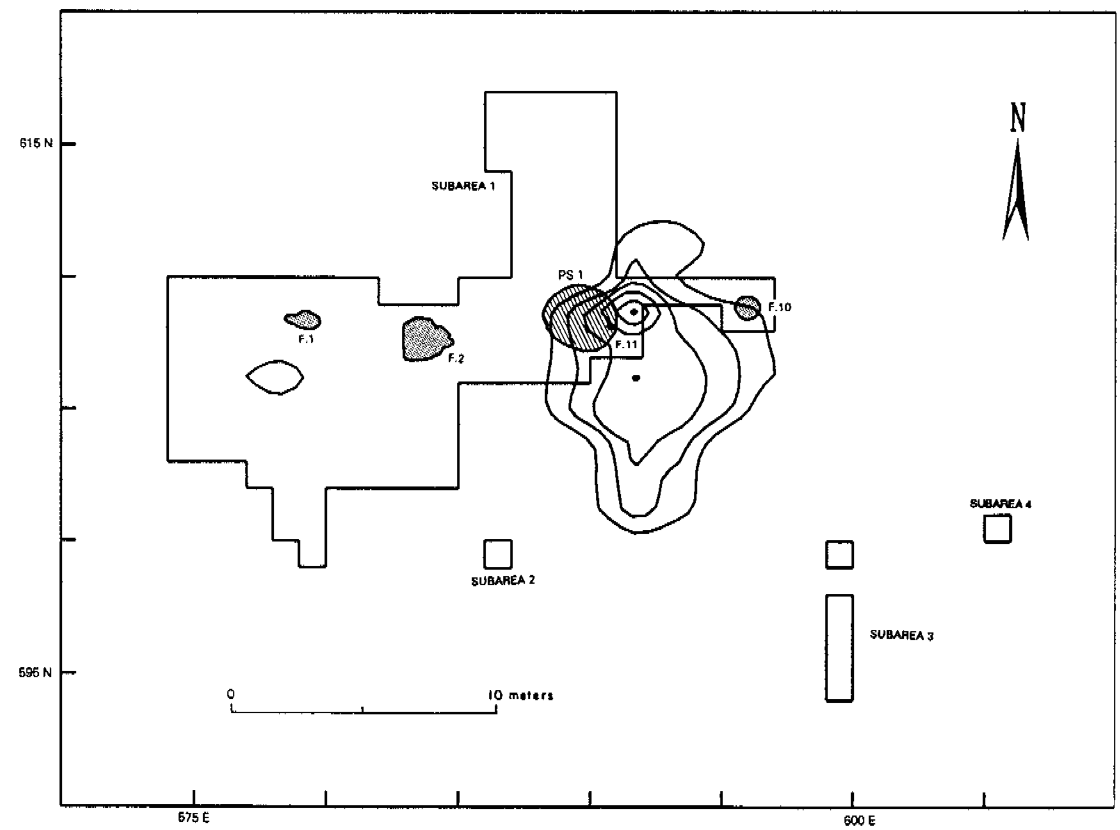

Figure 19-15. Distribution of burned rock in EA-1 at the Mockingbird site; minimum contour = 1, contour interval = 3.

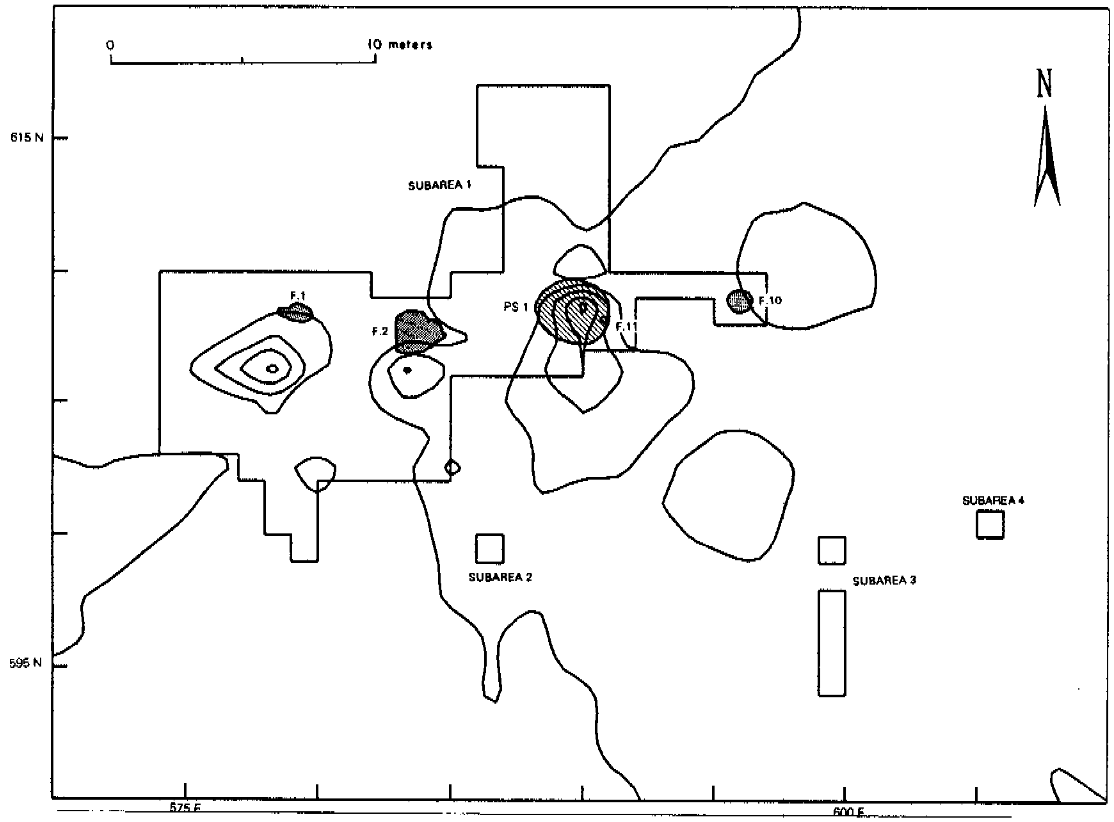

Figure 19-16. Distribution of burned rock in EA-1 at the Mockingbird site, Feature 11 eliminated; minimum contour = 1, contour interval = 1.

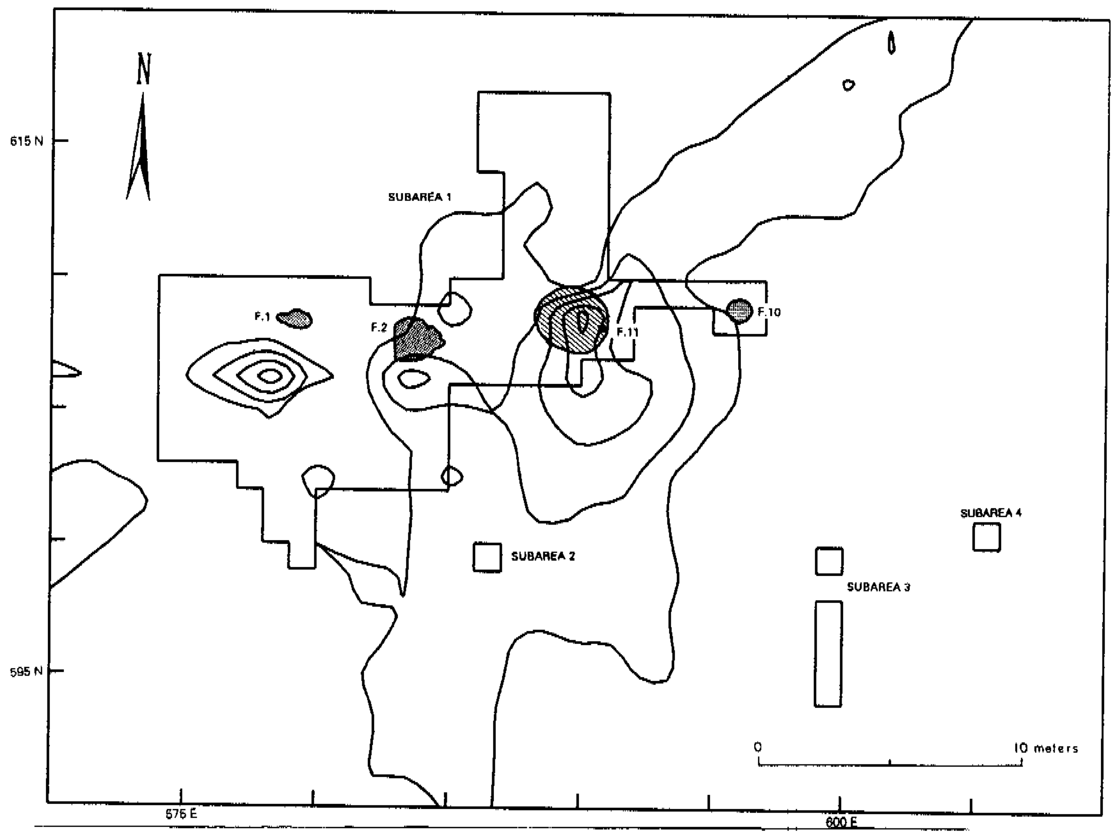

Figure 19-17. Distribution of burned rock and ground stone in EA-1 at the Mockingbird site, Feature 11 eliminated; minimum contour = 1, contour interval = 1.

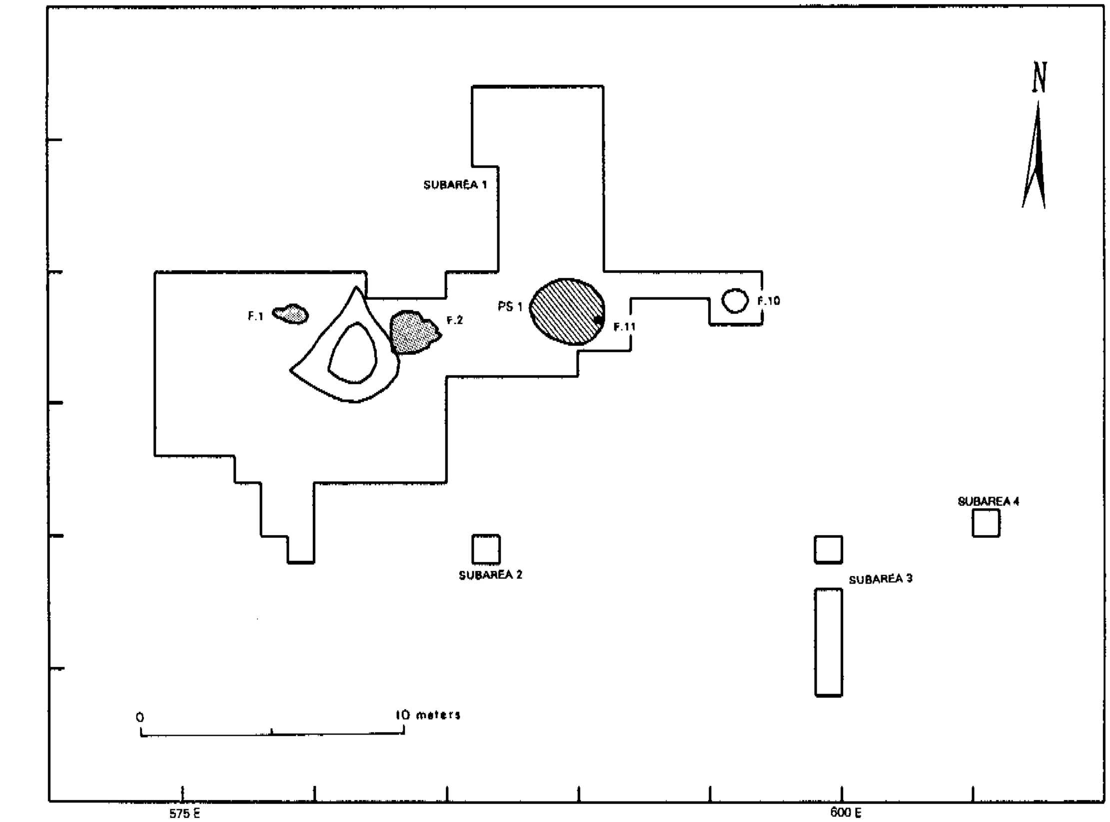

Figure 19-18. Distribution of chertic materials in EA-1 at the Mockingbird site; minimum contour = 1, contour interval = .5.

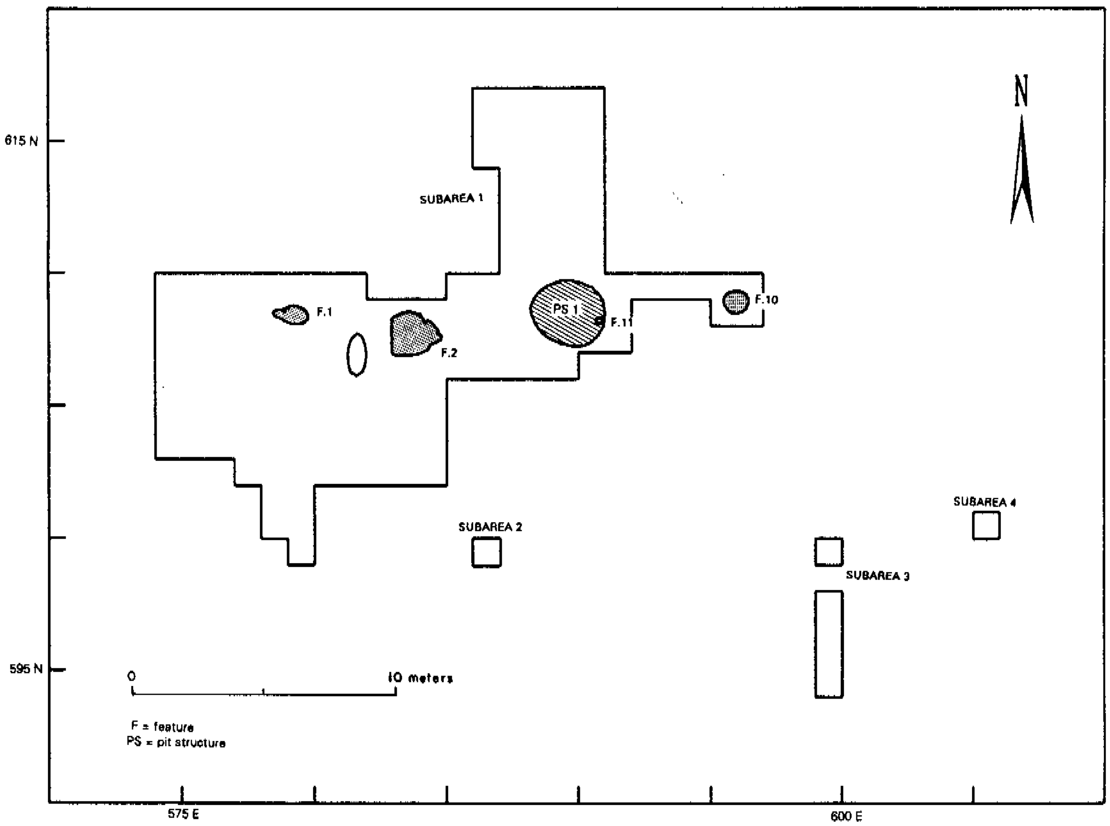

Figure 19-19. Distribution of aphanitic rhyolites in EA-1 at the Mockingbird site; minimum contour = 1, contour interval = .5.

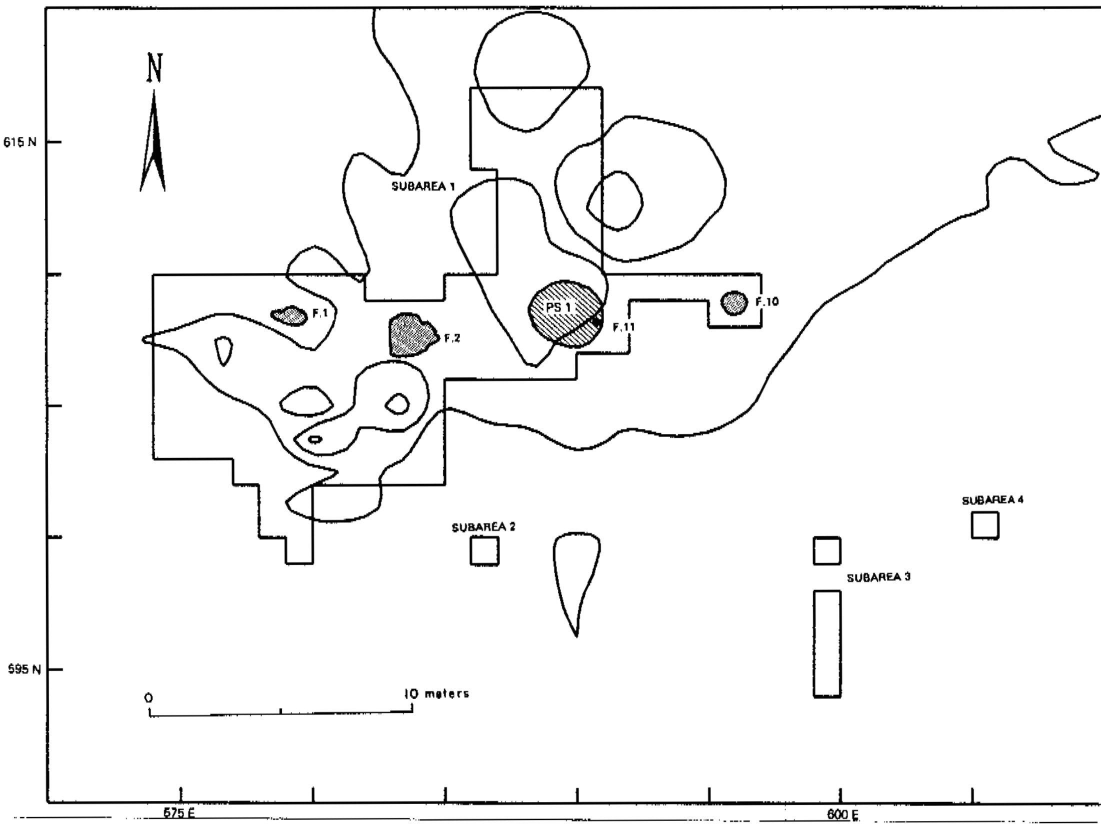

Figure 19-20. Distribution of coarse igneous materials in EA-1 at the Mockingbird site; minimum contour = 1, contour interval = .5.

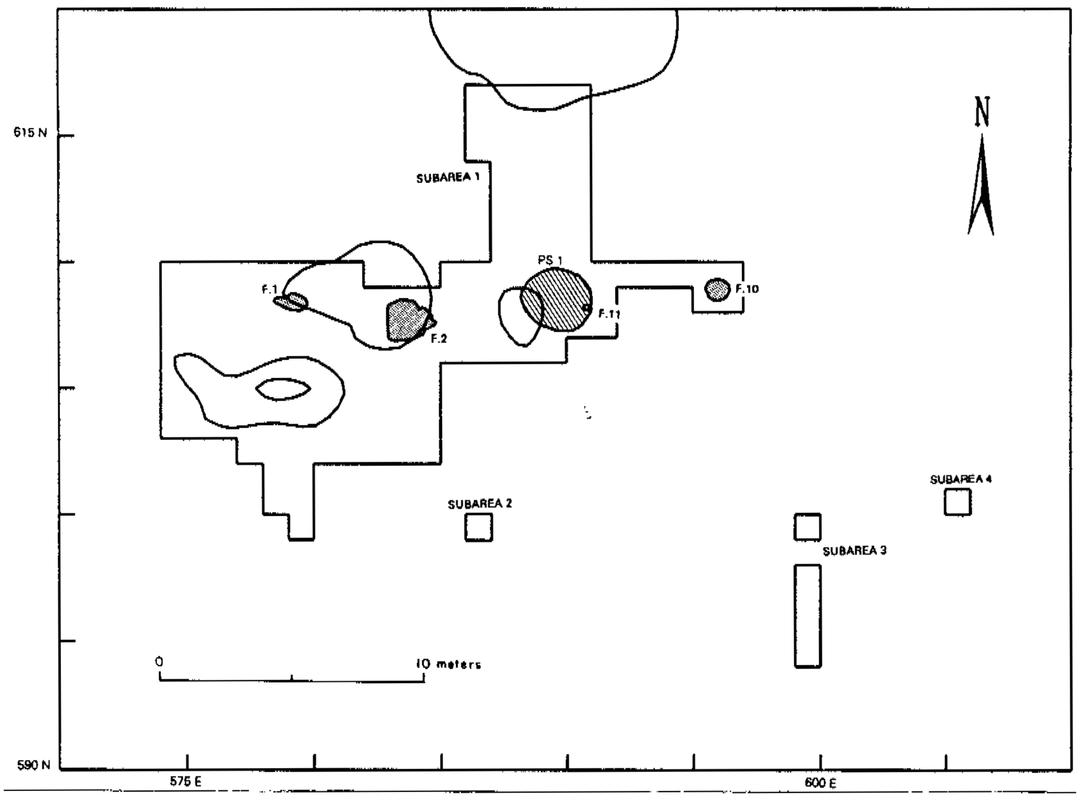

Figure 19-21. Distribution of sedimentary materials in EA-1 at the Mockingbird site; minimum contour = 1, contour interval = .5.

clusters in the west part of this area, especially around and to the south and west of Feature 2. There are also a few small clusters to the north of Feature 1, particularly of chertic materials. A second cluster of coarse igneous materials is visible to the north of Pit Structure 1, and a small cluster of sedimentary rocks occurs in and to the west of that structure. At least two relatively discrete reduction areas are indicated by these data. The main area of reduction was associated with hearths in the west part of the area, particularly Feature 2. A second area, which mostly contains coarse igneous materials, was north of Pit Structure 1.

When sherds, burned rock (including ground stone), and chipped stone artifacts are compared, their distributions are quite curious. While the distributions of these artifact categories overlap somewhat in the west and north parts of EA-1, there are distinct differences in the locations of clusters. Specific areas that contain large numbers of chipped stone artifacts rarely contain many sherds or fragments of burned rock, and vice versa. There seem to be two relatively discrete activity areas. The main activity area was west of Pit Structure 1 and south of Features 1 and 2. This zone may have extended further north, but since few artifacts were recovered from that area, our excavations did not extend far in that direction. The second activity area seems to have been north of Pit Structure 1, where no features were found. Time constraints did not allow much excavation around Feature 10, so it is impossible to determine whether that hearth also served as a focus of domestic activities. Likewise, we were unable to extend our excavations to the south of Pit Structure 1. It is quite possible that domestic activities and features were not confined to the areas that were investigated.

The only part of EA-1 that contained clusters of more than one artifact category was Pit Structure 1. While that structure was probably the focus of some activities, most domestic tasks were probably accomplished in extramural areas. A total of 54 artifacts (6 chipped stone, 17 burned rock, and 31 sherds) were recovered from the structure, excluding Feature 11. This comparatively large number of artifacts was surprising, particularly the amount of burned rock, and suggests that one of our original assumptions was incorrect. Pit Structure 1 was burned, probably around the time of abandonment, and the presence of relatively large numbers of artifacts suggests it was subsequently used for trash disposal. If this is correct, multiple occupations are indicated.

Two types of chronometric data were recovered from this part of the site. Radiocarbon samples from Pit Structure 1 and Feature 2 suggest a late Mesilla phase affiliation, which is at odds with the date provided by analysis of the ceramic assemblage. The presence of seven sherds from a single El Paso Polychrome jar and the character of the plain ware assemblage both suggest a later occupation, possibly Doña Ana or early El Paso phase (see "Analysis of Ceramic Artifacts from the Santa Teresa Sites"). El Paso Polychrome sherds do not occur elsewhere at the site, and Subarea 1 contained nine of the ten El Paso Brown rims recovered. The radiocarbon dates probably represent the use of old wood for fuel or construction and are not an accurate reflection of the period of occupation. This observation is very important because the El Paso Polychrome sherds were clustered together in a few grids in the southwest part of Subarea 1, and had we not dug there, all indications would have pointed toward a late Mesilla phase occupation. Thus, in many cases, the use of a small sherd assemblage or radiocarbon dates and a few nondescript sherds might not provide accurate dates for sites in this region.

Excavation Area 2

Three hearths were found in the seven discrete areas that were excavated in this part of the site. Subareas 3 and 4 were the largest zones of excavation, and hearths were only found in Subareas 3 and 5. Subarea 7 was dug during the testing phase, and Subareas 1, 2, and 6 were excavated to examine magnetic anomalies.

As Figure 19-22 shows, chipped stone artifacts mainly clustered in two areas: the south part of Subarea 4 and around Subarea 7. Three small clusters are visible in Subarea 3, and few chipped stone artifacts were found around Subarea 5. Thus, chipped stone artifacts do not appear to cluster around hearths in this part of the site as they did in EA-1. The distribution of sherds in Figure 19-23 is considerably different, with only one cluster in Subarea 4.

Figures 19-24 and 19-25 illustrate the distributions of various categories of hearth stones. Because the numbers of specimens falling into these categories were rather low, surface and subsurface materials are combined. Too few burned ground stone artifacts occurred for plotting, but most were found in the south part of Subarea 3 around Feature 3. Burned rock primarily clustered in that same subarea, around and north of Feature 8. A smaller concentration occurred in Subarea 4. When both categories are combined, the main clusters are virtually the same as those seen in the distribution of burned rock, which was not unexpected, since those materials dominate this data set.

Figures 19-26 through 19-29 illustrate the distributions of various material categories. Too few specimens of metamorphic materials occurred for that category to be plotted. Chertic materials (Fig. 19-26) mainly clustered in the north part of Subarea 4, with smaller concentrations around Subareas 3 and 7. Aphanitic rhyolites (Fig. 19-27) had a wider distribution but occurred mostly in the north part of EA-2, particularly in Subarea 4. Coarse igneous materials (Fig. 19-28) were distributed somewhat differently, with their densest concentration in and around Subarea 7 and smaller clusters in Subarea 1 and on the south side of Subarea 4. Sedimentary materials (Fig. 19-29) clustered in the west part of EA-2 around Subareas 3 and 5 and in Subarea 4. These data suggest that there were at least three distinct areas of reduction. Subarea 3 contained clusters of sedimentary and chertic materials. Most material categories clustered in Subarea 4, though coarse igneous and sedimentary materials were rather sparse. Subarea 7 contained small clusters of chertic materials and aphanitic rhyolites, and a dense cluster of coarse igneous materials which appears to continue east into Subarea 1.

When sherds, burned rock (including ground stone), and chipped stone artifacts are compared, their distributions differ in many ways. One way in which they are similar, however, is in their virtual absence from Subareas 2, 5, and 6. Subarea 4 contained relatively dense clusters of ceramic and chipped stone artifacts, as well as a small concentration of burned rock and ground stone. The distribution in Subarea 3 is opposite this pattern. That area contained the densest cluster of burned rock and ground stone in EA-2, and a light cluster of chipped stone artifacts. Subareas 1 and 7 contained clusters of chipped stone artifacts and probably represent a single area of reduction.

When chipped stone material categories were examined, similar differences were noted

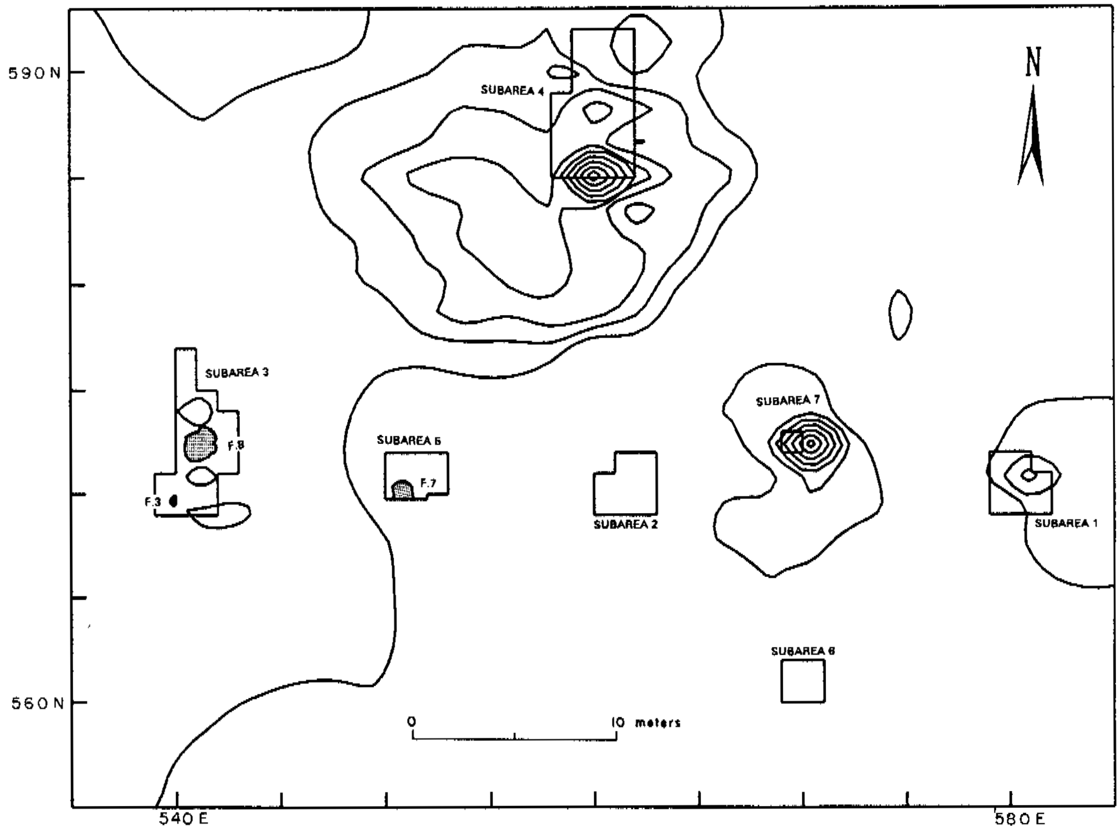

Figure 19-22. Distribution of chipped stone artifacts in EA-2 at the Mockingbird site; minimum contour = 1, contour interval = 1.

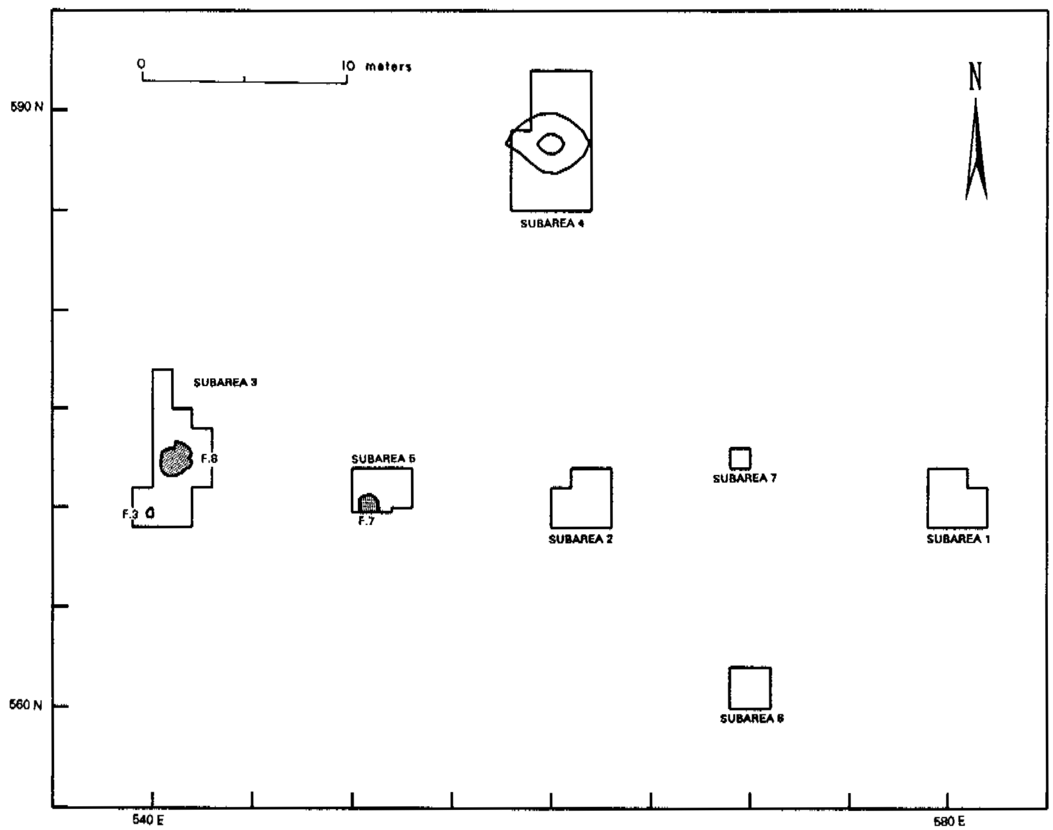

Figure 19-23. Distribution of sherds in EA-2 at the Mockingbird site; minimum contour = 1, contour interval = 1.

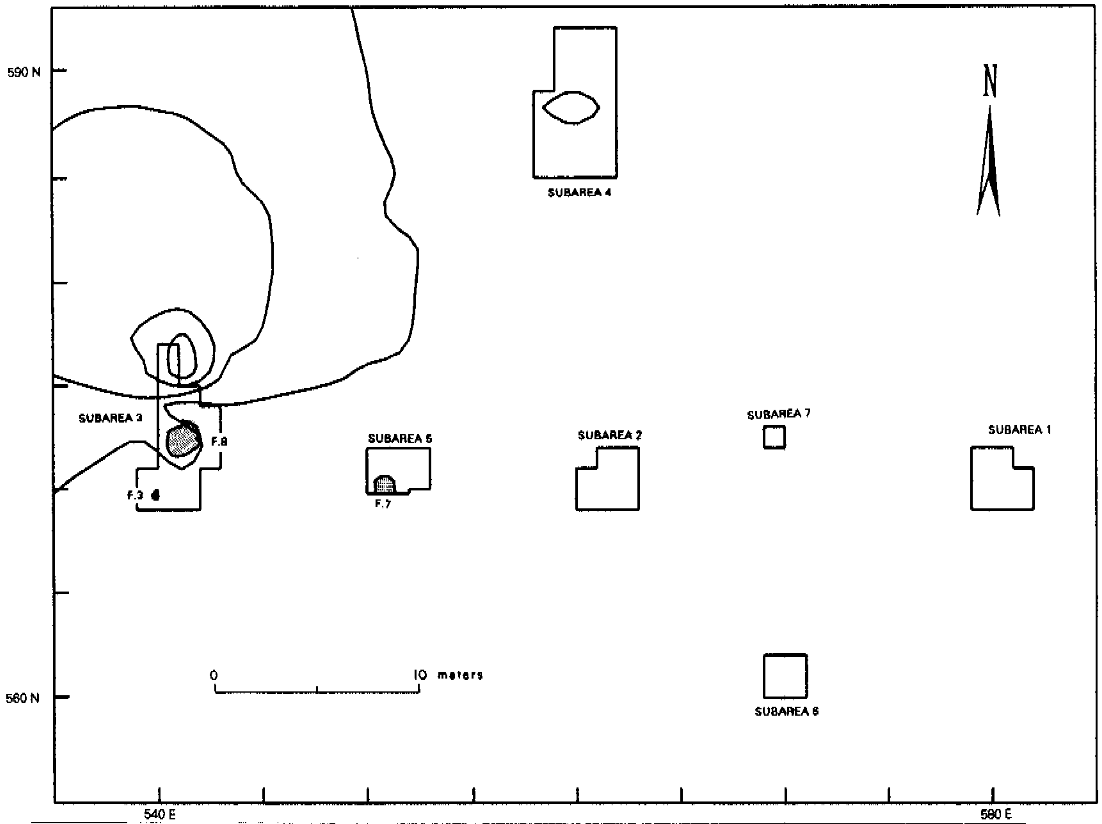

Figure 19-24. Distribution of burned rock in EA-2 at the Mockingbird site; minimum contour = 1, contour interval = 1.

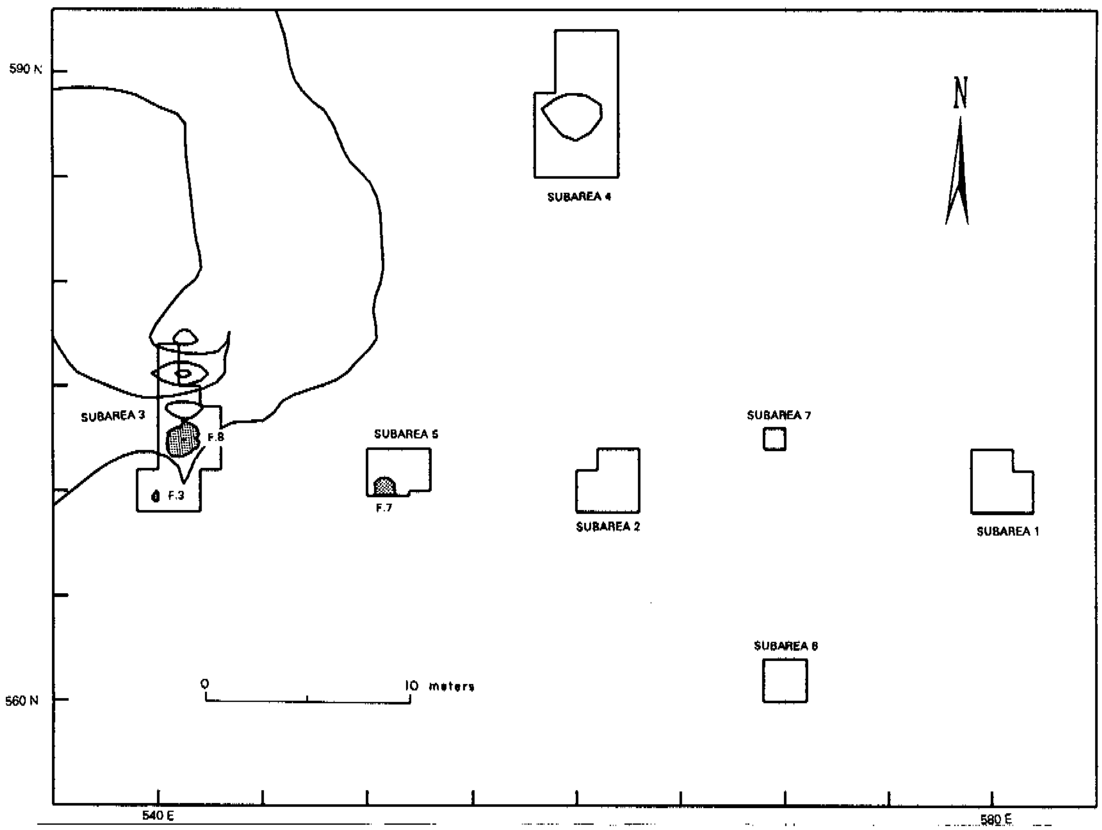

Figure 19-25. Distribution of burned rock and ground stone artifacts in EA-2 at the Mockingbird site; minimum contour = 1, contour interval = 1.

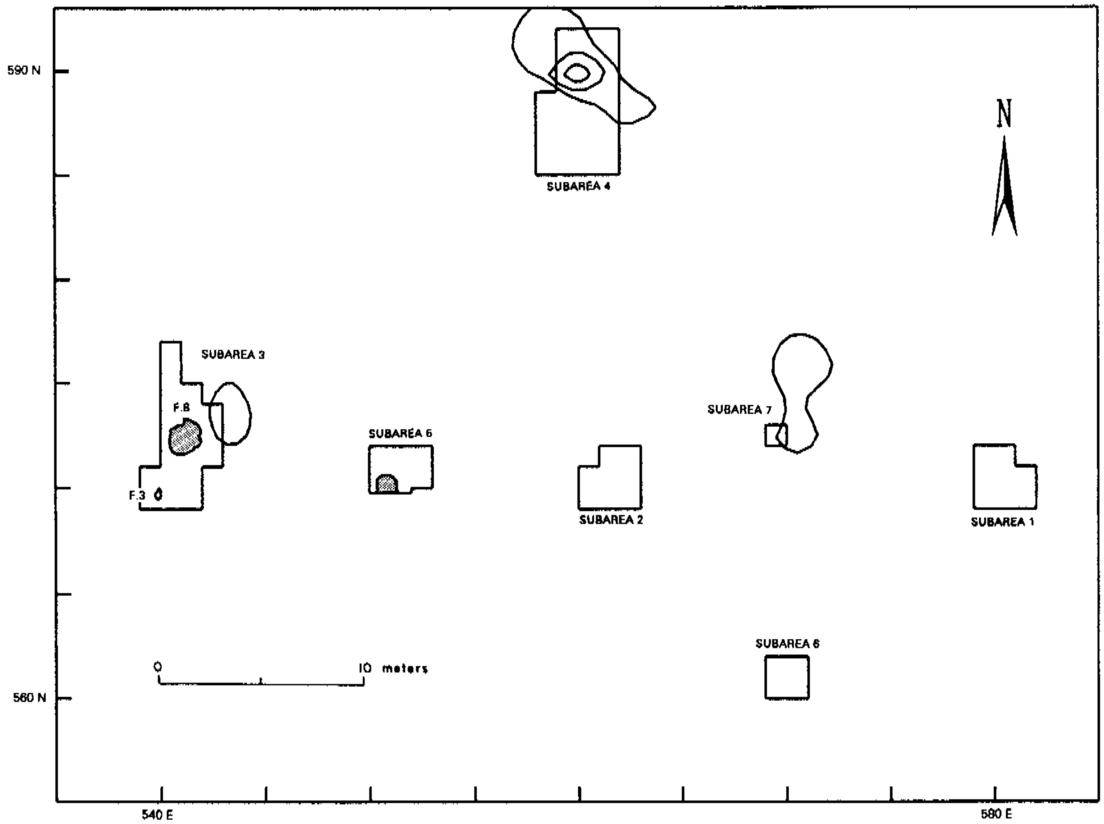

Figure 19-26. Distribution of chertic materials in EA-2 at the Mockingbird site; minimum contour = 1, contour interval = .5.

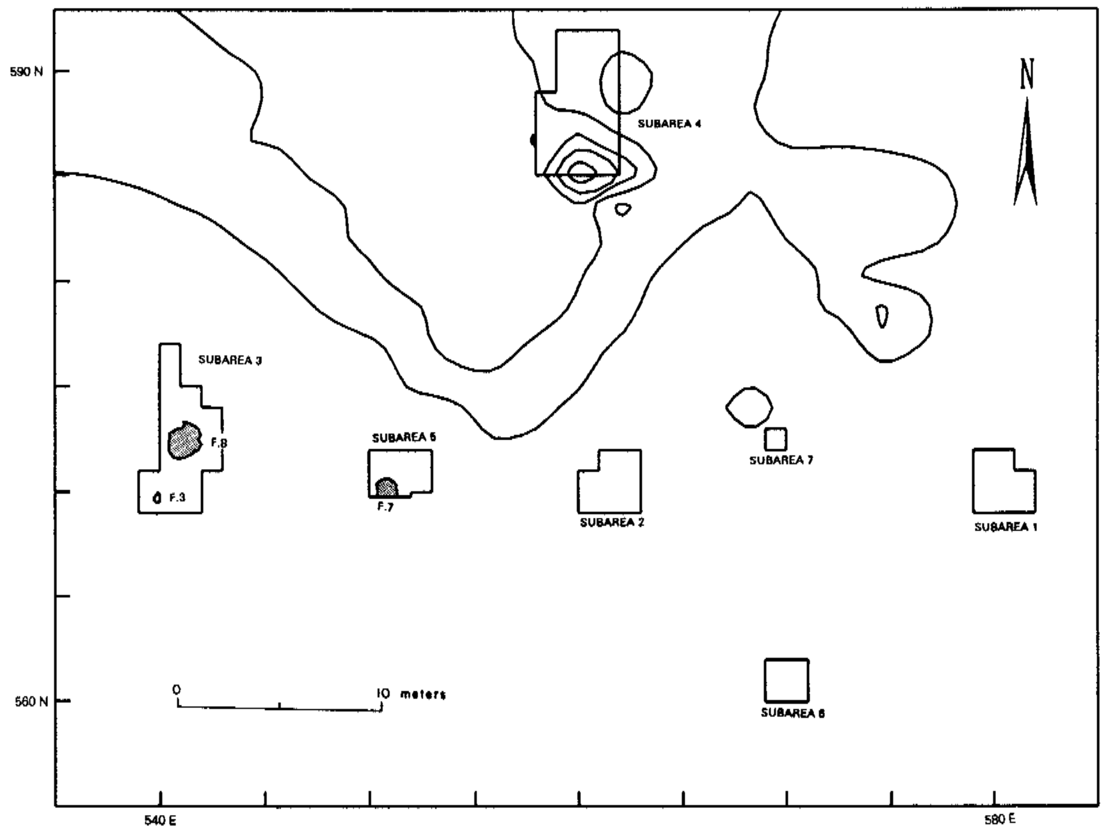

Figure 19-27. Distribution of aphanitic rhyolites in EA-2 at the Mockingbird site; minimum contour = 1, contour interval = .5.

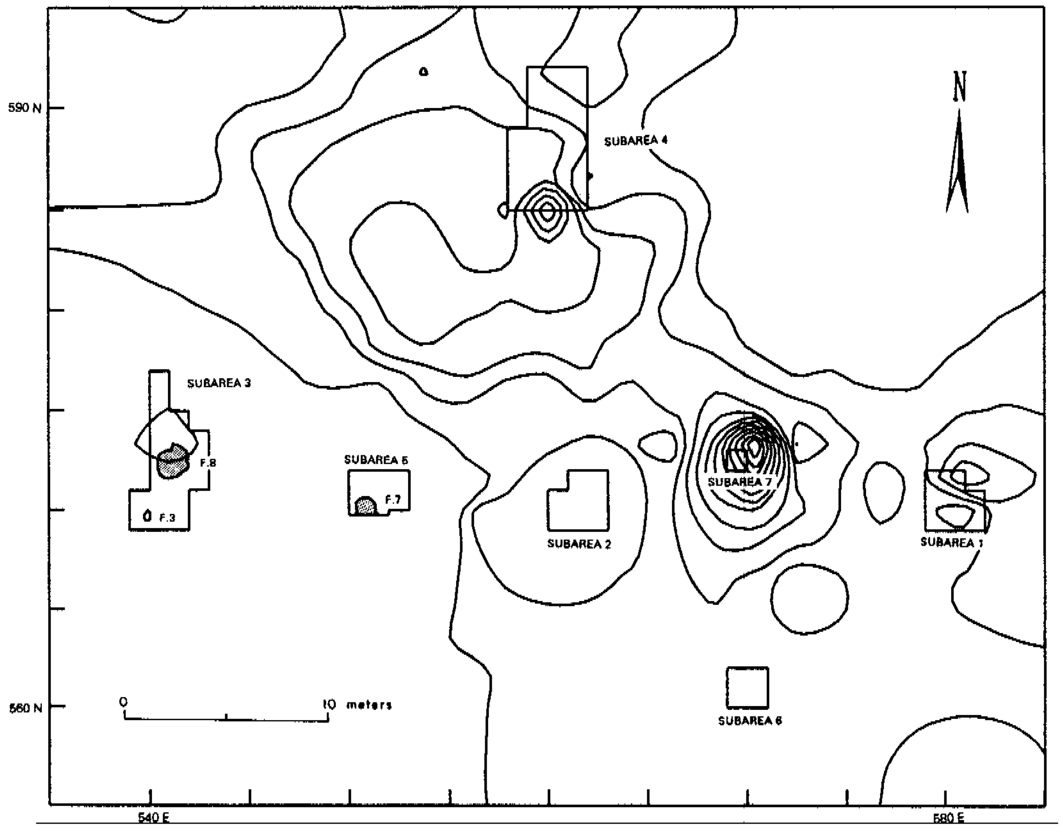

Figure 19-28. Distribution of coarse igneous materials in EA-2 at the Mockingbird site; minimum contour = 1, contour interval = .5.

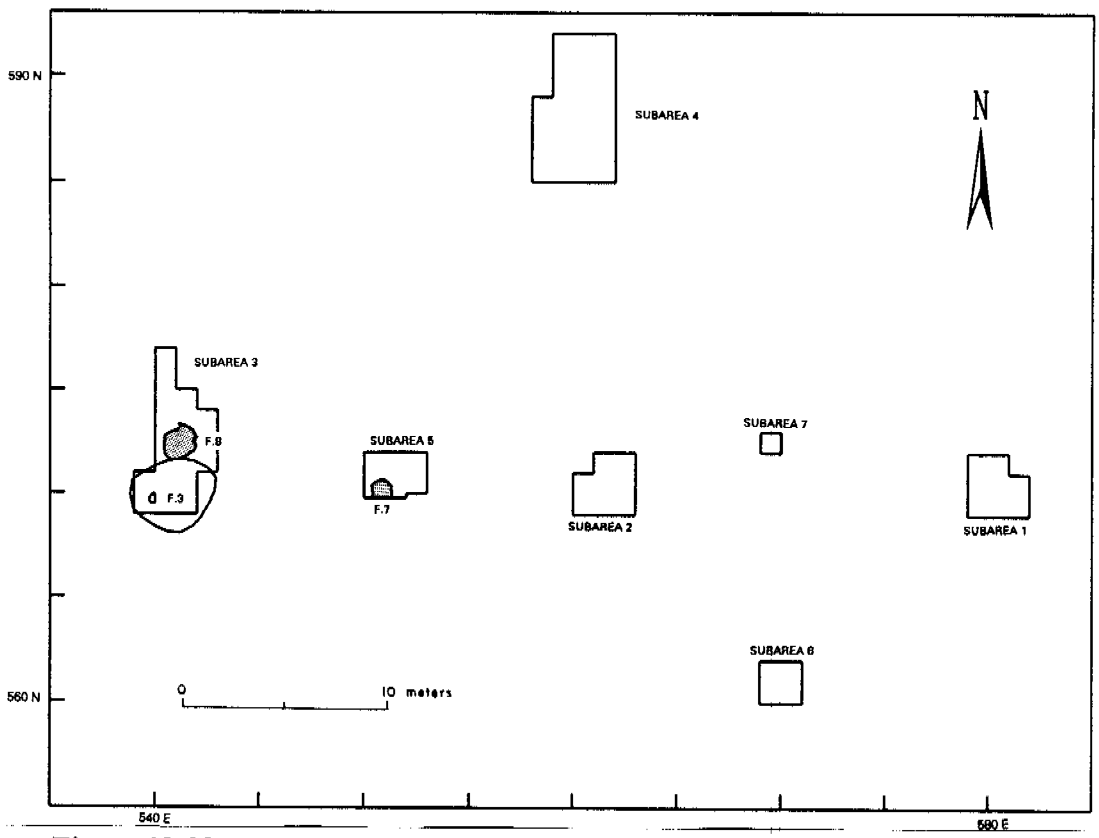

Figure 19-29. Distribution of sedimentary materials in EA-2 at the Mockingbird site; minimum contour = 1, contour interval = 1.

between subareas. Clusters of all five categories were found in Subarea 4. Only chertic and metamorphic materials clustered in Subarea 3. Coarse igneous materials clustered in Subareas 1 and 7, and there was also a small cluster of chertic materials in the latter. These differences suggest that there were corresponding variations in function for most subareas. Subareas 1 and 7 probably represent a chipping area, where mostly coarse igneous materials were worked. No activities can be defined for Subarea 2, which contained few chipped stone artifacts and no pottery. Subarea 3, which contained two hearths, a few sherds, and moderate amounts of chipped stone debris and burned rock (including ground stone), seems to represent a relatively discrete activity area.

Except for a lack of thermal features, Subarea 4 resembles the activity area defined in the west part of EA-1, Subarea 1. Comparatively large numbers of chipped stone artifacts representing a variety of materials, pottery, and burned rock were found in this zone. In addition, the soil containing these materials was stained by charcoal and ash. There are several possible explanations for this distribution. We may not have opened enough area to locate hearths that might occur in this area, though the lack of magnetometer evidence of any such features suggests that this is unlikely. It is also possible that hearths in Subarea 4 were destroyed by bioturbation. However, no part of this area contained denser staining, suggesting that this is also unlikely. Finally, this area could represent a toss zone associated with a structure that could not be defined, probably because it was ephemeral and unburned.

Subarea 5 contained a hearth and very few artifacts. The soil was not heavily stained around Feature 7, and a much earlier date was obtained for it than for any other hearth, suggesting that its use might not be associated with the main occupation. Subarea 6 contained no chipped stone or ceramic artifacts and does not represent an activity area.

Two types of chronometric data were recovered from this part of the site. A single radiocarbon date from Feature 7 (Table 8-2) is indicative of a Late Archaic occupation, while analysis of the ceramic assemblage provides no clear temporal association. Only 27 sherds were recovered from EA-2. All are plain brown wares, and only one is a rim sherd. Two different occupations could be represented. However, if use of old wood is responsible for the date from Feature 7, that hearth could date several hundred years later, placing it in the early Mesilla phase. Since pottery was found in Subareas 3 and 4, much of this area was clearly occupied during the Formative period, but exactly when is unclear. The lack of diagnostic sherds makes it difficult to assign this area to any particular phase, and we cannot assume that it was used at about the same time as EA-1, Subarea 1. Similarly, from the data presented thus far we also cannot assume an Early Formative period date.

Discussion

Little information is available from 7 of 11 analytic areas defined at the Mockingbird site. While this places some limitations on our ability to analyze site structure, it should be possible to draw some tentative conclusions. The distribution of cultural materials has been discussed for each excavation area, and some comparisons have already been made. We must now compare all excavation areas to determine whether multiple occupations are indicated.

Faunal Remains

The paucity of faunal remains from this site precluded discussing their distribution with the other artifact plots. However, the distribution of these materials is highly structured and very interesting. Bone was recovered only from the activity area southwest of Pit Structure 1 in EA-1, Subarea 1. The only specimen recovered near Pit Structure 1, from a cottontail, was not weathered or eroded, as were all other specimens, but nonetheless it is probably of cultural origin. A single pocket gopher bone found in the southwest corner of EA-1, Subarea 1, is probably also of cultural derivation. The remaining 42 fragments (95.5 percent) came from three adjoining grids south of Feature 1 and west of Feature 2 (604-606N/581E). Though the bone from this area was all badly eroded and splintered, it appears to represent the discarded lower leg of a single deer. Fragments of a tibia, metacarpal, and first phalange are present, and butchering marks were noted on some fragments.

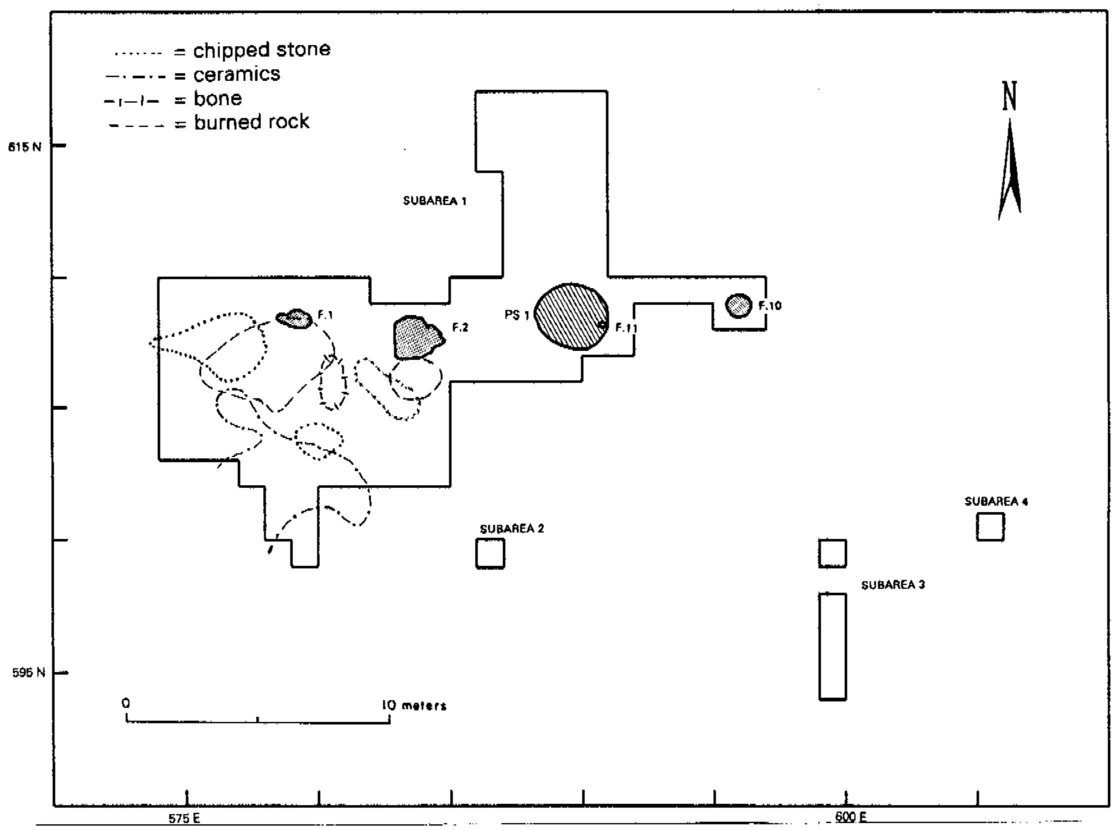

Figure 19-30. Centers of distribution for chipped stone, ceramic, bone, and burned rock artifacts in the west part of EA-1, Subarea 1, at the Mockingbird site.

Figure 19-30 shows the locations of highs in the distributions of various artifact categories in the west part of EA-1, Subarea 1. While there was some overlap between artifact categories, they tended to cluster in a spatially distinct pattern. Burned rock was adjacent to and south of both hearths. Chipped stone artifacts occurred in three clusters, two of which were also associated with hearths. Sherds concentrated further away from the hearths, and bone clustered between and to the south of the thermal features. If we are correct in assuming that most of the burned rock was used in food preparation, several activities can be defined that appear to have occurred in spatially distinct zones. Cooking activities occurred nearest the hearths, as might be expected. Chipped stone reduction probably occurred a bit further away from the hearths, and tasks using ceramic vessels were on the edge of the activity area.

Hearths

Only six hearths were encountered at this site, three each in EA-1 and EA-2. All of the former appear to have been related to Pit Structure 1, while the latter seem indicative of at least two occupational periods. It may be instructive to compare these features with those found at the Santa Teresa site to determine whether there might be any morphological or functional similarities.

As discussed in "The Structure of Archaeological Remains at The Santa Teresa Site (LA 86780)," hearths can be considered artifacts of human behavior, like chipped stone and ceramic materials. As such, characteristics of construction, content, and association can be compared and contrasted to help understand how this class of remains functioned. Information on the hearths excavated at the Mockingbird site is summarized in Table 19-5. Three shapes were found: oval, circular, and bowling pin. Two hearths fall into the former category, and one into each of the latter. The two remaining hearths were more difficult to classify. Feature 2 was irregular in shape, either because it was disturbed by rodent activity or it was comprised of a series of small shallow hearths that cut into one another. In either case, cultural or natural processes have obscured its original shape. Feature 3 was also difficult to classify because it was initially identified in a profile and incomplete. The shape of the remaining portion of this hearth suggests that it was originally either oval or bowling pin–shaped.

Table 19-5. Shape and depth data for hearths at the Mockingbird site

Feature	Depth	Size (sq m)	Shape	Burned Rock
1	.22 m	.23	bowling pin	1 (8.1 g)
2	.10 m	3.39	irregular	1 (1.5 g)
3	.11 m	.14 +	oval or bowling	-
7	.20 m	1.06 +	oval	-
8	.18 m	.88	oval	-
10	.33 m	.81	round	-

Burned rock was rare in these features. Though two hearths contained burned rock, only a single piece was found in either case. Since burned rock was otherwise rather common and mostly clustered near hearths, there are two possible explanations for this distribution. Either hearths that functioned as roasting pits were cleaned out after their last use, or burned rock was used for purposes other than roasting. A small body of experimental data (Duncan and Doleman 1991) suggests that the latter is possible, since the breaks found on burned rock and ground stone from this site seem indicative of stone boiling. However, analysis of burned rock from the Cox Ranch Project (Gerow 1994:269-272) suggests there may be problems with these conclusions. Her study suggests that fracture patterns may be at least partially conditioned by material type. In addition, she feels that all of the major material categories in her study tended to break in a blocky/angular pattern and concludes that this type of break does not necessarily indicate stone boiling, as Duncan and Doleman suggest. Curvilinear breaks are thought to be an accurate indicator of roasting, with other break types considered nondiagnostic. It should be stressed that these conclusions are based on a study of archaeological materials and not on experiments. Clearly, there is a need for such. It is possible that blocky/angular breaks indicate stone boiling for some materials but not for others and are therefore nondiagnostic in many cases. Similarly, some materials may tend to break in a curvilinear pattern when dry heat is applied, and others may not. Before we can begin ascribing functions to features containing burned rock with any confidence, these problems must be resolved.

Table 19-6. Break patterns on burned rock and ground stone artifacts by excavation area at the Mockingbird site (frequencies and row percentages)

Provenience	Angular	Curved	Indeterminate	Straight	Totals
EA-1, Subarea 1	69 36.1	31 16.2	77 40.3	14 7.3	191 73.5
EA-2, Subarea 1	1 100.0	0 0.0	0 0.0	0 0.0	1 0.4
EA-2, Subarea 2	0 0.0	0 0.0	0 0.0	1 100.0	1 0.4
EA-2, Subarea 3	8 27.6	0 0.0	18 62.1	3 10.3	29 11.2
EA-2, Subarea 4	2 28.6	3 42.9	2 28.6	0 0.0	7 2.7
EA-2, Subarea 5	2 100.0	0 0.0	0 0.0	0 0.0	2 0.8
Surface	20 71.4	1 3.6	6 21.4	1 3.6	28 10.8
Backhoe Trenches	0 0.0	0 0.0	1 100.0	0 0.0	1 0.4
Total Percent	102 39.2	35 13.5	104 40.0	19 7.3	260 100.0

Considering curvilinear fractures to be diagnostic of roasting, as Gerow (1994) suggests, the distribution of this type of fracture can be examined. The distribution of definable breaks is shown in Table 19-6. Curvilinear breaks were found on only 13.5 percent of the assemblage, and 88 percent of those artifacts were recovered from EA-1, Subarea 1. Thus, roasting rather than stone boiling may have been an important activity in that area. The only other curvilinear fractures found in excavation areas occurred in EA-2, Subarea 4. While the percentage is large, the sample from that area is too small to ascribe meaning to it.

Burned rock with curvilinear fractures was mostly scattered across EA-1, Subarea 1, rather than clustering near one or more hearths. No burned rock with curvilinear fractures was directly associated with Feature 1, suggesting that this feature may not have been used for roasting. A few fragments were recovered near Feature 2 but represent only 14 percent of the burned rock found within 2 m of that hearth. Curvilinear fractures do not dominate in that area, and it is difficult to ascribe a function on the basis of these few specimens alone.

By far the densest concentration of burned rock with curvilinear fractures occurred in and around Pit Structure 1: 38 percent of these artifacts were found inside or within 1 m of the structure and probably represent trash discarded in it. The presence of burned rock with curvilinear breaks throughout this part of the site may indicate that some roasting occurred there. However, it is not possible to determine which, if any, of the hearths were used for this purpose. Since these materials are scattered throughout the area, they were undoubtedly removed from the hearths in which they were used and discarded.

Table 19-7. Carbonized botanical specimens recovered from hearths at the Mockingbird site

Feature Number	Classification	Botanical Remains
1	small bowling pin-shaped	*Helianthus* sp.
		Sporobolus sp.
2	large irregular	*Sporobolus* sp.
3	small oval or bowling pin-shaped	-
7	large oval	*Portulaca* sp.
8	small oval	*Sporobolus* sp.
		Helianthus sp.
10	large round	*Portulaca* sp.
Pit Structure 1	shallow round	*Portulaca* sp.
		Sporobolus sp.

Table 19-7 shows the array of identified carbonized seeds recovered from the Mockingbird site. Unidentified seeds are not included since we could not determine whether they represented edible plant parts. It is always difficult to interpret what charred edible seeds from hearths mean, since they could derive from accidental burning as well as cooking. However, the relatively large number of examples may be indicative of accidental burning during processing or cooking. Feature 3 was the only hearth that did not contain identifiable carbonized seeds, but an unidentified type was found and may also represent food remains, though this is unresolved.

Carbonized edible seeds were also found in Pit Structure 1 from general fill and floor contact proveniences. Dropseed grass seeds and purslane (*Portulaca* sp.) were found in samples from just above the floor. Dropseed grass seeds were also found in a sample from the general fill. The presence of charred seeds within the structure could have several meanings. Perhaps the best interpretation is that they derived from episodes of hearth cleaning, when ashes and charcoal were discarded in the abandoned structure. A second possibility is that they represent edible seeds that were stored in the structure when it burned. However, no evidence was found to suggest the structure was still in use when it burned, so this possibility is weak. It is also possible that they represent building materials, but the lack of other parts of these plants argues against this interpretation.

To summarize, hearths were oval, circular, or bowling pin–shaped. The only exception was Feature 2, which was badly damaged by bioturbation. Burned rock was not common in these features, with very small amounts present in only a third of them. The only feature that contained numerous fragments of burned rock and ground stone was Feature 11, a probable heating pit that exhibited no evidence of burning. The presence of burned rock and ground stone near all hearths except Feature 7 suggests that stone boiling or roasting may have been common activities. Charred edible seeds were recovered from all but one hearth and may be evidence of food preparation or cooking. No hearths seem to have functioned solely as heat sources.

Seasonality and Occupational Type

Evidence of seasonality is provided by the carbonized plant remains illustrated in Table 19-7. Dropseed grass, sunflower, and purslane were all found in multiple samples. As indicated in the macrobotanical analysis, these types of seeds are most commonly available in the late summer to early fall, suggesting that the site was occupied at that time of year. Since virtually the same array of species is represented in each cluster of features, it is likely that at least the occupations represented by EA-1, Subarea 1, and EA-2, Subareas 3 and 5, occurred in the late summer or early fall.

Pollen analysis was less helpful in establishing seasonality (see "Intensive Systematic Microscopy of Pollen Samples from the Mockingbird Site"). The presence of elm pollen was especially troubling. It could reflect pollen rain at the time the sample was taken or contamination caused by bioturbation. In either case, it suggests that the reliability of these data are suspect. The presence of a single grain of pollen tentatively identified as corn is also troubling, especially in light of the lack of cultigen remains in macrobotanical samples. Some evidence of corn would be expected in flotation samples if it was used here, and none was found. Thus, we must view this single specimen with suspicion. Could it be evidence of a nearby cornfield? If so, the harvest was apparently transported away without being processed or consumed at the site, and this is unlikely. Corn stalks and husks would have been good fuel, yet there is no evidence that these materials were used. It is very unlikely that corn was present in any quantity at this site.

The only other evidence of seasonality is the configuration of the pit structure and the structure of the site. The floor of the pit structure was shallow and saucer-shaped, either from intentional excavation or as an unintentional result of cleaning. No evidence of an adobe or mud covering was found, even though the pit structure was apparently burned sometime after it was abandoned. Thus, it does not appear to have been weather-proofed. There is also a conspicuous absence of active heating features within this ephemeral structure. The only internal thermal feature was passive in nature. Rock was apparently heated in extramural hearths and placed in Feature 11 to warm the interior of the hut. Most activities appear to have occurred in extramural space, especially those involving fire.

These characteristics are consistent with a late warm season occupation. The structure of this site and the seasonality indicated by botanical remains and structure type fit Hard's (1983a) model of late Mesilla phase settlement and subsistence patterns, even though a somewhat later use is indicated by the ceramic assemblage. Hard (1983a) suggests that the desert basins were only open to use during the summer months, particularly during the rainy season, when water might be available in shallow playas. Only parts of the basins might be useable during dry years due to a lack of water. Ripening seeds were probably accessed from small foraging camps established where food, water, and firewood were all available.

This pattern does not fit the classic view of the Late Formative period, when settlement in sedentary farming villages is thought to have predominated. However, it does fit Mauldin's (1986) model of Late Formative settlement and subsistence. That model includes residence in permanent farming villages but suggests that they were abandoned for part of the year while much of the population moved onto the landscape in small foraging bands. As Mauldin (1986) suggests, late summer rainfall would allow much of the population to forage in other environmental zones, particularly the desert basins. The expected patterning at these sites is as follows:

> Secondary habitation sites should be characterized by less reoccupation, smaller groups, and occupation only during the late summer. Those secondary habitation sites in the central basin, where greater year-to-year variability in the resource base is predicted, will have a lower intensity of use relative to the secondary mountain periphery sites. Structures might be less formalized, if present at all, and well-defined activity and trash disposal areas are not expected. (Mauldin 1986:262)

He also feels that chipped stone assemblages on secondary sites in central basins should be characterized by the later stages of reduction. Neither chipped stone or ground stone artifacts should be plentiful, and assemblages should be dominated by pottery.

The Mockingbird site reflects several aspects of Mauldin's (1986) model, though it also differs from the predicted pattern. Use certainly seems to have occurred during the late summer, as his model suggests should be the case. The only structure found was rather ephemeral, and trash-disposal areas were not well-defined. Even though the pit structure was used for trash disposal after it was abandoned, the amount of debris it contained was rather small and probably reflects sporadic use for this purpose. Several apparent activity areas were defined, but in most cases they seem to have been used for multiple tasks rather than discrete activities. No artifact categories were plentiful on this site, though the chipped stone assemblage outnumbered sherds.

There was no indication that the later stages of reduction dominated in the chipped stone assemblage; indeed, the character of this assemblage suggests that plenty of early stage core reduction occurred there. Ground stone tools were rare, and most may represent materials scavenged from earlier sites for reuse as hearth stones.

This site mostly fits the pattern for a Late Formative period foraging camp as modeled by Mauldin (1986). It also fits the pattern for Early Formative period foraging camps as suggested by Hard (1983a). Indeed, had we not recovered El Paso Polychrome sherds, it would have been assigned to the earlier period. The close resemblance of this site to Mesilla phase foraging camps demonstrates the persistence of many adaptational characteristics throughout the Formative period. Even though villages began to be occupied on a more permanent basis during the Late Formative, mobility remained part of the adaptational repertoire. However, rather than nearly constant movement around the landscape, late prehistoric mobility was probably seasonal and tethered, occurring mainly in the late summer, when monsoons provided water in the desert basins, where seeds were ripening. These foragers remained tethered to their home villages and probably transported surplus foods back to them for storage. Thus, foraging may have served a dual purpose. It not only relieved stress on resources near villages, but it also allowed the harvesting and storage of wild plant foods for cold season consumption.

Occupational Dates and Geomorphology

Unfortunately, stratigraphy at the Mockingbird site closely resembled that found at the Santa Teresa site. In essence, no stratigraphic breaks were defined that were not of cultural origin. The parabolic dune upon which this site was established appears to have been almost constantly building, and only a single massive layer of sand was found. Thus, we must rely upon elevations, artifact assemblages, and the few reliable dates that were obtained for any interpretation of the relationship between clusters of features and artifacts.

Top and bottom depths for each feature are shown in Table 19-8. In general there is a fairly close correspondence between top elevations of features that cluster in specific excavation areas. In particular, top elevations for Features 1 and 2 and Pit Structure 1 in EA-1 are all very close. Feature 10 is a bit deeper, but a 10 cm difference is probably negligible. Top elevations for all three hearths in EA-2 are also very closely grouped. The radiocarbon date obtained for Feature 7 suggests a Late Archaic affinity, so it should be deeper than Features 3 and 8, which should date to the Formative period, since pottery was found in association with them. Yet Feature 7 occurred at a slightly higher elevation. This either suggests that the original surface was undulating, that the radiocarbon date for this feature is wrong, or that Features 3 and 8 date much earlier than assumed. Unfortunately, the lack of temporally diagnostic artifacts around Feature 7 makes it difficult to determine which might be correct.

The variance in feature depths between EA-1 and EA-2 may be indicative of multiple occupations. Thus, it is possible that at least part of EA-2 was occupied at an earlier date than EA-1, Subarea 1, and could represent an Early rather than Late Formative use. EA-1, Subarea 1, appears to represent a single discrete occupation that entailed use of a shallow pit structure and at least three hearths. Most activities occurred to the west and north of the structure, though space on other sides was also used for some tasks. The amount of cultural debris inside the pit structure is suspicious. Signs of burning were obvious during excavation, and while cultural materials were comparatively abundant within the structure, none were in contact with the floor. Thus, the structure was probably used for trash disposal during a later occupation, which most likely occurred within a few years, if not seasons, since the pit was apparently still open.

Where was this later use of the site centered? EA-2 is a possibility, though the lack of accurate temporal information makes this difficult to determine. The character of EA-2, particularly Subareas 3, 4, and 7, suggests that it represents a second occupation area. The lack of structural remains in that area is probably not important. Considering the character of local sand deposits, there is little likelihood that structural remains would be visible unless they burned. However, feature elevation information suggests that EA-2 may represent an earlier rather than later component.

Table 19-8. Elevation data for features at the Mockingbird site

Provenience	Feature Number	Mean Top Depth (m below datum)	Maximum Bottom Depth (m below datum)
EA-1, Subarea 1	1	10.20	10.41
	2	10.21	10.28
	10	10.30	10.63
	Pit Structure 1	10.15 to 10.20	10.35
EA-2, Subarea 3	3	11.11	11.19
	8	11.13	11.28
EA-2, Subarea 5	7	11.03	11.19

Differences in the distributions of chipped stone material categories across the site support the possibility that these areas represent different components. While chertic and metamorphic materials were relatively ubiquitous, aphanitic rhyolites clustered in EA-2. Coarse igneous materials were also most common in that part of the site, with a small cluster in EA-1. These differences could be a reflection of multiple uses separated by both space and time. However, they could also represent different material selection processes between groups of concurrent occupants.

Thus, we have three equally valid possibilities, and it will be difficult to determine which is correct. It is likely that at least two occupational episodes are represented. The date and character of Feature 7 and the area surrounding it suggest a Late Archaic use, though this is not supported by elevation data. EA-1 appears to represent a single discrete use of the area. The same is possible for the rest of EA-2 (Subarea 5 excepted), though it is difficult to say whether it represents an earlier, concurrent, or later occupation than EA-1. This aspect of our analysis has been unsatisfactory, and this question is taken up in more detail in the next chapter.

Conclusions

While we found it impossible to determine just how many occupations were represented at the site, we were able to draw several conclusions. The Mockingbird site appears to represent a multioccupational locale, containing perhaps as many as three separate episodes of use. A small Late Archaic component is suggested by Feature 7. The rest of EA-2 appears to represent a separate occupation, perhaps as early as the Mesilla phase. The best dated and understood component contains the pit structure and features in EA-1, Subarea 1. That occupation occurred during the Late Formative period, either late in the Doña Ana phase or early in the El Paso phase. Each possible use seems to have been during the late summer, which corresponds to most models of land use for the Early and Late Formative periods.

An occupation postdating the use of EA-1, Subarea 1, is likely, since it appears that Pit Structure 1 was used for trash disposal after it was abandoned and burned. While it is possible that parts of EA-2 could represent that occupation, there are great differences in feature elevations that render this possibility very tentative. Distributions of artifacts, particularly in EA-1, Subarea 1, suggest a patterning to activities. Various artifact categories clustered in different parts of that area, suggesting that the tasks in which they were used were spatially discrete. A similar patterning was not discernable in other parts of the site, mostly because only chipped stone and burned rock were well represented.

Thus, even considering the difficulties involved in understanding the spatial and elevational distribution of artifacts and features at this site, it was possible to clearly define at least one component. The small foraging camp that was thus defined demonstrates the continued use of residential mobility into a period that is more often characterized by the establishment of large permanent villages.

CONCLUSIONS: INTERPRETING CULTURAL REMAINS AT THE SANTA TERESA PORT-OF-ENTRY

James L. Moore

A detailed research design was presented in "The Santa Teresa Project Research Orientation," based on previous studies in the region and models of Jornada Mogollon settlement and subsistence presented in "Changing Scales of Mobility in the Southern Jornada Mogollon Region." In general, our investigations were aimed at defining the nature of cultural remains at these sites and determining what that information could tell us about prehistoric adaptations in the Mesilla Bolson. In particular we were interested in how local geomorphology and settlement systems were related and what we would be able to determine about the types of occupations represented at these sites.

Most studies in the basins of south-central New Mexico have to contend with a long history of erosion, which has compressed cultural remains into a "palimpsest" or mixture of many separate occupations. Often, all that remains is a jumble of artifacts and features representing numerous occupational episodes that are virtually impossible to sort out. Several geomorphological studies of our project area suggested we could be dealing with a rare situation, one in which local dunes have been continually building with no discernable periods of erosion. This is discussed in "Geomorphology of the Santa Teresa Sites," where it is demonstrated that geomorphological strata that are widespread and relatively well dated throughout this region were not encountered at our sites. It is likely that sand has been continually accumulating in these deposits since at least the Late Archaic period and probably for a considerably longer time.

Knowing that the sand sheet in which our sites occur is evidence of continual accretion of eolian sediments showed that our geomorphological situation was unique when compared with most other archaeological studies in the region. During initial testing it was evident that features occurred at a variety of depths at these sites (Moore 1992). Since we seemed to be dealing with what can essentially be called an uncompressed palimpsest, it became necessary to determine the meaning of this distribution. This brings us to the first question defined in our research orientation: is the occurrence of features and cultural deposits at a variety of depths in these dunes evidence of multiple occupations spanning a large number of years, or does it reflect a few occupations on an undulating dune surface, similar to the present landscape?

Our second major area of interest concerns the type of occupations(s) represented by these remains. In particular, we were interested in determining what these sites could tell us about variation in the scale of mobility through time. If the scale of mobility changed, we expected to encounter differences in chipped stone technology. Specifically, we predicted that evidence for the use of large general purpose bifaces should be found in Archaic contexts and absent from Formative assemblages. This process is tied to the use of a curated reduction strategy by highly mobile societies and use of expedient reduction strategies by less mobile groups. If these sites exhibited evidence of differences in the scale of mobility, variation in the range of raw materials selected for use should also be apparent.

Three possible occupational types were modeled: foraging camps, logistical camps, and farming camps. While potential difficulties in distinguishing between these types of occupation were noted, we felt that enough data might be available to suggest which were most likely. This part of the study is also closely related to an examination of mobility patterns. If the population remained mobile throughout the occupation of this region but there were differences in the scale of mobility, those differences should be discernable in the structure of features, cultural deposits, and assemblages.

While some of these questions have been partially addressed in several previous chapters, most have not been discussed in detail. In addition, we have not yet compared remains from the Santa Teresa and Mockingbird sites to see what they can tell us about the big picture. Thus, in the remainder of this chapter we address questions raised in the research orientation with data from both sites.

Dating and Geomorphological Relationships

Dating the Mockingbird Site

Dates for the Mockingbird site were derived from radiocarbon samples and pottery. Unfortunately, pottery dates do not correspond with radiocarbon dates. Old wood seems to be the cause of this discrepancy. Three radiocarbon dates were obtained (Table 8-2), two from EA-1, Subarea 1, and one from EA-2, Subarea 5. We initially felt that these dates would be indicative of the periods of use for the features they came from, as well as nearby features thought to be related. Because many charcoal samples obtained during this project were very small and could only be dated using an accelerator mass spectrometer, we were unable to process many samples from this site.

Dates from EA-1, Subarea 1, were consistent, and suggested a late Mesilla phase affiliation for that part of the site. However, several sherds from a single El Paso Polychrome jar were recovered from the associated artifact scatter, suggesting that the radiocarbon dates were too early by several centuries. Because of this, we were forced to discard the radiocarbon dates and assign these remains to the late Doña Ana phase or early El Paso phase.

Feature 7 provided the only radiocarbon date for EA-2 and suggested a Late Archaic occupation. Few artifacts were found in direct association with this feature. Only one sherd was recovered near Feature 7, and since it came from the first level of excavation, it is of questionable association. However, the presence of this artifact very near Feature 7 could suggest that we are dealing with old wood in this part of the site as well. Considering a date between A.D. 200 and 500 for the beginning of the Mesilla phase, use of wood that was only a few hundred years old could easily produce the date we obtained for Feature 7. Thus, while the date range for this feature suggests it was used during the Late Archaic, we can not rule out an early Mesilla phase affiliation. Consider once again Smiley's (1985) analysis of radiocarbon samples from Black Mesa. In that study he found there was an 80 percent chance that dates were overestimated by more than 200 years, and a 20 percent chance they were overestimated by more than 500 years

(Smiley 1985:385-386). Thus, it is not only possible, but probable, that radiocarbon dates from this site are too early by up to several centuries.

Two other hearths were found near Feature 7: Features 3 and 8. The area in which they occurred was arbitrarily labeled EA-2, Subarea 3, and this does not preclude a close relationship with Feature 7. Indeed, when the upper elevations of these features are compared, they correspond rather closely. The upper edges of Features 3 and 8 are actually 8 to 10 cm deeper than Feature 7, though this difference is probably negligible because of undulations in the original occupational surface. Differences between the upper elevations of these features and those in EA-1, Subarea 1, are not negligible, however. Features in EA-1, Subarea 1, were nearly 1 m higher in the dune. That amount of vertical difference is probably significant and suggests that the occupation of EA-1, Subarea 1, should date considerably later than that of EA-2, Subareas 3 and 5.

It was unfortunately impossible to recover evidence of direct relationships between groups of features because of the nature of dune deposits. Even though various trenches and other exposures provided us with a cross section of the upper 4 to 5 m of the sand sheet, the only variations noted were in hue and compaction, unrelated to soil formation. Thus, there was no way to directly tie features together other than proximity. Assuming that our analysis is correct, two different occupational levels are represented by the features at this site. The lowest contains three hearths and a few artifacts and appears to represent an Early Formative period occupation. The later use represents the most extensive occupation, and occurred during the Late Formative period. A Late Archaic occupation, as suggested by radiocarbon dates, is unlikely and probably represents use of old wood for fuel.

Dating the Santa Teresa Site

Temporal data for the Santa Teresa site are a little more straightforward, though they are still open to interpretation. Five radiocarbon dates were obtained from this site and do not correlate with dates for the few sherds that were recovered. Of the 17 sherds found at the site, 14 are from a single Mimbres Corrugated vessel, all of which were recovered from EA-3, both in Subarea 2 and between Subareas 1 and 2. As we concluded in "The Santa Teresa Site (LA 86780)," these artifacts represent a pot or large sherd that was shattered and scattered when a brush rake was used to remove overburden. Ceramic and chipped stone artifacts cluster in different parts of EA-3 and are probably unrelated. This is supported by the close resemblance of the chipped stone assemblage from this area with that of EA-1, which dates to the Late Archaic. The Mimbres Corrugated vessel seems to represent a much later occupation than the rest of the assemblage. There are two possible explanations for this phenomenon. The simplest is that the vessel was displaced from a higher elevation by earth-moving activities. However, it is also possible that the vessel was at the bottom of a feature that cut into earlier deposits. While we cannot determine the exact mechanism that deposited sherds at this depth, it is unlikely that there is any relation between them and other materials in this area.

Two of the three remaining sherds were recovered from the southern part of the site and were not associated with any features or artifact clusters. It is likely that these artifacts also reached the depth at which they were found through disturbance rather than in situ deposition. The last sherd was found near EA-4, in the north part of the site, and could reflect a Formative period occupation in that area. However, a radiocarbon date from Feature 4 suggests that a Late Archaic affiliation is more likely. Like the other pottery at this site, the sherd found near EA-4 probably reached that depth by mechanical disturbance.

None of the few sherds recovered from this site appear to be related to the rest of the assemblage. They do, however, indicate there was later occupation. A late Mesilla phase use is indicated by sherds from the Mimbres Corrugated vessel, and it is possible that the other sherds are from that occupation as well. Since pottery from at least one overlying occupation occurred at this level, is it possible that other artifacts are also related to that later use? Unfortunately, this question is impossible to answer. However, distributions of chipped stone, ground stone, and burned rock artifacts are mostly patterned and suggest that most are related to the Archaic occupation. If a few lithic artifacts from later occupations were mixed in with the Archaic assemblage, their effect on the overall distribution of materials was negligible.

All dates obtained from features at this site were Archaic in age. However, two distinct clusters were apparent. Two adjacent hearths dated to the Middle Archaic (Features 7 and 14), while others dated to the Late Archaic (Features 4, 9, and 17). The total lack of sherds in excavation areas from which radiocarbon dates were obtained suggests that Archaic occupations are indeed indicated. Thus, the old wood problem is probably negligible as far as specifying a general period of occupation is concerned.

Upper elevations of features generally tend to correspond to dates. The Middle Archaic hearths were between 12 and 25 cm deeper than two of the Late Archaic hearths, while the third Late Archaic hearth was 5 to 8 cm deeper than the Middle Archaic features. We felt that this distribution reflected an undulating prehistoric dune surface. Indeed, the dated hearths were separated by a total of only 33 cm of elevation, which over a distance of more than 100 m is not a great amount of variation.

Thus, while we cannot use feature depths to assign absolute dates, the results of this study are encouraging. In general, the greater the depths at which hearths were found, the older they were, though some evidence suggested that the prehistoric dune had an undulating surface similar to that of the modern dune. Since this also appears to be true of the Mockingbird site, it should be possible to compare and contrast our findings from both locales.

The Big Picture: Comparison of Dates and Elevations from Both Sites

When sites were examined individually there was a general correspondence between dates and feature depths. This is also evident when data from both sites are combined. Five feature clusters from both sites were dated. Pit Structure 1 and Features 1, 2, and 10 in EA-1, Subarea 1, at the Mockingbird site were assigned a Late Formative period date, ca. A.D. 1150 to 1250. Features 3, 7, and 8 in EA-2, Subareas 3 and 5, probably date to the Early Formative period, ca. A.D. 200 to 750. At the Santa Teresa site, Features 4, 9, and 17 dated to the Late Archaic period, while Features 7 and 14 were Middle Archaic.

Figure 20-1 shows the distribution of dated features and excavation areas for both sites (age is unscaled but increases to the right). Again, there is a general correspondence between dates and depths. Dated Archaic features at the Santa Teresa site cluster at elevations ranging from 12.72 to 13.05 m below datum. Probable Early Formative features at the Mockingbird site cluster at elevations ranging from 11.03 to 11.13 m below datum, while Late Formative features cluster at elevations ranging from 10.20 to 10.30 m below datum.

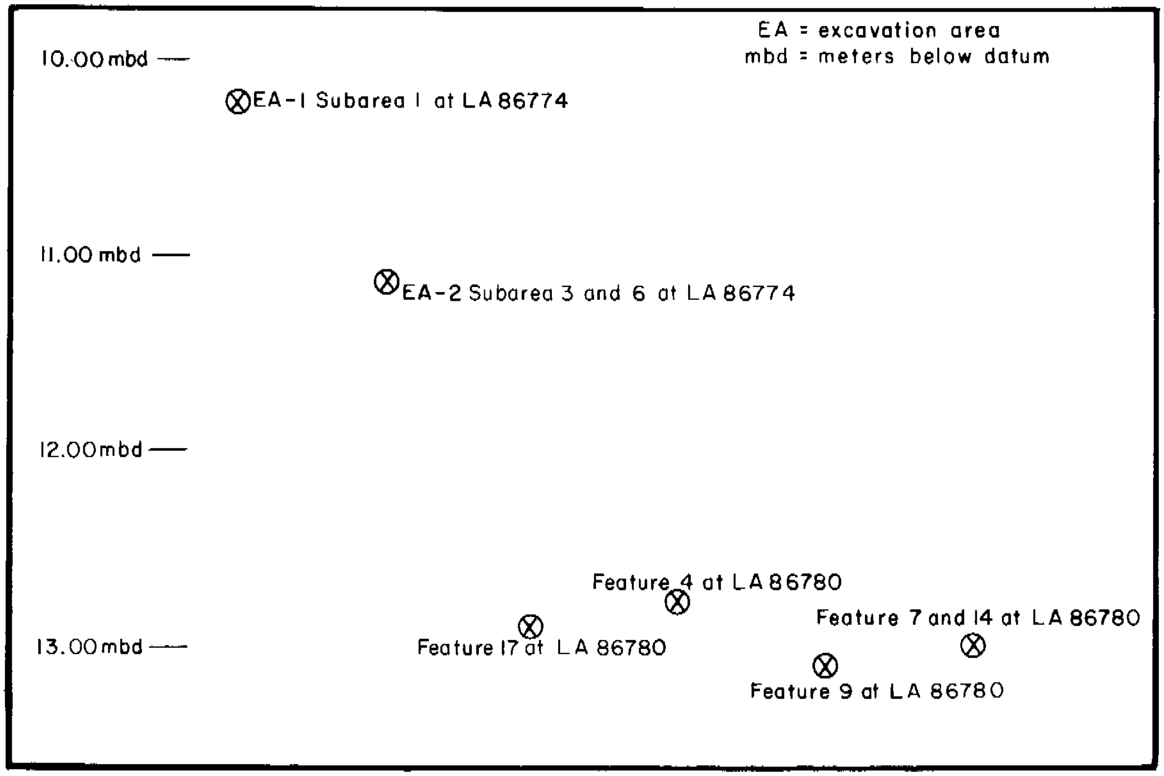

Figure 20-1. Distribution of dated features and excavation areas at both sites by elevation; ages increase to right.

This correspondence breaks down a bit when individual features at the Santa Teresa site are considered. Statistically, Features 4 and 9 are part of the same population at the 95 percent level of confidence. Yet they are the shallowest and deepest of the dated hearths at this site. Feature 17 is the youngest of the dated features and falls between Features 4 and 9 in elevation. Features 7 and 14 are by far the oldest of the dated hearths, yet Feature 9 was deeper. Date ranges for Features 4 and 17 overlap slightly at the second standard deviation (Table 18-13), as does the range for Feature 4 and the later of two possible ranges for Feature 9. While old wood could be responsible for part of this phenomenon, it is unlikely that it is the only culprit. These hearths probably represent separate occupational episodes on an undulating dune surface. The only hearth that may be out of place, vertically, is Feature 9. Occupation of a low swale would account for the occurrence of this hearth at a lower elevation than the Middle Archaic features in EA-8. Since we are looking at features spread over nearly 200 meters of site, such relatively minor horizontal variation is not surprising.

While elevations and dates are not directly correlated, there is a correspondence between certain elevation ranges and dates. The lack of considerable elevation variation between Middle and Late Archaic features at the Santa Teresa site suggests that sand accretion was slow between ca. 2600 B.C. and A.D. 1 or that there was a period of erosion between those times. Since no evidence for erosional unconformities was found, the former may be more likely.

Sand accretion seems to have been relatively rapid between the Late Archaic and Late Formative periods. There is an elevation difference of as much as 2.8 m between deposits from those periods. While this may be partly accounted for by an undulating or sloping dune surface, most of the elevation difference is undoubtedly due to sand accretion. This suggests an average buildup of 0.23 cm per year during that period. While this rate was probably not constant and cannot be used to absolutely date materials in adjacent parts of the dune, it does suggest that EA-2, Subareas 3 and 5, at the Mockingbird site reflect an occupation falling between the Late Archaic and Late Formative periods. At 190 cm above the Late Archaic zone at the Santa Teresa site, a 0.23 cm per year rate of accretion would yield a difference of approximately 814 years. While this approach obviously cannot be used to absolutely date that zone, it does suggest an Early Formative period use is likely.

The only cultural zone for which a probable date has not been determined is EA-2, Subarea 4, at the Mockingbird site. That zone contained a thick stratum of lightly discolored sand which probably represents a bioturbated activity area. Artifacts were common in this part of the site (117 specimens) and rather evenly distributed between elevations of 10.45 and 10.95 m below datum in grids that were excavated by 10 cm levels rather than strata. This is lower than the Late Formative deposits and higher than the probable Early Formative deposits. Chipped stone artifacts are vertically sized in EA-2, Subarea 4; that is, they decrease in size as depth increases (Table 20-1). However, artifacts in the lowest level (10.85 to 10.95 m below datum) were nearly as large as those from the highest level. Vertical sizing was expected and corresponds to a phenomenon described by Doleman (1992). The fact that artifacts in the lowest level were, on the average, larger than those from other levels except the uppermost 10 cm may suggest that it is the approximate locus of deposition. That depth probably reflects an Early Formative occupation, since it is only 10 to 20 cm higher than deposits from that period in EA-2, Subareas 3 and 5.

Table 20-1. Average sizes of chipped stone artifacts by level for EA-2, Subarea 4, at the Mockingbird site

Level	Mean Length (cm)	Mean size (sq cm)
1	2.3	6.51
2	1.8	3.21
3	1.5	2.46
4	1.4	1.93
5	2.0	4.19

Using these data, Wilson (this volume) determined that characteristics of the ceramic assemblage, both alone and in comparison with chipped stone, are indeed indicative of a Mesilla phase occupation in EA-2, Subareas 3 and 5, and EA-2, Subarea 4. Thus, these parts of the site are assigned an Early Formative date and are generally considered together in the rest of this discussion, though they probably represent separate uses of the site during that period.

In summary, there is a correspondence between elevations of occupational zones and dates at these sites, suggesting this general area was occupied on many occasions over a long period. In most cases it is virtually impossible to separate materials from individual occupational episodes unless they were separated by a substantial period of time. Overall, however, the clustering of features and artifacts at different elevations is meaningful and shows that, rather than a palimpsest, our deposits were uncompressed. Depths were used to tentatively estimate relative dates for materials but could not be used to assign absolute dates. Part of the reason for this is an undulating dune surface. For example, the modern dune surface at the Mockingbird site was lower in elevation in EA-2 than in EA-1. Did this result from differential erosion related to modern vegetation, or is it a function of long-term patterns of sand accretion? We unfortunately cannot answer this question because of the homogeneity of sand deposits across both sites. However, even though there were inconsistencies, dates and elevations are clearly related. Features dating to the Archaic were much deeper than those dating to the Early Formative, which were deeper than features dating to the Late Formative. Within limits, then, our tentative assignments seem justified.

The Nature of Prehistoric Occupations at the Santa Teresa Port-of-Entry

Our analysis in the previous section and in discussions of the structure of archaeological remains suggest that both sites contained multiple components. At least four Archaic occupations were represented at the Santa Teresa site, while the Mockingbird site contained at two Early Formative use areas and evidence for one or more Late Formative uses. We must now determine the types of occupations represented and whether we can define differences between them. We may also be able to examine the nature of mobility in these periods with site data. In particular, we can try to determine whether chipped stone reduction and material selection strategies reflect similarities or differences in mobility between occupational periods. Archaic and Late Formative components are relatively well dated. Early Formative components are less securely dated, but assignments based on elevations and assemblage characteristics seem accurate. Thus, all materials from the Santa Teresa site are considered Archaic. EA-2, Subareas 3, 4, and 5 from the Mockingbird site are Early Formative; and EA-1, Subarea 1, at that site is Late Formative.

According to our model, if there were equivalent levels of mobility during the Archaic and Early Formative periods, assemblages from both should reflect reduction strategies aimed at maximizing the amount of useable edge, exhibit differences in how local and nonlocal materials were reduced and used, express the maximization of materials through use of large general purpose bifaces (though there should be no evidence for the manufacture of such tools at our sites), reflect the same approximate range of raw materials, and possess large ranges of both formal and informal tools. We also considered the possibility that different levels of mobility might be evidenced between the Archaic and Early Formative periods, and certainly between the Archaic and Late Formative periods. If so, we should see differences in reduction strategies and evidence for use of large general purpose bifaces should only occur in Archaic assemblages. Formative period tool kits should only contain bifaces with specific functions. They should also contain a smaller range of formal and informal tools, and there should be significant differences in materials selected for reduction.

Three types of camps were modeled in the research design: foraging, logistical, and farming. All should have been used on a short-term basis, though farming camps might exhibit evidence of use over one or more seasons. According to our model, storage features should occur if the site was used as a farming camp, and specific trash disposal areas might also be present. Logistical camps could also contain storage features, depending on how winter villages were supplied. Storage features would have been unnecessary if foods were gathered at logistical camps and immediately transported to the winter village. However, storage features would be required if winter villages were supplied from logistical caches. The former pattern is probably more likely, though the latter could also have been used. If storage features occur on a site, the presence or absence of formal trash disposal might be the only way to distinguish between these types of occupations.

Some differences in the types and ranges of plant foods exploited are also expected. Foraging camps should evidence a wide range of wild floral and faunal foods. No cultigens should occur, and only locally available species should be present. The range of foods in a logistical camp should be much narrower and, again, no cultigens or nonlocal foods are expected. Farming camps should contain a wide range of local wild foods. However, in this case we should also find evidence of cultigens as well as foods from distant ecozones.

Some differences in the range of tool types might also be expected. Logistical assemblages should reflect a very narrow range of activities, while both foraging and farming camp assemblages should evidence a much wider range of activities, reflecting the more generalized nature of their occupations. However, the size and range of tool kits also depend on factors that are unrelated to how sites were originally used. Length of occupation can help determine the size and nature of an assemblage. Sites occupied for only a few days may contain little evidence of the tasks that were performed there, simply because tools were not discarded or lost. In general, as occupations increase in length, assemblages are larger, and more tools and types of tools occur. Thus, the longer an occupation lasted, the better the chances that a representative selection of tools was left behind.

Recycling of materials from earlier sites is another factor that can affect the range of tools in an assemblage. As shown by our analysis of ground stone tools, large numbers of certain types of artifacts may have been recycled. In particular, ground stone tools may have been obtained from earlier sites for use as hearth stones. At the same time, chipped stone artifacts were probably also reused, as suggested by Camilli (1988). This can affect assemblages in two ways. First, certain artifact classes may be absent or represented by few examples because most were removed for reuse by later occupants of the region. Second, certain classes of artifacts on a site may have been used for a purpose that is totally different from what they were originally designed for. Thus, most ground stone tools from our sites were used as hearth stones rather than to process plant foods. The fact that ground surfaces are present is incidental to their function in these assemblages.

Residential structures should be ephemeral in each type of camp. However, we noted that structures on farming camps might contain evidence of reuse, and this should not occur at the other camp types. Farming structures might also contain internal thermal features, because occupancy during the growing season can include some cold nights. The probability that such features will occur in structures used at foraging or logistical camps is much smaller. In general, redundant groups of features might reflect multiple uses for the same purpose, though they could also reflect the presence of several groups. Foraging and farming camps should contain wider ranges of feature types because, presumably, a wider range of tasks were performed at those types of sites than at logistical camps.

It may be very difficult to choose between these possibilities with the rather limited amount of data available from our sites. However, we should be able to suggest which types of occupation are more or less likely.

Comparison of Chipped Stone Assemblages

In our earlier analysis we were able to define several Archaic, Early Formative, and Late Formative components. In most instances it is difficult to separate materials from components dating to the same general period. Even if we were able to do so, most components would contain too few artifacts to allow detailed comparison. To facilitate comparison we will combine components from each general time period. Thus, all materials from the Santa Teresa site are considered Archaic. EA-2, Subareas 3, 4, and 5, from the Mockingbird site are assigned to the Early Formative period, while materials from EA-1, Subarea 1, are assigned to the Late Formative period.

Table 20-2. Material types by occupational period (frequencies and column percentages)

Material Type	Archaic	Early Formative	Late Formative
Cherts	411 45.6	17 15.3	32 18.2
Pedernal chert	9 1.0	3 2.7	5 2.8
Silicified woods	8 0.9	0 0.0	2 1.1
Obsidian	8 0.9	1 0.9	1 0.6
Undifferentiated igneous	9 1.0	2 1.8	1 0.6
Basalt	17 1.9	2 1.8	5 2.8

Material Type	Archaic	Early Formative	Late Formative
Rhyolite	78 8.6	43 38.7	78 44.3
Aphanitic rhyolite	294 32.6	27 24.3	17 9.7
Limestone	22 2.4	2 1.8	1 0.6
Sandstone	1 0.1	3 2.7	1 0.6
Siltstone	2 0.2	1 0.9	3 1.7
Undifferentiated metamorphic	9 1.0	0 0.0	3 1.7
Quartzite	32 3.5	0 0.0	3 1.7
Quartz arenite	2 0.2	10 9.0	24 13.6
Total Percent	902 75.9	111 9.3	176 14.8

Table 20-2 illustrates the distribution of material types by period. Major differences are visible in percentages of cherts, rhyolites, aphanitic rhyolites, and quartz arenite. Archaic components contain considerably higher percentages of chert and aphanitic rhyolites than Formative assemblages, while the latter contain much higher percentages of rhyolites and quartz arenite. In terms of overall material selection, Formative components resemble one another much more closely than either does the Archaic components. Elyea (1989) noted a similar distribution of materials in her survey near Santa Teresa. She found that Archaic sites contain higher proportions of waxy cherts, obsidians, chalcedonies, and mudstones, while Formative components contain higher percentages of dull cherts, rhyolites, and carbonates (Elyea 1989:29). The distinction between waxy and dull cherts was probably textural: waxy cherts are finer grained. Whalen (1981a) noted differences between Early and Late Formative material selection in the Hueco Bolson. While chert dominates assemblages from both periods, he found good evidence for an increase in the use of igneous materials in the Late Formative period (Whalen 1981a:76).

Material types are collapsed into more general categories in Table 20-3. Archaic components are clearly dominated by chertic and glassy/fine igneous materials, while coarse igneous materials are most common in Formative assemblages. While chertics are also rather common in later components, they are more than twice as abundant in Archaic assemblages. Coarse sedimentary materials are much more common in Formative period components, though they comprise only small parts of those assemblages.

Table 20-3. Material categories by period (frequencies and column percentages)

Material Type	Archaic	Early Formative	Late Formative
Chertics	428 47.5	20 18.0	39 22.2
Fine sedimentary materials	24 2.7	3 2.7	4 2.3
Coarse sedimentary materials	3 0.3	13 11.7	25 14.2
Glassy/fine igneous materials	302 33.5	28 25.2	18 10.2
Coarse igneous materials	104 11.5	47 42.3	84 47.7
Coarse metamorphic materials	41 4.5	0 0.0	6 3.4
Total Percent	902 75.9	111 9.3	176 14.8

Significant differences are also visible in the distribution of material textures (Table 20-4). Glassy textures comprise very small percentages of each component and can probably be ignored. However, much higher percentages of fine-grained materials were used in Archaic components. In this small set of assemblages we can see that the use of fine-grained and medium-grained materials appears to decrease through time, while the use of coarse-grained materials increases.

Table 20-4. Material textures by period (frequencies and column percentages)

Texture	Archaic	Early Formative	Late Formative
Glassy	8 0.9	1 0.9	1 0.6
Fine-grained	478 53.0	37 33.3	52 29.5
Medium-grained	364 40.4	44 39.6	49 27.8
Coarse-grained	52 5.8	29 26.1	74 42.0
Total Percent	902 75.9	111 9.3	176 14.8

In terms of material type and texture selection, Early and Late Formative period assemblages are more similar to one another than either is to the Archaic. While assemblages from the two later periods differ slightly where these attributes are concerned, it is difficult to determine whether those differences are due to real variation or sample size. However, differences between Archaic and later assemblages are undoubtedly real.

Table 20-5. Debitage categories by period (frequencies and column percentages)

Debitage Type	Archaic	Early Formative	Late Formative
Angular debris	216 24.9	32 34.4	60 36.8
Core flake	639 73.7	61 65.6	102 62.6
Biface flake	9 1.0	0 0.0	0 0.0
Bipolar flake	3 0.3	0 0.0	1 0.6
Total Percent	867 77.2	93 8.3	163 14.5

Some variation can also be discerned in debitage assemblage characteristics, which are shown in Table 20-5. Biface flakes occur in the Archaic assemblage but are conspicuously absent from the Formative assemblages. It may be meaningful that modified flake platforms also occurred only in the Archaic assemblage. While only a few biface flakes were found at the Santa Teresa site, all were probably removed from large general purpose bifaces, since none have lengths or widths consistent with removal from small tools. Bipolar flakes occur in both Archaic and Late Formative assemblages, suggesting the use of similar methods to reduce small nodules that could not otherwise be flaked. Flake to angular debris ratios are 3.01 for the Archaic assemblage, 1.91 for the Early Formative assemblage, and 1.72 for the Late Formative assemblage. While the latter two assemblages have similar flake to angular debris ratios, they are both much lower than the Archaic ratio. We can suggest some reliance on large curated bifaces for the Archaic, along with a somewhat more systematic reduction of cores.

Table 20-6 illustrates the distribution of chipped stone tools by period. Though the Archaic assemblage seems to contain a wider variety of tool types than the Formative assemblages, the cautions discussed earlier must be considered. Since the number of tool types present at a site usually varies with assemblage size, larger assemblages should contain more types of tools. Thus, since the Archaic assemblage is much larger than the Formative assemblages, this difference may simply be the result of sample error. Table 20-7 illustrates various ratios for tools, including both formal and informal categories. While tools comprise only small percentages of each assemblage, they are somewhat more common in Formative assemblages. This is also reflected by the ratio of chipped stone artifacts to tools: a somewhat higher Archaic ratio indicates that tools are actually less common in that assemblage. A much higher Archaic ratio of chipped stone artifacts to tool types indicates that there is less actual variety in the array of tools in that assemblage. Unless large numbers of tools were removed from Archaic components but not from Formative components, these findings suggest that our original prediction is not upheld. The larger number of Archaic tool types is probably due to assemblage size rather than differences in mobility or site type.

Table 20-6. Tool types by period (frequencies)

Tool Type	Archaic	Early Formative	Late Formative
Debitage tools	19	3	4
Core tools	3	-	-
Hammerstones	2	1	2
Chopper-hammerstones	1	-	-
Small bifaces	1	1	2
Large bifaces	2	-	-
Projectile points	4	-	-
Total	32	5	8

Table 20-7. Tool ratios for each component

Component	Percentage of Tools in Assemblage	Chipped Stone Artifacts/Tool Types	Chipped Stone Artifacts/Tools
Archaic	3.6	128.85	28.18
Early Formative	4.5	37.00	22.20
Late Formative	4.5	58.66	22.00

Several trends are apparent from this discussion. Even though the number of components examined was small, there are clear differences between Archaic and Formative chipped stone assemblages, while Early and Late Formative period assemblages are quite similar. This suggests a difference in the scale of Archaic and Formative period mobility, but not in the scale of Early and Late Formative period mobility. In this case our model suggests there will also be differences in how local and nonlocal materials were reduced. Unfortunately, only small percentages of all three assemblages could be assigned to either category, and very few pieces of debitage with attributes characteristic of specialized reduction techniques can be assigned to a source category. Thus, we cannot really assess the fit of our data with this prediction. However, as Table 20-8 shows, the Archaic assemblage contains a much higher percentage of nonlocal materials than do either of the Formative assemblages. While this is not indicative of differential reduction of local and nonlocal materials, it does suggest that a much larger region was exploited by the Archaic groups using this area.

Table 20-8. Material sources by period (frequencies and column percentages)

Source	Archaic	Early Formative	Late Formative
Local	87 9.6	14 12.6	38 21.6
Nonlocal	162 18.0	7 6.3	8 4.5
Indeterminate	653 72.4	90 81.1	130 73.9
Total Percent	902 75.9	111 9.3	176 14.8

There was a clear selection for finer-grained materials in the Archaic assemblage, while coarser-grained materials were much more common in the Early Formative assemblage. Though our data sets are small, there may be some evidence for continued intensification of this process into the Late Formative. This appears to reflect a differential use of certain material categories, in which coarse sedimentary and igneous materials are much more common in Formative assemblages, and chertic and glassy/fine igneous materials in the Archaic assemblage.

Thus, the Archaic assemblage is clearly different from the Formative assemblages, which closely resemble one another. Some of our data suggest that these variations reflect differences in the scale of mobility. A much higher use of nonlocal materials during the Archaic may be evidence for the exploitation of a larger region than used by Formative groups. In particular, the Archaic population seems to have ranged into the Franklin Mountains, and while there they obtained lithic materials directly from their sources. Formative populations do not seem to have traveled as far, at least on a regular basis. Curated biface use during the Archaic also suggests a higher degree of mobility, though there is only a small amount of evidence for this strategy in our assemblage. As concluded in "Analysis of the Santa Teresa Chipped Stone Artifact Assemblages," this is probably due to the size and quality of available nodules. Cores appear to have been reduced more carefully during the Archaic, producing larger ratios of flakes to angular debris. This can also be characteristic of a higher level of mobility, though this is not always the case.

While the occupations from all three periods represented at our sites are probably indicative of residential mobility, analysis of the chipped stone assemblages suggests there were differences in the degree of mobility reflected. The Archaic components suggest a larger overall range of movement and more frequent moves. We also see some use of a curated strategy, which reflects concern with the weight of materials carried, and evidence for predicted shortages of high quality materials as reflected by transport of more nonlocal materials into the desert basin. Divergence in material selection characteristics between Archaic and Formative components may also indicate different task requirements. Thus, a different range of activities, either related to food processing or manufacturing/maintenance, can be suggested.

Comparison of Features and Occupational Intensity

Table 20-9 illustrates artifact counts for potential components at the Santa Teresa site, represented by clusters of features or artifacts as well as individual features. Component 1, which contained eight hearths and over 65 percent of the artifacts that could be assigned to individual components, represents the most extensive use of the site. Components 3 and 4 contained three morphologically and probably functionally distinct hearths apiece, yet there were few associated artifacts other than burned rock. This is probably an indication of short-term residential use.

Numerous chipped stone artifacts were found in Component 2, but it is difficult to determine what this assemblage represents. Lacking associated features, we could not decide whether it represents a separate occupation zone or an activity area related to another component. Conservatively, we must consider it representative of a separate, moderate-length use. Components 5, 6, 7, and 8 each had few or no associated artifacts. If we are correct in assuming that these areas represent discrete occupational zones, very short-term residential episodes are indicated for each of them.

Table 20-9. Artifact counts for possible components at the Santa Teresa site

Component	Chipped Stone	Ground Stone	Burned Rock	Totals
Component 1: EA-1 and EA-3	531	34	375	940
Component 2: EA-2	76	2	21	99
Component 3: EA-4	3	3	180	186
Component 4: EA-5	6	16	131	153
Component 5: EA-7	-	-	27	27
Component 6: EA-8	15	1	6	22
Component 7: EA-9	2	2	3	7
Component 8: EA-10	-	-	-	0

Most of the residential episodes that can be defined at this site were apparently very short-term, even in cases where multiple hearths were present. Just as an estimate, these occupations may have been on the order of a few days. A slightly longer occupation is probably indicated for EA-2, but we cannot rule out the possibility that this area was related to Component 1, which represents the only relatively long-term use of the site. This use may have been on a scale of weeks rather than days, though this is impossible to determine for certain.

The Component 1 occupation may represent the use of this area by several families, hence the different occupational areas. Other components seem to represent use by small groups, probably single families. Again, these conclusions are very tentative because there is no way to associate numbers of hearths and artifacts with group size.

Table 20-10 shows artifact counts for potential components at the Mockingbird site. Component 1, which certainly represents the most extensive use of this site, contained the only structure as well as half of the extramural features and 80 percent of the artifacts that can be associated with discrete occupations. Components 2 and 3 each contained much smaller numbers of artifacts, suggesting less lengthy uses. However, other evidence suggests that the three Formative period occupations at the Mockingbird site were longer than any of the occupations defined at the Santa Teresa site. All three occupational zones at the Mockingbird site were stained a slightly darker shade than overlying and underlying sand deposits. The source of this staining was undoubtedly charcoal and ash generated by those occupations and scattered through these zones. While small stains were encountered at the Santa Teresa site, particularly in EA-1, Subarea 1, the amount of soil discoloration was nowhere near as extensive. Longer occupations undoubtedly resulted in the generation and spread of more charcoal and ash than did shorter uses. Thus, the greater degree of staining at the Mockingbird site suggests that all three components were used for longer periods than any of the Archaic components at the Santa Teresa site, even though some of the latter generated many more artifacts.

Table 20-10. Artifact counts of possible components at the Mockingbird site

Component	Chipped Stone	Ceramic	Ground Stone	Burned Rock	Totals
Component 1: EA-1, SA-1	176	218	47	267	708
Component 2: EA-2, SA-3 and 5	23	5	-	33	58
Component 3: EA-2, SA-4	84	21	2	10	117

These data also suggest a difference in the scale of mobility between the Archaic and Formative periods. Most Archaic residential episodes appear to have been very short-term, leaving behind little evidence other than hearths and a few associated artifacts. Even Component 1 at the Santa Teresa site was probably used for a fairly short period, perhaps as long as a few weeks, but almost certainly no longer. Formative period components at the Mockingbird site seem to represent longer uses, though they often produced fewer artifacts. Thus, while mobility continued to be used as an adaptive strategy during the Archaic and Formative periods, there was a difference in scale. Late summer/early fall residential movement was probably more frequent during the Late Archaic. Formative period occupations may have been longer because foraging zones were more circumscribed by a denser population and because foods were gathered to provision the winter village as well as feed site occupants. Thus, Formative period camps may have served a dual foraging/logistical function. While site occupants were subsisting as foragers, they may also have been collecting surplus foods for transport to the winter village.

Occupational Type

While we assumed that these sites represent multiple-use foraging camps in the last section, we have not yet applied our data to the models presented in the research orientation. This must be done to test whether this assumption is correct. Three categories of occupation types were modeled: foraging camps, logistical camps, and farming camps. Each should be distinguishable from the others based on characteristics of artifact assemblage, and feature and structure types.

Evidence for repeated short-term occupations was found at the Santa Teresa site. Occupations at the Mockingbird site appear to have been somewhat longer. No signs of macroband use were found, though the most extensive component at the Santa Teresa site may represent occupation by more than one family. The only structure found at either site was ephemeral and contained no active thermal features, though a warming pit was found within it. While no other evidence of structures was noted, it is likely that some sort of shelter was built during most occupations, particularly those that lasted for more than a few days. The lack of evidence for such may be ascribed to the nature of sand deposits, and the likelihood that Pit Structure 1 at the Mockingbird site was the only one that happened to burn. The probable reuse of Pit Structure 1 for trash disposal after it burned represents the only evidence for a possible formalized midden area. Even so, most rubbish was discarded as sheet trash in activity areas.

We found a fairly narrow range of subsistence remains at both sites, but considering the poor preservation of both floral and faunal materials, little meaning can be ascribed to this. However, it is important that only locally available food remains were recovered. No evidence of floral or faunal foods from other ecozones was found. This includes the deer bone from EA-1, Subarea 1, at the Mockingbird site. While deer are often considered to be residents of the riverine and montane ecozones, they also forage in the desert basins. In fact, a doe was observed on several occasions by port-of-entry personnel at the Mockingbird site while data recovery was being conducted.

There is some redundancy of features and artifact assemblages, particularly at the Santa Teresa site. All evidence of seasonality suggests that occupations at both sites occurred during the late summer or early fall, and use at no other time of the year is indicated. No cultigens were found, with the exception of a possible corn pollen grain at the Mockingbird site. However, the lack of corn macrobotanical specimens from that site suggests that this specimen was from another type of grass.

These general characteristics could be indicative of any of the defined patterns of use. However, more specific attributes may help to choose among them. Strictly logistical uses are probably not indicated for either site. The more extensive components contain evidence for a wider range of extractive, processing, and manufacturing/maintenance tasks than would be expected at logistical camps. In addition, the wide discrepancy in assemblage size between many components is more suggestive of a foraging use. Logistical camps should reflect rather similar lengths of occupation. While there is some redundancy in feature morphology and probably function between several components, particularly those in EA-1, EA-4, and EA-5 at the Santa Teresa site, there is also quite a bit of variation in assemblage size and content.

Likewise, farming camps do not seem indicated. Archaic occupations were all relatively short-term and occurred only in the late summer to early fall. While the three definable components at the Mockingbird site all seem to represent longer periods of occupation, they also reflect late summer to early fall use. Thus, in both cases there is evidence for occupation during the time of year in which harvesting would occur, but there is no evidence for use during the planting season. Large amounts of wild plant foods are not available in the desert basins at that time of year. Perhaps the only exception would be leaf succulents, and no direct evidence for the processing of those foods was found. Other plant foods would have to be brought in from elsewhere and would probably include cultigens. No evidence of either was found.

At least one Late Formative farming camp has been excavated nearby, and neither of our sites resembles that locale in the types of structures or features encountered. At least one pit structure and numerous pits were found at NMSU 1393 (Batcho et al. 1985). The pit structure was square, with a very level floor and formal interior hearth. At least two large probable storage pits were found outside the structure. Charcoal created by the use of corn cobs for fuel was recovered from a storage pit. Thus, this site contained a rather substantial structure with an active internal heating feature, large-scale storage, and evidence of cultigens. All three of these attributes are missing from our sites, suggesting that they functioned differently.

While evidence is rather scanty, these sites appear to represent multioccupational foraging camps. As discussed earlier, longer periods of occupation at the Mockingbird site may be indicative of a coincident logistical function in which foods were collected for storage at the winter village. Unfortunately, we have no direct evidence for this function, so it remains speculative.

Assorted Comments

Many ideas and much information are synthesized in this report. As often happens in an endeavor of this nature, some ideas were noted in passing and never again touched upon because there simply was not a good place to fit them in. Other concepts were not mentioned earlier, but seem relevant at this point in the discourse. Thus, this section contains discussions of some of these ideas, either because they are relevant to the flow of the report or are worthy of development in other studies.

Climate and Occupation

Our initial assumptions concerning ties between the southern Jornada region and the Casas Grandes sphere of influence concerned shifting centers of regional exchange and interaction. This mostly involved the coincidence of timing between the temporal boundaries of the El Paso phase and the rise to prominence and fall of the Casas Grandes towns. We assumed that economic factors were behind expansion of the Casas Grandes system into the southern Jornada region, which in turn was behind many of the radical changes in the settlement and subsistence system that occurred at that time. The peripheral position of the southern Jornada in the Casas Grandes system could be assumed to be a function of distance, with that area lying outside the zone of coercive control of the Casas Grandes towns. However, this relationship could also be environmentally derived. Rather than being actively drawn into the Casas Grandes sphere of influence, the southern Jornada people may have used more active participation in that interaction system to counter a population-food supply imbalance caused by environmental fluctuations. Thus, rather than viewing the impetus for participation in a large regional system as originating outside the southern Jornada region, internal factors could have been responsible.

Contrary to the model of an arid Altithermal originally proposed by Antevs (1955), Martin (1963) suggested this period may have been characterized by a wet climate, particularly in the Southwest. This was due to the effect of warmer temperatures at high latitudes, which cause a northward shift of subtropical high pressure areas, resulting in increased summer rainfall (Bayham and Morris 1990:33). Using this concept, Bayham and Morris (1990) constructed curves illustrating changing patterns of global temperature, solar activity, and glacial fluctuations during the Holocene in northern latitudes, finding that each of these measures corresponded strongly with one another (Bayham and Morris 1990:33).

The temperature curve derived from this study allowed Bayham and Morris (1990) to demonstrate a pattern of fluctuating use of the Picacho dune field in south-central Arizona. Periods of cultural use corresponded with periods of thermal maxima and presumably higher moisture levels. While we do not have enough data to do a comparable study at Santa Teresa, it may be instructive to examine the periods of occupation at our sites in light of this curve.

Figure 20-2 graphs the occupational periods for our sites against the curve constructed by Bayham and Morris (1990:34-35). Absolute dates were provided by radiocarbon samples and ceramic assemblages. Each absolutely dated occupation falls within a period of thermal maxima. Dates for the Early Formative period occupation at the Mockingbird site were estimated and span a long interval, falling within both periods of thermal maxima and minima. This occupation should be disregarded, since it was impossible to more accurately delineate its boundaries.

While this tentatively suggests both the accuracy of the model and the possibility that most cultural use of the Santa Teresa area was during periods of thermal maxima, the sample of dated occupations from these sites is too small for this analysis to be conclusive. However, it is possible to expand the data base with other absolute dates to further test the model and our tentative conclusions. A total of 61 radiocarbon dates from 42 features and pit structures is available for the area, produced by this study, the survey conducted by Ravesloot (1988a), and excavations by Roney and Simons (1988) and O'Leary (1987). Where multiple dates are available for features, only the most recent was used. These data are graphed against Bayham and Morris's (1990) information in Figure 20-3. Dates that intersect periods of thermal maxima were considered indicative of occupations during those periods. Even so, a chi square test indicated there was a better than 20 percent chance that this distribution was random.

Considering Smiley's (1985) contention that 80 percent of Southwestern radiocarbon dates overestimate ages by up to 200 years, radiocarbon date ranges were shifted 200 years toward the present. While this produced a higher chi square value (1.41 versus 0.31, 1 df), there is still a better than 20 percent chance that the distribution is random. Interestingly, when uncorrected dates were used there was a significant correlation between date ranges and periods of thermal maxima.

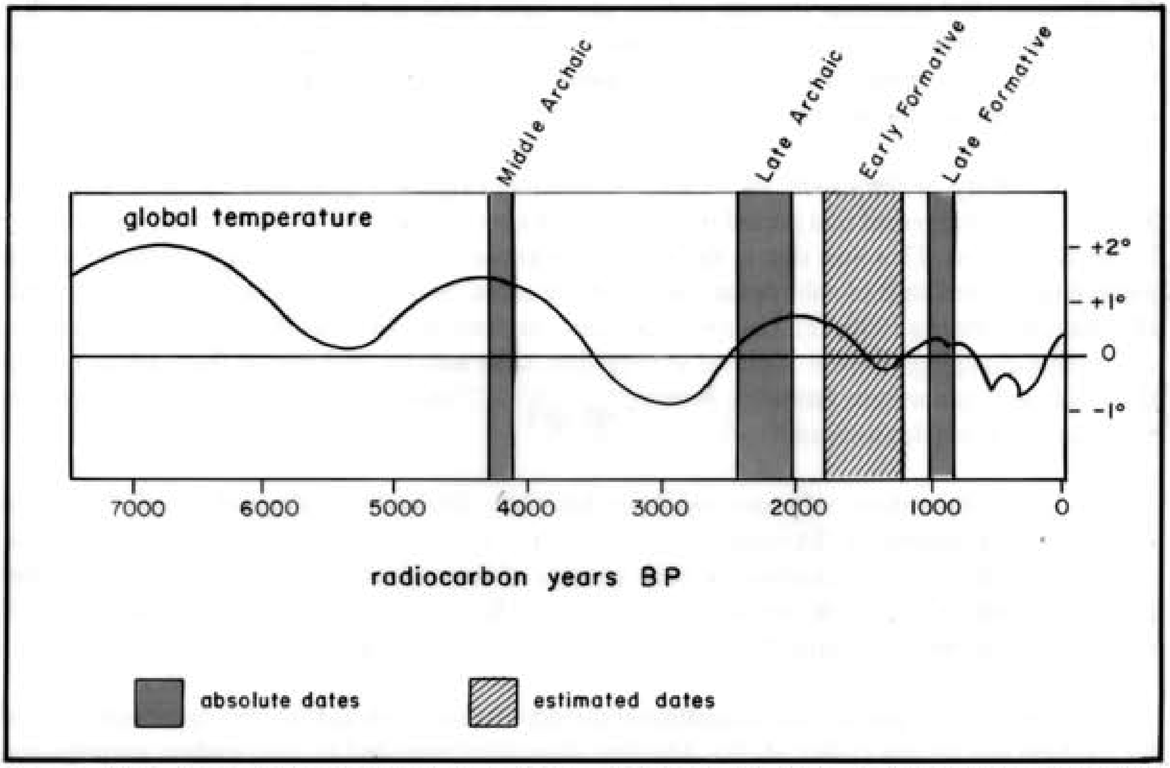

Figure 20-2. Occupational data for the Santa Teresa Port-of-Entry sites graphed against Bayham and Morris's (1990:34-35) global temperature curve.

Thus, while there is a correlation between absolute dates for our sites and periods of thermal maxima, the correlation disappeared with the larger sample of dates. Use of the Santa Teresa area may have been dependent on factors other than more intense monsoon seasons. In a study of tree-ring data from Arroyo Hondo near Santa Fe, Rose et al. (1981:105-106) found that late summer rain was the most stable part of the precipitation cycle from at least the late A.D. 900s to the present. Spring to early summer rainfall was more variable and less predictable. This pattern seems to have prevailed across most of New Mexico. Ahlstrom et al. (1995) define two patterns of precipitation for the Southwest over the past 2,000 years. The northwest part of the Southwestern region was usually characterized by a bimodal pattern, in which precipitation had distinct peaks in summer and winter (Ahlstrom et al. 1995:136). The southeast part of the Southwestern region, which includes the Jornada Mogollon area, was characterized by a summer dominant (monsoonal) precipitation pattern (Ahlstrom et al. 1995:136).

In most models of the southern Jornada settlement and subsistence system discussed earlier ("Changing Scales of Mobility in the Southern Jornada Region"), the use of desert basins was scheduled for the late summer, the only time of year when rainfall was reliably predictable. Had those areas been used for more permanent residence or during other seasons, it is likely that the pattern observed by Bayham and Morris (1990) would have been replicated. As more sites are investigated and the number of absolute dates increases, it may be useful to compare periods of more intensive basin use with the temperature curve to determine whether such phenomena as the expansion of farming sites into more marginal zones was driven by increased late summer precipitation. Unfortunately, there appears to be no link between this phenomenon and short-term

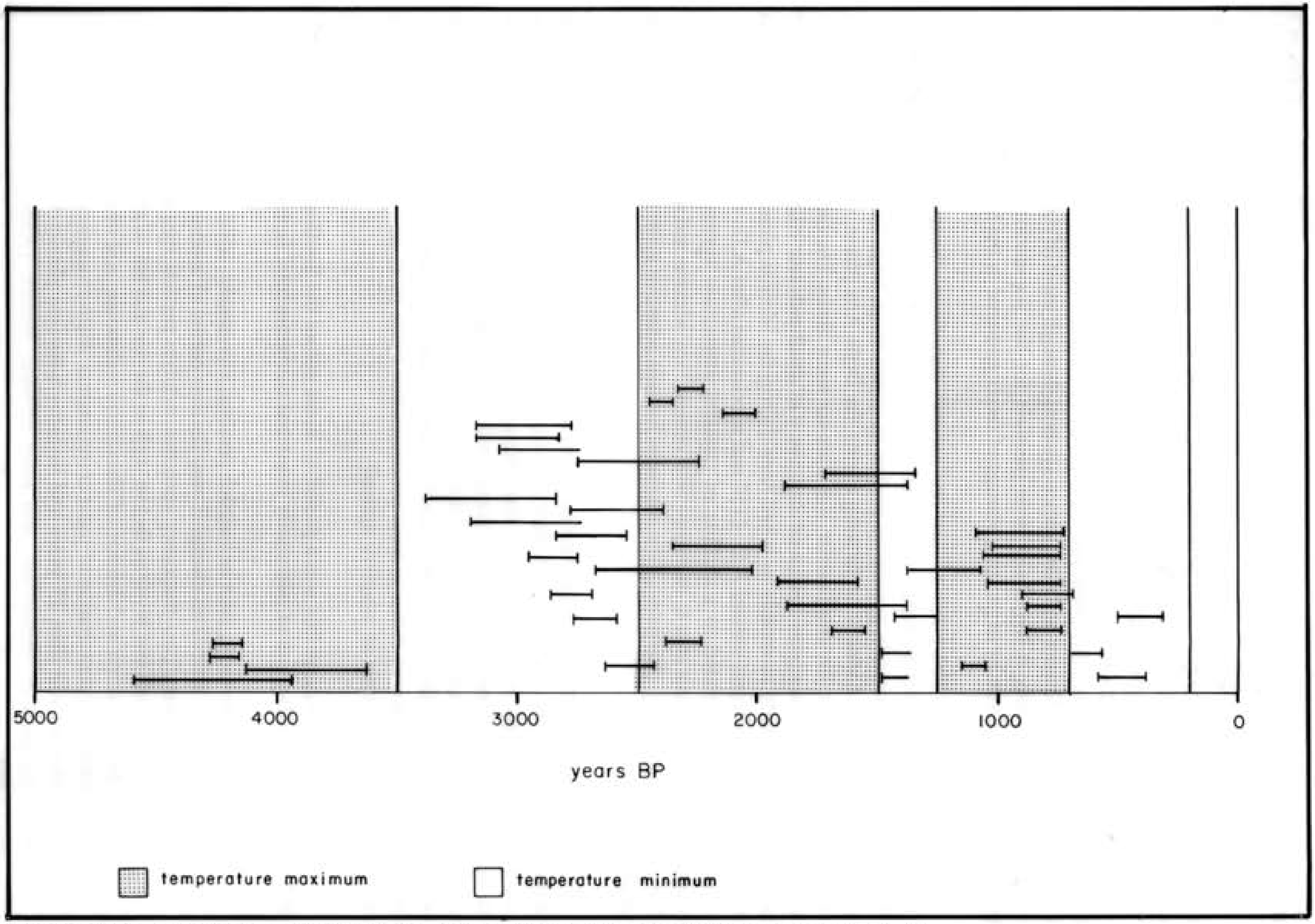

Figure 20-3. Radiocarbon dates for the Santa Teresa area graphed against periods of temperature, minima and maxima.

use of the basins, like that represented by the Santa Teresa and Mockingbird sites.

The temperature curve may have some important implications regionally, however. A period of thermal maxima prevailed between ca. A.D. 700 and 1250. This is a very interesting period, spanning the years between the end of the early Mesilla phase and the beginning of the El Paso phase. If the assumptions made by Bayham and Morris (1990) are correct, this represents a period of increased monsoonal moisture, which should correspond with increased productivity in the inner basins. Perhaps this phenomenon is partly responsible for the relative conservatism of southern Jornada settlement and subsistence systems through most of this period. Beginning in the late Mesilla phase, it may have been possible for the population to maintain a low dependence on agriculture by expanding storage of foods gathered in the basins.

Depending on which point of view one accepts, significant changes began to occur in southern Jornada lifestyles by either A.D. 1100 or A.D. 1200. If, as Carmichael (1983, 1984, 1985a, 1985b, 1986b) contends, population peaked in certain areas, large villages were occupied, and there was major dependence on farming during the Doña Ana phase, these changes began as early as A.D. 1100. As discussed earlier, this does not seem likely. The little evidence we have for the Doña Ana phase suggests continued occupancy of small pithouse villages by a population that was probably nearly as mobile as it had been during the Mesilla phase. Major changes in lifestyle seem to have begun around A.D. 1150 and accelerated after A.D. 1200. Initially, these changes were mostly related to a shifting of regional interaction systems from a focus on exchange with the Mimbres area to exchange with central New Mexico and northern Chihuahua. After A.D. 1200 the very character of the southern Jornada adaptive system underwent radical change.

Regionally, this is a very important period of time. The Mimbres and Chaco systems both collapsed between A.D. 1130 and 1150, leaving a vacuum that was soon filled by Casas Grandes in the south. At the same time the southern Jornada may have been transformed from a peripheral role in the Mimbres system to an active participant in the Casas Grandes interaction sphere. Suddenly, much of the population resided in nucleated communities and depended on farming to a much greater extent than before. But can this transformation be directly linked to influence from Casas Grandes, or was it due to local processes that made more active participation in a larger organizational system an adaptive option?

Climatic data suggest this was a period of stress across the Southwest. Ahlstrom et al. (1995) provide a classification of potentially important environmental factors:

> *Stable factors* are those, such as bedrock geology, topography, soils, and climate type, that exhibit little or no change during the time period of interest, in this case the last 2000 years. *Low-frequency variation* exhibits periodicities greater than or equal to 25 years and involves factors such as the rise and fall of alluvial water tables, the deposition and erosion of floodplain sediments, and changes in the composition and distribution of plant communities. *High-frequency variability* entails periods less than 25 years and includes botanical phenomena such as pollen production, streamflow, and most climatic factors. (Ahlstrom et al. 1995:126)

Dean et al. (1994:84-85) indicate that a combination of favorable low-frequency and high-frequency variations between A.D. 925 and 1130 created a period of "particularly auspicious" climatic conditions. Current data suggest that population peaked across the Southwest during this period (Dean et al. 1994:75). Conditions worsened across most of the Southwest after A.D. 1130, and this situation prevailed until 1180. This period of unfavorable climatic conditions may have contributed to the collapse of a well-established, long-term settlement and subsistence system in the southern Jornada area, just as it probably contributed to the fall of the Chacoan and Mimbres systems. As Rose et al. (1981:105) note for the Santa Fe area, late summer rainfall appears to be fairly stable and less variable than other parts of the precipitation cycle, especially the late spring-early summer component. The curve constructed by Bayham and Morris (1990:34-35) suggests that declining global temperatures may have led to a decrease in the amount of moisture produced during the monsoon season. This does not mean that the monsoon cycle ended, only that there was less rainfall during that season. Indeed, Ahlstrom et al. (1995:136) indicate that, while the bimodal precipitation pattern of the northwest part of the Southwestern region became unstable between A.D. 1250 and 1450, the summer-dominant precipitation pattern of the southeast part of the region persisted.

Less precipitation in the late summer would have a direct impact on the amount of vegetal foods available in the desert basins by decreasing the production of annuals such as sunflower and grasses. Variation in the amount of precipitation at other times of the year can severely effect the productivity of mesquite, another of the critical plant foods available in the basins. Brethauer (1979:70) indicates that mesquite can use both surface moisture, when it is available, and deeper subsurface moisture, when it is not. This makes mesquite relatively resistant to droughts and short-term climatic variation. However, citing Herbel et al. (1974:910), Brethauer (1979:71) also notes that mesquite productivity is heavily dependent on winter and spring moisture and that pods will only fully develop when more than 50 mm of precipitation falls between January and the middle of May. Thus, fluctuations in winter and spring precipitation can affect the productivity of this plant, while reductions in the amount of rainfall in the monsoon season affects the productivity of annuals.

Periods of thermal maxima were probably optimal for hunters and gatherers in the basins of south-central New Mexico. Increased monsoonal rains meant greater production of annuals. If winter and spring precipitation was sufficient, the mesquite crop would also be plentiful. Rabbit populations, too, are affected by patterns of rainfall and vegetative growth. As few as two litters might be produced in poor years, versus good years, when as many as six can be born (L. Mick-O'Hara, pers. comm., 1995). Certainly there were years in which winter-spring precipitation, late summer rainfall, or both were insufficient and times were lean. Overall, however, people appear to have been able to rely on hunting and gathering to a higher degree during periods of thermal maxima, even as the population reached levels that required heavier dependence on farming in other regions.

In large part, this was probably because of the types of foods available in the desert basins. Residence in winter villages usually requires the ability to store foods for the long period of low productivity during winter. Cultigens were best suited for this role in many areas. Indeed, there is evidence that corn was of moderate importance in the early Mesilla phase and increased in importance after that time. But wild plants dominated the Early Formative diet and remained an important food source through the Late Formative. It is likely that this was due to the eminent storability of many of the plant foods produced by the desert basins, mesquite and annual seeds in particular. The availability of high quality, storable wild plant foods meant that cultigens did not have to be relied upon to the same extent as they were elsewhere. Thus, the population could remain fairly mobile, moving around the landscape to exploit seasonally available resources.

A combination of climatic factors may have forced major changes in this adaptive system around A.D. 1130 or 1200. Overall, the trend was probably toward decreased productivity in the desert basins, particularly the late summer annuals. The overall decrease in precipitation may have affected the productivity of mesquite as well. At the same time, decreased vegetation would result in fewer litters being born to rabbits in the basins, significantly reducing that food source. We may not be talking about a huge decrease in productivity. If population levels were high enough, a moderate decrease could have been sufficient to produce stress in the system and require the selection of alternate means of food production.

For the southern Jornada population this meant adoption of more intensive farming to counter shortfalls in food production. Since suitable farm land is generally restricted to the Rio Grande floodplain and adequately watered alluvial fans, aggregation into nucleated villages may have been necessitated. More active participation in a regional exchange and interaction system centered on the Casas Grandes towns of northern Chihuahua may have been another way to buffer the productive system. Hunting and gathering, still used to produce a significant percentage of the diet, was at least temporarily inadequate as a subsistence base. Since sedentary lifestyles usually lead to decreased birth spacing and population growth, in a few generations the population could have increased to a level that eliminated a return to mobility as a subsistence base, even when environmental conditions improved.

While this line of thought is highly speculative, it does provide an possible explanation for the long dominance of mobility as an adaptive strategy in the southern Jornada region. It also provides a rationale for the collapse of that system and adoption of one that was much more dependent on agriculture and extraregional ties. The structure of wild resources may have allowed the southern Jornada people to remain highly mobile and dependent on hunting and gathering long after other groups found it necessary to settle down and expand their farming base. But this was apparently only possible as long as a period of thermal maxima was producing heavy monsoon rains and good crops of storable wild plant foods. When a period of thermal minima set in, the population was apparently too large to continue to be sustained by this system, and a much higher dependence on agricultural produce was necessitated.

Pottery Use and Mobility

The use of ceramic vessels and a hunter-gatherer lifestyle are often considered mutually exclusive in the Southwest. Thus, the assumption is often made that groups that used pottery were fairly dependent on farming. But this is not necessarily true. Pottery was also made and used by groups that were mostly or wholly dependent on hunting and gathering. Thus, the manufacture and use of pottery is not necessarily indicative of a decrease in mobility, though variations in mobility through time may be visible in changing patterns of vessel use, form, and decoration.

A few examples should suffice to illustrate this point.

The Paiute and Shoshone were apparently manufacturing pottery in the Great Basin by A.D. 700 to 1000, based on cross-dates with Anasazi types (Madsen 1986:213). A hunter-gatherer lifestyle prevailed throughout the prehistory of the western Great Basin (Elston 1986:148), with pottery occurring after A.D. 1100 (Elston 1986:145). Pottery was introduced into the eastern Great Basin by A.D. 400 to 500, accompanied by small amounts of corn (Aikens and Madsen 1986:160). However, the immediate impact of these introductions was apparently small, because the same basic lifestyle prevailed for at least several hundred more years (Aikens and Madsen 1986). While the Southern Paiute seem to have made and used pottery since A.D. 1000 or 1200, their subsistence was based on hunting and gathering until the nineteenth century (Kelly and Fowler 1986). Pottery was a late introduction to the Owens Valley Paiute, appearing in the mid-seventeenth century and disappearing about 200 years later (Liljeblad and Fowler 1986:421). Throughout this period, subsistence was based on the exploitation of a wide variety of wild plants and animals.

Somewhat farther afield, investigations of Seacow River Bushmen sites in South Africa show a well-developed ceramic industry coexisting with a hunter-gatherer lifestyle (Sampson 1988). In many ways, this area is similar to much of the southern Jornada region in that it is semiarid, with vegetation dominated by a low desert scrub and varying amounts of grasses, and no trees. The Seacow River Bushmen were very mobile hunter-gatherers, along the lines of the Kalahari San (Sampson 1988:39). Pottery consisted of grass-tempered, slab-built, thick-walled, vertical-sided, flat-bottomed cooking bowls (Sampson 1988:41).

As shown by these few examples, pottery manufacture and use can coexist with a hunting and gathering lifestyle. Whether ceramic technology was introduced by other groups or developed indigenously is of no consequence to this discussion. What is important is that the occurrence of pottery is by no means an assurance that farming was a dominant part of the subsistence system. Thus, hunter-gatherers, part-time horticulturists, and full-time farmers all made and used pottery vessels, and the occurrence of sherds alone is no indication of the degree of reliance on cultivated foods.

Summary

This analysis was able to address the major questions posed in our research design, though not in the detail we hoped would be possible. Examination of the geomorphology of the Santa Teresa and Mockingbird sites suggested that both were in a single massive sand horizon built during a long period of almost continual accretion. General periods of occupation were reflected by remains occurring at different elevations, suggesting that the placement of features and artifacts in this ancient parabolic dune can be used to provide relative dates. Unfortunately, since this landform probably had an undulating surface similar to that of the modern dune, a finer-tuned assignment of dates is not possible.

Both sites appear to represent repeated occupations by small foraging bands. Most

Archaic occupations were shorter in duration than those of the Formative, perhaps on a scale of days versus weeks. This difference may be indicative of variable scales of mobility. As noted earlier, this could be because the area was more densely populated during the Formative period, forcing groups into smaller foraging territories. It is also possible that longer stays were occasioned by a more intensive collection strategy in which surplus for storage and use at winter villages was also produced.

This study has several important implications. Had these sites been in a more normal geomorphological situation for this region, cultural materials would probably have been compressed into a single layer exposed in a series of deflation basins between coppice dunes. Few hearths could be expected to survive, and it would be virtually impossible to separate components to even the degree accomplished in this study. Thus, we have evidence of how sites in the desert basins would be structured had erosion not compressed most cultural deposits into a palimpsest.

We also have indications that, while mobility remained an important part of the subsistence strategy into the Late Formative period, it was scaled differently than during the Archaic. Foraging camps may have been occupied for longer periods than was normal during the Archaic and may also have served a logistical purpose. Farmsteads were also apparently used during the Late Formative period, as suggested by findings at NMSU 1393 (Batcho et al. 1985). Perhaps both types of sites were integral components of the Late Formative settlement and subsistence system. High moisture levels during some years may have allowed expansion of farming into parts of the central basins where sufficient supplies of water were available. Farmsteads could also have served as collection stations during the harvest season, when cultigens as well as wild plants were collected for storage and transport to winter villages. Farming was probably restricted to the best-watered zones along the Rio Grande or on alluvial fans in more normal years. During those years, the desert basins were probably used as foraging zones during the late summer to early fall. In dry years it may not have been possible to exploit them at all because of a lack of water and a significant drop in wild plant production.

Thus, mobility was probably scaled to environmental conditions. During some years the population may have exhibited a very high degree of mobility during much of the year, almost reminiscent of the Archaic pattern. In others, they may have remained in winter villages and perhaps farmsteads for most of the year. While our study was not able to provide conclusive proof of this pattern, it does provide preliminary information on the continuing use of mobility as a subsistence strategy into the Late Formative period in the Jornada region.

RECOMMENDATIONS

James L. Moore

All intact structures and features encountered at the Santa Teresa site (LA 86780) and the Mockingbird site (LA 86774) were investigated, and adjacent zones were excavated to search for other nearby features and associated activity areas. The Santa Teresa site was badly disturbed by mechanical equipment before our study began, exposing numerous features and artifacts. A proton magnetometer was used to examine the portion of this site that contained most of the features and artifacts to determine whether more deeply buried deposits were present. Only weak magnetic anomalies were found, and excavation in those areas encountered no cultural deposits. Since no other features were visible and there was no evidence for underlying cultural deposits, excavation was ended at this site.

The Mockingbird site originally consisted of a scatter of surface artifacts in deflation basins between coppice dunes. A structure and nearby extramural hearth that were found during testing were relocated and excavated, and the area around these features was investigated to look for other features or activity areas. The entire site was examined with a proton magnetometer, which defined a series of weak magnetic anomalies. We were encouraged by this examination, because it was also able to find the structure and hearth we already knew were present. The strongest magnetic anomalies were investigated to determine what they represented, revealing an additional occupational area containing two hearths. In addition, a series of trenches was mechanically excavated to look for other evidence of occupation. At least two hearths were located by this method. Further excavation occurred in areas that had produced relatively large numbers of artifacts during testing.

Upon completion of these specialized studies and excavations we concluded that there was little likelihood that other potentially important features, structures, or cultural deposits remained uninvestigated at these sites. These conclusions were transmitted to the General Services Department in a letter dated October 12, 1994. We recommended that no further work was necessary at these sites since their potential to provide further information concerning the prehistory of this part of New Mexico seemed exhausted by our data recovery program.

Artifacts recovered during this investigation are curated in the Archaeological Research Collection of the Museum of New Mexico. Field notes are on file at the Archaeological Records Management Section of the Historic Preservation Division.

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