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Prehistoric Burned Brush Structures and a Quarry Site along the Carlsbad Relief Route, Eddy County, New Mexico

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ADMINISTRATIVE SUMMARY

Between April 14 and July 25, 1997, at the request of the New Mexico State Highway and Transportation Department (NMSHTD), the Office of Archaeological Studies (OAS) excavated two prehistoric sites along the Carlsbad Relief Route in Eddy County, New Mexico. The sites consisted of a lithic procurement area (LA 29362) and an occupational area with several brush structures (LA 29363).

Trojan Hill, LA 29362, is a large quarry area where stone materials were being tested. A variety of materials was present on the surface and in the subsurface deposits. Materials such as chert, quartzite, silicified wood, chalcedony, rhyolite, and siltstone were found. Most of these materials were waste pieces ranging from large to small in size, especially the quartzite. Evidence of attempts at tool manufacture was noted on some of the artifacts. The site is located on BLM and BLM-leased land.

Macho Dunes, LA 29363, is a large residential occupation containing several burned brush structure remains with internal features and many outside associated thermal and storage pits. Five structures were excavated and each had interior hearths and pits. The site seems to represent a winter occupation of several families or groups of people at a seasonal campsite. The ceramics and 20 radiocarbon samples place the major occupation of the site within the Formative period at about A.D. 770. However, site use ranged between the Middle Archaic at ca. 2280 B.C. to the Late Globe phase ca. A.D. 980. The site is located on BLM land.

Funds provided by the NMSHTD and the Federal Highway Administration were used for this project.

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INTRODUCTION

The Carlsbad Relief Route is part of the Waste Isolation Pilot Program (WIPP) road project (Fig. 1). The New Mexico State Highway and Transportation Department (NMSHTD) proposes to improve County Road 604 (NMSHTD No. WIPP-7615(8) in Eddy County. The excavation was requested by the Environmental Section of the NMSHTD. A limited testing program was conducted by Office of Archaeological Studies (OAS), Museum of New Mexico, in December 1996 and January 1997 (Zamora 1997). Funds provided by the NMSHTD and the Federal Highway Administration were used for this project.

Between April 14, 1997, and July 25, 1997, OAS personnel began the data recovery phase at Trojan Hill (LA 29362) and Macho Dunes (LA 29363). A total of 68 days per person were expended in the field on the project and the laboratory time was a total of 136 days. The principal investigator was Yvonne R. Oakes, the project supervisor was Dorothy A. Zamora, assisted by Philip R. Alldritt and James A. Quaranta. Laborers included Dixie Henry, Steve Kopecky, Jessie Murrell, Bob Sparks, Chris Sparks, Jennifer Ware, and Alice Wydro.

Trojan Hill is a large extensive quarry site located on a low rise overlooking the community of La Huerta. It covered an enormous area— 25,935 sq m. The surface artifacts consisted of mostly primary core flakes in large concentrations. Within these concentrations, there are many different types of materials; however, the most common material type was purple quartzite. No features and only four ceramics were found on the site within the right-of-way, making it difficult to determine the age or cultural affiliation. One small broken, Archaic-like projectile point was recovered. However, it has been reworked suggesting that it was possibly curated by later people.

Toward the east, away from the site, two small hearths were found and excavated and produced C-14 dates ranging between A.D. 1025 and A.D. 1195. These two hearths could have been used during the period that people were occupying the site; however, this is only speculation. The site straddles BLM and BLM-leased land.

Macho Dunes is located on the edge of the Alacran Hills sand dunes protected by a high ridge covered with dense vegetation. It is located on BLM-owned land. It covers 48,750 sq m within the sand dunes. Several blowouts and dunes were extensively stripped and consequently, six discrete areas of occupation were found. These areas were identified with the letters A through G. Areas A and E contained thermal features that had been built into the sandstone bedrock. A calibrated C-14 date of 380 B.C. to 5 B.C. was produced for the hearth in Area A and A.D. 800 to A.D. 1030 for the hearth in Area E. Both features exhibited oxidization and contained charcoal. Many features were found in Areas B through F, with Area B having three of the brush structure remains. Area F was under a 2.0 m high sand dune and contained 12 pits and 1 roasting pit, suggesting an exterior activity area. The other two structures were found in Areas C and D, as were several extramural pits. Area G did not contain any cultural remains.

In each of the structures, interior hearths were found along with storage pits. One structure, Structure 2, had been heavily burned and contained sand oxidation and charcoal staining. This was also the deepest of the structures, reaching 30 cm in depth. Each of the structures also produced a C-14 date ranging from A.D. 720 to A.D. 875, placing them within the Formative period.

An attempt was made to date the site by archaeomagnetic sampling, but it was unsuccessful because there were not enough binding agents in the sand to hold the soil together. We had to rely on the carbon-14 samples and ceramic cross-dating.

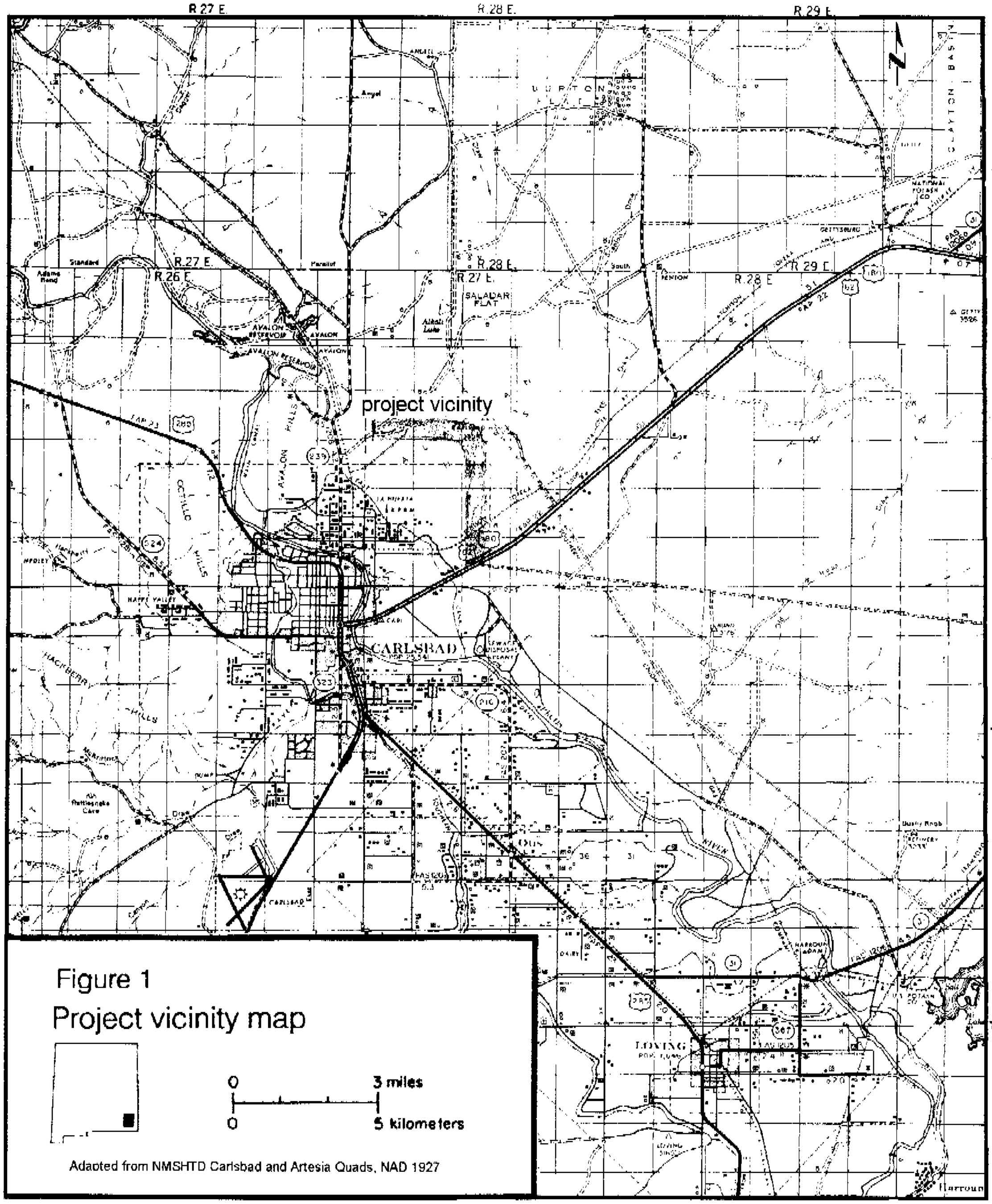


Figure 1
Project vicinity map

ENVIRONMENTAL SETTING

Physiography

The project area lies within the peninsular wedge of the Chihuahuan Desert biozone extending north from the New Mexico-Texas border and is bounded on the east and west by the Llano Estacado and the Guadalupe Mountains (Medellin-Leal 1982). The Pecos River is the dominant physiographic feature in the area. It runs through a narrow channel from the Sangre de Cristo Mountains and the gradient becomes gentler and the valley wider after it leaves De Baca County (Katz and Katz 1993). Today the Pecos River contains multiple dams that control its flow making it not as rough as in earlier days. Sheridan (1975:3) states that the Spanish explorers mentioned it as "a river of violent extremes, excessive sins, and a habitual transgressor of natural law." The project area is devoid of perennial water sources, except for the Pecos River 6 km to the west. Any surface water is diverted into local sinks and basins or filtered quickly into the sands (Lovelace 1972:30). Typically, water has always been a problem to prehistoric and historic people in southeast New Mexico (Haskell 1977:13).

The local geology is defined by Permian Age San Andreas Limestone of the Rustler Formation (Dane and Bachman 1965) with extensive gypsum and anhydrite beds along the Pecos River. Associated derivative soils in the project area are Gypsiorthids-Torreothents-Gypsum Land and Paleorthids-Haplargids (Maker et al. 1974) and are manifested in thin eolian layers 10 to 80 cm deep over bedrock bases and broken caliche beds. Additional eolian deposits of fine-grained Pecos River Alluvium are locally aggregated into active or dormant dunes, in which depths above bedrock can reach 5 m (Maker et al. 1974). Both Trojan Hill and Macho Dunes fall into the former of these depictions with average depths under 1 m; however, Macho Dunes is dominated by active dunes measuring 3 m in height. Dissolution of the Permian bedrock that underlies the Pecos River is a process that may have begun in the Jurassic period (Hawley et al. 1976:246). The Pecos River and Carlsbad Caverns, along with numerous depressions, developed in the Permian (Katz and Katz 1993). Katz and Katz (1993) also state that three massive collapses occurred under the Pecos Valley north of Carlsbad during the Quaternary period, allowing the Pecos River to cut northward and capture any east-flowing streams.

As the Pecos Valley widened and deepened, alluvial materials, such as the Gatuna Formation, were deposited (Reeves 1972:110). Bachman (1974) and Hawley et al. (1976) believe the formation probably dates early to middle Pleistocene, post-dating the deposition of the Ogallala Formation or Caprock (Katz and Katz 1993).

The Gatuna Formation consists of reddish brown silt, sand, and clay (Hendrickson and Jones 1952:25). It contains sandstone, mudstone, conglomerates, limestone and gypsum (Kelly 1971). Blackdom, Orchard Park, and Lakewood are the three terraces present in the Pecos Valley near Roswell (Fiedler and Nye 1933) and have been traced south to Carlsbad and north to Ft Sumner (Collins 1985; Jelinek 1967; Hawley et al. 1976). The Blackdom terrace is composed of sand, silt, and gravels of the Pleistocene (Hendrickson and Jones 1952:9). The Orchard Park terrace is made of silt, sand, and clay, and make up the agricultural surfaces of the Pecos Valley. The Lakewood terrace forms the bottomlands of the Pecos River and major tributaries (Hawley et al. 1976). It is very alkaline and not good for agricultural purposes. Archaeological sites occur within and on top of this surface, and some are incorporated into dune deposits (Collins 1985).

Between the Pecos Valley and the Llano Estacado lie the Mescalero Plains (Reeves 1972). The eolian sand covers the gravels that contain quartzite, chert, and other siliceous materials found in the Ogallala Formation. Dunes and hummocks are common in the Mescalero Plains.

Flora

The majority of the locally sparse vegetation is associated with the Desert Grasslands (Figs. 2 and 3). Brown (1982) refers to it as semidesert grasslands. He also states that this vegetation type is a "distinctive separate biome." Shrub steppe combined with grama steppe form a piedmont desert grassland (Dick-Peddie 1993). Palatable grasses are replaced by forb shrubs in intense grazing (Whitfield and Anderson 1938). Campbell (1929) also found that overgrazing changed grama grass range to mesquite dune type. The desert grasslands border the Chihuahuan desert scrub (Dick-Peddie 1993:107) and the dominant grass is black grama, although it is difficult to separate the two.

Some of the grasses that are present within the Desert Grasslands are alkaline sacaton, western wheatgrass, Indian ricegrass, galleta, blue grama and black grama, to name a few. The vegetation found in

Figure 2. Environment at Trojan Hill, looking west.

Figure 3. Environment at Macho Dunes, looking south.

the samples from Macho Dunes correlate to the Desert Grasslands as defined by Dick-Peddie (1993) and others. It includes little-leaf sumac, one-seed juniper, white thorn acacia, mesquite, fourwing saltbush, yucca, snakeweed, wait-a-bit, goosefoot, and purslane (Figs. 2 and 3).

Mesquite has been utilized since prehistoric times. There is extensive documentation of its use in southern New Mexico (O'Laughlin 1980; Oakes 1981; Carmichael 1981). There is a wide range of mesquite use, such as for food, salve, fuel, fiber, and as a base for drink (Oakes 1981). Carmichael (1981:59) states that its popularity may stem from widespread availability, nutritional value, and seasonal dependability. Usually the pods are gathered when ripe in the fall; however, both the flower and pod can be eaten raw (Oakes 1982). Mesquite has an advantage over other vegetal resources, since it can be sorted without special preparation (O'Laughlin 1980).

Other species such as yucca, fourwing saltbush, goosefoot, and purslane have been utilized throughout prehistoric times in the Southwest (Toll 1997). Several pollen profiles at the Lubbock Lake site produced pine pollen dating ca. 8600 to 8300 B.C. At Gardener Springs cheno-ams decreased and grass increased at about 2000 B.C. Pollen from oak, madron, hackberry, juniper, and ash were found at Pratt Cave dating 550 B.C.

Fauna

Several faunal species are present in the area, such as pronghorn, cottontail rabbit, and jackrabbit. Smaller rodent species are also found, such as gopher and mouse. Antelope and mule deer have also been occasionally noted. Species associated with riverine and wetland environments have been noted on sites 2 to 3 miles away and include turtle, fish, and migratory birds.

Bison were present along the western boundaries near the Pecos River until the late nineteenth century. Trojan Hill did not have any faunal remains; however, Macho Dunes contained a number of taxa. They include large mammal, medium mammal, small mammal, jackrabbit, cottontail rabbit, indeterminate canis, mouse, gopher, rat, squirrel, porcupine, hawk, frog or toad, box turtle, and fresh water shell. One modern cow bone was recovered just below the surface (0-15 cm) in a small dune.

Climate

Climatic changes occurred in New Mexico during the Tertiary period. Desert vegetation appeared during the time when uplifts of the Sierra Nevada, Cascades, and Coast Range proceeded at a rapid geological pace (Dick-Peddie 1993). During the late Eocene to the Oligocene the climate in the Rocky Mountain West was becoming cooler and drier (Dick-Peddie 1993). With continued climatic changes and mountain uplifts during the Miocene, new vegetation migrations were initiated and grasslands were formed (Dix 1962). Sage pollen has been found from the dating to the late Miocene.

Vegetation zones during the late Pleistocene were displaced to lower elevations of 3,000 to 4,000 ft (Dick-Peddie 1993). These zones are found today. Dwarf juniper was found at 2,000 m (6,600 ft) in the Guadalupe Mountains. Today the closest is 400 km (248 miles) north. In the Llano Estacado the spruce forest changed to woodlands dominated by piñon that stretched from southern Missouri to north Texas (Dick-Peddie 1993). Dick-Peddie also states that woodland vegetation covered areas in southern New Mexico 24,000 years ago. Today they are covered by desert grasslands or Chihuahuan desert scrub at an elevation of 1,750 m (5,800 ft).

Major changes occurred between 15,050 B.C. and A.D. 1350. There was a warming and drying trend at ca. 10,000 B.C., with a drop in winter precipitation at approximately 6000 B.C. However, a drier shift took place between 3050 B.C. and 2050 B.C. Another cooling trend occurred at 550 B.C. with a warming trend at A.D. 850 (Dick-Peddie 1993). Hall (1977) believes that the climate stabilized at A.D. 1350 in New Mexico.

The local climate today is characterized by mild winters and hot summers, with a mean January temperature of 5.1°C (41.2°F) and a mean of 26.3°C (79.3°F) in July. The yearly mean temperature is approximately 15.9°C (60.6°F), with an average of 200 frost-free days (Tuan et al. 1973). Summer-dominant precipitation patterns result in a mean annual rainfall amount of 305 mm (12.0 inches), in which 203 mm (7.9 inches) falls between April and September (U.S. Department of Commerce 1965; Tuan et al. 1973).

CULTURAL SETTING

The most recent detailed overviews prepared for southeastern New Mexico include Stuart and Gauthier (1983), Sebastian and Larralde (1989), and Katz and Katz (1993). These overviews have outlined the major sequences occurring in southeastern New Mexico Paleoindian, Archaic, and Formative periods.

Paleoindian (circa 10,500 B.C. to 6200 B.C.)

A total of 113 Paleoindian sites have been recorded for southeastern New Mexico, of which 19 are in Eddy County. Katz and Katz (1993) observed that these were located on hilltops and not in the sand dunes. Most of the Paleoindian remains are found along the Llano Estacado, the Mescalero Pediment, or the eastern escarpment of the Guadalupe Mountains (Oakes 1985).

Eleven radiocarbon dates have been obtained and range from 10,000 B.C. to 5500 B.C. for Clovis, Folsom, and Plano sites. Katz and Katz (1993) refer to these as Paleoindian 1, Paleoindian 2, and Paleoindian 3. They all have similar subsistence adaptations, which include large mammal hunting and wild food gathering (Kyte 1984b:12). Paleoindian components are identified by the type of spear points, such as the Clovis point (Clovis phase), which is characterized as a large lanceolate with a thin concave base and bifacial fluting. One site has been found by Hester (1972) at Blackwater Draw Locality 1. The Folsom point (Folsom phase) is a medium-sized lanceolate with a broad channel flake on both sides (Katz and Katz 1993). Sites associated with the Folsom phase include Blackwater Draw (Sellards 1952; Hester 1972; Stevens 1973) and Elida (Warnica 1961).

Archaic (5200 B.C. to A.D. 500)

The Archaic period in the southeast region seems to start during the Middle Archaic instead of the Early Archaic period (Wiseman 1997). There seems to be a hiatus between the Paleoindian period and the beginning of the Archaic period. Katz and Katz (1993) attribute this to warmer climatic changes. The changes seem to have taken a toll on populations, and by 2000 B.C. a modern semi-arid climate and a mixed modern flora and fauna had been established for southeastern New Mexico (Katz and Katz 1993:114). The warmer climate is also attributed to the scarcity of bison and other large game, evident at Lubbock Lake and Yellow Canyon. Subsistence practices included both riverine and upland plant and animal species (Wiseman 1997).

Climate conditions improve around 2000 B.C. There is a decrease in Chenopodiaceae and increase in grasses at Gardner Springs. Hall (1985:112) states the decline in Atriplex (saltbush) and an increase in grasses could possibly be a response to a slightly wetter climate. Pollen from Pratt Cave in the Guadalupe Mountains around McKittrick Canyon Creek, in Texas, contained oak, madrone, hackberry, juniper, and ash. Above the canyon where the environment is drier, grasses, composites, and herbaceous plants are dominant. Van Devender (1980) suggests that piñon nuts were carried in by Archaic people. Hotter and drier conditions brought steppe grasslands to areas that once supported savannahs and parklands, causing severe erosion in alluvial valleys (Katz and Katz 1993). Desert grasslands were the major vegetation type. By the Late Archaic, modern plant communities were established, containing cacti, yucca creosote bush, ocotillo, and agave (Katz and Katz 1993). Bison were present in the Pecos Valley and on the Llano Estacado. At Fresnal Shelter, corn, mescal, piñon, and yucca were present.

Some fauna recovered from caves in the Guadalupe Mountains contained bison, Merriam elk, deer, squirrels, and mice (Sebastian and Larralde 1989). Wimberly and Eidenbach (1981) recovered deer, antelope, bison and sheep from Fresnal Shelter. At the Garnsey Springs Campsite, Parry and Speth (1984) recorded rabbit bones. Freshwater mussel shells are frequently found in the middle Pecos Valley during the Archaic period.

Although Archaic sites are found in all the major ecozones, most are found in low ecozones such as scrublands, grasslands, and desert-scrub (Katz and Katz 1993). Over half of the sites recorded in southeastern New Mexico are found in Eddy County, in blowouts, dunes, ridges, and hillslopes of the Pecos Valley. The lowest elevations would be the blowouts and dunes, while ridges and hillslopes are slightly higher (Katz and Katz 1993).

Hearths, burned rock rings, and multiple features are characteristic of Archaic sites. Fire-cracked rock is common, as are lithic artifact scatters. There are also a large number of plant processing features recorded, suggesting that there is a shift in the use of the landscape or subsistence activities to plant gathering along with hunting (Katz and Katz 1993). Katz and Katz (1993) also point out that habitation features have been recorded at some Archaic sites situated in the grassland zone in the way of caves and brush structures suggesting that small groups of people were staying at specific locales for a limited amount of time.

Classification of Archaic sites is frequently determined by projectile point styles found on the sites (Oakes 1985). Those types found in southeastern New Mexico are provided in Leslie's (1978) typology. The Early Archaic projectiles are characterized as large, straight-stemmed points with indented, concave, or straight bases (Hokanson 1996) such as Jay, Bajada, Pedernales, Kinney, and Pandora, to name a few, but these are not generally found in southern New Mexico. The Middle Archaic or Avalon phase does not contain any diagnostic points, but there are several radiocarbon dates ranging from 2687 ± 210 B.C. to 1170 ± 70 B.C. (Katz and Katz 1985).

The Terminal Archaic or Brantley phase (A.D. 1 to A.D. 750) continues the previous patterns and evidenced a greater use of burned rock rings (Wiseman 1997). With the continuation, there is a definite increase in upland subsistence resources such as sotol and agave. Most burned rock rings are associated with chipped stone scatters; however, diagnostic artifacts may be absent (Katz and Katz 1993). Projectile points are classified as medium-size dart points with stems that vary in shape. The appearance of diagonal notching on projectile points is also evident. Projectile points such as San Pedro, Pecos, and Leslie's (1978) 6C, 6D and 8A types are associated with the Brantley phase.

Formative Period (A.D. 500 to A.D. 1540)

Changes occur, marking the end of the Archaic period. Ceramics and arrow points are found, as are domestic features. However, Stuart and Gauthier (1981), Oakes (1982), and Fifield (1984b) argue that Archaic adaptations continued into the Ceramic period, incorporating ceramics and cultigens. Katz and Katz (1993) also find similarities between the Archaic and their Formative I phase.

Globe Phase (A.D. 500 to A.D. 1150)

Early Globe Phase (A.D. 500 to A.D. 750). According to Katz and Katz (1993) the Formative 1 period includes the Late Hueco (Leslie 1979), Early 18-Mile (Jelinek 1967), and Globe (Katz and Katz 1985a) phases. Because the Globe phase is included in the Formative 1 period, the dates from the Katz and Katz 1993 overview are earlier and it is assumed that the Globe phase began earlier than A.D. 750.

These earlier patterns of a riverine orientation and short-term camps near water continue in the Brantley area of the Middle Pecos (Katz and Katz 1993). The projectile points for the Formative 1 and the Late Archaic are dart points with convex to straight edges, straight to convex bases, and diagonal notching (Katz and Katz 1993). The most noticeable characteristic change is the size of the Archaic dart points compared to the Formative 1 points. The differences are that they are larger than an arrow point, but smaller than a dart. Katz and Katz (1993) refer to them as "darrow" points. The ground stone artifacts are one-hand flat manos and unshaped metates. Bedrock mortars are also characteristic. Brown ware ceramics dominate the assemblage and the majority are Jornada Brown. Pecos Micaceous Brown, South Pecos Brown, and Alma Plain are also present.

Middle Globe Phase (A.D. 750 to A.D. 950). This phase corresponds to the Formative 2 (Katz and Katz 1993), the early Querecho (Leslie 1979), and late 18-Mile (Jelinek 1967). During the Middle Globe, identifiable architecture, arrow points, and black-on-white pottery are the main characteristics. Several radiocarbon date distributions suggest a more sedentary way of life (Katz and Katz 1993). Leslie (1979) reports the presence of clay floors in association with the shinnery oak belt in the southeast. Jelinek (1967) found pithouses and contiguous surface rooms of this phase in the Middle Pecos Valley. At Brantley, stone circles, rings, and scatters were noted, suggesting an upland subsistence and settlement orientation instead of a riverine one (Katz and Katz 1985a).

The ground stone artifacts remain the same, and there is no noticeable appearance change in the projectile points, except in size. Types such as Leslie's 3A (Scallorn) and 3B (Scallorn variant) are a characteristic of the phase. Local brown ware ceramics predominate and include South Pecos Brown and Middle Pecos Micaceous brown. The first appearance of painted pottery is found at this time. Red Mesa Black-on-white is commonly found in the northern region and Cebolleta Black-on-white in the southern region.

Late Globe Phase (A.D. 950 to A.D. 1075). The Late Globe phase corresponds with the Formative 3 phase in the Brantley area (Katz and Katz 1993), Early Mesita Negra in the Middle Pecos area (Jelinek 1967), Lehmer's (1948) Early Capitan and Mesilla phases of the Jornada Branch, and Late Querecho (Corley 1965; Leslie 1979) in the Eastern extensions.

The Late Globe phase is characterized by large sites. Leslie (1979) notes a large concentration of small pit structures located at permanent water sources and also oriented toward the exploitation of shinnery oak (Katz and Katz 1993). Larger sites were also observed by Jelinek (1967) in the Middle Pecos region.

The projectile points remain the same in size; however, there are more Scallorn and Scallorn variants (Type 3A to 3F) and Livermore types (Leslie 1979). The ground stone exhibits more modification as seen in oval basin metates and convex manos (Leslie 1979). Brown ware ceramics still dominate the assemblage; however, both local and nonlocal gray wares appear. The dominant type of gray ware is Crosby Black-on-gray. Local and nonlocal brown wares continue and Cebolleta Black-on-white replaces Mimbres Black-on-white.

Oriental Phase (A.D. 1125 to A.D. 1375)

While plain brown ware pottery continues throughout the region, there are stylistic changes during the Oriental phase, the most noticeable being painted pottery. El Paso Polychrome and Three Rivers Red-on-terrocotta are present in the early part of the phase (ca. A.D. 1150), while Lincoln Black-on-red and Chupadero Black-on-white are still present around the 1400s.

The projectile points or arrow points are small and triangular. These types occur throughout the Southwest and in the Plains. They are similar to Leslie's (1979) types 2A and 2B and are characterized as side-notched forms with concave bases (Leslie 1979). The ground stone remains the same as in the previous phases, with oval basin metates; however, the manos (one-hand) more frequently have opposing ground surfaces (Katz and Katz 1993).

Architecturally, the beginning of the Oriental phase contains subterranean structures. At about the middle of the phase (A.D. 1200) the structures become rectangular slab-based surface rooms (Katz and Katz 1993).

Other phase sequences for the same time period are Jelinek's (1967) Late Mesita Negra, Crosby phase, and Late McKenzie, Leslie's (1979) Maljamar and the Early Ochoa, and the Katzes' (1993) Formative 4 through 7 for the southeastern region.

Phenix Phase (A.D. 1375 to A.D. 1500)

Very little is known about the Phenix phase; however, Katz and Katz (1993) state that there are dates and dated sites assigned to this phase. Intrusive pottery disappears from sites and local textured brown ware such as Ochoa Indented is the remaining type. Projectile points such as the Washita and Toyah are present on the sites and are usually the only diagnostic artifacts. Radiocarbon dates, along with local pottery and projectile points show that several large architectural sites of the late Oriental phase continued to be occupied during the Phenix phase

Tipi rings instead of small stone circles are now present. Gunnerson (1956) states that the Athabaskans apparently appeared in the Greater Southwest, including southeastern New Mexico, sometime within this 125-year interval (Katz and Katz 1993). One other phase, the late Ochoa (Leslie 1979), corresponds with the Phenix phase.

DATA RECOVERY PLAN

(Adapted from Wiseman 1996b)

Theoretical Perspective

Prehistoric occupation of southeastern New Mexico has been documented from the Paleoindian period through the presence of the Mescalero Apache, a period of over 13,000 years. Earlier research goals in the region were geared mainly to defining the culture history of the region (Lehmer 1948) and its specific cultural attributes (Mera 1943). Interest in refining cultural manifestations, principally ceramics, has continued up to the present with the work of Greer (1965), Runyon and Hedrick (1973), Brook (1975), and Leslie (1979). However, today professional research goals have taken on broader, more regional aspects with primary interests in differentiating sedentary phases (Whalen 1977; Katz and Katz 1985a), determining site functions (O'Laughlin 1980; Wiseman 1996), assessing subsistence bases (Basehart 1974; Oakes 1985), and correlating site locations with environmental parameters (Oakes 1985; Katz and Katz 1993). While explanation of the settlement-subsistence dynamics of southeastern New Mexico is still tenuous at best, the potential for systemic explication now and in the future is extremely promising.

Several general statements about the environment and the sites may be made. The desertic condition of unproductive soils, frequent lack of potable water, undependable precipitation, and surficial nature of the cultural remains would seem to preclude use of the sites as sedentary habitation units. We suggest that the sites were temporary campsites or specialized activity locales used by foragers and collectors of differing chronological periods.

We are basing our proposed research upon an environmental frame of reference that states culture is adaptively organized to solve specific problems posed by the environment. One primary problem for regional groups is the acquisition of subsistence items. Thus, variability in a culture's systemic organization is responsive to the variability in availability of food. Some adaptive responses could include collecting, foraging, hunting, storage, trade, sedentism, mobility, etc., or any combination thereof. We believe there were specific environmental variables in the Carlsbad region that conditioned the selection of particular food procurement strategies such as (1) seasonality of availability, (2) quantity of biomass, (3) accessibility of resources, and (4) density of the participating population. We believe the generalized strategy of wild food gathering would have been the best adaptive response to the local environment.

Background Considerations

Katz and Katz (1985a) provide an excellent outline of prehistoric cultural developments in the Guadalupe Mountains-Carlsbad region. But the Katzes would be the first to admit that this sequence, which covers Paleoindian through early historic Native American periods, requires verification and elaboration. The last two Formative periods—Globe (A.D. 750-1150) and Oriental (A.D. 1150-1450)—are not as well known as earlier ones, largely because aboriginal use of the greater Carlsbad area had decreased markedly in favor of the Guadalupe Mountains and their foothills west of the Pecos River. The two project sites likely represent the Brantley (terminal Archaic) and Globe (Formative period) phases and lie east of the foothills of the Guadalupe Mountains. In the nearby area, the Querecho phase represents the same cultural adaptation as the Globe phase. They provide an excellent opportunity to examine prehistoric adaptations during these phases and to verify or modify the shift in subsistence emphasis posited by the Katzes.

As discussed in more detail below, horticulture evidently was not practiced prehistorically in the Guadalupe-Carlsbad region. This fact, plus other characteristics, have led Robert Mallouf (1985) to suggest that the prehistoric remains of the southern Guadalupe Mountains are more closely associated with the Trans-Pecos culture area of west Texas (the western "arm" of the state, except El Paso County) than with the Jornada-Mogollon to the west and north. We concur with Mallouf. Drawing on the Katzes work at Brantley, we suggest that the same applies to the Carlsbad area as well, including the sites being considered for the present project. However, a formal line of demarcation between the Trans-Pecos (including the Guadalupe-Brantley region) and the Jornada-Mogollon remains to be defined.

There are several implications of the assignment of the Guadalupe-Carlsbad region to the Trans-Pecos. First, as far as can be ascertained at present, the peoples inhabiting the Trans-Pecos with the exception of those at La Junta de los Rios on the Rio Grande (present-day Presidio, Texas) lived an Archaic-like, hunter-gatherer lifestyle throughout the prehistoric and historic periods. Many late prehistoric sites in the Trans-Pecos produce small amounts of pottery, but all of it was probably traded in from nearby regions. Most or all of the pottery on Guadalupe-Brantley sites came from the Sierra Blanca and El Paso regions to the northwest and west, respectively.

Hunter-Gatherer Subsistence Systems

Past research in the Guadalupe-Carlsbad region, as in the Trans-Pecos in general, indicates that baked succulents such as lechuguilla and sotol were a fundamental aspect of pottery period (Late Prehistoric) subsistence (Greer 1965, 1967, 1968; Roney 1985; Katz and Katz 1985a). Archaeological remains of baking ovens usually take the form of midden rings or circles of burned rock surrounding central pits, though burned-rock mounds of other shapes are also known (S. Katz, pers. comm. 1996; R. Phippen, pers. comm. 1996). Midden circles date as early as the Middle Archaic period in Texas but are more common in later time periods. Most dated ovens in the eastern Trans-Pecos, including the Guadalupe Mountains, belong to the post-A.D. 500 pottery period (Roney 1985:144). Since these succulents provide a reliable, year-round source of carbohydrates, they were understandably important to prehistoric and historic diets and probably obviated the value of, or need for, many other carbohydrate sources including corn (Sebastian and Larralde 1989; Roney 1985).

W. H. Wills (1988:54-55) points out that succulents are usually scattered across the landscape rather than clumped, which probably affected humans in yet another way. He posits that the scattered nature and year-round availability of these resources in the Trans-Pecos led to the retention of a more nomadic, "forager" pattern, rather than a less nomadic, logistically organized pattern (Binford 1980). In simplest terms, foragers move to the food, and collectors move the food to the people. Collectors do this by means of task groups that are sent out to obtain specific resources and return them to the group, a behavior warranted by resources that occur in clumped or patchlike distributions. The primary differences between collector and forager lifestyles are the degrees and ways in which people plan, organize, and conduct their food-quest in response to resource distributions and seasons of availability.

In theory, forager and collector sites should have fairly distinctive attributes. These might be summarized as follows:

> **Forager** sites should be similar, and their archaeological visibility should be subtle, perhaps even inconspicuous, because people are moved to the resources, the sites are inhabited for shorter periods of time, have smaller accumulations of trash, and similar ranges of artifact types. They are occupied for relatively short periods of time (days or few weeks), relatively few items (manufacturing debris, broken artifacts, etc.) should be left behind.
>
> **Collectors** send out work parties to set up temporary special-activity sites, collect the target resource(s), and take the food back to long-term base camps. The characteristics of both should be as follows:
>
> *Base camps* are generally quite visible archaeologically because they are used for a wide range of daily activities, resulting in the accumulation of a wide range of artifact types, activity areas, and refuse deposits. Some form of structure, whether ephemeral or more substantial in construction, is usually present, as are pits for the storage of food and other items. Base camps are generally used over long periods of time (several months) each year for several years, sometimes in sequential years and sometimes in staggered years or sets of years. A logistically organized group generally has only one or two base camps that it uses during a given year.
>
> *Special activity sites,* on the other hand, are created during collecting expeditions, might be used only once, and are almost invisible archaeologically because they are used for only short periods, have little or no accumulation of nonperishable debris and broken artifacts, and have limited artifact inventories that reflect comparatively few activities.

While we generally agree with Wills' proposition, we, like Sebastian and Larralde (1989) and Collins (1991:8), emphasize the view that these strategies--foragers and collectors--are two ends of a continuum, not a dichotomy. In a given year or over a series of years, some groups may actually employ both strategies because of factors relating to season, climatic regimen, economic success, demography, competition, and other factors (see Boyd et al. 1993 for a recent discussion). Sebastian and Larralde present an example of a "mixed" forager/collector strategy in the concept of "serial foraging." Using the Archaic peoples of southeastern New Mexico as an example, they define serial foraging as follows (Sebastian and Larralde 1989:55-56):

> A strategy of **serial foraging** involves a small residential group that moves into the general vicinity of an abundant resource and camps there,

uses the target resource and other hunted and gathered resources encountered in the general area until the target resource is gone, or until another desired resource is known to be available, and then moves on to the next scheduled procurement area. Such a strategy could be expected to create a great deal of redundancy in the archaeological record, an endless series of small, residential camps from which daily hunting-and-gathering parties move out over the surrounding terrain, returning to process and consume the acquired foods each evening. If the resources were randomly distributed, all the sites would look generally the same. But since many of the resources appear in the same place year after year or in some other cyclical pattern, some sites tend to be reoccupied.

Reoccupied sites, then, would be a clustering of small, single-event, serial-foraging sites. But, Sebastian and Larralde (1989:56) envisage a complicating factor:

> The only exception to the rule of basically redundant but sometimes overlapping small campsites would be the winter camps. Given the relatively brief winters of the Roswell District, many of the sites would, on the surface, be no different in appearance from reoccupied short-term camps. Excavation of such sites might recover resources indicating a winter seasonal occupation or features indicative of storage, however. If we were able to differentiate single, large-group occupations from multiple, small-group occupations, we might find that winter sites differ from warm season camps in that they were occupied by larger groups.

In the above scenario, the settlement types of serial foragers should then start taking on the appearance of collectors' sites. While this introduces some difficulty in archaeological studies, it probably approximates reality to a greater degree and certainly seems to make better sense with respect to the archaeological record of southeastern New Mexico as we become increasingly familiar with it.

In addition to feature and artifact content of sites, Collins (1991:7-8) suggests biological correlates of forager and collector sites, particularly those involving burned rock middens. He suggests that the difference between the two might be signaled by whether the plant species processed are r-selected or not. That is, collectors would focus on r-selected species that are available in large numbers/amounts during short periods of time, requiring some form of preparation and storage for long-term benefit to humans. Foragers, on the other hand, would rely mostly on those plant species that are available throughout the year, precluding the need for storage but usually requiring greater mobility because their distribution across the landscape is general, not patchy. Collins suggests that animal species might also be conducive to this type of analysis, but because animals are mobile, they are not particularly useful in this regard.

In regards to subsistence strategies, it is appropriate to touch on the subjects of gardening-farming and food storage. The evidence for prehistoric horticulture in the Guadalupe-Carlsbad region is minimal at present. Roney (1985:44) states that corn was recovered from only three sites, all of them caves in the Guadalupe Mountains, but in each case, few remains were found. The Pratt Cave example (now published as Schroeder 1983:67) involves one or more corn kernels recovered from the vicinity of a hearth. Since two chile seeds were recovered from a lower level in the same test, it seems likely that the corn was introduced during the historic period by Apaches, rather than during Archaic times as suggested by Roney. According to Roney, the proveniences and temporal associations of the other two reports of corn are also uncertain. This leads us to conclude that horticulture either was not practiced by many of the prehistoric inhabitants of the Guadalupes or was practiced on only a very limited scale. Degree of dependency on corn in the Carlsbad area is an unresolved issue and will be addressed with the subsistence data obtained from the two sites to be excavated.

Storage, usually in the form of pits, is believed to be a key signal as to the existence and identification of base camps and habitation sites. The storage of quantities of foodstuffs is a characteristic of logistically organized subsistence systems. Generally speaking, storage implies a location that is easily protected or otherwise secure from theft. Sebastian and Larralde (1989:86) advance the interesting hypothesis that, because some resource patches are spread over the landscape and create a logistical problem for exploitation, some people may actually have cached foods in the collection areas and then moved their families from cache to cache as needed throughout the winter season. This constitutes yet another variation on the forager theme. But while it may actually reflect the situation in southeastern New Mexico, it also has the strong potential for confusing the interpretation of archaeological remains.

So how does one come to grips with this problem? Collins (1991:7-8), in discussing research on burned-rock middens in Texas, provides us with a test for determining whether a forager system or a collector system prevailed during the occupation of a specific site or set of sites. He posits:

> Therefore, complex components associated with burned rock middens which evidence quantities of remains of any one or more r-selected resources to the near exclusion of other kinds of resources imply, at least to some degree, the adaptive characteristics listed above and would favor an interpretation that burned rock middens were specialized food preparation features. Mesquite beans, prickly pear tunas, all deciduous nuts such as pecans and acorns, and psoralea are examples of r-selected plant foods. The geographic distribution of burned rock middens [in Texas] does not encompass the range of any notable r-selected animal species, however, seasonal availability of some animals, such as bison or migratory waterfowl could sometimes trigger behavior similar to that of r-selected resource exploitation, but the availability of such resources is not sufficiently reliable to result in the establishment of the same adaptive pattern.
>
> In contrast, plant and animal foods that are edible and available for all or much of the year (sotol, prickly pear pads, lechuguilla, antelope, rabbits, deer, bison in some areas, fish, mussels, turkey, and others) can be exploited in the more generalized foraging strategy and have different behavioral correlates. Evidence that foods of this kind provided the principal staples of groups responsible for burned rock middens would be evidence that these were not specialized food processing facilities, and that those responsible may have been foragers.

Data Recovery Questions

The investigations proposed for the project sites will be directed towards answering basic questions about settlement and subsistence behavior in the north end of the Trans-Pecos culture area. The main thrust will focus on documenting and validating the culture sequence recently formulated and outlined by Paul and Susana Katz (1985a), expressed as follows.

Judging by surface manifestations, LA 29362 is Archaic and LA 29363 is early in the Late Prehistoric or Formative period. Feature types identified include possible hearths, structures, burned-rock scatters, and artifact scatters. The proposed data recovery project will investigate these features. Part of the effort will also focus on finding and excavating any pits or other features currently masked by the dunes and artifact concentrations. Every effort will be made to recover and record information pertinent to the research outlined below and the specific questions that follow.

(1) Evaluate (verify or modify) our perception of the cultural content of the Brantley and Globe phases, and where possible, augment the criteria by which the phases can be distinguished. These phases span the terminal Archaic through the early Late Prehistoric periods in the regional sequence (Katz and Katz 1985a).

(2) Evaluate (substantiate, refute, or modify) the subsistence trend outlined by the Katzes (1985a) for the Carlsbad area. The Katzes believe that a major subsistence shift took place during the prehistoric sequence. Riverine resources such as mussels were important foods during the Avalon, McMillan, and Brantley phases (Middle Archaic through terminal Archaic), and nonriverine resources were largely supplemental. But starting in the Brantley phase, and continuing throughout the Globe, Oriental, and Phenix phases (the entire Late Prehistoric period), upland resources became more important and riverine resources less important. While this is better conceived as a change in emphasis, rather than a sharp change from one set of resources to another, it led to a markedly reduced human presence along the Pecos River.

Although the Katzes' reconstruction of the settlement and subsistence patterns appears justified by their data, we believe that the number of sites and components investigated by them are relatively few in number and, being concentrated near the Pecos River channel, do not fully represent the river valley occupation. Our project sites, being closer to the river, should permit us to fine-tune our perceptions of the entire riverine settlement.

(3) Determine whether the inhabitants of the Guadalupe-Carlsbad region farmed and if so, determine how prominently cultigens figured in the diet relative to wild foods. Given their proximity to horticultural peoples of the Southwest, it is surprising that prehistoric peoples in the Guadalupe-Brantley region did not farm. But, assuming that they did not farm, we then need to determine whether the reasons are cultural, demographic, climatic, or some combination of these. Could it be that the increased utilization of succulent baking precluded the need for, or usefulness of, the adoption of farming, as has been suggested?

1. Are the prehistoric components of the project sites foraging or collecting, base camps/habitation sites, special activity sites, or some combination?

If LA 29362 functioned as a foraging locus, the following characteristics are expected:

(1) Evidence of repeated short-term occupations (numerous redundant features scattered over the landscape). Attributes that should not occur include long-term storage features, residential structures, formal midden deposits. Attributes that may be present may include ephemeral structures, sheet trash deposits, and a wide variety of manufacturing maintenance and food procurement activities (Moore 1996).

(2) Formal interior heating should be absent.

(3) Evidence for a wide range of floral and faunal resources in the diet. Cultigens would likely be rare. Only local food remains should be found.

If LA 29363 was used by ceramic period logistical task groups, the following characteristics could be expected:

(1) Evidence of relatively longer period of occupation than at LA 29362. Storage facilities may be present and there may be specific trash disposal and activity areas.

(2) Structures should be shallow and reflect warm-season use, although interior hearths could be present.

(3) Evidence for a wide range of floral and faunal resources in the diet. Cultigens may occur. Foods from nonlocal sources may be found.

(4) Structures and/or thermal features should be present and may evidence signs of reuse. Or there may be evidence of redundant or related features representing repeated use over time.

(5) A variety of food containers (ceramics) should be present, although they may be limited in number.

It may be difficult to distinguish between these patterns of use in some cases, particularly if curation of tools occurred at either site. However, the compilation of data should allow us to assess the assemblages and determine the patterns of use.

LA 29363 (Macho Dunes) contains a possible pit structure and a baking pit, and several burned-rock areas. But are storage pits, other kinds of pits (for processing foods), and other types of thermal features also present on this and LA 29362? It is virtually guaranteed that the two sites were occupied more than once during the prehistoric period. Assuming so, we need to discover not only what kinds of features are present, but also which ones were contemporaneous and which were not. Were the activities or site function during each component the same or different?

At this stage in the investigations we have few observational data and facts by which to judge the answers to these questions. More intensive work will probably greatly modify our perceptions and interpretations of the prehistoric components at the project sites. The minimal data available suggest that two or more components are present at LA 29363 and probably represent two or more phases in the Katzes' sequence. The validity of this expectation requires confirmation. To do this, we will need to discover, isolate, and study features and artifacts belonging to separate occupations (components).

Once individual components are defined, we can then proceed to document the activities that took place at each. The cultural features (storage pits, other types of pits, hearths, baking pits, etc.), associated artifactual materials, and the patterning of these remains are critical in defining site types through an analysis of the activities represented. Important subsidiary studies will assist in determining site type, as well as overall subsistence patterns, and include floral, faunal, and artifactual data, as discussed below.

2. What artifact assemblages are present at the project sites? What types of tools and manufacture debris are present? What are the relative abundances of the various types? On the basis of the artifacts, what types of activities were performed at the sites? How do these assemblages compare with those from other sites in the region?

Both sites have produced lithic artifacts. LA 29363 has also produced pottery and ground stone. Intensive surface investigation and excavation may produce other artifact types (projectile points, bifaces, ornaments, etc.) as well.

The types of artifacts at a site help define the kinds of activities that took place at each specific location (component). Manos and metates imply grinding plant foods, projectile points imply hunting, and scrapers imply hide dressing. Multipurpose tools such as hammerstones, awls, and drills, and manufacture debris such as chipped lithic debris, shell fragments, and some types of fragmentary artifacts, imply a host of generalized activities involving the manufacture or maintenance of items associated with day-to-day living. A wide range of artifact and debris types imply a base camp/habitation situation, and fewer artifact and debris types imply special activity sites. The percentage of each category will provide a *very rough* index to the relative frequency of occurrence of each activity at the site.

Caution is required in interpreting the data in this manner because of the effects of tool use-life on artifact assemblage composition (Schlanger 1990). This line of interpretation makes several assumptions about the data and the activities they represent, and the technique greatly simplifies a number of complex variables and conditions.

We will compare the project sites with other sites in the Guadalupe-Carlsbad region. Sites to be used in this comparison include cave, shelter, and open sites investigated by the Katzes (1985a) and Southern Methodist University (Henderson 1976; Gallagher and Bearden 1980; Roney 1985; Applegarth 1976).

3. What plants and animals were being processed or consumed at the project sites? What biotic communities were being exploited? Were the inhabitants of the sites exploiting all available biotic communities or only selected ones? Were cultigens being grown and consumed? During which season or seasons were the sites occupied?

The project sites have the potential of producing burned plant remains and possibly some animal bone. Cooking activities probably took place at both sites, as attested by the probable hearths, baking pit, burned-rock concentrations, and quantities of burned rocks on LA 29363 and by the extensive lithic scatter at LA 29362.

Plant and animal remains recovered at archaeological sites provide first line evidence for reconstructing various aspects of the human food quest. Animal bones and the pollen and charred remnants of plants will be studied to identify the species present and the biotic zones exploited, characterize the diet and food preparation techniques, and provide insights into the effects of taphonomic processes on the archaeological record. Floral and faunal data also have the potential to provide information on season of the year that they were collected or hunted. Although only certain plant and animal remains provide seasonal data, they are very useful in helping define the time of the year the sites were occupied. Since it is unlikely that the data from the project sites constitute a total view of the diet throughout the year or through time, it will be necessary to compare these results with those of other projects in the region to gain a better understanding of the total subsistence system.

As mentioned in an earlier section of this document, it is imperative that we establish whether or not domestic plants were grown in the Guadalupe-Carlsbad region. Leslie's (1979) assessment of the structural sites in the vicinity of Hobbs in far southeastern New Mexico, though without benefit of flotation and pollen recovery techniques, suggests that corn was not being grown east of the Pecos River within New Mexico. The WIPP Project (Lord and Reynolds 1985), located between Leslie's sites and the Pecos River, excavated three nonstructural sites but failed to find evidence of cultigens in flotation and pollen samples. On the other hand, corn was clearly being grown within the Pecos Valley at Roswell (Kelley 1984, Appendix 6; Rocek and Speth 1984; Wiseman 1984) and probably near Fort Sumner as well (Jelinek 1967). Thus, if cultigens are documented for the project sites, then the relative quantities may help us determine if the site occupants were farmers or full-time hunter-gatherers. Relatively large numbers of domestic remains would indicate that the people were farmers. Small amounts of cultigens would be less clear, for hunter-gatherers could have obtained them in trade from farmers.

4. What exotic materials or items at the sites indicate exchange or mobility?

Intensive surface investigation and excavation at the two sites may produce examples of imported materials. At the present time, some scholars also believe that all pottery is intrusive to the Seven Rivers region in that it was produced in the Sierra Blanca and traded into Seven Rivers. Since exotic or trade materials are by their very nature generally few in number in any site, concerted effort will be made to recover them.

Materials and artifacts not naturally available in a region are indicative of either exchange relationships with other people or a mobility pattern that permits a group to acquire these items during their yearly round. Judging which situation is applicable to the project sites is difficult and will require careful comparison with data from the Roswell region. If we can determine whether the site occupants acquired the goods through trade or by direct access, we will gain perspective on the territory they used and therefore on the identity of the people themselves.

The absence of exotic materials is another matter entirely. In small sites and sites of short occupation, the absence of exotics can be misleading simply because such items may not have had time to find their way into the archaeological record. Or, perhaps the occupants simply did not acquire exotic materials. But this is precisely where comparisons with other assemblages in the region and the long-term accumulation of excavation data from numerous sites, both large and small and of all types, is necessary for acquiring perspective and, eventually, resolving the problem.

5. What are the dates of occupation at the various project sites?

Since it is likely that the sites were occupied on one or more occasions during the prehistoric period, dating individual features and components is crucial. At the individual feature level, we need to determine which are contemporaneous (or approximately so) and which are not. This will enable us to define the dates of each component and the activities performed at the different time periods at the sites. This in turn will permit documentation of site and region use through time, whether or not these uses changed through time, and if they did change, the directions, intensity, and, hopefully, the reasons for those changes. Dating information will also permit us to assess the Katzes' chronology, phase sequence, and postulated cultural changes for the Guadalupe-Carlsbad region.

The dating situation is critical in southeastern New Mexico where dendrochronology, the most accurate and preferred dating technique, works poorly or not at all (W. Robinson, pers. comm. 1975). Few absolute dates derived by other techniques are currently available (Sebastian and Larralde 1989). Recent advances in radiocarbon dating make it the most viable technique for southeastern New Mexico at the present time. Obsidian hydration and thermoluminescence have been tried in the region, but because these techniques have many problems and are not generally reliable, they will not be used in this study.

During excavation, charcoal will be recovered from as many features and cultural situations as possible. Because of the importance of dating the project sites, we will submit both very small samples (for accelerator mass spectrometry analysis) and bulk samples (carbon-stained sands) for dating if necessary.

SITE-SPECIFIC DATA RECOVERY QUESTIONS

(Adapted from Oakes 1997)

LA 29362

Trojan Hill consists of an extensive lithic artifact concentration focused in three areas on the south side of the proposed highway construction. It is believed to be late Archaic. However, contemporaneity of the several concentrations needs to be established through absolute dating methods or by the presence of diagnostic artifacts. Excavation procedures will concentrate on the denser artifact clusters in search of hearths or pits that may contain charcoal for dating. Flotation and pollen samples will aid in determining the subsistence items utilized on the site and the season of site use.

The presence of a large number of lithic artifacts will help in determining the activities performed at the site and provide a functional site classification. If the site is Archaic, a large proportion of the lithic assemblage may be biface flakes. Efforts to carefully retrieve such flakes will be made through the use of smaller-sized screens, if necessary. No sherds should be associated with any Archaic features.

We also need to determine if the site is characterized by a single use episode or is a result of multiple occupations. If the site represents a palimpsest of Archaic activities over time, any retrieved dates may exhibit a relatively wide rather than narrow time frame. Our understanding of Archaic mobility patterns are almost unknown for the region. If Archaic peoples are fully mobile, we would expect expedient investment of labor in hearths, storage facilities, and dwellings. The presence or absence of exotic materials will tell us considerably about Archaic mobility and exchange networks. Domestication of cultigens would not be likely. If site occupants maintained a seasonal round between the riverine environment of the Pecos River and the Guadalupe Mountains, only seasonal subsistence resources should be present in the archaeological record. In addition, a highly mobile group would not be expected to produce long-term storage facilities (as stated above); however, temporary facilities for the gathering and holding of specific food items while awaiting processing might be present.

LA 29362 may represent a foraging locale probably used repeatedly over time by Archaic populations. Hearths should be extramural and exhibit expedient preparation, although many may be scattered over the site. These could also be evidence of some specialized activity at the site, such as rock quarrying, gathering of specific wild food, or hunting for game. The numerous lithic artifacts and lack of subsurface materials spread along the ridge would suggest repeated encampment of a very short term by the same or similar cultural group.

Broad areas of the site will be surface stripped to the former prehistoric surface in order to recover any hearth or pit areas. Any soil found in these features will be retrieved for macrobotanical and palynological analyses. Dating of features is a priority. In the absence of datable materials, the lithic artifacts will be examined for known Archaic attributes, e.g., high frequencies of biface thinning flakes. Eighth-inch screen will be used in order to retrieve any small lithic items.

LA 29363

Given that pits and thermal features are present at LA 29363, we propose that the area served as a locale for the temporary collecting of subsistence items. The presence of ground stone indicates that processing of materials occurred on the site.

Macho Dunes has many discrete blow-outs containing cultural material within the dunal topography. While ceramics post-dating A.D. 800 were recovered from several of them, not all locales contained sherds. This could indicate an earlier and repeated use over a long period of time for this site. Determining temporality for the many cultural proveniences within the proposed right-of-way is important for understanding periods of site use and various site functions. The patterning of cultural features within the dunes is also critical to understanding cultural associations of the various blow-out locales.

The presence of possible residential pit structures is very important because such features are rare in the Carlsbad area and would provide a major step toward understanding residential mobility patterns during the Formative period. The roasting pit in another provenience could provide much needed subsistence data and information on seasonality of use of the area. Surfaces around these and all excavated features will be carefully traced in order to recover all associated components.

While it is assumed that all ceramics are intrusive to the Carlsbad region, petrographic analysis of all, or a sample of, the recovered sherds should determine the presence of local or exotic tempers and help to resolve the issue of whether all ceramics are intrusive. Because this issue has not been definitively decided, an OAS ceramic expert will visit the site region in search of potential clay and tempering resources. Recovered ceramics will also be used to evaluate the validity of placing the site within the Globe phase (or Formative period; Katz and Katz 1993).

Ground stone in several discrete locations on the site indicates the processing of subsistence items, possibly mesquite products, or grasses. It is also possible that corn was grown nearby and processed on the site. Pollen washes from ground stone and soil samples may inform on the potential use of domesticates.

If LA 29363 is a ceramic period collecting area, used possibly as a temporary campsite, then pits, hearths, grinding stones, and food containers should be present. The presence of possible temporary residential pit structures would probably indicate a base camp area. Interior hearths within structures would suggest a winter occupation period.

Every attempt will be made to locate all cultural features and retrieve macrobotanical and palynological samples from these. Datable materials will also be recovered, if possible. Spatial plotting of artifacts around features will assist in determining function of the feature and in assigning a time frame to the feature.

FIELD METHODS

Excavation methods were followed as outlined in the Data Recovery Plan (Zamora 1997). Datums set during the testing phase were reestablished and north-south and east-west baselines were placed over the sites. These provided the coordinates for a 1-by-1-m grid system to be imposed over each site. Elevations were taken from the northwest corner of each plotted grid using a transit and stadia rod in order to maintain horizontal control. All surface collections and excavation units were within the grid system. Hand tools such as shovels, trowels, picks, and brushes were used in the excavations. At LA 29363, mechanical equipment was used to remove overburden from large dunes to assist in uncovering buried cultural features. The dunes were removed in 20 cm increments in order to minimize damage to the underlying cultural resources.

We did not employ any mechanical work on LA 29362 because the site was very shallow with no more than 5 cm of depth in some areas and 15 cm in others. Most of the depth came from around bushes, where the soil had accumulated.

Excavation units were placed in areas of known features or surface artifact concentrations and then extended as features were encountered. All were dug in 10 cm levels except where stratigraphic breaks were evident. The features were divided into halves, a soil profile was drawn, and then the rest of the fill was removed in stratigraphic levels. Areas around the features were stripped down to a utilized soil surface where possible, enabling us to find other cultural features.

All soil from the excavations was passed through an ⅛-inch wire mesh, and all of the artifacts were bagged by level. Floor artifacts found at LA 29363 were mapped and bagged separately. Flotation, pollen, and C-14 samples were collected from each feature on the site.

Several mechanically dug trenches were placed at Macho Dunes in areas of low artifact densities to ensure that no cultural features were present. Several high dunes were leveled to the sterile red sand in 20 cm levels in order to expose buried features.

Individual grid excavation forms were filled out for every level excavated as was a feature form for each feature, detailing depth, type of artifact recovered, and soil type and color based on the Munsell scale. All stratigraphic levels and cross sections were drawn along with a plan view for each feature. Photographs were taken both before and after excavation. When all the excavation work was completed, the sites were mapped using a total station.

Thermal features are features that could not be absolutely identified as either a hearth or roasting pit, but exhibit characteristics such as oxidation, burned rock in and around the feature, and charcoal in the fill. The fill contained an abundant amount of charcoal with the sides of the pits exhibiting oxidation from burning. Storage pits were identified by the absence of burning or charcoal with a mottled fill and ranged from small to large in size. Pot rests were identified as shallow pits present on the floor of the structures, usually containing ceramic fragments on the bottom of the pit. Postholes contained wood fragments in the fill and were small in size.

All artifacts and samples collected will be curated at the Archaeological Research Collections (ARC) at the Laboratory of Anthropology, Museum of New Mexico. Field maps and notes, analytical data sheets, and photographs will be deposited at the Archeological Records Management Section (ARMS) of the State Historic Preservation Division.

SITE SUMMARY—TROJAN HILL, LA 29362

Trojan Hill covers 25,935 sq m (399-by-65 m). It is an extensive lithic procurement area with three discrete artifact clusters (Fig. 4). The North Loop (County Road 604) road has previously removed a portion of the site to the north. Three dense artifact scatters (Areas A through C) were excavated for a total of 630 sq m. Area A was the largest of the scatters and 456 sq m were dug. In Areas B and C 100 sq m were excavated in each unit. The artifacts are scattered throughout the site; however, the densest concentration was in Area A (Figs. 5-6). There were no features present; however, two hearths were excavated 67 m beyond the site to the east. A C-14 sample was collected from both hearths and produced calibrated dates of A.D. 1195 for Hearth 1 and A.D. 1025 for Hearth 2. The wood used in the hearths was identified as juniper. Because of the distance separating the two, it is not known if these hearths are related to the site occupation.

One possible deflated hearth was noted, but well away from the scope of work to the south on the hill slope, outside of the right-of-way. It consists of fire-cracked rock (FCR) with few lithic artifacts surrounding an area of approximately 1-m sq.

A total of 797 grid units were hand excavated with an average depth of 3.75 cm. There was 29.8 cubic m of soil removed and screened. There was no mechanical means of soil removal (Figs. 7-8).

Setting

The site is located on top of a small ridge that contains mesquite, creosote, and various grasses. They had been mechanically removed partially to the north by the original construction of the North Loop road. A light scatter of artifacts is present on the other side of the road; however, there is absolutely no depth. Surface artifacts are all that is present on the north edge of the site.

To the south, outside the right-of-way, the scatter is not as heavy as on top of the ridge; however, a deflated hearth is present. A scatter of FCR measuring 54-by-60 cm makes up this feature. There is no soil discoloration, and a trowel revealed there was very little depth (4 cm). No charcoal was noted.

Artifacts

The artifacts from Trojan Hill consist of lithic artifacts except for four ceramic fragments. They total 12,269 artifacts. Over half of the artifacts are core flakes (Table 1). There is an abundant amount of natural chert and quartzite found in the gravels above bedrock. These materials were visible in the road cut.

Site Interpretation

It is clear that the site was a lithic procurement area by the amount of large cores and debitage found on the surface. Many concentrations found on the site contain debitage that can be refitted onto the core. The two most common material types were chert and quartzite. The larger cores were the quartzite probably because the raw material is more abundant and larger in size.

There are no dates to place the site within a specific a cultural period. One biface found on the site is broken and not identifiable. The presence of four ceramics would suggest that it may have been occupied during the Formative period but this is only speculation since the ceramics consisted of four Playas Incised sherds (ca. A.D. 1200) from the same vessel.

The two hearths found 67 m east of the site date to the Formative period. Hearth 1 dates to the Late Globe or Early Phenix phases, and Hearth 2 to the Late Globe phase. With so much space between the hearths and the main portion of the site, it is possible that these hearths are from small campsites not related to the site. However, it could be that the inhabitants using these hearths also used the site to procure some of their lithic material.

While the raw materials were probably exploited throughout a long time span, there is no evidence to confirm use by a particular group. The absence of tools or tool-shaping flakes would suggest that the primary use of the site was for material selection and procurement.

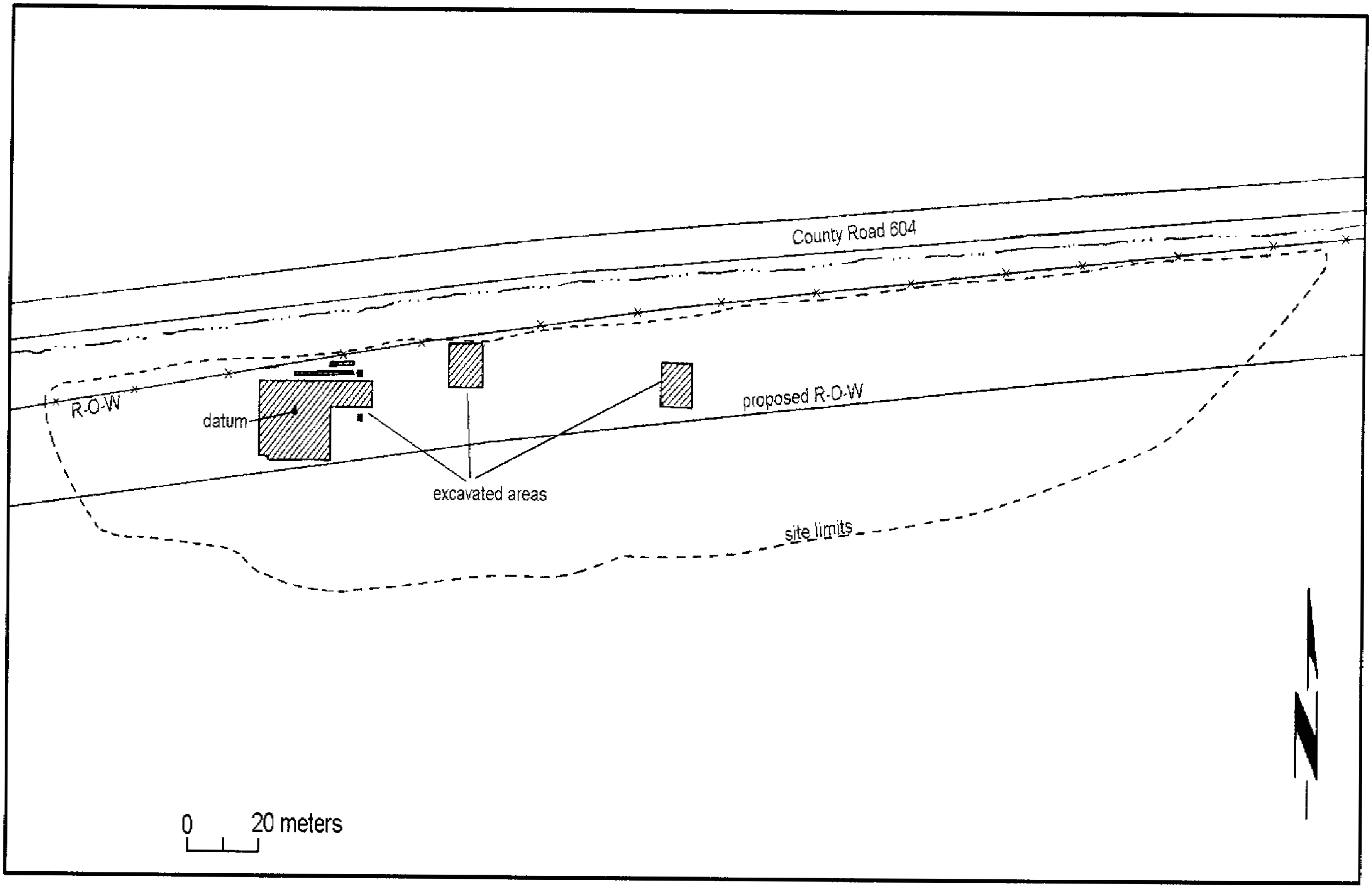


Figure 4. Trojan Hill, LA 29362, site map.

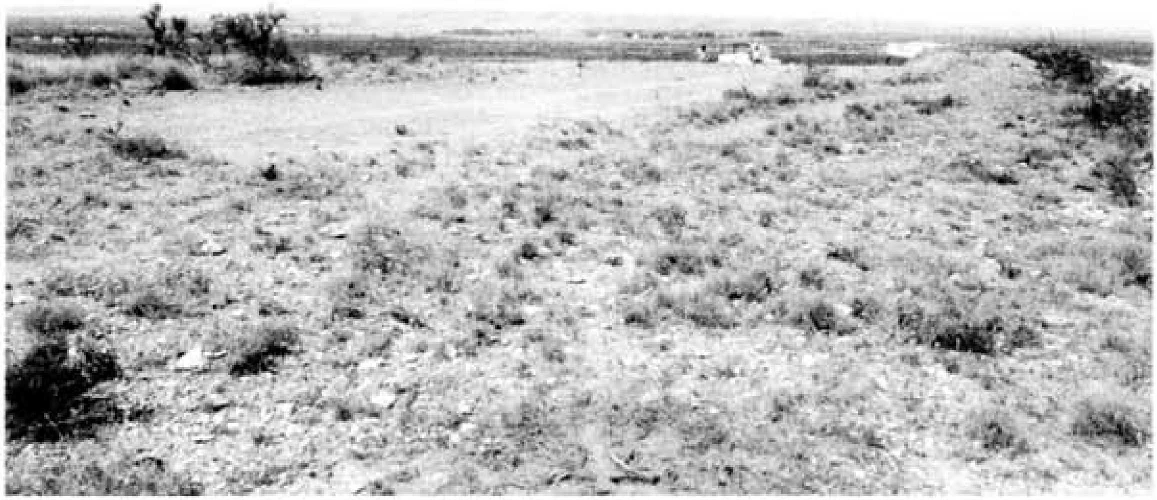


Figure 5. Trojan Hill, Area A excavations, looking west.

Figure 6. Close up of Area A at Trojan Hill. Note: bedrock is near the surface.

Figure 7. Area B excavations at Trojan Hill, looking northeast.

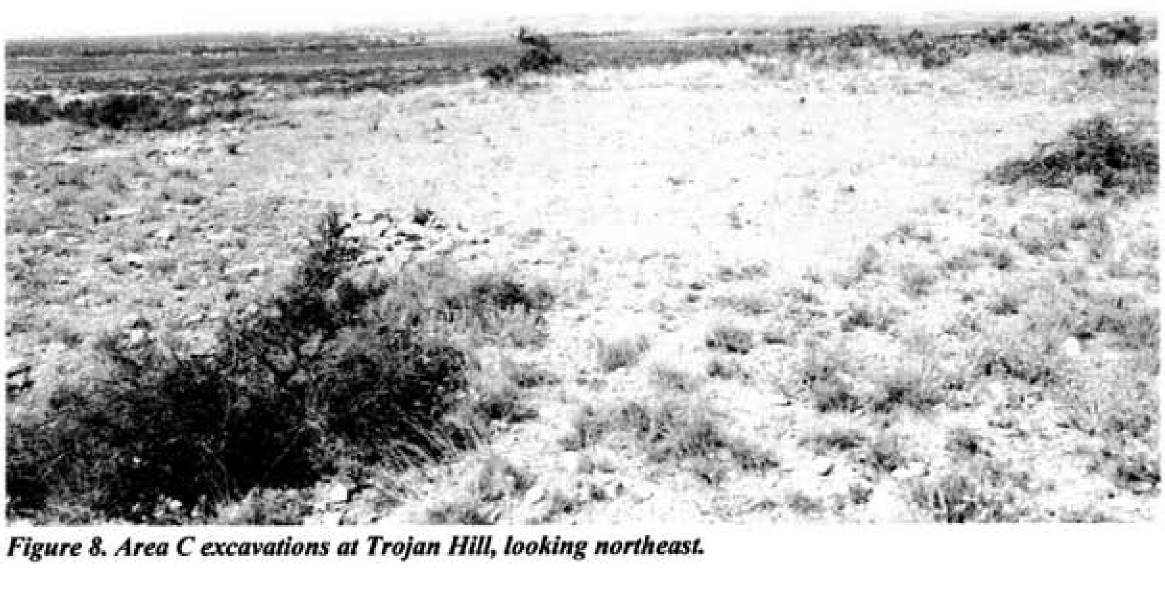


Figure 8. Area C excavations at Trojan Hill, looking northeast.

Table 1. Lithic Artifacts from Trojan Hill

CELLS: Count Row Percent Column Percent	MATERIAL TYPE												ROW TOTAL
	Chert	Chalcedony	Silicified Wood	Obsidian	Igneous	Basalt	Granite	Rhyolite	Limestone	Siltstone	Quartzite	Hematite	
Angular Debris	2253 50.7% 33.6%	37 .8% 36.6%	14 .3% 35.0%		1 .0% 7.1%	1 .0% 16.7%		22 .5% 20.0%	5 .1% 23.8%	103 2.3% 26.0%	2007 45.2% 41.2%		4443 100.0% 36.2%
Core Flake	4137 56.5% 62.1%	62 .8% 61.4%	23 .3% 57.5%	1 .0% 100.0%	12 .2% 85.7%	5 .1% 83.3%	1 .0% 100.0%	85 1.2% 77.3%	15 .2% 71.4%	276 3.7% 70.4%	2721 37.0% 55.8%	1 .0% 100.0%	7364 100.0% 60.0%
Biface Flake											1 100.0% .0%		1 100.0% .0%
Tested Cobble	116 69.5% 1.7%		2 1.2% 5.0%		1 .6% 7.1%			1 .6% .9%		1 .6% .3%	46 27.5% .9%		167 100.0% 1.4%
Core	169 59.7% 2.5%	2 .7% 2.0%	1 .4% 2.5%		1 .6% 7.1%			2 .7% 1.8%	1 .4% 4.8%	12 4.2% 3.1%	96 33.7% 2.0%		283 100.0% 2.3%
Cobble Tool	1 100.0% .0%												1 100.0% .0%
Biface	2 100.0% .0%												2 100.0% .0%
Unworked cobble	3 37.5% .0%										5 62.5% .1%		8 100.0% .1%
COLUMN TOTAL	6706 54.7% 100.0%	101 .8% 100.00%	40 .3% 100.0%	1 .0% 100.0%	14 .1% 100.0%	6 .0% 100.0%	1 .0% 100.0%	110 .9% 100.0%	21 .2% 100.0%	392 3.2% 100.0%	4876 39.7% 100.0%	1 .0% 100.0%	12269 100.0% 100.0%

SITE SUMMARY—MACHO DUNES, LA 29363

Macho Dunes is probably a seasonal base camp because of the several brush structural remains present. It covers almost 48,750 sq m (524,757 sq ft). The site contains the remains of 5 brush structures and 35 thermal and storage features (Fig. 9), dating primarily to the Globe phase (A.D. 752 to A.D. 800), although features date from the Middle Archaic to the Late Globe phase at ca. A.D. 980. Preservation of the site was very good because the features had been sealed by the sand leaving them in fair to good condition. Most of the disturbance was caused by root and rodent activity. However, mechanical disturbance was notable around Structures 2 and 4.

There is evidence of spalling on the ceramics, indicating cooking was being performed on the site. The extramural thermal features and the interior hearths would probably confirm cooking activities. The pollen samples were negative; however, the macrobotanical samples included goosefoot, purslane, and carpetweed as subsistence items and mesquite, one-seed juniper, Mexican crucillo, and four-wing salt bush for fuel wood.

Setting

Macho Dunes is located east of Carlsbad along the North Loop Road, in Eddy County. It is on the edge of the Alacran Hills sand dunes. It sits directly south of (and protected by) a high ridge of sand covered with dense vegetation that prehistorically provided shelter from the prevailing north and northeast blowing winds (Figs. 10-12). Of the almost 48,750 sq m (524,757 sq ft) on the site, 924 sq m were excavated by hand and 1,637 sq m (17,621 sq ft) were mechanically removed.

Cultural Units

Area A

Area A was the first unit to be excavated. It is located on top of the knoll where bedrock outcrops near the surface. One hearth was found on the edge of the road cut and was built into the bedrock. It measured 53 cm north-south by 35 cm east-west and was 15 cm in depth (Fig. 13). A total of 65 sq m (700 sq ft) were excavated around the hearth in order to locate other features; none, however, was present.

A radiocarbon sample was collected from the feature and produced a calibrated and corrected date of 380 to 5 B.C. with an intercept date of 185 B.C., suggesting the hearth was used during the Late Archaic period.

Artifacts. Area A contained 78 artifacts of which all were lithic artifacts (Table 2). The most common material type was chert (73.1 percent) and the core flakes (71.8 percent) dominated the assemblage (Table 3).

Area B

Area B contained several features (Fig. 14). The remains of three brush structures were excavated along with nine extramural features. The area covers 17 m north-south by 14 m east-west for a total of 238 sq m. It is located south of Area A where is it protected from the wind (Figs. 15-16). The artifact density was among the highest (n = 483) on the site. This includes surface and subsurface artifacts (Table 4). Descriptions of artifacts from each structure are as follows:

Table 2. Lithic Artifacts from Levels in Area A

Cells: Count Row Column	Level			Row Total
	Surface	General Fill	Hearth	
Angular Debris	3 14.3% 60.0%	17 81.0% 23.6%	1 4.8% 100.0%	21 100.0% 26.9%
Core Flake	2 3.6% 40.0%	54 96.4% 75.0%		56 100.0% 71.8%
Core		1 100.0% 1.4%		1 100.0% 1.3%
Column Total	5 6.4% 100.0%	72 92.3% 100.0%	1 1.3% 100.0%	78 100.0% 100.0%

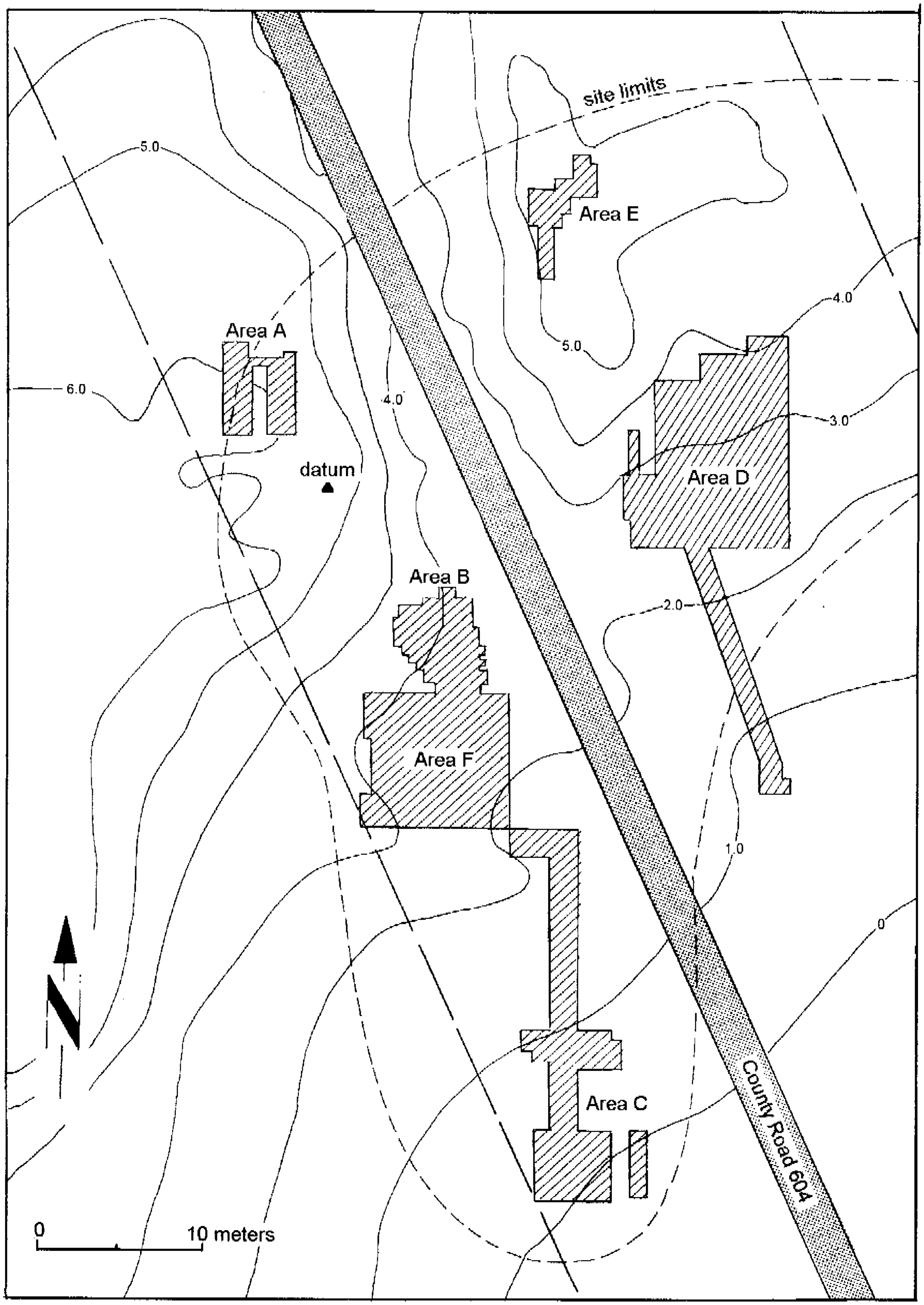


Figure 9. Macho Dunes, LA 29363, site map.

Table 3. Lithic Artifact Material Types from Area A

Cells: Count Row Column	Material Type				Row Total
	Chert	Chalcedony	Basalt	Quartzite	
Angular Debris	16 76.2% 28.1%			5 23.8% 31.3%	21 100.0% 26.9%
Core Flake	40 71.4% 70.2%	3 5.4% 100.0%	2 3.6% 100.0%	11 19.6% 68.8%	56 100.0% 71.8%
Core	1 100.0% 1.8%				1 100.0% 1.3%
Column Total	57 73.1% 100.0%	3 3.8% 100.0%	2 2.6% 100.0%	16 20.5% 100.0%	78 100.0% 100.0%

Table 4. Artifacts from Area B

Cells: Count Row Column			Hearth 3	Structure 1		Structure 2			Structure 3		Total
	Surface	General Fill	Subfloor	Fill	Subfloor	Fill	Floor	Subfloor	Fill	Subfloor	
Lithic Artifacts	3 .9% 75.0%	221 66.2% 69.7%	3 .9% 100.0%	38 11.3% 65.5%	38 11.3% 95.0%	6 1.8% 25.0%	4 1.2% 21.0%	1 .2% 50.0%	14 4.2% 63.6%	2 .5% 16.6%	334 100.0% 69.1%
Ceramics	1 .9% 25.0%	72 64.8% 22.7%		11 9.9% 18.9%	1 .9% 2.5%	14 12.1% 58.3%			4 3.6% 18.1%	8 7.2% 66.6%	111 100.0% 22.9%
Ground Stone		21 60.0% 6.6%		9 25.7% 15.5%	1 2.8% 2.5%	4 11.4% 16.6%	15 42.8% 78.9%	1 2.8% 50.0%	3 2.7% 13.6%	2 5.7% 16.6%	35 100.0% 7.2%
Fauna		2 66.6% .6%							1 33.3% 4.5%		3 100.0% .6%
Column Total	4 .8% 100.0%	317 65.6% 100.0%	3 .6% 100.0%	58 12.0% 100.0%	40 8.2% 100.0%	24 4.9% 100.0%	19 3.9% 100.0%	2 .4% 100.0%	22 4.5% 100.0%	12 2.4% 100.0%	483 100.0% 100.0%

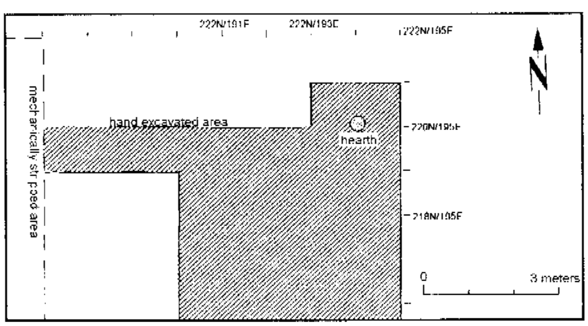


Figure 10. Plan of hand excavation and mechanical scraping, Area A. Hearth 1 is located in northwestern corner.

Structure 1

This structure is the largest of those found and is located at the bottom of the knoll in a flat area. It is oval in shape and has been dug into the sterile red sand and contained floor features.

Stratigraphy. Three strata were identified in the fill of the structure (Fig. 17). Stratum 1, Munsell color 5YR 5/4 reddish brown, was the modern top soil, a very dry, fine eolian sand. This level was 8 cm thick. Stratum 2, 32 cm thick, was an eolian sand with cultural fill that was mottled, charcoal stained, and contained charcoal and artifacts. The Munsell color was 5YR 6/8 reddish yellow. Stratum 3 was the sterile red sand that underlies the site. Its thickness ranged from 10 to 30 cm and is 5YR 6/8 reddish yellow on the Munsell color chart.

Figure 11. Macho Dunes, Area A, before excavations. Hearth 1 is being mapped on left side of photograph.

Figure 12. West side of Macho Dunes, looking north.

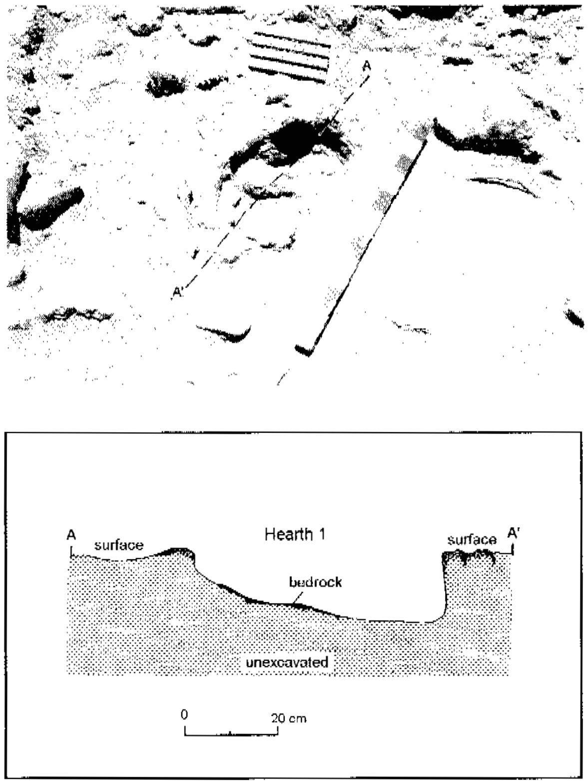


Figure 13. Area A, Hearth 1, built into the bedrock. Profile is north-south.

Architectural Details. The remains of the structure measured 7.4-by-4.6 m by 18 cm in depth (Figs. 18-19).

Walls. The walls of the feature are curved and slope inward. They are constructed of the natural sterile sand, which is semicompact. In areas it is very hard. When the sand is wet there is no difference in compactness.

Floor. The floor surface of the structure is heavily charcoal-stained and oxidized in some areas. A semicompact surface makes up the floor; however, when exposed to the sun and wind for a period of time it becomes very sandy. The areas that are very compact and contain a lot of calcium carbonate are fairly stable and hold together very well.

There was an area to the east where there may have been an entrance. The floor tapered out in Grid 171N/225E and the surface disappeared.

Floor Features. There were five floor features present on the floor, including a hearth, possible posthole, and three storage pits.

Hearth. The hearth measured 48-by-50 cm with a depth of 24 cm (Fig. 20). The fill was a dark gray, orange, and black mottled sand with a large amount of charcoal. A calibrated and corrected C-14 date of A.D. 865 to A.D. 985, with an intercept date of A.D. 895, was produced.

Storage Pits. Five storage pits were excavated in Structure 1 (Figs. 21-22). All the pits were burned and contained charcoal. The fill for each was a black charcoal-stained sand with oxidization. These pits are listed in Table 5.

Table 5. Storage Pit Dimensions and Dates, Structure 1

Feature	Length (cm)	Width (cm)	Depth (cm)	Date
Pit 2	46	44	29	
Pit 4	20	20	10	
Pit 8	41	38	6	A.D. 665-960
Pit 9	81	71	25	A.D. 770-1010
Pit 10	37	35	18	A.D. 660-995

Extramural Features. An exterior surface was found in Area B that contained several features, of which three were associated with Structure 1 (Table 6). Two are storage pits and the other is possibly a posthole. Pit 6 is located next to the structure. Although the fill was charcoal-stained, it lacked the oxidation that was present in the other hearths, suggesting that the feature may have been a storage pit instead of a hearth. In addition, this area contained so much charcoal staining in the fill of all the features and on the floors and surfaces, that if a feature did not exhibit some type of oxidation we considered it a storage pit. Pit 7 is identical to Pit 6 (Fig. 23). It is approximately 3 m southwest of Structure 1. The fill again was charcoal-stained, but oxidation was lacking.

Table 6. Extramural Storage Pits and Postholes

Feature	Length (cm)	Width (cm)	Depth (cm)
6	43	53	23
7	28	32	10
5 (posthole)	8	5	3

One small posthole was found 60 cm north of the pit structure. No other postholes were found in this area; however, there was an abundant amount of root and rodent activity so that they could have been obliterated.

Artifacts. A few artifacts were recovered from Structure 1. They include 9 ceramics, 76 lithic artifacts, and 9 pieces of ground stone for a total of 93 artifacts. Most of the artifacts were from the fill of the structure, except for one South Pecos Brown sherd found in Pit 9. Table 7 represents the ceramics recovered from Structure 1.

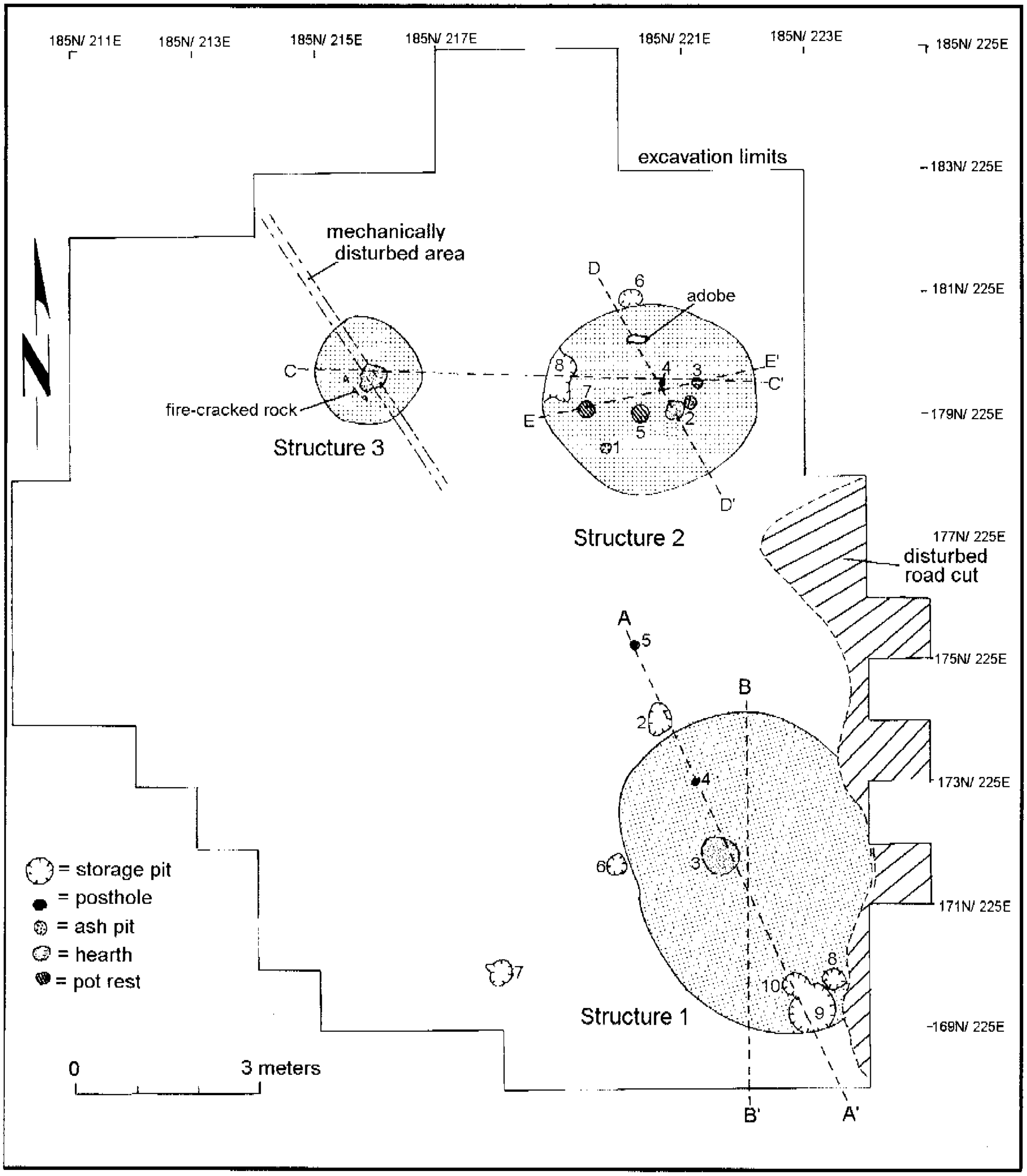


Figure 14. Area B, structural remains and extramural features.

Figure 15. Area B, before excavation.

Figure 16. Area B, excavated. Structure 1 is in the left foreground.

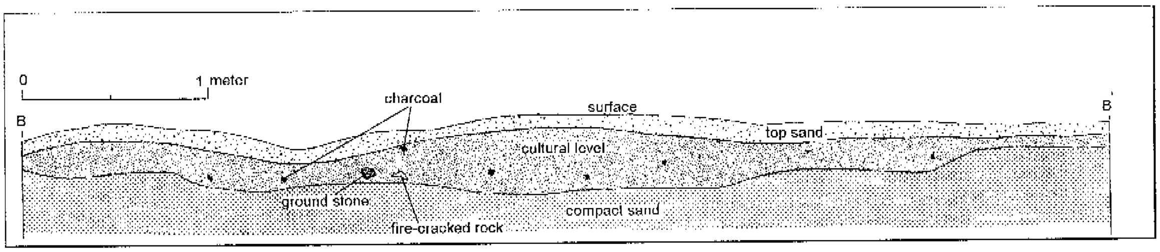


Figure 17. Photograph and profile of Structure 1, Area B.

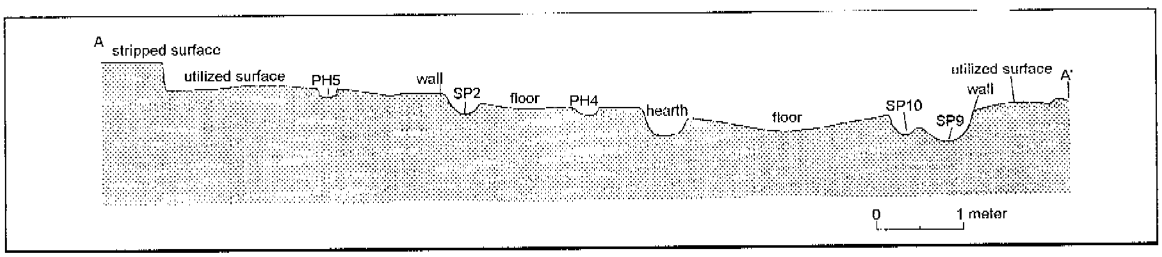


Figure 18. Structure 1, Area B, profile.

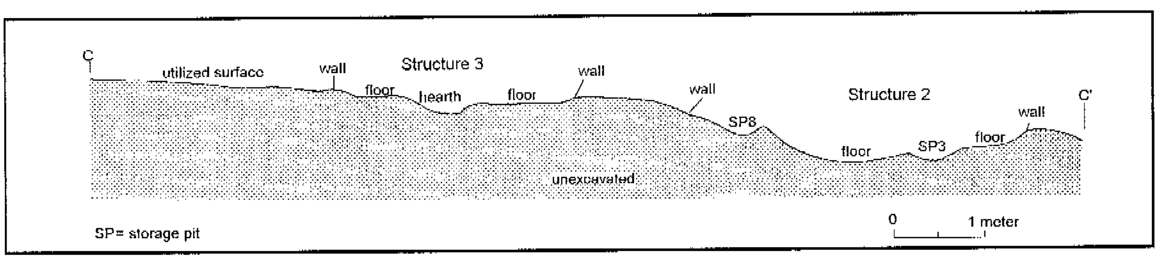


Figure 19. Structures 2 and 3, Area B, profile.

Table 7. Ceramics Recovered from Structure 1

Cells: Count Row Column	Feature		Row Total
	Structure	Pit 9	
Jornada Brown	1 100.0% 12.5%		1 100.0% 11.1%
El Paso Brown	4 100.0% 50.0%		4 100.0% 44.4%
South Pecos Brown	1 50.0% 12.5%	1 50.0% 100.0%	2 100.0% 22.2%
Jornada/South Pecos Brown	1 100.0% 12.5%		1 100.0% 11.1%
McKenzie Brown	1 100.0% 12.5%		1 100.0% 11.1%
Column Total	8 88.9% 100.0%	1 11.1% 100.0%	9 100.0% 100.0%

Ceramic cross-dating of the site places it into the Globe phase of the Formative period. The later McKenzie sherd would suggest that the site was occupied during the later portion of the phase (A.D. 1200 to A.D. 1300). However, it is not impossible that this ceramic was transported to the site by someone passing through. The C-14 date from Hearth 1 and this ceramic suggest that the site was occupied during the latter portion of the phase.

The lithic artifact assemblage is represented by angular debris, core flakes, and cores. The material types for Structure 1 are in Table 8. Core flakes (60.5 percent) represent more than half of the assemblage. The most common material type was chert (73.7 percent). Just two cores were recovered and both had flakes removed from multiple directions. There is also a fair amount of angular debris, suggesting that tool manufacturing was performed.

Table 8. Lithic Artifacts from Structure 1

Cells: Count Row Column	Artifact Morphology			Row Total
	Angular Debris	Core Flake	Core	
Chert	20 35.7% 69.0%	35 62.5% 76.1%	1 1.8% 100.0%	56 100.0% 73.7%
Siltstone	2 66.7% 6.9%	1 33.3% 2.2%		3 100.0% 3.9%
Quartzite	7 41.2% 24.1%	10 58.8% 21.7%		17 100.0% 22.4%
Column Total	29 38.2% 100.0%	46 60.5% 100.0%	1 1.3% 100.0%	76 100.0% 100.0%

Ten ground stone items were collected from Structure 1. Eight of the ground stone pieces from the structure were retrieved from the fill. One indeterminate metate fragment was recovered from Pit 9. The ground stone from Structure 1 is listed in Table 9.

Sandstone is the most commonly used material type for the ground stone and is available throughout the area. The quartzite can be found along the river beds and in the alluvial deposits.

Table 9. Ground Stone Artifacts from Structure 1

Cells: Count Row Column	Function					Row Total
	Indeterminate	Lapidary Stone	One-hand Mano	Metate	Basin Metate	
Red Sandstone				2 100.0% 66.7%		2 100.0% 20.0%
Yellow Sandstone				1 50.0% 33.3%	1 50.0% 100.0%	2 100.0% 20.0%
White Sandstone			3 100.0% 75.0%			3 100.0% 30.0%
Fine Sandstone			1 100.0% 25.0%			1 100.0% 10.0%
Quartzite	1 50.0% 100.0%	1 50.0% 100.0%				2 100.0% 20.0%
Column Total	1 10.0% 100.0%	1 10.0% 100.0%	4 40.0% 100.0%	3 30.0% 100.0%	1 10.0% 100.0%	10 100.0% 100.0%

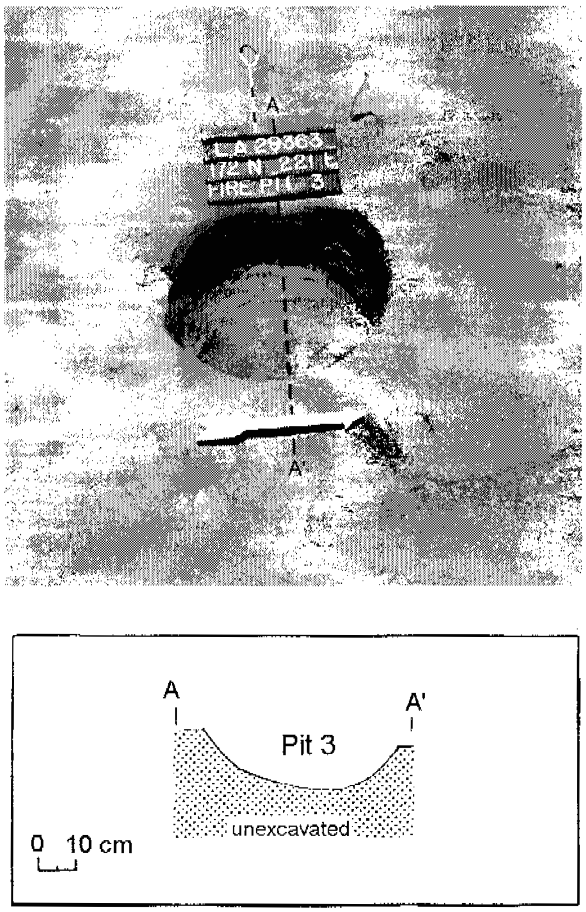


Figure 20. Structure 1, hearth, Area B; east-west profile.

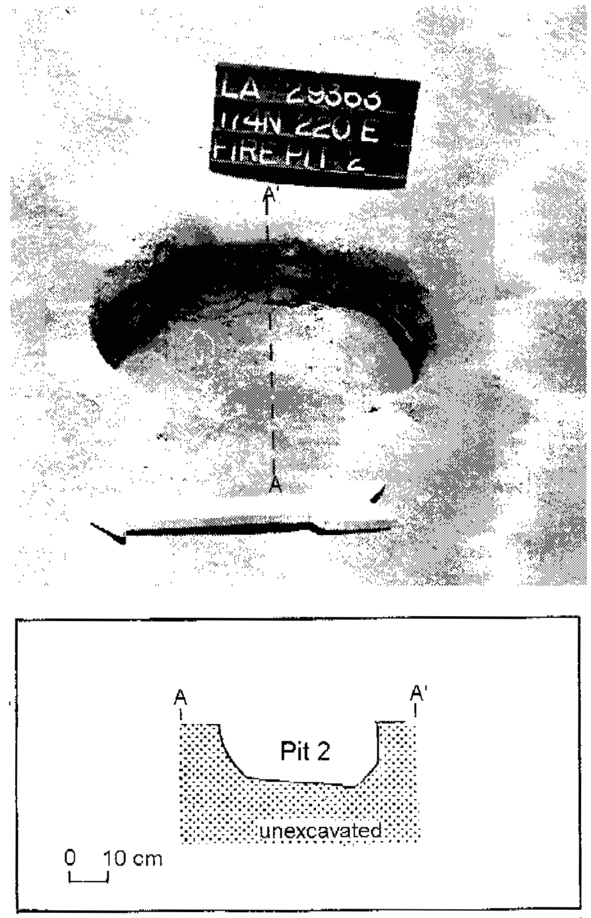


Figure 21. Structure 1, Pit 2; east-west profile.

Structure 2

Structure 2 is the deepest of all the structures on the site. It is located at the base of the knoll near the road cut. It is circular in shape and was burned, with oxidation present throughout (Fig. 24). Several samples for archaeomagnetic dating were collected from the hearth, but did not produce results.

Stratigraphy. There were only two stratigraphic levels in this structure (Fig. 25). The first level was the modern top soil that exhibited staining and the beginning of the oxidation, Munsell 10YR 3/3 dark brown. The second level was the fill of the structure and it consisted of red oxidized sand, charcoal staining and an abundant amount of charcoal. The Munsell color was 5YR 5/4 reddish brown. Two calibrated and corrected dates of A.D. 665 to A.D. 960 with an intercept date of A.D. 785 and A.D. 665 to A.D. 885 with an intercept of A.D. 770 were obtained for the structure.

Architectural Details. The structure is 2.75 m north-south by 3.25 m east-west and 35 cm deep (Fig. 26).

Walls. The walls are fairly shallow, semicompact oxidized sand, 5 cm to 8 cm. The structure is saucer-shaped and the walls flare out in profile instead of having a basin shape.

Floor. The floor surface is a charcoal-stained oxidized red compact sand containing several features. It was more stable and not sandy when exposed to the elements, possibly because of its greater depth.

Floor Features. Eight floor features were excavated in Structure 2 and are listed below.

Hearth. The hearth consisted of two adjoining pits, with one serving as an ash pit. It is located off-center of the structure and is 30 cm in diameter and 10 cm deep (Fig. 24). The ash pit is immediately next to the hearth giving an appearance of a Figure 8. The ash pit is 20 cm in diameter and 12 cm deep. The fill consisted of a black charcoal-stained fine sand.

Storage Pits. Two storage pits were excavated in Structure 2 (Figs. 27-28). The fill consisted of a black, charcoal-stained sand with flecks of charcoal. However, there was not enough charcoal from the features for radiocarbon samples. All the shallow pits were built into the red sterile clay and each exhibited little oxidation. The measurements for the features are in Table 10.

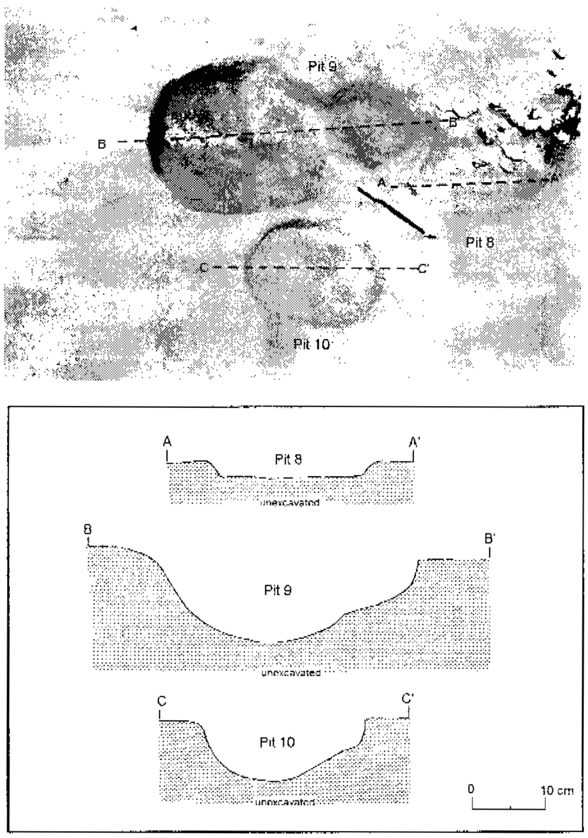


Figure 22. Structure 1, Pits 8, 9, and 10; east-west profiles.

Table 10. Storage Pit Dimensions from Structure 2

Feature	Length (cm)	Width (cm)	Depth (cm)
3	20	24	6
5	20	20	4

Pot Rests. The pot rests were identified as shallow saucer-shaped pits on the floor and base of walls (Figs. 29-31). They are 2 to 3 cm deep with the exception of a Feature 8, which is large and sits against the wall of the structure. The fill from the pot rests was a black, charcoal-stained sand with minute charcoal flecking. No charcoal samples were recovered from the features. Measurements for the features are in Table 11.

Table 11. Pot Rest Dimensions for Structure 2

Feature	Length (cm)	Width (cm)	Depth (cm)
1	55	46	3
7	40	34	2
8	60	55	6

Posthole. One posthole was excavated 40 cm north of the hearth (Fig. 32). The fill was a black, charcoal-

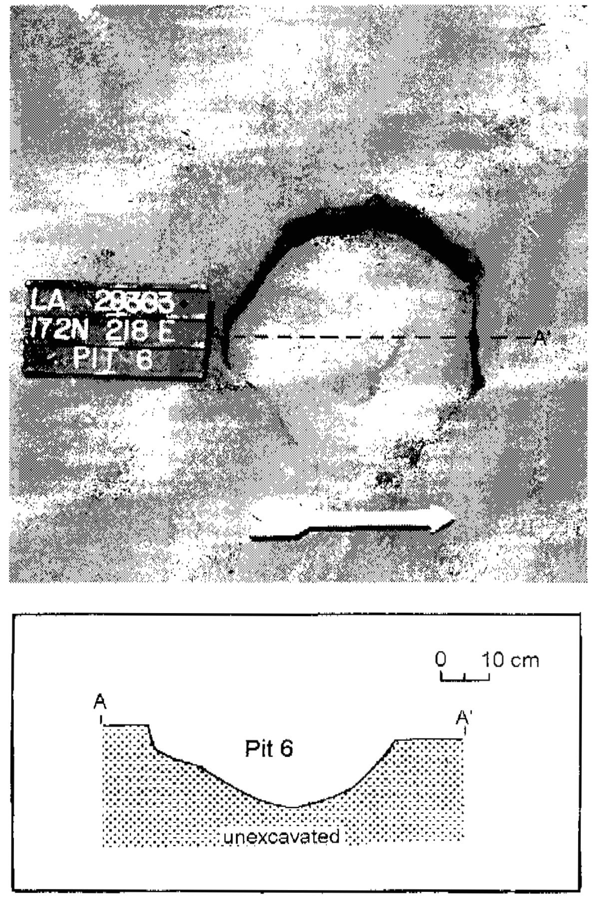


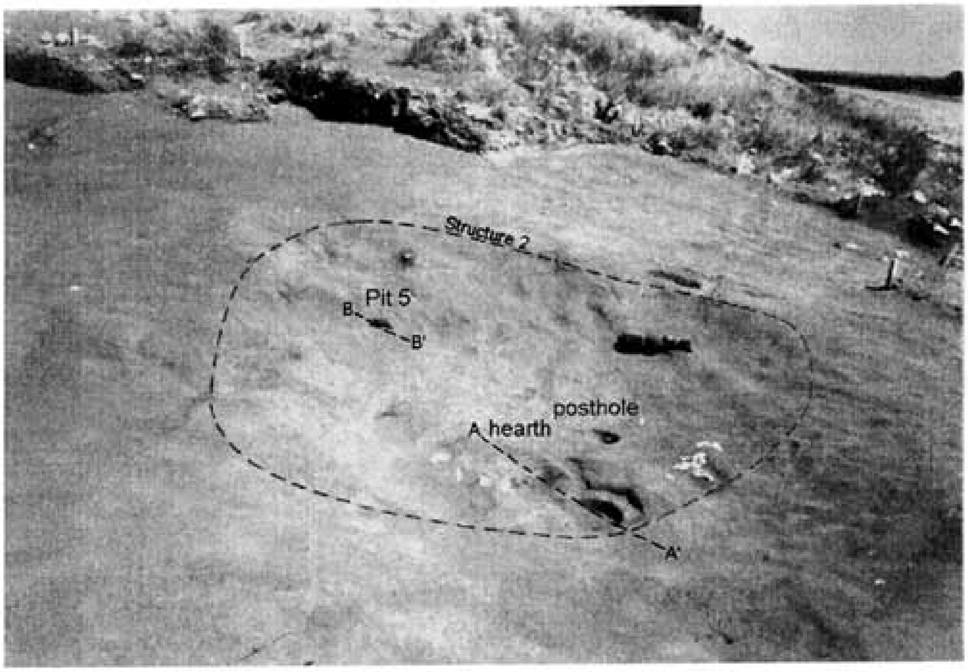
Figure 23. Extramural Pit 6, north-south profile.

stained sand and it measured 8 cm north-south by 12 cm east-west with a depth of 6 cm. This was the only posthole found in the structure and may have served as a support post. The outside surface was also excavated around the feature but only one feature was found.

Extramural Feature. One extramural pit was excavated immediately north of the structure (Fig. 33). It was circular in shape and measured 25-by-32 cm and 4 cm deep. The fill was a black, charcoal-stained sand with oxidization. It is possible that this feature may have been used for storage; however, the oxidization in the pit would suggest some type of thermal activity.

Artifacts

Structure 2 contained 21 lithic artifacts, 14 ceramics, 23 pieces of ground stone, and one turtle carapace fragment for a total of 59 artifacts. Two corrected calibrated C-14 dates were obtained for Structure 2. They are from a storage pit (A.D. 665 to A.D. 960) and a posthole (A.D. 665 to A.D. 885). These dates are associated with the Globe phase and would correspond with the ceramics.



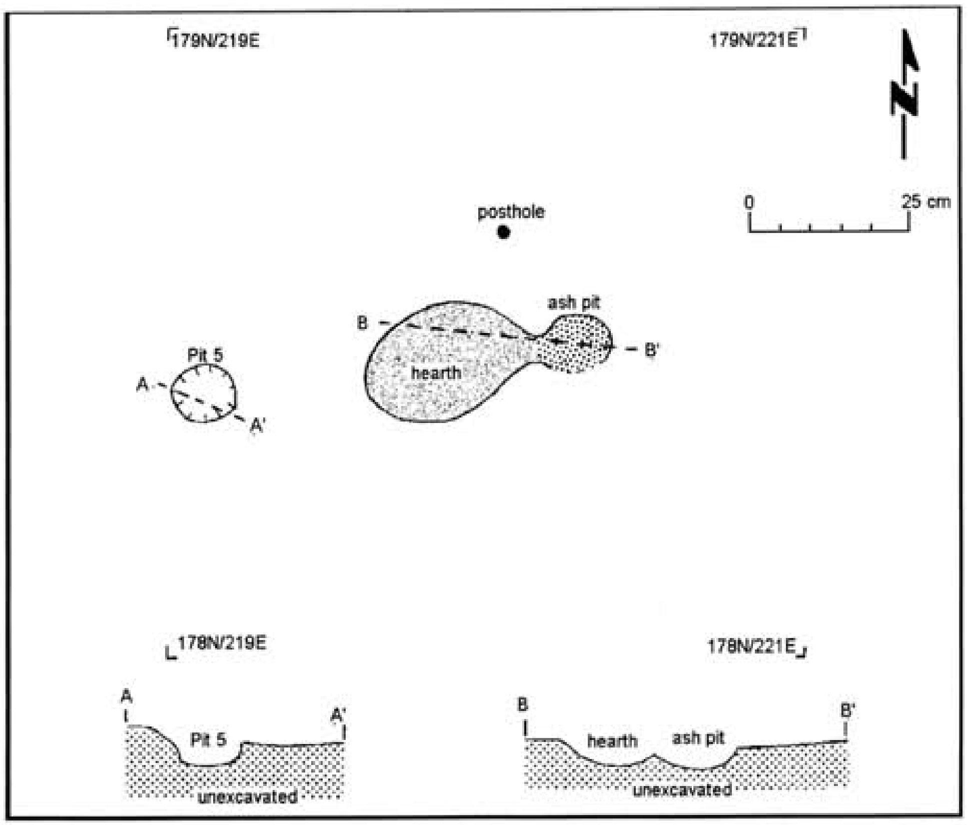


Figure 24. (a) Structure 2, looking north; (b) plan and profile of Structure 2 hearth, ash pit, and pit.

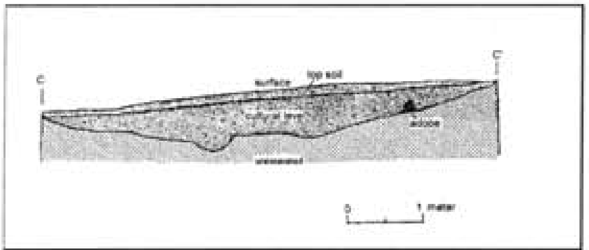


Figure 25. Structure 2 soil profile.

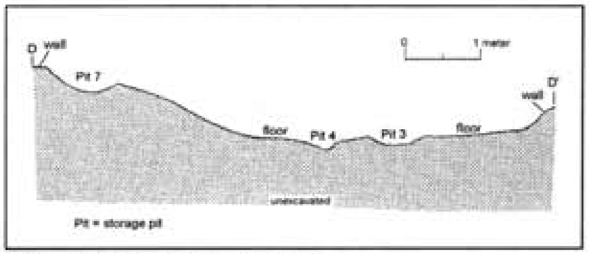


Figure 26. Structure 2, profile.

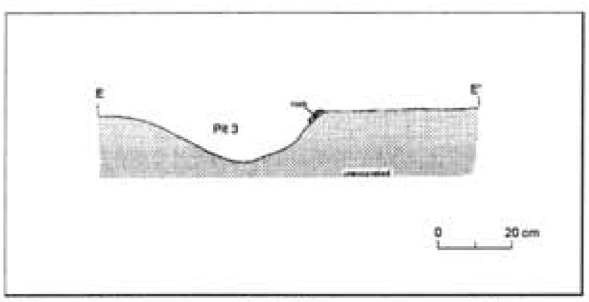


Figure 27. Structure 2, Pit 3, east-west profile.

The ceramics will be discussed in detail by Wilson (this volume). The three types of ceramics found in Structure 2 are listed in Table 12.

Table 12. Ceramics Recovered from Structure 2

Cells: Count Row Column	Feature		Row Total
	Structure 2 Fill	Pit 2 Fill	
Jornada Brown	9 100.0% 69.2%		9 100.0% 64.3%
El Paso Brown	2 66.7% 15.4%	1 33.3% 100.0%	3 100.0% 21.4%
McKenzie Brown	2 100.0% 15.4%		2 100.0% 14.3%
Column Total	13 92.9% 100.0%	1 7.1% 100.0%	14 100.0% 100.0%

In the lithic assemblage, the core flakes are the most common and comprise over half of the assemblage (Table 13). The most common material is chert, which can be found in arroyo cuts and along the river. Quartzite is also very common in the area. One small reworked unidentifiable projectile point was recovered from the fill of the structure. It is made of white chert and has a concave base with possible side notching.

Several ground stone artifacts (n = 23) were found in Structure 2 (Table 14), with 62 on the floor and 42 percent in Pit 2 (Table 15). Two metate fragments and six one-hand manos were in the floor assemblage implying that food processing was being performed. One of the fragments was from a basin metate, which would suggest seed processing.

Sandstone was the material of choice and is present in the immediate area. Color was monitored for sourcing and for texture of the material. The red sandstone is coarser than the white; however, both were regularly used. The ground stone section will present more detail on material types.

Structure 3

Structure 3 is located 1.20 m east of Structure 2. It is circular, shallow, saucer-shaped structure dug into the red, sterile sand. The structure consists of a central hearth with a small scatter of fire-cracked rock. Mechanical machinery removed the center of the structure and hearth (Fig. 34) by accident when removing dunal overburden.

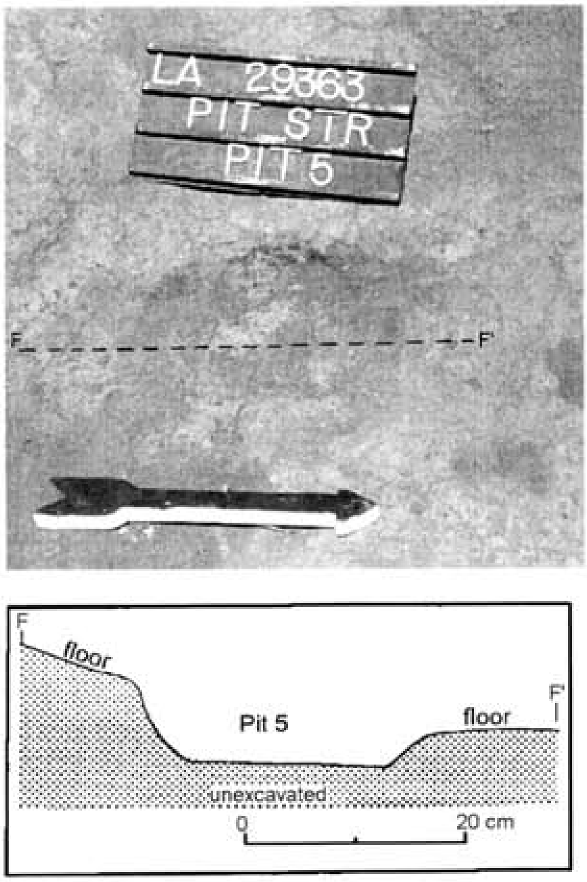


Figure 28. Storage Pit 5; plan and north-south profile.

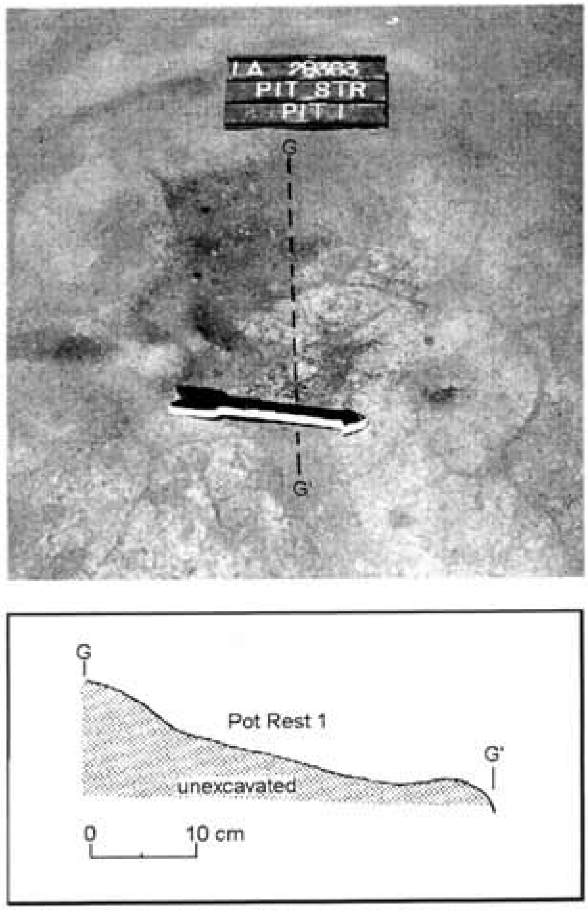


Figure 29. Structure 2, Pot Rest 1; plan and east-west profile.

Table 13. Lithic Artifacts from Structure 2

Cells: Count Row Column	Material Type		Row Total
	Chert	Quartzite	
Angular Debris	5 83.3% 33.3%	1 16.7% 16.7%	6 100.0% 28.6%
Core Flake	9 69.2% 60.0%	4 30.8% 66.7%	13 100.0% 61.9%
Tested Cobble		1 100.0% 16.7%	1 100.0% 4.8%
Multidirectional Core	1 100.0% 6.7%		1 100.0% 4.8%
Column Total	15 71.4% 100.0%	6 28.6% 100.0%	21 100.0% 100.0%

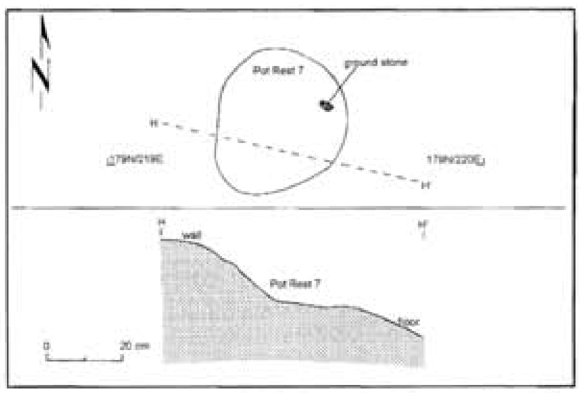


Figure 30. Structure 2, Pot Rest 7; plan and profile.

Table 14. Ground Stone Artifacts from Structure 2

Cells: Count Row Column	Function					Row Total
	Indeterminate	Polishing Stone	One-hand Mano	Metate	Basin Metate	
Red Sandstone	2 50.0% 20.0%	1 25.0% 100.0%	1 25.0% 16.7%			4 100.0% 17.4%
Yellow Sandstone	4 36.4% 40.0%		4 36.4% 66.7%	2 18.2% 40.0%	1 9.1% 100.0%	11 100.0% 47.8%
White Sandstone with Mica	4 66.7% 40.0%		1 16.7% 16.7%	1 16.7% 20.0%		6 100.0% 26.1%
White Sandstone				2 100.0% 40.0%		2 100.0% 8.7%
Column Total	10 43.5% 100.0%	1 4.3% 100.0%	6 26.1% 100.0%	5 21.7% 100.0%	1 4.3% 100.%	23 100.0% 100.0%

Table 15. Ground Stone Found on the Floor of Structure 2

Cells: Count Row Column	Level			Row Total
	Feature fill	Floor	Sub Floor	
Indeterminate	**3 30.0% 42.9%**	**6 60.0% 40.0%**	**1 10.0% 100.0%**	**10 100.0% 43.5%**
Polishing stone	**1 100.0% 14.3%**			**1 100.0% 4.3%**
One-hand Mano		**6 100.0% 40.0%**		**6 100.0% 26.1%**
Metate	**3 60.0% 42.9%**	**2 40.0% 13.3%**		**5 100.0% 21.7%**
Basin Metate		**1 100.0% 6.7%**		**1 100.0% 4.3%**
Column Total	7 30.4% 100.0%	15 65.2% 100.0%	1 4.3% 100.0%	23 100.0% 100.0%

Stratigraphy. The fill of the structure was shallow, consisting of a blackened sand with a little oxidization especially in the center around the hearth. The feature was not found until the overburden, 30 cm thick, was removed. There were no stratigraphic breaks in the fill of the structure.

Architectural Details. The structure is 1.65 m north-south by 1.67 m east-west. The structure is very shallow with a depth of 8 cm to 10 cm.

Walls. The saucer-shaped structure has gently sloping sides that are semicompact and charcoal-stained. Where there is heavy charcoal staining, the walls are compact.

Floor: The floor is also semicompact and charcoal-stained. Near the hearth the floor is more compact and exhibits oxidation. One floor feature was excavated.

Floor Features. A central hearth was excavated that measured 36 cm north-south by 32 cm east-west and 10 cm deep. The fill consisted of charcoal-stained sand and charcoal. The interior and rim of the hearth was reddened. An archaeomagnetic sample was taken from the rim of the hearth, but it did not produce a date. A radiocarbon sample produced a calibrated and corrected dates of A.D. 865 to A.D. 985 with an intercept at A.D. 895. The date places the feature

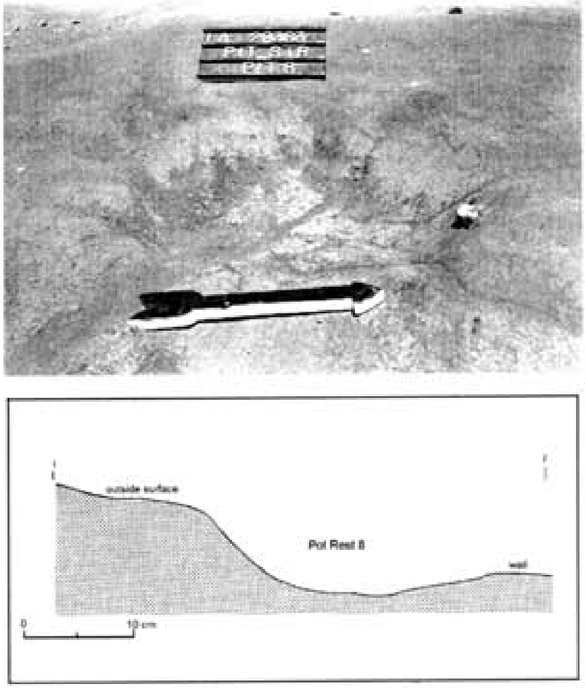


Figure 31. Structure 2, Pot Rest 8; plan and north-south profile.

during the Late Globe phase.

Artifacts

The artifacts for Structure 3 consisted of 16 lithic artifacts, 12 ceramics, and five ground stone items for a total of 33 artifacts.

The recovered ceramics from the structure were from the fill (33.3 percent) and from the hearth (66.7 percent). South Pecos Brown was the dominant ceramic type and all were found in the hearth (Table 16).

Table 16. Ceramics Recovered from Structure 3

Cells: Count Row Column	Level		Row Total
	Structure Fill	Hearth Fill	
Jornada Brown		1 100.0% 12.5%	1 100.0% 8.3%
El Paso Brown	3 100.0% 75.0%		3 100.0% 25.0%
South Pecos Brown		7 100.0% 87.5%	7 100.0% 58.3%
McKenzie Brown	1 100.0% 25.0%		1 100.0% 8.3%
Column Total	4 33.3% 100.0%	8 66.7% 100.0%	12 100.0% 100.0%

Figure 32. Structure 2, Posthole 4.

The chipped stone is well distributed; core flakes, however, dominate the assemblage (Table 17). Chert continues to be the material of choice at 56.3 percent. The majority of the lithic artifacts were recovered from the structure's fill.

Table 17. Lithic Artifacts from Structure 3

Cells: Count Row Column	Material Type		Row Total
	Chert	Quartzite	
Angular Debris	3 50.0% 33.3%	3 50.0% 42.9%	6 100.0% 37.5%
Core Flake	5 55.6% 55.6%	4 44.4% 57.1%	9 100.0% 56.3%
Core	1 100.0% 11.1%		1 100.0% 6.3%
Column Total	9 56.3% 100.0%	7 43.8% 100.0%	16 100.0% 100.0%

The ground stone from this structure consisted of five items (Table 18). All of them were made from sandstone and were differentiated by color and texture. They were recovered either from the structure fill or in the hearth. Two metate fragments were found in the hearth. They exhibited burning, suggesting that they were probably used as hearthstones. The one-hand mano and the metate fragment found in the fill implies food processing.

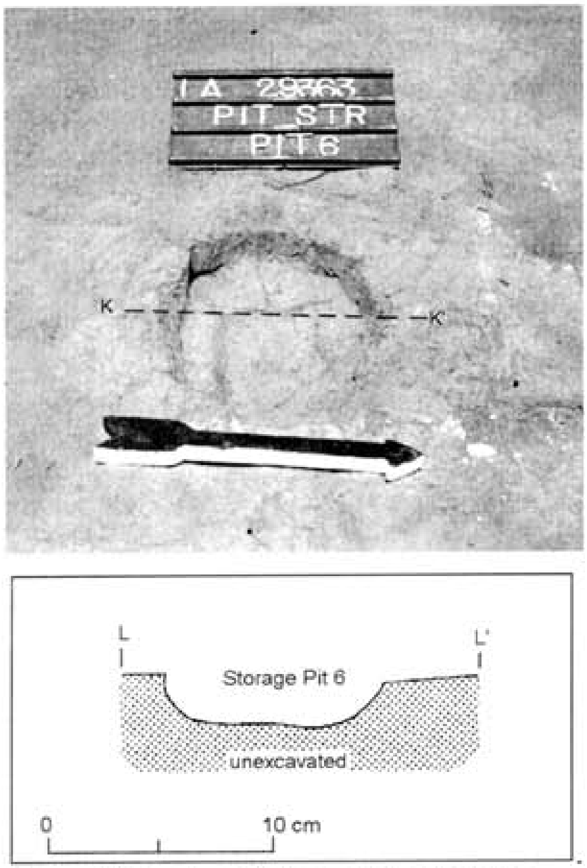


Figure 33. Structure 2, Storage Pit 6; plan and profile.

Table 18. Ground Stone Artifacts, Structure 3

Cells: Count Row Column	Artifact Function		Row Total
	One-hand Mano	Metate	
Red Sandstone	1 100.0% 50.0%		1 100.0% 20.0%
Yellow Sandstone	1 25.0% 50.0%	3 75.0% 100.0%	4 100.0% 80.0%
Column Total	2 40.0% 100.0%	3 60.0% 100.0%	4 100.0% 100.0%

Area C

Area C is located between two large hummocks and has been deflated to 15 cm above the red sterile sand. The vegetation surrounding the location consists of large sumac and mesquite bushes. It is protected by large dunes from the winds blowing in any direction. The scatter of a few artifacts, the presence of a small one-hand mano, and a light scatter of fire-cracked rock was the basis for excavating in this area. The outline of the structure was found 25 cm below the present ground surface. The fire-cracked rock was not associated with the structure. The rock was probably associated with a now-deflated thermal feature. Part of the dune was removed by hand, the rest by mechanical means.

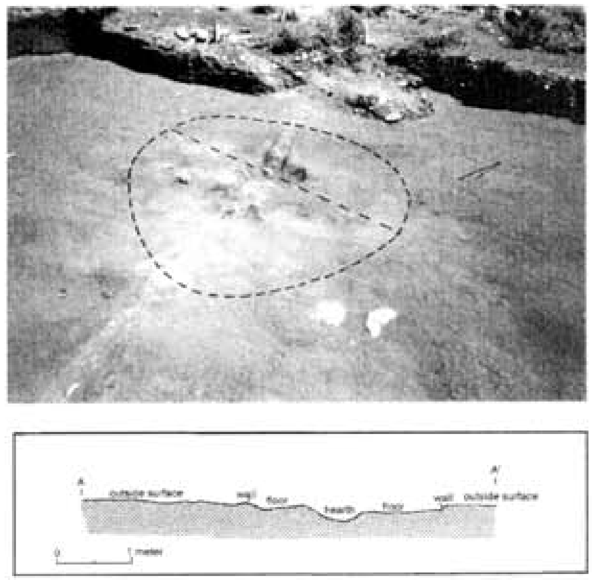


Figure 34. Structure 3, facing northwest; plan and east-west profile.

Structure 4

Structure 4 is located in the southern portion of Area C (Fig. 35) and is approximately 72.0 m south of Area B. It was situated between two large sand dunes with heavy vegetation. The structure is a very shallow, saucer-shaped, circular feature that was burned and contains three postholes and a hearth. Two extramural features, a roasting pit and a storage pit, were found on the utilized exterior surface. Two other pits, a hearth, and a storage pit were excavated 14.0 m north of the Structure. Two calibrated and corrected C-14 dates were obtained. One was from a roasting pit from the structure, which produced a date of A.D. 690 to A.D. 970 with an intercept date of A.D. 885. The other was from an interior hearth, which dated A.D. 680 to A.D. 905 with an intercept date of A.D. 790. The two calibrated dating periods are statistically the same.

Stratigraphy. There was only one stratigraphic level in the fill of the structure. It consisted of a mottled dark brown soil that had been charcoal-stained.

Architectural Details. Structure 4 is 2.0 m north-south by 3.0 m east-west, with a depth of 4 cm (Fig. 36).

Walls. The sides of the pit were 2 to 3 cm deep with the lowest point in the center of the structure. The charcoal-stained side walls were compacted sand.

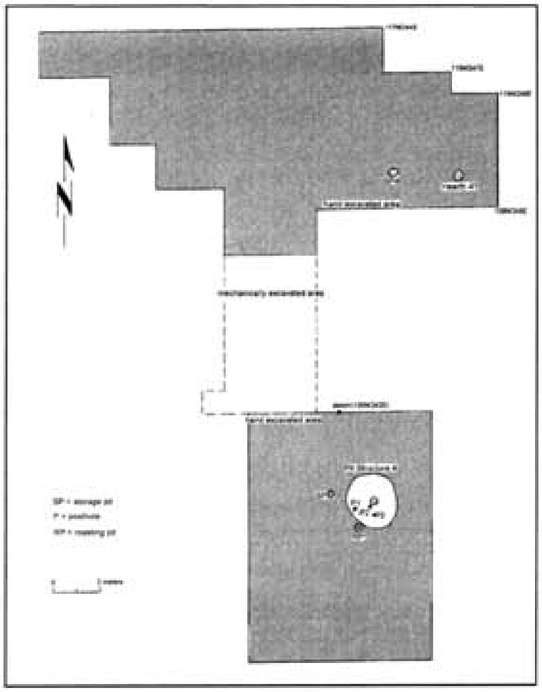


Figure 35. Area C and extension; Pit Structure 4.

Floor. The floor, like the walls, consisted of a compact charcoal-stained sand, which in some areas was oxidized.

Floor Features. Four interior features were excavated, consisting of a hearth and three postholes.

Hearth. The hearth is located almost in the center of the feature (Fig. 37). It is 34 cm north-south by 41 cm east-west and 8 cm deep. It has been disturbed by extensive rodent burrowing along the northeast portion. The bottom of the hearth was also disturbed by rodent activity. The fill of the hearth consisted of black, charcoal-stained sand with fragments of burned wood. The interior of the hearth exhibited spots of oxidation along the sides and bottom.

Postholes. The postholes that were excavated were first thought to have been rodent burrows; however, when the fill was removed, the features were obviously purposefully well constructed. The sides and bottom of the holes were compact reddish sand that did not resemble a rodent burrow (Fig. 37). The fill consisted of yellow sand with charcoal with a mean depth of 4 cm (Table 19).

Table 19. Posthole Measurements, Structure 4

Posthole Number	Diameter (cm)	Depth (cm)
1	12	2
2	15	6
3	15	5

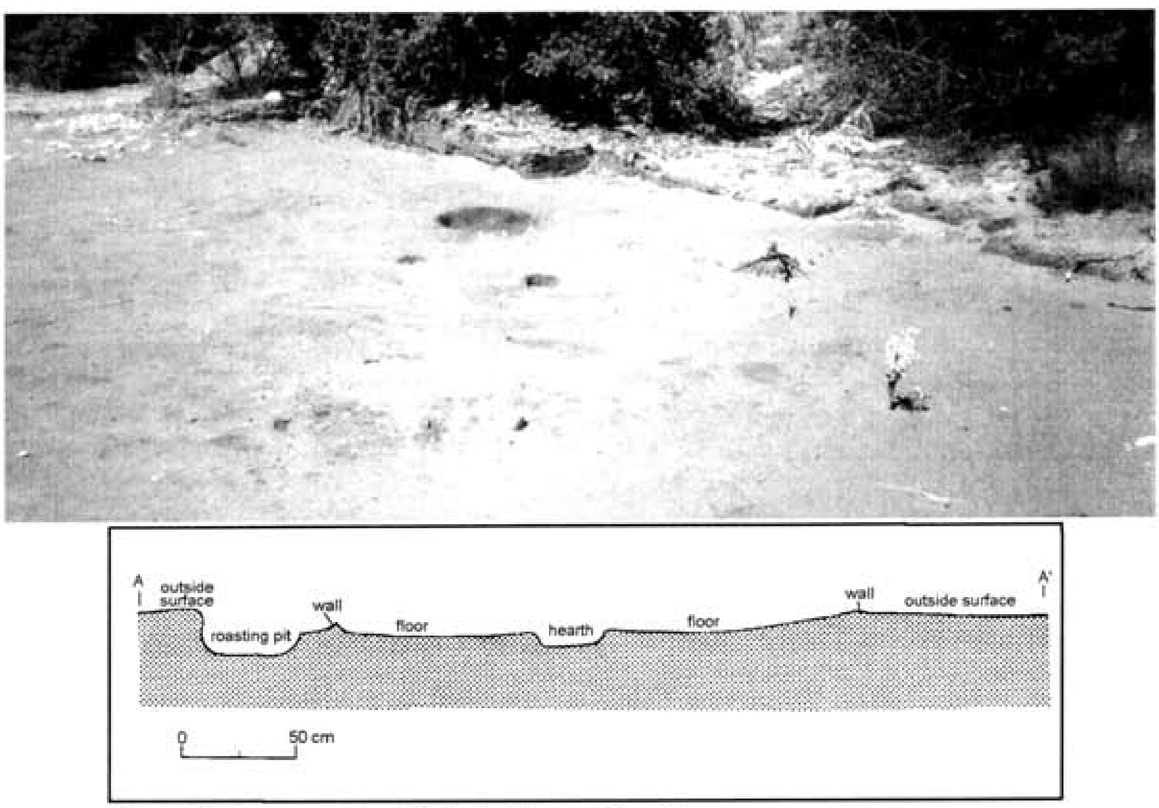


Figure 36. Structure 4; profile including roasting pit.

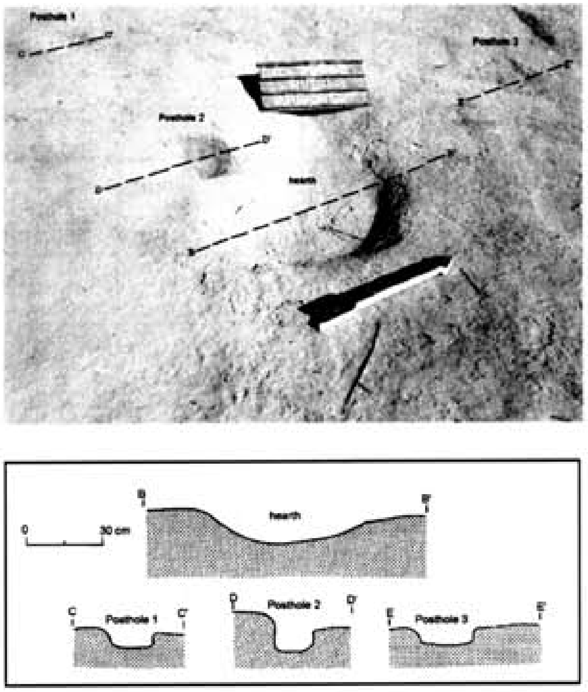


Figure 37. Structure 4 interior hearth and postholes.

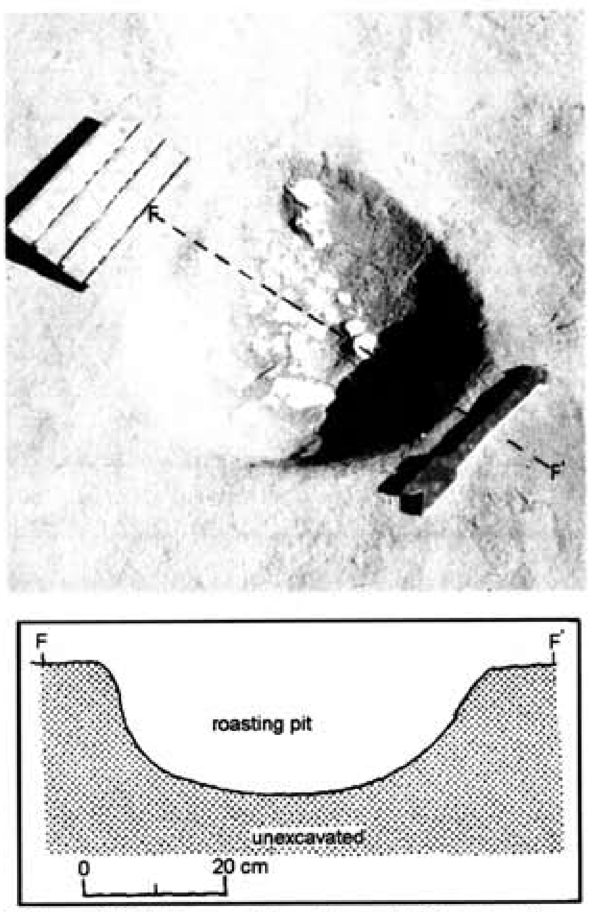


Figure 38. Extramural roasting pit, Structure 4.

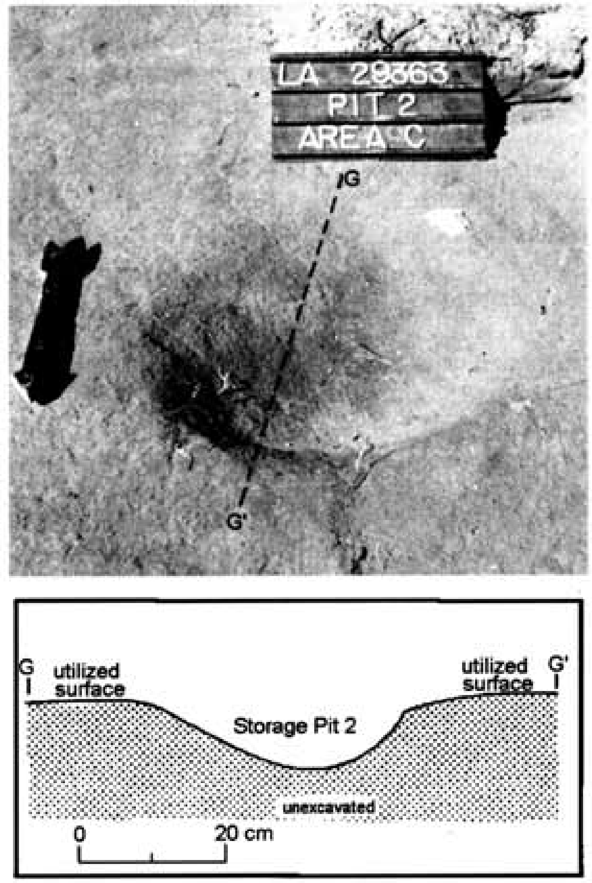


Figure 39. Extramural storage pit, Structure 4.

Extramural Features

Two features were excavated outside of Structure 4. They consisted of a roasting pit measuring 55 cm in diameter and a depth of 18 cm (Fig. 38). The bottom of the pit contained small cobbles and a few lined the sides. The fill was blackened by charcoal; however the charcoal consisted of a few minute fragments, not enough for a C-14 date.

A storage pit was also excavated 1.20 m northwest of the roasting pit. It is oval-shaped and measures 47 cm north-south by 35 cm east-west and 8 cm deep (Fig. 39). The fill was a black charcoal-stained sand with very little charcoal. Soil oxidation was present in small areas suggesting burning.

Artifacts

Area C contained over 200 artifacts. Most of the artifacts were from the area around Structure 4. Of 132 lithic artifacts, 84.2 percent are made from chert (Table 20). Out of 80 ceramics, South Pecos Brown represents 76.3 percent of the assemblage (Table 21). Two indeterminate ground stone artifacts made of red sandstone were recovered from the surface.

Seven artifacts were recovered from inside the structure. They consisted of a Jornada Brown sherd, El Paso Brown sherd, three pieces of angular debris, a core flake, and a biface flake. The lithic artifacts were made of chert and siltstone. No ground stone was present in the structure.

Area C Extension

Two other thermal pits were found in the extension. Pit 40 was found 28 cm under the modern sand. It is 34 cm north-south by 44 cm east-west and 8 cm deep (Fig. 40). The fill consisted of mottled blackened sand with charcoal. Pit 40 may have served as a hearth.

Pit 41 is a hearth, which was found under a small 40-cm-high sand dune. It is 43 cm north-south by 38 cm east-west and 25 cm deep (Fig. 41). The fill was black, charcoal- filled sand. It contained a single flake, which had been burned. A calibrated and corrected C-14 date of A.D. 665 to A.D. 885 was obtained with a intercept date of A.D. 775, placing it during the Middle to Late Globe phase.

Area D

Area D is located on the east side of the North Loop Road (Fig. 42). It covered 472 sq m (1,548 sq ft), of which 299 sq m was hand excavated. Mechanically removed fill included dunes over 2.0 m high. Below these dunes were cultural features including Structure 5, several storage pits, postholes, hearths, and a ramada-like unit.

Structure 5

Structure 5 was found under a 2.6-m-high sand dune. The overburden was removed mechanically. It is a saucer-shaped, irregular oval that is very shallow. Within the structure were a rectangular pit and two small postholes. There was no hearth present; however, the exterior fire-cracked area and a small thermal feature would suggest that most of the activities were performed outside. There is not a C-14 date for the structure itself, but an external pit, Pit 61, did produce a calibrated and corrected date of A.D. 655 to A.D. 890 with an intercept date of A.D. 770.

Stratigraphy. The fill of the feature consisted of a charcoal-stained, dark brown sand, 10YR 3/3 on the Munsell color chart. There were no stratigraphic breaks within the fill.

Architectural Details. The structure is 1.30 m north-south by 1.29 m east-west and 2 cm deep (Fig. 43).

Walls. The sides of the structure are 2 cm high and consist of semicompact reddish sand.

Table 20. Lithic Artifacts from Area C

Cells: Count Row Column	Material Type			Row Total
	Chert	Siltstone	Quartzite	
Angular Debris	32 78.0% 33.3%	2 4.9% 100.0%	7 17.1% 43.8%	41 100.0% 36.0%
Core Flake	61 89.7% 63.5%		7 10.3% 43.8%	68 100.0% 59.6%
Biface Flake	1 100.0% 1.0%			1 100.0% .9%
Tested Cobble			1 100.0% 6.3%	1 100.0% .9%
Multi-directional Core	2 66.7% 2.1%		1 33.3% 6.3%	3 100.0% 2.6%
Column Total	96 84.2% 100.0%	2 1.8% 100.0%	16 14.0% 100.0%	132 100.0% 100.0%

Table 21. Ceramics from Area C

Cells: Count Row Column	**Level**			**Row Total**
	Surface	**General Fill**	**Feature Fill**	
Jornada Brown		2 66.7% 2.6%	1 33.3% 50.0%	3 100.0% 3.8%
El Paso Brown		9 90.0% 11.7%	1 10.0% 50.0%	10 100.0% 12.5%
South Pecos Brown	1 1.6% 100.0%	60 98.4% 77.9%		61 100.0% 76.3%
Jornada/South Pecos Brown		5 100.0% 6.5%		5 100.0% 6.3%
McKenzie Brown		1 100.0% 1.3%		1 100.0% 1.3%
Column Total	1 1.3% 100.0%	77 96.3% 100.0%	2 2.5% 100.0%	80 100.0% 100.0%

Floor. The floor is a fairly even, reddish brown sand with little staining and no oxidization.

Floor Features. Three features were found on the floor of the structure (Fig. 44). They consist of a rectangular-shaped pit and two small postholes. The Pit is 24 cm long, 8 cm wide, and 10 cm deep. The fill was mottled with black, charcoal-stained sand and minute charcoal flecks. The interior of the pit was very compact sand, suggesting it had been smoothed.

The two postholes are small, 12 cm in diameter and 5 cm deep. The interiors of these postholes were also

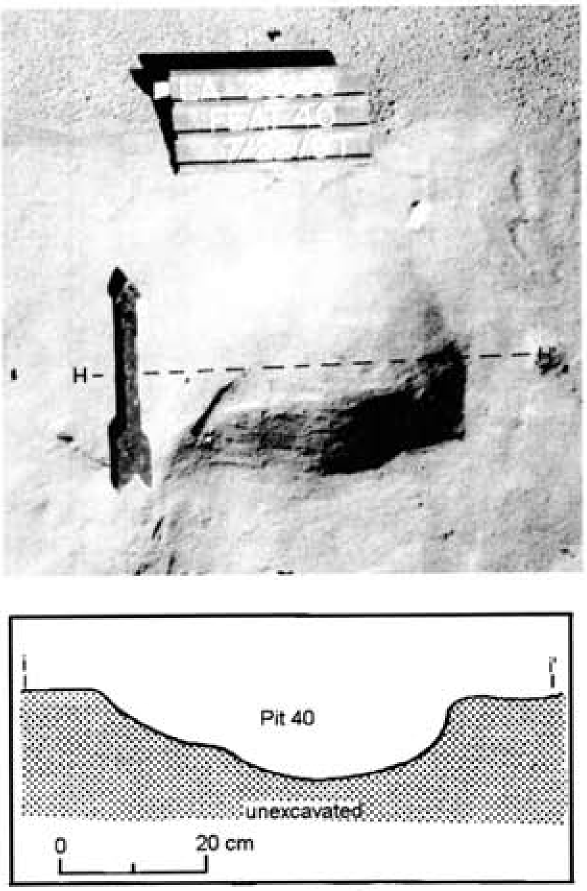


Figure 40. Pit 40, plan and profile.

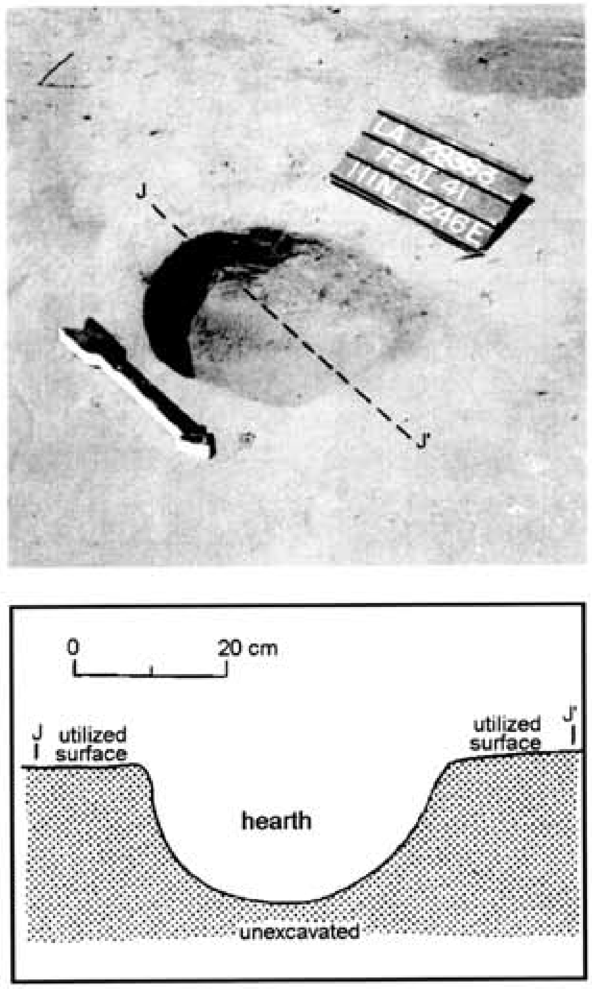


Figure 41. Area C Extension, hearth; plan and profile.

composed of compact sand, exhibiting a smoothed appearance. The fill consisted of dark brown sand with minute flecks of charcoal.

Extramural Features

Several pits near the structure were excavated (Table 22), including a roasting pit, a thermal pit (60), a possible roasting pit (61), a storage pit (63) and two postholes (62 and 67). The fill of the storage pits and the postholes consisted of a dark brown sand with charcoal flecking (Figs. 45-46). The thermal feature contained fill that was black and contained charcoal. Oxidization was present at the bottom of the pit and there was a small scatter of fire-cracked rock around it. The roasting area consisted of fire-cracked rock that seemed as though it had been deflated. There was no evidence of a pit, only the concentration of rocks. The rocks exhibited a little oxidation and the soil around it was slightly blackened.

It is possible that there may have been some type of structure near the roasting pit as suggested by the presence of the two postholes.

Table 22. Extramural Pit Dimensions in Area D

Feature	Length (cm)	Width (cm)	Depth (cm)
60	56	46	6
61	52	62	12
62	12	12	5
63	20	20	8
67	4	4	10

Isolated Hearths

Two isolated hearths were found under a 1.69-m-high dune. The area around the hearths was charcoal-stained, and in areas, charcoal was present. There was a low density of artifacts recovered from this area. The hearths are adjacent to one another and are very similar. The fill of both was mottled black charcoal-stained sand with little charcoal.

Thermal Pit 50 is 55 cm north-south by 56 cm east-west and is 24 cm deep. The feature was dug into

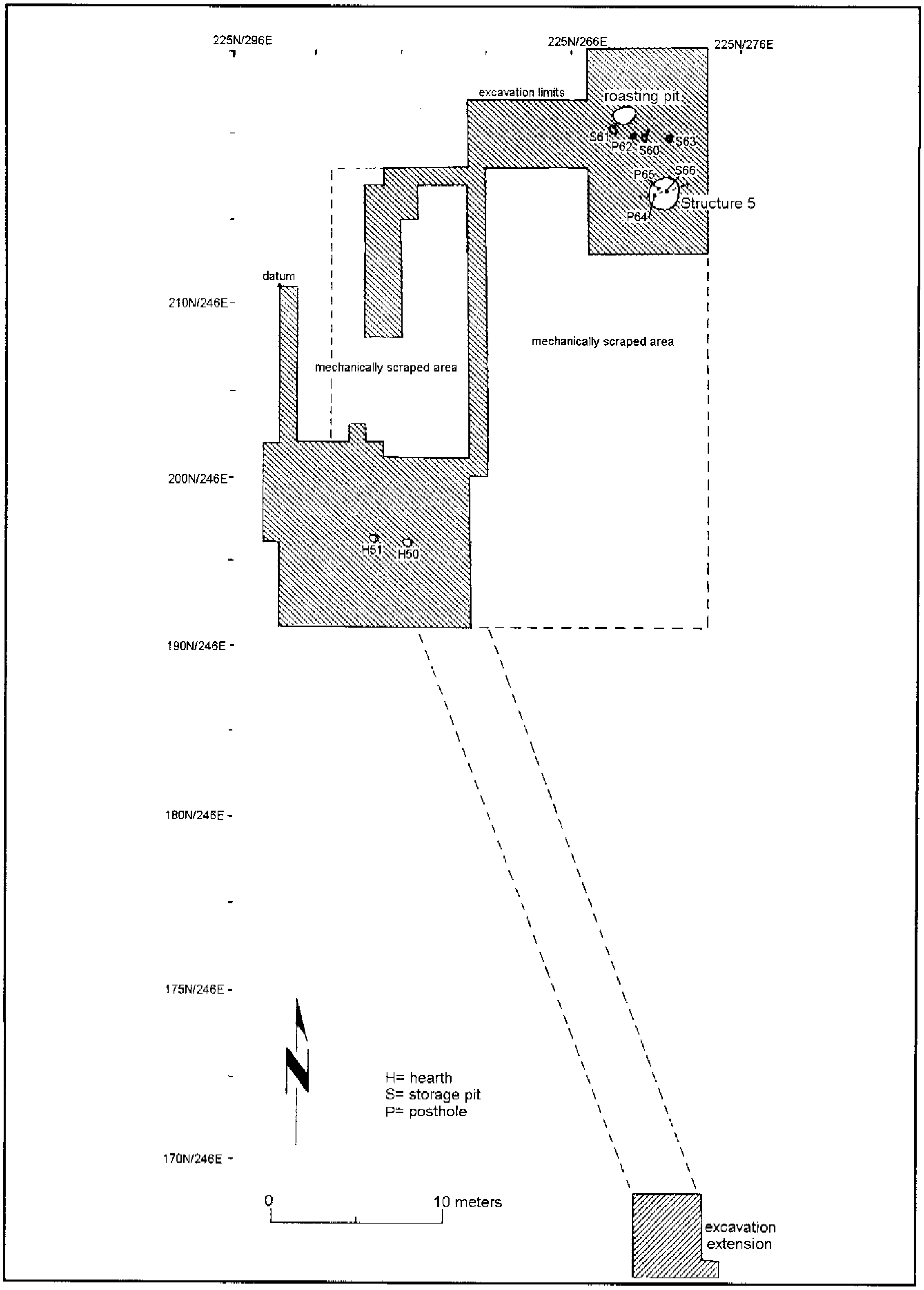


Figure 42. Area D, showing hand excavations and mechanical scraping limits.

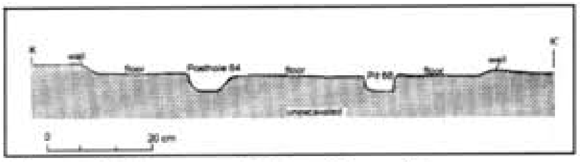


Figure 43. Structure 5, Area D, profile.

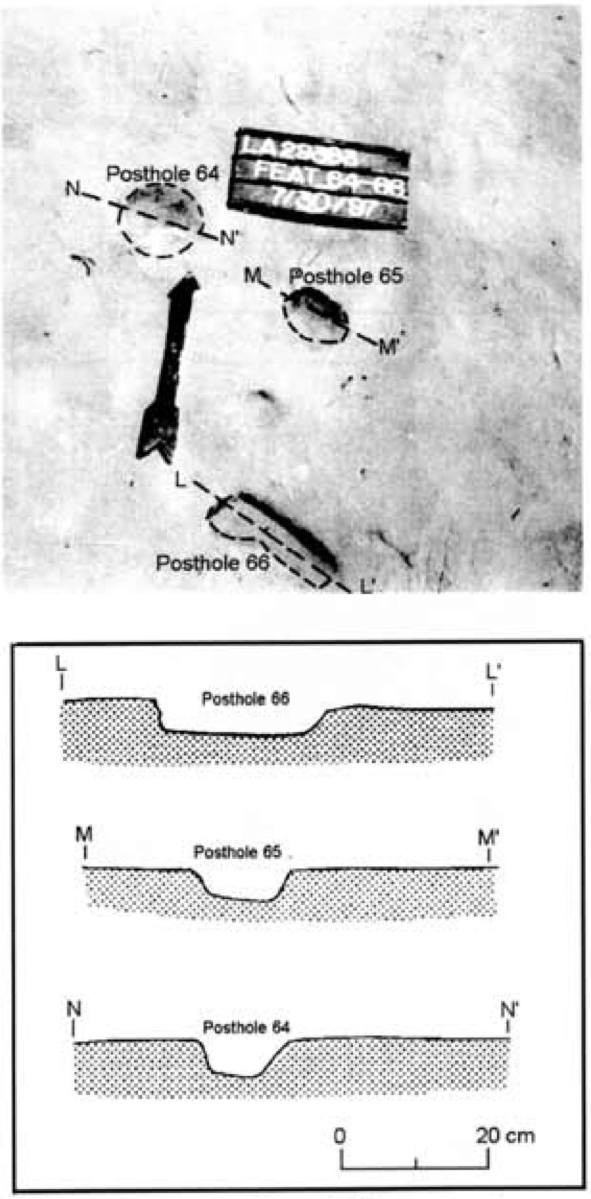


Figure 44. Structure 5 interior features and profiles.

the sterile sand with the sides gently sloping making a circular basin shape (Fig. 47). Thermal Pit 51 is 55 cm north-south by 53 cm east-west and 22 cm deep. The pit is a deep basin with charcoal-stained walls (Fig. 48). No

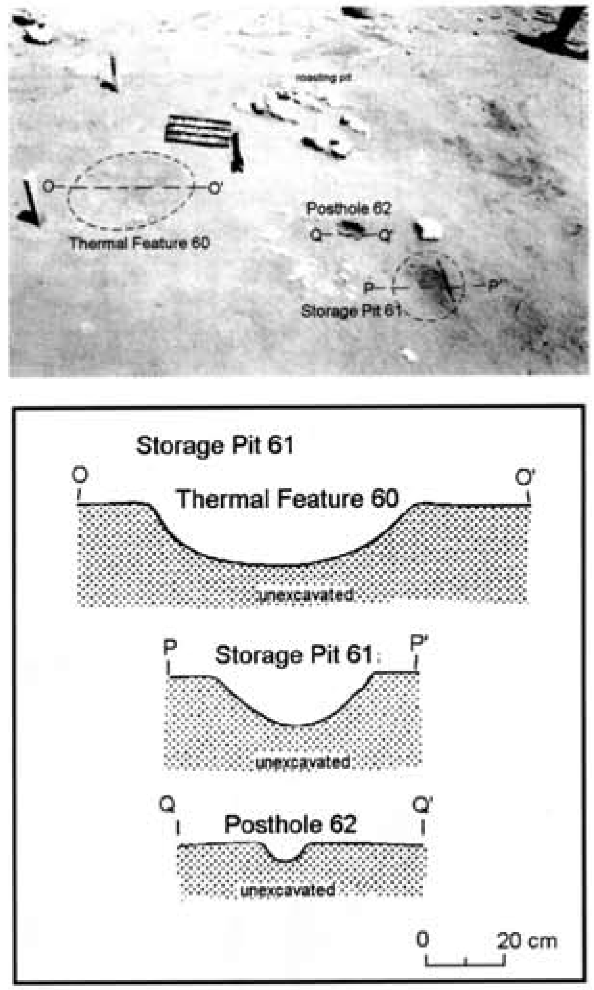


Figure 45. Deflated, rock-lined roasting pit (top of photograph); Thermal Feature 60 (left); Posthole 62 (center); Storage Pit 61 (right). All profiles are east-west.

artifacts were recovered from the fill of the features; however two C-14 samples produced calibrated and corrected dates of A.D. 660 to A.D. 1205 (with an A.D. 960 intercept) for Thermal Pit 50 and A.D. 640 to A.D. 890 (with an A.D. 705 intercept) for Thermal Pit 51. It is possible that Feature 50 was reused as suggested by the radiocarbon dates.

Artifacts

The artifacts from Area D consisted mostly of lithic artifacts, which totaled 264 items (Table 23). The ceramics (Table 24) and the ground stone (n = 1) were fewer in number. The ground stone is represented by one metate fragment. Posthole 62 contained one El Paso Brown ceramic and three core flakes. Pit 60 also contained one angular debris artifact.

Table 23. Lithic Artifacts from Area D

Cells: Count Row Column	Material Types					Row Total
	Chert	Chalcedony	Silicified Wood	Siltstone	Quartzite	
Angular Debris	51 76.1% 24.4%	1 1.5% 50.0%	1 1.5% 100.0%		14 20.9% 27.5%	67 100.0% 25.4%
Core Flake	151 79.5% 72.2%	1 .5% 50.0%		1 .5% 100.0%	37 19.5% 72.5%^	190 100.0% 72.0%
Tested Cobble	4 100.0% 1.9%					4 100.0% 1.5%
Core	3 100.0% 1.4%					3 100.0% 1.1%
Column Total	209 79.2% 100.0%	2 .8% 100.0%	1 .4% 100.0%	1 .4% 100.0%	51 19.3% 100.0%	264 100.0% 100.0%

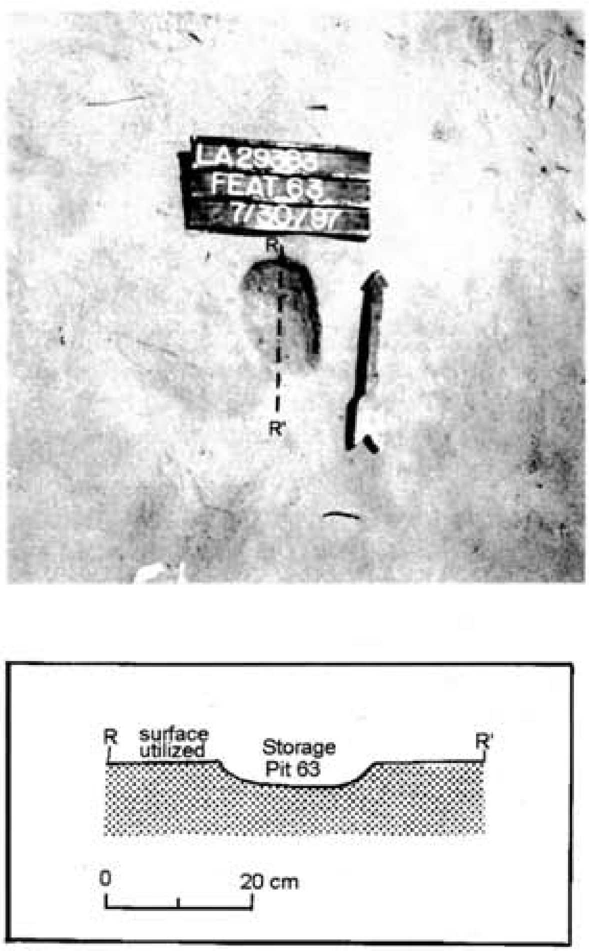


Figure 46. Area D, Storage Pit 63; plan and north-south profile.

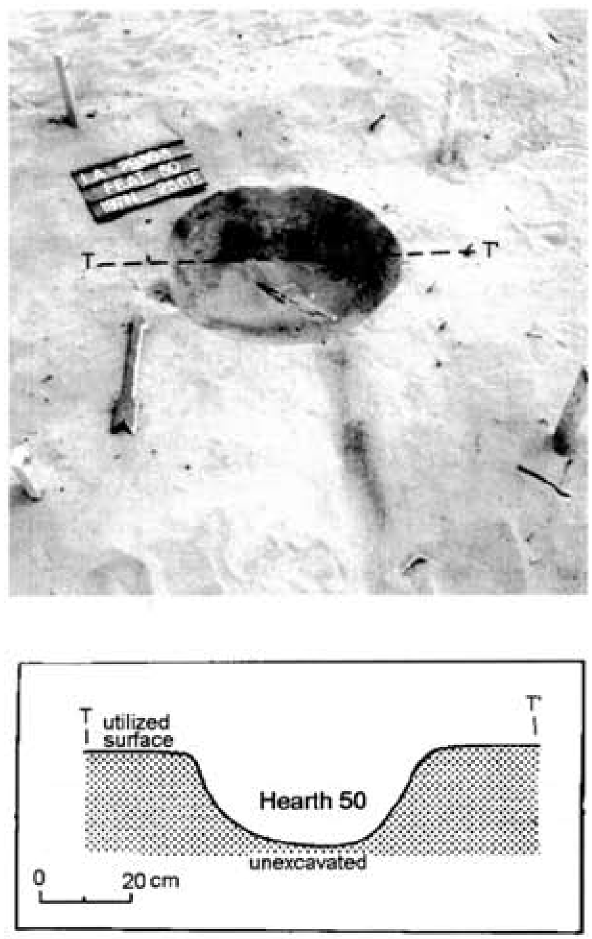


Figure 47. Area D, Hearth 50; plan and east-west profile.

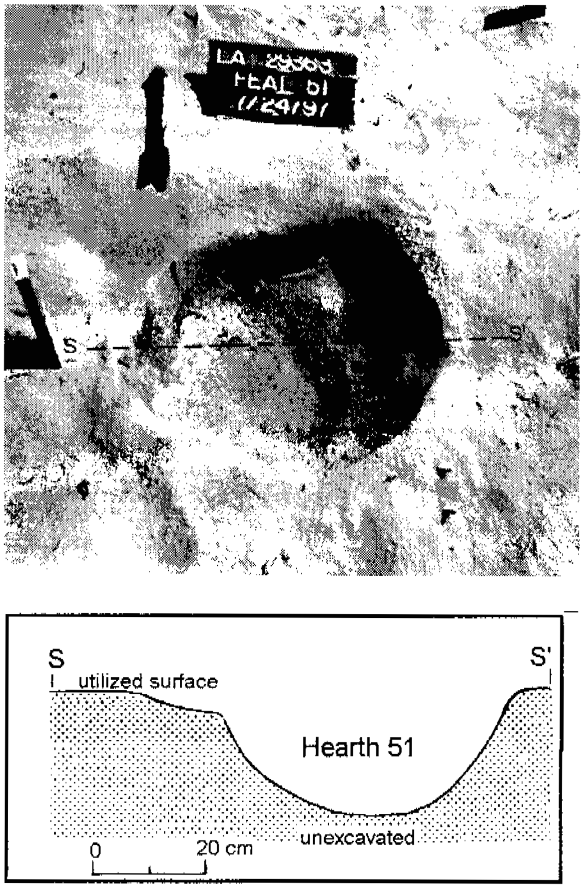


Figure 48. Area D, Hearth 51, plan and east-west profile.

Table 24. Ceramic Artifacts from Area D

Cells: Count Row Column	Level		Row Total
	General Fill	Subfloor	
Joranda Brown	4 100.0% 13.3%		4 100.0% 12.9%
El Paso Brown	22 95.7% 73.3%	1 4.3% 100.0%	23 100.0% 74.2%
South Pecos Brown	2 100.0% 6.7%		2 100.0% 6.5%
Jornada/South Pecos Brown	2 100.0% 6.7%		2 100.0% 6.5%
Column Total	30 96.8% 100.0%	1 3.2% 100.0%	31 100.0% 100.0%

Area E

Area E is located to the east across the North Loop Road on the top of the knoll. A total of 66 sq m (710 sq ft) were surface-stripped around a hearth built on top of the bedrock (Fig. 49). In most cases, bedrock was reached through excavation except in areas around the vegetation. One grid unit was taken down to bedrock (23 cm) and reached sterile red sand. Although there was some depth in this area, approximately 20 cm, the hearth was visible on the surface. Fire-cracked rock was scattered in a 1-m area and the soil was charcoal-stained.

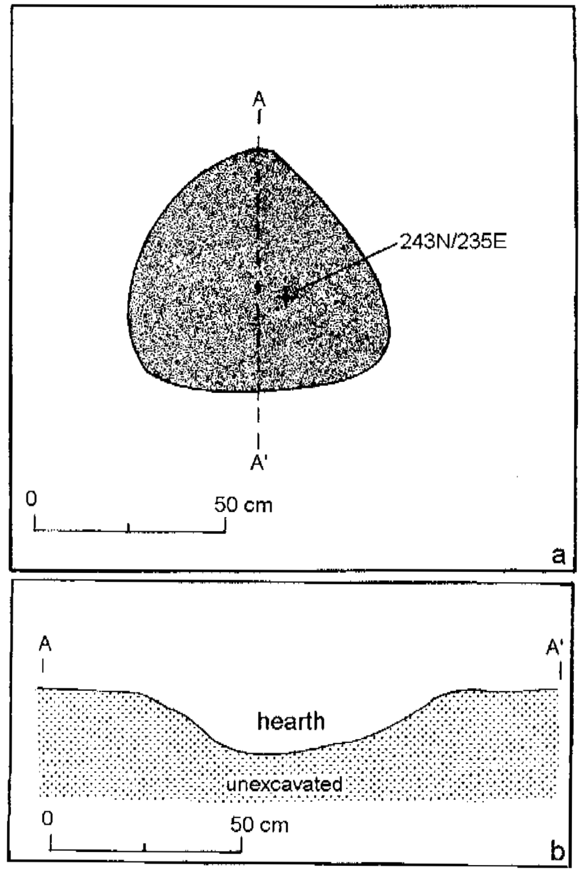


Figure 49. Area E, Hearth, plan and north-south profile.

The hearth measured 44 cm north-south by 60 cm east-west and 12 cm deep (Fig. 49). The fill of the feature was heavily stained sand with bits of oxidized sand. The bedrock under the fill was also burned, exhibiting oxidization and crazing. Enough charcoal was present for a C-14 sample. A calibrated and corrected date of A.D. 800 to A.D. 1300 with an intercept at A.D. 975 was produced for the hearth. This places the feature into the later portion of the Middle Globe phase and the beginning of the Late Globe phase. There were no artifacts associated with this feature.

Artifacts

Although no artifacts were found in the hearth, the area excavated around the feature produced 129 lithic artifacts, six ceramics, and four ground stone artifacts. The chipped stone artifacts consisted of mostly core flakes (Table 25).

Table 25. Lithic Artifacts from Area E

Cells: Count Row Column	Artifact Morphology			Row Total
	Angular Debris	Core Flake	Core	
Chert	23 20.9% 85.2%	83 75.5% 84.7%	4 3.6% 100.0%	110 100.0% 85.3%
Chalcedony	1 33.3% 3.7%	2 66.7% 2.0%		3 100.0% 2.3%
Quartzite	3 20.0% 11.1%	12 80.0% 12.2%		15 100.0% 11.6%
Basalt		1 100.0% 1.0%		1 100.0% .8%
Column Total	27 20.9% 100.0%	98 76.0% 100.0%	4 3.1% 100.0%	129 100.0% 100.0%

The ceramics recovered consisted of two types, El Paso Brown (n = 1) and South Pecos Brown (n = 5). The ground stone fragments consisted of two basin metates, one slab metate, and an indeterminant fragment. Their functions were determined by the shape of the ground surface. The basin metates had concave grinding surfaces with circular striations and the slab metate had a flat grinding surface.

Area F

Area F was under a 2.0-m-high sand dune, of which half was removed by hand. It covers an area of 577 sq m (6,211 sq ft), of which 233 sq m (2,508 sq ft) were hand excavated and 354 sq m (3,810 sq ft) were removed mechanically (Fig. 50). It contained hearths, storage pits, and a roasting pit. Under the sand dunes, an area with 15 features was excavated (Figs. 51-52). These features included hearths, postholes, storage pits, and a roasting pit. The pits had been dug into the reddish sterile compact sand.

Thermal Features. The thermal features were identified by the amount of charcoal found in the fill of the pit (Table 26). Oxidization was another factor that was considered. The fill of the thermal features consisted of charcoal-stained sand with charcoal and charcoal flecking (Figs. 53-57). Burned rocks were usually found in the soil and exhibited reddening. C-14 samples were collected from each of the thermal features along with flotation samples. Pit 29 was rock-lined with limestone at the bottom of the pit. The charcoal flecks present in the fill were too small and too few to collect.

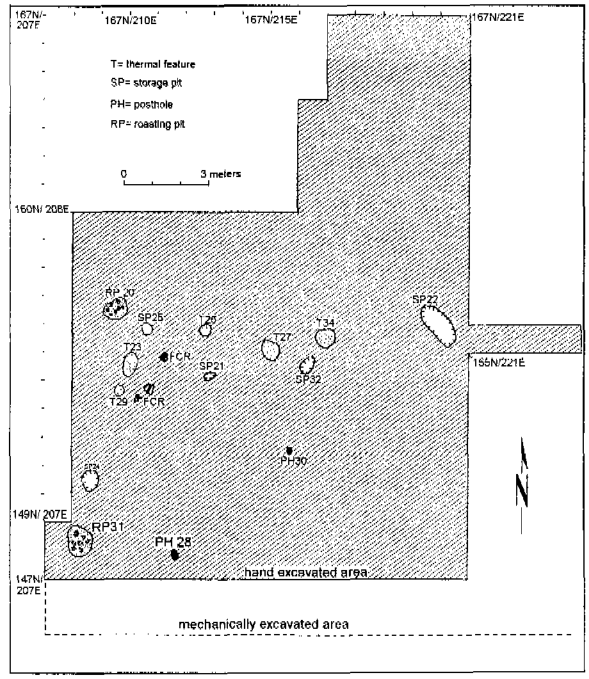


Figure 50. Area F, plan view of excavations.

Table 26. Thermal Feature Measurements

Feature Number	Length (cm)	Width (cm)	Depth (cm)	Date
20 Roasting Pit	35	48	9	
23	80	43	25	A.D. 655 to A.D. 890
26	47	56	22	
27	60	52	27	A.D. 675 to A.D. 895
29	32	30	7	
34	42	40	7	A.D. 540 to A.D. 890

A roasting pit (31) was also excavated and was located east from the main concentration of pits (Fig. 58). It was under a mesquite bush causing the fire-cracked rock to be scattered. The pit was a very shallow irregular oval with charcoal-stained sand. Limestone lined the bottom of the pit, which was 86 cm long by 81 cm wide and 9 cm deep (Figs. 59-60). The limestone rocks exhibited blackening and characteristic burning such as breaking and crazing. A light scatter of fire-cracked rock was also present outside the feature. Charcoal was found throughout the feature and produced a date of 2460 B.C. to 2165 B.C. with an intercept date of 2280 B.C., suggesting use during the Middle Archaic period.

Storage Pits. Several pits that did not exhibit burning were identified as storage pits (Figs. 61-66). The fill from these pits was a reddish brown, mottled sand that did not contain any charcoal (Table 27).

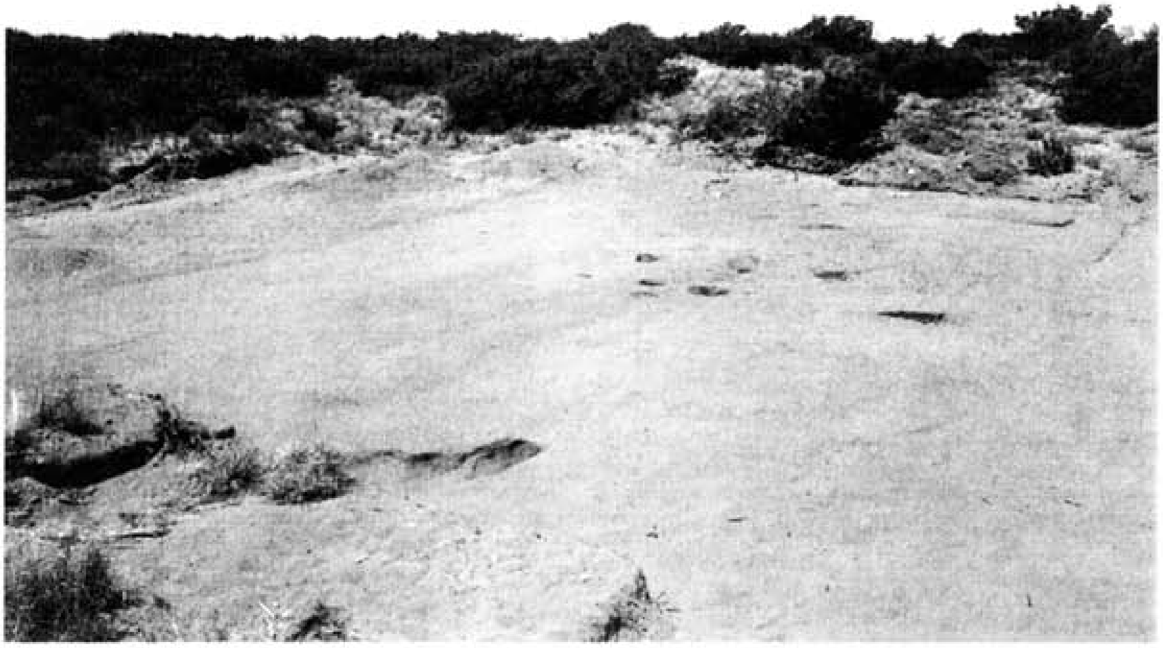


Figure 51. Area F, pits, facing south.

Figure 52. Area F pits, facing south.

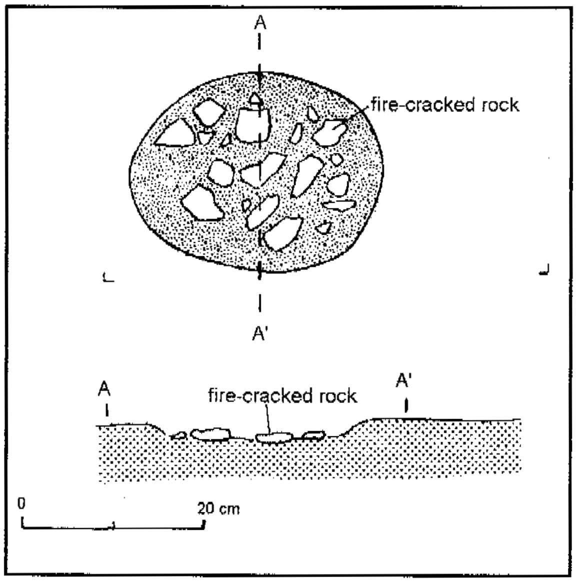


Figure 53. Area F, Thermal Feature 20, plan and profile.

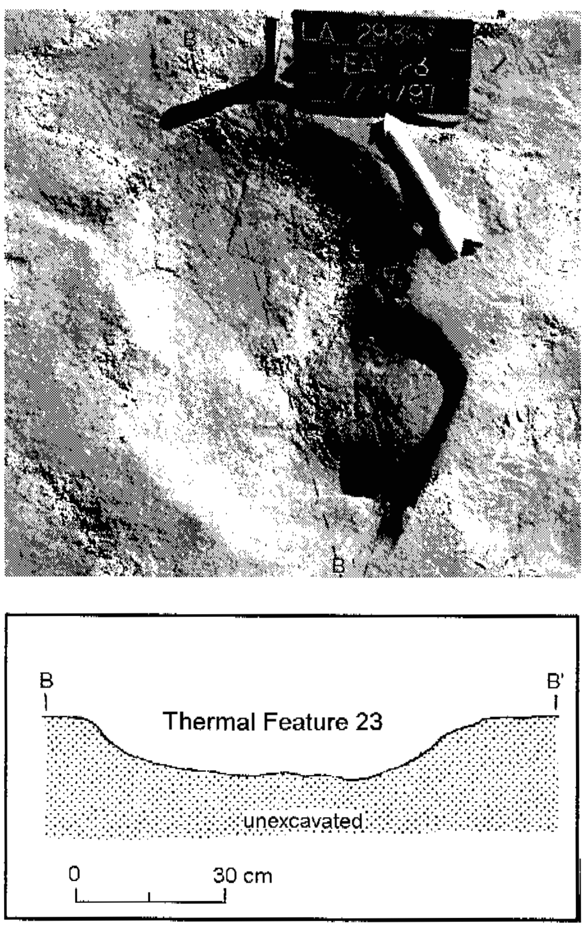


Figure 54. Area F, Thermal Feature 23, plan and north-south profile.

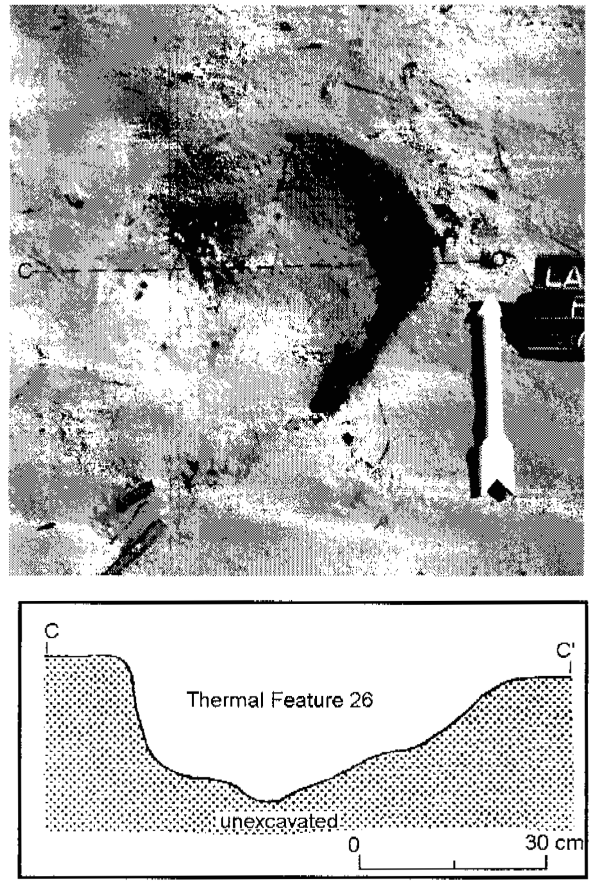


Figure 55. Area F, Thermal Feature 26, plan and profile.

Table 27. Area F Storage Pit Measurements

Feature Number	Length (cm)	Width (cm)	Depth (cm)	Date
21	46	46	14	A.D. 885 to A.D. 1035
22	74	104	37	
24	34	30	7	
25	37	25	5	
32	40	50	12	
33	50	38	7	

Postholes. Two possible postholes were excavated. They were small, shallow, round features (Figs. 67-69). One (28) was 20 cm in diameter and 5 cm deep and the other (30) was 10 cm in diameter and 5 cm deep. The fill was a charcoal-stained sand with charcoal flecking. No artifacts were found in the fill. The interiors of each were compacted sand. No rodent activity was noted in either of the features.

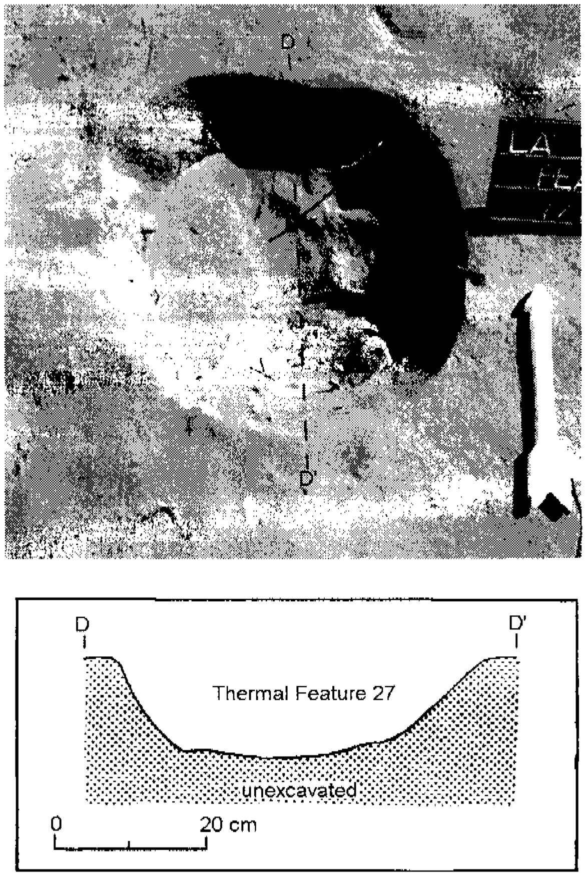


Figure 56. Area F, Thermal Feature 27, north-south profile.

Artifacts

A total of 298 artifacts were recovered from Area F. This includes the surface, subsurface, and feature artifacts (Table 28).

Table 28. Artifacts from Area F

Cells: Count Row Column	Level			Row Total
	Surface	General Fill	Feature Fill	
Lithic Artifact	5 2.1% 83.3%	208 90.0% 84.2%	18 7.7% 40.0%	231 100.0% 77.5%
Ceramics	1 1.9% 16.6%	35 67.3% 14.1%	16 30.7% 35.5%	52 100.0% 17.4%
Ground Stone		4 100.0% 1.6%		4 100.0% 1.3%
Fauna			11 100.0% 24.4%	11 100.0% 3.6%
Column Total	6 2.0% 100.0%	247 82.8% 100.0%	45 15.1% 100.0%	298 100.0% 100.0%

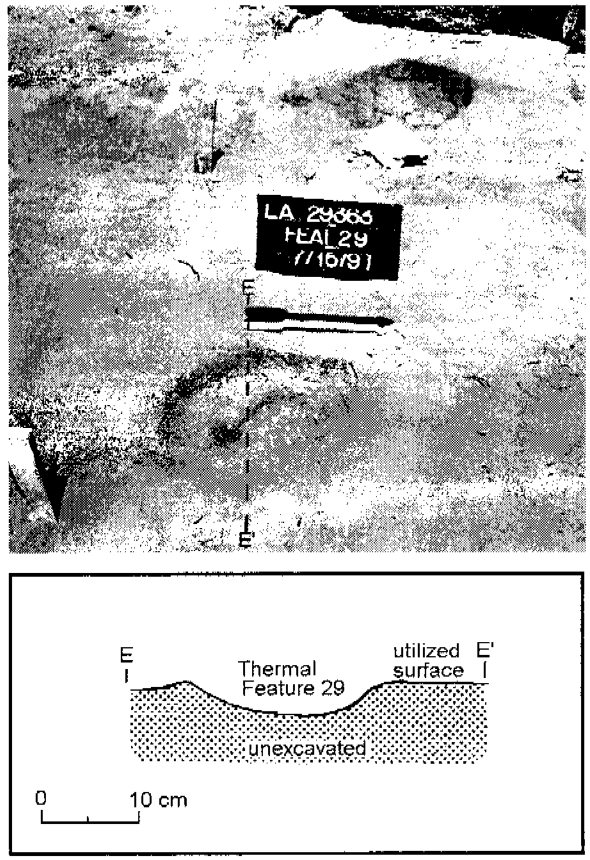


Figure 57. Area F, Thermal Feature 29, plan view and east-west profile.

Several features did contain artifacts including chipped stone and ceramics. The lithic artifacts totaled 18 items (Table 29).

The ceramics from the features place them during the Formative period (Table 30). The C-14 dates range from A.D. 655 to A.D. 1035, which suggests that the features were used during the Globe phase.

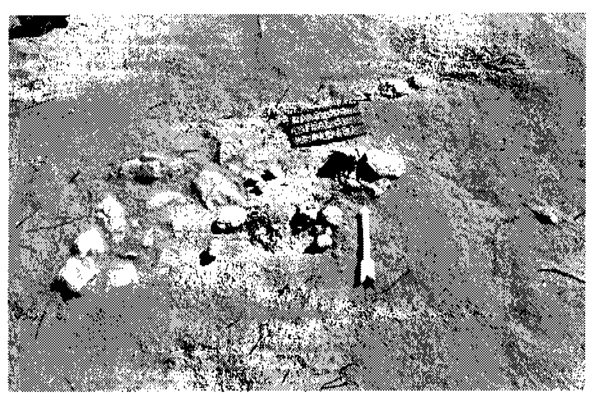


Figure 58. Exposed roasting pit, before excavation.

Figure 59. Excavated roasting pit with fire-cracked rock removed.

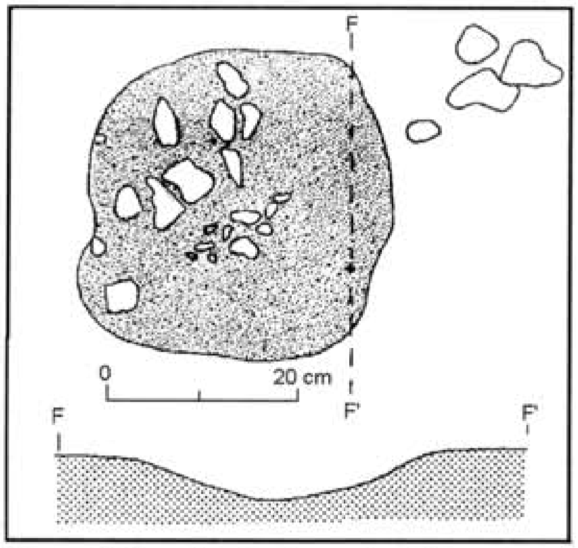


Figure 60. Roasting pit, plan and profile.

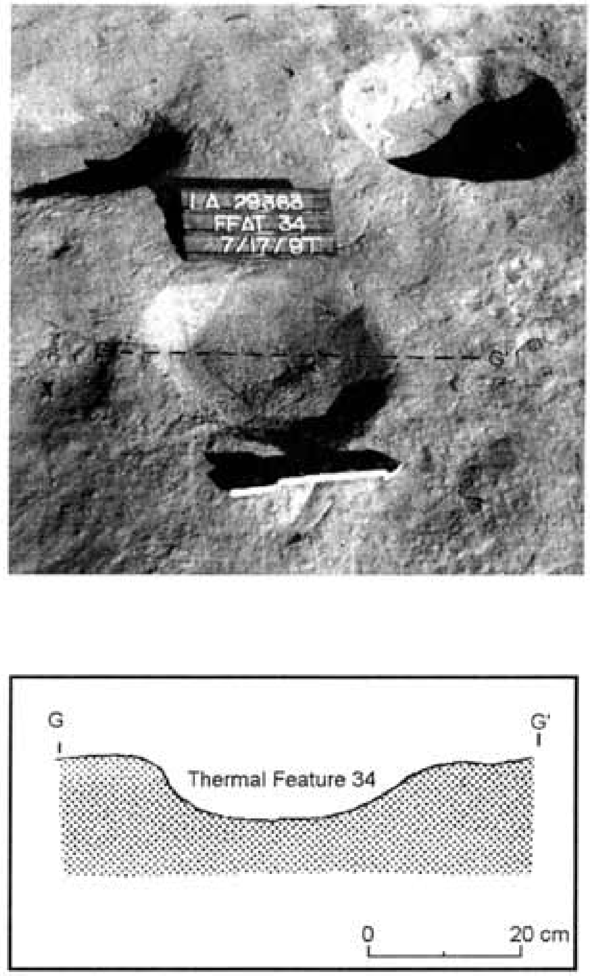


Figure 61. Area F, thermal Feature 34; Storage Pit 33 is on the left and thermal Feature 27 is on the right; north-south profile.

Table 29. Lithic Artifacts by Feature in Area F

Cells: Count Row Column	Feature							Row Total
	Thermal Pit 20	Storage Pit 21	Storage Pit 22	Thermal Pit 26	Thermal Pit 27	Thermal Pit 29	Storage Pit 32	
Angular Debris	1 50.0% 100.0%			1 50.0% 100.0%				2 100.0% 11.1%
Core Flake		3 20.0% 100.0%	3 20.0% 75.0%		7 46.7% 100.0%	1 6.7% 100.0%	1 6.7% 100.0%	15 100.0% 83.3%
Biface Flake			1 100.0% 25.0%					1 100.0% 5.6%
Column Total	1 5.6% 100.0%	3 16.7% 100.0%	4 22.2% 100.0%	1 5.6% 100.0%	7 38.9% 100.0%	1 5.6% 100.0%	1 5.6% 100.0%	18 100.0% 100.0%

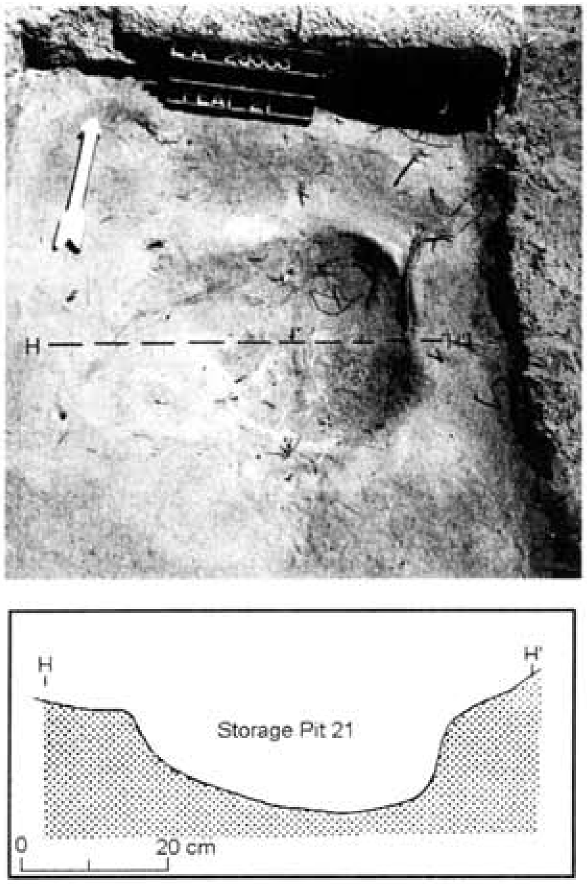


Figure 62. Area F, Storage Pit 21, plan and northeast-southwest profile.

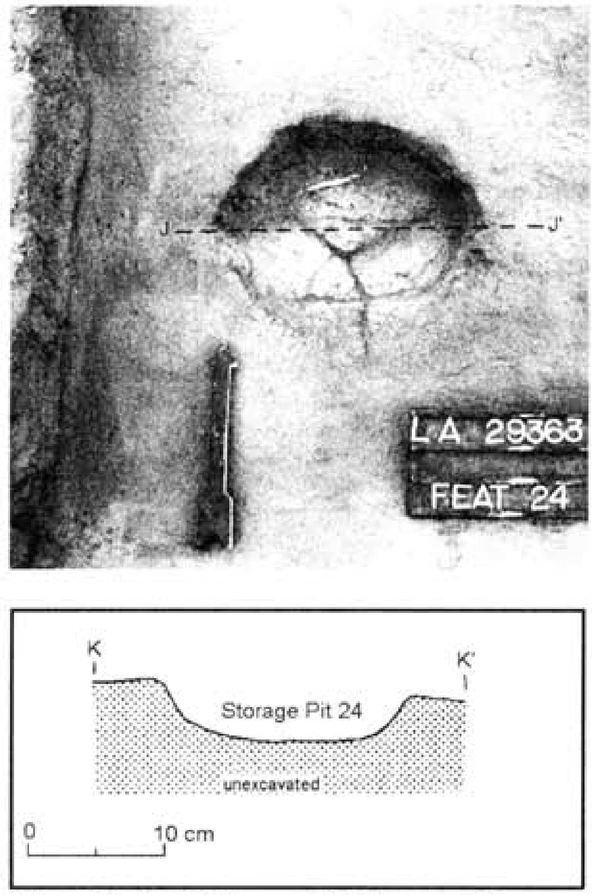


Figure 64. Area F, Storage Pit 24, plan and east-west profile.

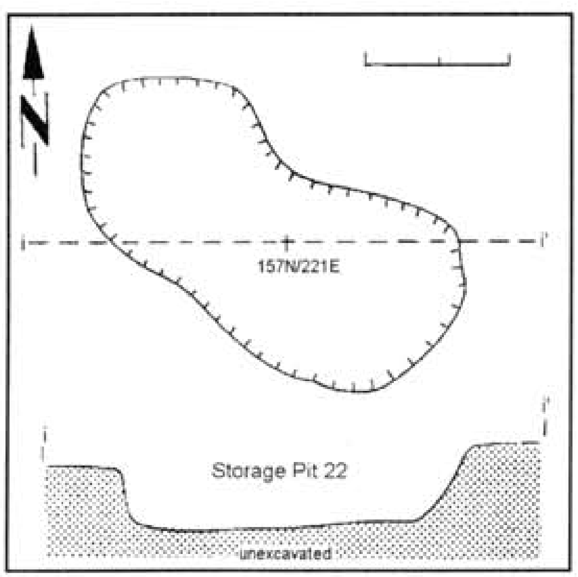


Figure 63. Area F, Storage Pit 22, plan and profile.

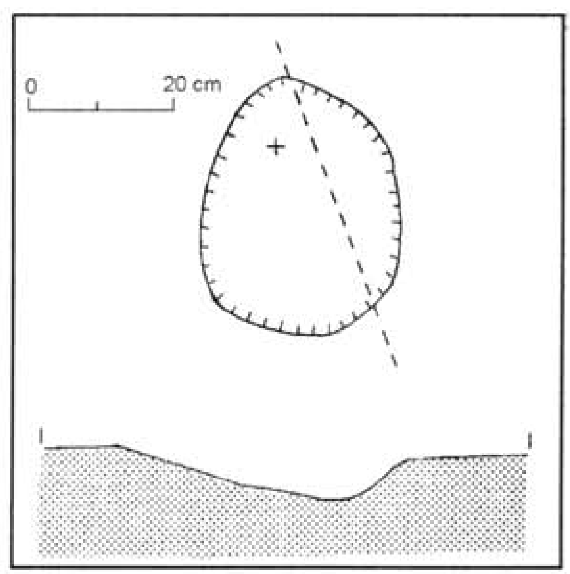


Figure 65. Area F, Storage Pit 25, plan and profile.

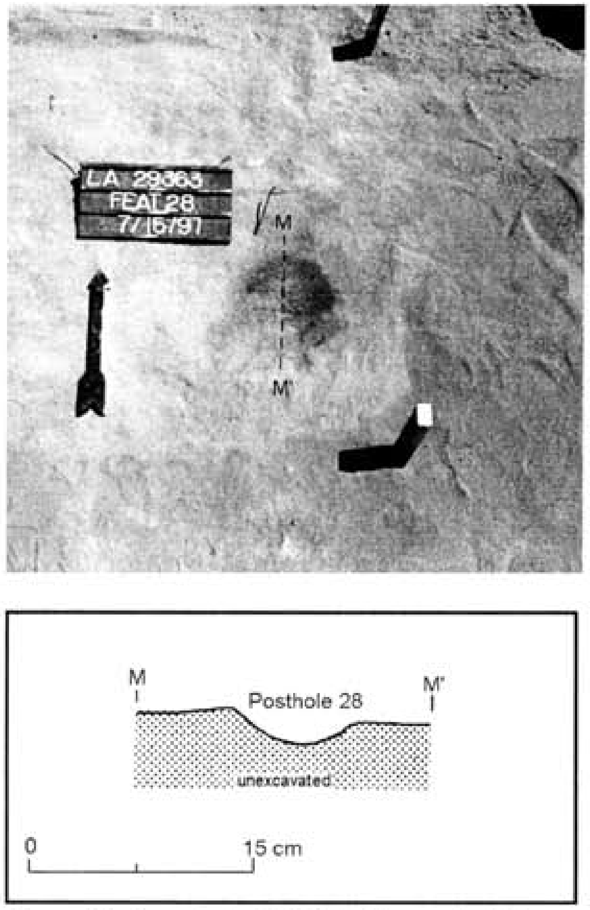


Figure 66. Area F, Posthole 28. Feature is to the right of north arrow; profile is north-south.

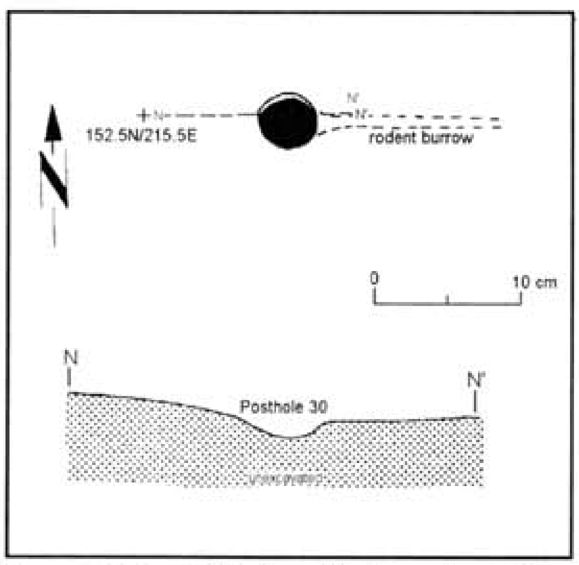


Figure 67. Area F, Posthole 30, plan and profile.

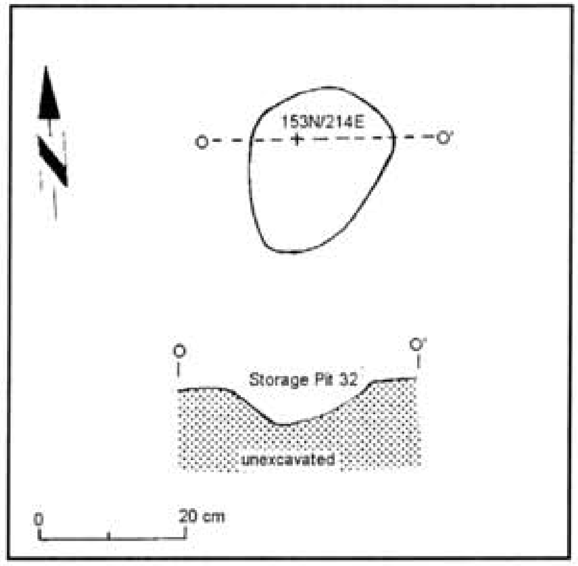


Figure 68. Area F, Storage Pit 32, plan and profile.

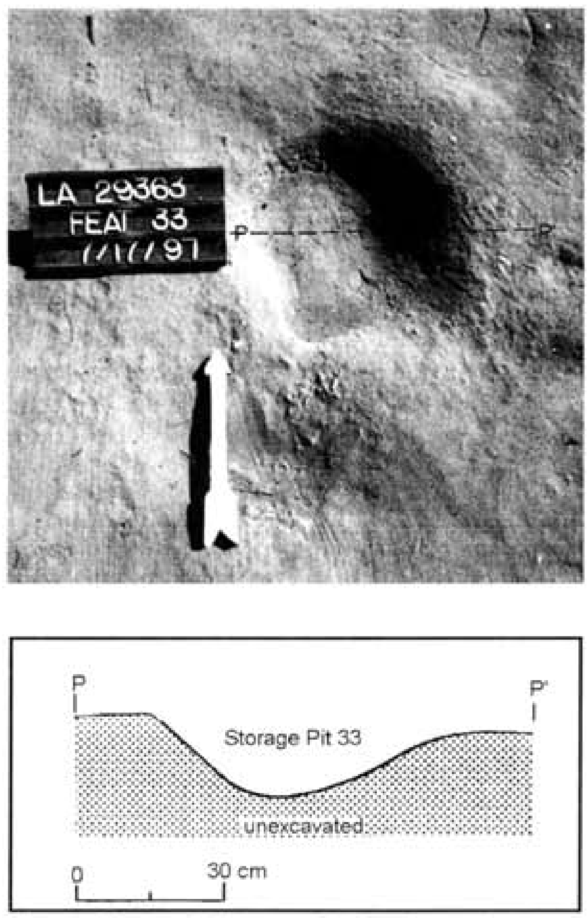


Figure 69. Area F, Storage Pit 33, plan and east-west profile.

Table 30. Ceramics from Features in Area F

Cells: Count Row Column	Feature				Row Total
	Storage Pit 21	Thermal Pit 23	Thermal Pit 26	Thermal Pit 27	
Jornada Brown	1 100.0% 50.0%				1 100.0% 6.3%
El Paso Brown	1 10.0% 50.0%		7 70.0% 63.0%	2 20.0% 100.0%	10 100.0% 62.5%
South Pecos Brown			4 100.0% 36.4%		4 100.0% 25.0%
Jornada/South Pecos Brown		1 100.0% 100.0%			1 100.0% 6.3%
Column Total	2 12.5% 100.0%	1 6.3% 100.0%	11 68.8% 100.0%	2 12.5% 100.0%	16 100.0% 100.0%

The three pieces of ground stone were found in the general fill. Two of the three were associated with Pits 32 and 34. They consist of an indeterminate fragment, one-hand mano, and metate fragment. The metate fragment is associated with Thermal Feature 34 and the indeterminate ground fragment was recovered from around Storage Pit 32.

CERAMIC ARTIFACT ASSEMBLAGE

C. Dean Wilson

A total of 291 sherds were recovered during the data recovery phase of the Carlsbad Relief Project. This includes 287 sherds from LA 29363 and 4 sherds from LA 29362 (Table 31). The analysis of these sherds involved the recording of both descriptive attributes and typological categories. In order to compare trends noted at these sites to those in surrounding areas, analysis strategies and categories previously discussed in other studies were used here (Hill 1996a; Jelinek 1967; Kelley 1984; Mera 1943; Runyon and Hedrick 1987; Wiseman 1996; 1997).

Descriptive Attributes

A range of ceramic descriptive attributes of potential use in the dating of sites and components, as well as the determination of the area of origin and use of ceramic vessels represented, were recorded. Ceramic attributes recorded during this analysis include temper, surface manipulation, sherd thickness, and vessel form.

Temper Categories

Temper was assigned to basic categories by examining freshly broken sherd surfaces through a binocular microscope. Igneous tempers were divided into several groups based on color, size, and crystalline structure. More detailed characterizations of temper are provided through petrographic analysis of seven sherds assigned to various temper categories (see Hill, this volume). Almost all of the tempers identified represent crushed igneous rock.

The most common group is represented by a leucocratic igneous rock containing both feldspar and quartz that may represent crushed granites or monzonites. This group is identified by the dominance of milky white to clear gray grains probably representing feldspar along with some quartz. Dark fragments representing hornblende are often absent, and when present they consist of very small and sparse fragments associated with these other mineral particles. Fragments noted in sherds from this site assigned to this temper appear to be relatively small, and the large grains noted in sherds assigned to this type from the El Paso area tend to be absent.

Another temper group was distinguished by numerous very small and profuse clear to dark fragments, and is referred to here as crystalline igneous rock. Larger grains are sometimes present and are usually roundish and crystalline in structure. These fragments appear to be crystalline or sugary in appearance. This group may represent the use of Capitan aplites. Petrographic analysis indicates a granite aplite (Hill, this volume).

The other temper group is represented by the dominance of gray feldspar fragments presumably from syenites from somewhere in the Sierra Blanca (Wiseman 1998). Feldspar fragments tend to be similar in appearance and are angular and sparsely scattered. Smaller grains of other minerals are rare if present at all. Feldspar fragments are large compared to other temper fragments and are often readily visible even without the aid of a binocular microscope, and protrude into the sherd surfaces. These fragments tend to be opaque and gray to off-white in color. Smaller grains of other minerals are rare if present.

Sand refers to the presence of rounded or subrounded, white to translucent well-sorted medium to coarse quartz grains. Small angular fragments sometimes occur along with these grains indicating the use of crushed sandstone or sand weathered from nearby sandstone.

Table 31. Ceramic Types from Carlsbad Relief Sites

Pottery Types	LA 29363		LA 29362	
	Count	Percent	Count	Percent
Plain Brown Body	262	91.3		
Plain Brown Rim	14	4.9		
Thin Brown Ware	11	3.8		
Playas Incised			4	100.0
Total	287		4	

Surface Manipulation

Surface manipulations reflecting the presence and types of surface textures and polishing were recorded for both interior and exterior sherd surfaces. Plain unpolished refers to surfaces where coil junctures have been completely smoothed, but surfaces are unpolished. Polished surfaces are those that have been intentionally polished after smoothing. Polishing implies intentional smoothing with a polishing stone to produce a compact and lustrous surface. Slightly polished refers to a plain, slightly compacted or polished surface. Heavily polished refers to a lustrous compact surface that has obviously been heavily polished. Unpolished striated refers to the presence of a series of long shallow parallel grooves resulting from brushing with a fibrous tool on an unpolished surface. Surface worn or missing refer to cases where a distinctive surface cannot be recognized due to the absence or disturbance of that surface.

Vessel Form

Sherd-based vessel form categories reflect shape or portion of the vessel from which a sherd was derived. Categories identified were based on rim shape or the presence and location of polish and painted decorations. While it is often easy to identify the basic form (bowl versus jar) of body sherds from many Southwestern regions by the presence and location of polishing or painted decorations, such distinctions are not as easy for Jornada Brown Ware types. For example, Jornada Brown Ware bowl and jar sherds can be polished or smoothed on either side. Therefore, body sherds exhibiting equal amounts of polishing on both sides were simply assigned to an Indeterminate body, polished on both sides category. Sherds with heavier polish or painted decoration on interior surfaces were classified as bowl body. Those exhibiting a higher polish or painted decoration on the exterior surface were assigned to a jar body category. Cooking-storage jar neck sherds were identified by the presence of distinct saddle-shaped curves characteristic of necks belonging to this form. Cooking-storage jar rim sherds also exhibit the distinct shape of a necked jar. Bowl rim refers to sherds exhibiting 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.

Clips from sherds were also fired to controlled oxidation conditions at a temperature of 950 degrees C in order 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.

Ceramic Types

Ceramic types represent groupings that relay information about combinations of traits with temporal, spatial, and functional significance. All of the 287 sherds recovered from LA 29363 represent plain brown ware utility ware types, while the four sherds from LA 29362 belong to a single red ware vessel.

Jornada Brown Ware Types

The presence of brown ware sherds, derived from a relatively large number of vessels at LA 29363, provided a rare opportunity to examine ceramic patterns associated with an occupation dating before the introduction of textured and painted ceramic types into the Pecos Valley. Plain brown wares appear to have been produced in some areas of the Jornada Mogollon in southeastern New Mexico as early as A.D. 200 and represent the dominant ceramics until at least the middle thirteenth century (Hill 1996a, 1996b). Unfortunately, it is difficult if not impossible to distinguish Jornada region brown wares produced throughout this long span. Thus, the placement of the ceramic assemblage at LA 29363 early in the Jornada Mogollon ceramic sequence is based on the lack of associated textured or painted types rather than the characteristics of plain brown ware sherds recovered from this site.

Brown wares from various areas of the Jornada region including the Carlsbad area have long been divided into a series of types based on combinations of attributes thought to be spatially sensitive. Distinctions of various types are based on differences in surface color, polish, and temper postulated for plain brown ware ceramics from different areas of the Jornada Mogollon region (Jelinek 1967; Jennings 1940; Lehmer 1948; Whalen 1994; Wiseman 1996a, 1998). Unfortunately, recent studies indicate a great deal of overlap in the attributes of brown utility ware tempering materials from different areas of the region (Hill 1996a, 1996b; Whalen 1994). These examinations indicate strong similarities in both pastes and manipulations of brown ware pottery found in both the riverine and mountainous areas of the Jornada Mogollon. Even petrographic analysis involving detailed characterizations of pastes and temper from distinct areas of the region could often not distinguish pottery originating in distinct areas of the Jornada Mogollon country (Hill 1996a). Therefore, many recent studies have simply lumped plain brown ware sherds previously assigned to types such as El Paso Brown, Jornada Brown, or South Pecos Brown into a single plain brown ware type, and have attempted to examine variation through the independent examination of various paste and technological attributes (Hill 1996a, 1996b; Whalen 1994).

Others have suggested that subdivisions within Jornada Brown Ware pottery are in fact useful, although factors other than spatial variation may also be reflected. In recent studies, Wiseman (1996a, 1998) continues to use modified versions of brown ware types described by Jelinek (1967). In this typology Jornada Brown, also recently referred to as Sierra Blanca variety (Wiseman 1998), is described as generally having well-polished surfaces that obscure temper grains. Temper fragments are described as small, consisting of a profusion of small equally sized grains. Jornada Brown Ware vessels are usually thick (6 to 8 mm) and vessel shapes tend to be regular.

Another category sometimes recognized is South Pecos Brown. This type is generally well smoothed, and polishing may be strong to absent. Temper is represented by sparse large gray feldspar fragments, which frequently show through the surface, and appears to indicate syenite from the Sierra Blancas. This temper results in blocky to tabular paste cross sections. The protruding temper cracks are often surrounded by very small radial cracks and surface clays that have contracted or shrunk toward the body clay. Vessel shapes also tend to be more irregular than Jornada Brown. A few sherds exhibiting the overall characteristics intermediate between South Pecos Brown and Jornada Brown were assigned to a Jornada/South Pecos Brown category. These appear to be similar to sherds described as South Pecos-like Brown by Wiseman (1996a).

El Paso Brown is mainly distinguished from Jornada Brown by the profusion of large fragments including rounded quartz fragments, representing granite temper, which may protrude through the surface. El Paso Brown sherds also tend to be soft and have less evidence of polish or luster and more scraping marks on the interior surface. Pastes tend to be dark or brown with a dark core.

McKenzie Brown is characterized by abundant crushed quartz temper. Pastes are tan to black with a black core. Walls tend to be thin, and surfaces are smoothed with some polishing.

Most problems in the use of these brown ware types stem from various mixes in attributes used to define different plain brown ware types. For example, the presence of a temper category used to define one type may occur along with surface manipulation commonly used to define another (Wiseman 1996a). Still, the use of different Jornada Brown Ware type categories may provide an opportunity to monitor variability in assemblages from sites in different areas that may be of spatial or temporal significance, and may be cumbersome to monitor by distributions of attributes alone.

During the present study, different classification strategies were employed during various phases of the analysis. All but the four Playas Red Incised sherds from LA 29362 were assigned to Jornada Plain Brown Ware type categories group (Table 31). All four sherds from LA 29362 were classified as Playas Incised and were from the same vessel. These sherds exhibited fine incised decoration on a very polished surface. While Playas Incised was described for sherds from Casas Grandes in northern Mexico (DiPeso et al. 1974), a variety of this type also appears to have been produced in the Sierra Blanca region (Wiseman 1981).

All of the 287 sherds from LA 29363 represent variations of plain brown ware from the Jornada region. Three categories of Jornada Plain Brown Wares were recognized based on the presence of a rim and their thickness (Table 31). Sherds exhibiting plain polished surfaces were assigned to either a plain brown body or plain brown rim category. A few very thin sherds, less than 4 mm in thickness and similar to those derived from El Paso Polychrome, were placed into a thin brown ware category.

Plain brown ware sherds assigned to these categories were then placed into a previously defined regionally specific grouping. A sample of the sherds classified as plain brown ware was first separated by Regge Wiseman. Based on information regarding such divisions and my examination of sherds that Wiseman assigned to various types, I assigned the remaining brown ware sherds to various categories (Table 32). Variation in paste and temper resulted in the recognition of a number of different brown ware groups. Definite overlap is represented; in some cases sherds assigned to different vessels could have been produced in the same regions and even by the same potters. Recording these categories provides information relating to the nature of brown ware variation at sites excavated during the Carlsbad Relief Project. Additional information relating to plain brown wares from this project are indicated by distributions of attributes recorded (Tables 33-37). These distributions are consistent with attributes described for the various categories, as the dominance of dark high iron paste, small igneous temper, well-polished surfaces, and wide vessel walls are all typical of Jornada Brown. Distributions of various attributes noted in plain brown wares are discussed in more detail in later.

Dating of Sites

The four sherds from the single Playas Incised vessel at LA 29362 indicates a pot drop, which may or may not be associated with quarry activity. The presence of this vessel, however, indicates some presence of Jornada Mogollon groups during the thirteenth and fourteenth centuries.

Table 32. LA 29363 Temper by Brown Ware Group

Cells: Count Row Column	Paste					Row Total
	Dark gray to black oxidized	Dark gray to black cross section	Brown and reddish throughout	Oxidized, red-brown outside, dark gray-black inside	Red and gray streaks	
Jornada Brown	10 19.6% 30.3%	17 33.3% 9.0%	2 3.9% 14.3%	2 3.9% 10.0%	20 39.2% 64.5%	51 100.0% 17.8%
El Paso Brown	12 11.5% 36.4%	70 67.3% 37.0%	10 9.6% 71.4%	8 7.7% 40.0%	4 3.8% 12.9%	104 100.0% 36.2%
South Pecos Brown	9 8.7% 27.3%	80 76.9% 42.3%	1 1.0% 7.1%	8 7.7% 40.0%	6 5.8% 19.4%	104 100.0% 36.2%
Jornada/South Pecos Brown	1 9.1% 3.0%	6 54.5% 3.2%	1 9.1% 7.1%	2 18.2% 10.0%	1 9.1% 3.2%	11 100.0% 3.8%
McKenzie Brown		6 100.0% 3.2%				6 100.0% 2.1%
Thin unpainted (El Paso)	1 9.1% 3.0%	10 90.9% 5.3%				11 100.0% 3.8%
Column Total	33 11.8% 100.0%	189 65.9% 100.0%	14 4.9% 100.0%	20 7.0% 100.0%	31 10.8% 100.0%	287 100.0% 100.0%

Table 33. LA 29363, Paste Cross Section by Brown Ware Group

Cells: Count Row Column	Paste					Row Total
	Dark gray to black oxidized	Dark gray to black cross section	Brown and reddish throughout	Oxidized, red-brown outside, dark gray-black inside	Red and gray streaks	
Jornada Brown	10 19.6% 30.3%	17 33.3% 9.0%	2 3.9% 14.3%	2 3.9% 10.0%	20 39.2% 64.5%	51 100.0% 17.8%
El Paso Brown	12 11.5% 36.4%	70 67.3% 37.0%	10 9.6% 71.4%	8 7.7% 40.0%	4 3.8% 12.9%	104 100.0% 36.2%
South Pecos Brown	9 8.7% 27.3%	80 76.9% 42.3%	1 1.0% 7.1%	8 7.7% 40.0%	6 5.8% 19.4%	104 100.0% 36.2%
Jornada/South Pecos Brown	1 9.1% 3.0%	6 54.5% 3.2%	1 9.1% 7.1%	2 18.2% 10.0%	1 9.1% 3.2%	11 100.0% 3.8%
McKenzie Brown		6 100.0% 3.2%				6 100.0% 2.1%
Thin unpainted (El Paso)	1 9.1% 3.0%	10 90.9% 5.3%				11 100.0% 3.8%
Column Total	33 11.8% 100.0%	189 65.9% 100.0%	14 4.9% 100.0%	20 7.0% 100.0%	31 10.8% 100.0%	287 100.0% 100.0%

Table 34. LA 29863 Vessel Form by Brown Ware Group

Cells: Count Row Column	Vessel Form									Row Total
	Indeterminate body, polished both sides	Bowl rim	Bowl body	Jar body	Cooking/ storage jar rim	Cooking/ storage jar neck	Indeterminate	Seed jar rim	Indeterminate, missing surface	
Jornada Brown	21 41.2% 42.9%	4 7.8% 30.8%	8 15.7% 57.1%	17 33.3% 9.9%					1 2.0% 4.3%	51 100.0% 17.8%
El Paso Brown	9 8.7% 18.4%		4 3.8% 28.6%	81 77.9% 47.1%		3 2.9% 25.0%		2 1.9% 100.0%	2 4.8% 21.7%	104 100.0% 36.2%
South Pecos Brown	2 18.2% 4.1%	7 6.7% 53.8%	1 1.0% 7.1%	64 61.5% 37.2%	1 1.0% 100.0%	5 4.8% 41.7%			15 14.4% 65.2%	104 100.0% 36.2%
Jornada/South Pecos Brown	2 18.2% 4.1%	1 9.1% 7.7%	1 9.1% 7.1%	2 18.2% 1.2%		4 36.4% 33.3%	1 9.1% 100.0%			11 100.0% 3.8%
McKenzie Brown		1 16.7% 7.7%		5 83.3% 2.9%						6 100.0% 2.1%
Thin Unpainted (El Paso)	6 54.5% 12.2%			3 27.3% 1.7%					2 18.2% 8.7%	11 100.0% 3.8%
Column Total	49 17.1% 100.0%	13 4.5% 100.0 %	14 4.9% 100.0%	172 59.9% 100.0%	1 .3% 100.0%	12 4.2% 100.0%	1 .3% 100.0%	2 .7% 100.0%	23 8.0% 100.0%	287 100.0% 100.0%

Table 35. Interior Manipulation by Brown Ware Group

Cells: Count Row Column	Interior Manipulation						Total
	Plain polished	Plain slightly polished	Plain heavily polished	Plain unpolished with striations	Surface missing	Surface worn	
Jornada Brown	10 19.6% 5.5%	32 62.7% 42.1%	8 15.7% 61.5%			1 2.0% 25.0%	51 100.0% 17.8%
El Paso Brown	92 88.5% 50.5%	7 607% 9.2%		1 1.0% 100.0%	4 3.8% 36.4%		104 100.0% 36.2%
South Pecos Brown	73 70.2% 40.1%	19 18.3% 25.0%	3 2.9% 23.1%		7 6.7% 63.6%	2 1.9% 50.0%	104 100.0% 36.2%
Jornada/South Pecos Brown	1 9.1% .5%	8 72.7% 10.5%	1 9.1% 50.0%			1 9.1% 25.0%	11 100.0% 3.8%
McKenzie Brown	5 83.3% 2.7%	1 16.7% 1.3%					6 100.0% 2.1%
Thin unpainted (El Paso)	1 9.1% .5%	9 81.8% 11.8%	1 9.1% 7.7%				11 100.0% 3.8%
TOTAL	182 63.4% 100.0%	76 26.5% 100.0%	13 4.5% 100.0%	1 .3% 100.0%	11 3.8% 100.0%	4 1.4% 100.0%	287 100.0% 100.0%

Table 36. LA 29863 Exterior Manipulation by Brown Ware Group

Cells: Count Row Column	Exterior Manipulation					Row Total
	Plain unpolished	Plain slightly polished	Plain heavily polished	Surface missing	Surface worn	
Jornada Brown	8 15.7% 4.3%	40 78.4% 45.5%	1 2.0% 33.3%	1 2.0% 25.0%	1 2.0% 16.7%	51 100.0% 17.8%
El Paso Brown	93 89.4% 50.0%	11 10.6% 12.5%				104 100.0% 36.2%
South Pecos Brown	75 72.1% 40.3%	22 21.2% 25.0%	1 1.0% 33.3%	3 2.9% 75.0%	3 2.9% 50.0%	104 100.0% 36.2%
Jornada/South Pecos Brown	1 9.1% .55	9 81.85 10.2%	1 9.1% 33.3%			11 100.0% 3.8%
McKenzie Brown	5 83.3% 2.7%	1 16.7% 1.15				6 100.0% 2.1%
Thin unpainted (El Paso)	4 36.4% 2.2%	5 45.5% 5.7%			2 18.2% 33.3%	6 100.0% 2.1%
Total	186 64.8% 100.0%	88 30.7% 100.0%	3 1.0% 100.0%	4 1.4% 100.0%	6 2.1% 100.0%	287 100.0% 100.0%

Data from LA 29363 provide important information relating to the characteristics of pottery from the early Jornada Mogollon occupations, dating prior to the introduction of textured, painted, or slipped types. An important issue is whether the sample of sherds from LA 29363 is large enough to determine if the absence of later decorated types is not simply the result of chance occurrence from the breaking of a small number of vessels in an area where decorated vessels were always rare. Despite the small sample size, sherds represented are derived from a large number of vessels as indicated by their very scattered contexts of recovery (Zamora, this volume) and wide range of surface and paste characteristics. Thus, the absence of decorated sherds at this site appears to reflect an occupation during the time prior to the appearance of decorated and textured wares at sites in southeastern New Mexico. Such occurrences of brown ware sherds from this large a number of vessels without any associated textured or decorated seems to be unique in this region, as most sites assigned to early ceramic phases yielded smaller ceramic samples or contained later contaminants (Katz and Katz 1993). Excavated features at LA 29363 included five structural remains and a number of hearths and smaller surface features (Zamora, this volume).

Several phase sequences have been defined for the prehistory of southeastern Mexico that include phases or occupations containing plain brown wares as the sole ceramic type for various regional sequences (Sebastian and Larralde 1989; Katz and Katz 1993). Unfortunately, all of these early ceramic phases are poorly defined. This results from the general absence of studies reporting dated assemblages with relatively large numbers of pottery without later textured or decorated types. Regional sequences defined for southeast New Mexico that may include occupations with early brown ware components include the Sierra Blanca (Kelley 1984), the Middle Pecos (Jelenek 1967), the eastern extension (Corley 1965; Leslie 1979), the eastern Guadalupes (Applegarth 1976; Katz and Katz 1979), and the Carlsbad Basin (Katz and Katz 1985a).

Other sites in areas of Texas to the south and east of southeast New Mexico containing similar plain brown wares have also been documented. Along the Pecos River just to the south of the New Mexico border is the northern sector of the Eastern Trans-Pecos as defined by Mallouf (1985). These include sites with Jornada Mogollon ceramics that appear to reflect occupations closely related to those along the Pecos River in southeastern New Mexico. Brown ware sherds have also been noted at sites along the Pecos River in Pecos and Crockett counties in the northeastern Trans-Pecos country of Texas (Rogers 1972). Some of these sherds were assigned to Caddoan types, others to Jornada Mogollon types, and a few were interpreted or described as local manufacture of either Caddoan or Jornada influence (Rogers 1972). A few sites to the east of the New Mexico border assigned to the neo-American phase as defined for the Llano Estacada region of Texas have also yielded low amounts of Jornada Brown Ware pottery and evidence of semipermanent structures (Collins 1968). While such occupations in Texas have been assigned to other regional schemes, they appear to be most closely related to occupations in New Mexico assigned to the eastern extension of the Jornada Mogollon.

Katz and Katz (1993) propose a broad chronology for southeastern New Mexico that crosscuts various regional sequences and includes seven pottery-yielding periods. Pottery-yielding occupations begin with the Formative 1, which is tentatively postulated as dating between A.D. 500 and 750, and is solely separated from Late Archaic occupations by the additional occurrence of relatively low frequencies of brown ware pottery. Types postulated to occur at components dating to this phase include Middle Pecos Brown, South Pecos Brown, Jornada Brown, and Alma Plain. Local phases included late Hueco for the southeastern extension (Leslie 1979), early 18-Mile for the Middle Pecos area north of Roswell (Jelinek 1967), undefined early ceramic period of the Sierra Blanca (Sebastian and Larralde 1989), and the Early Globe defined at the Brantley Reservoir near Carlsbad (Katz and Katz 1985b). Formative 2 is dated between A.D. 700 and 900 (Katz and Katz 1993) for which a reduction in activity during the phase or a more centralized settlement pattern was identified based on the existing suite of radiocarbon dates (Katz and Katz 1993). The first sedentary villages of pithouse and surface rooms appear in the Middle Pecos at this time (Jelinek 1967). Ceramic assemblages were dominated by Middle Pecos Micaceous Brown but were also described as having Red Mesa Black-on-white in the north and Cebolleta Black-on-white in the south (Katz and Katz 1992). These white wares types are not present at sites in southeastern New Mexico until after A.D. 900 (Peckham 1990). Other information relating to the timing of the introduction of white wares is discussed later in this chapter.

Given the lack of well-dated sites in southeastern New Mexico yielding distinct brown ware ceramic assemblages, much of the dating of early brown ware occupations in this area is based on comparisons with better-dated sites of the southern Jornada Mogollon to the west where similar ceramics have been recovered, as well as dated sites in other regions yielding these ceramic types. The great majority of the well-defined and dated early brown ware occupations of the Jornada Mogollon are associated with the Mesilla phase defined for the southern Jornada area along the Rio Grande Valley in south-central New Mexico and the western Trans-Pecos of Texas (Lehmer 1948; Whalen 1994). The early beginning date for these occupations was not recognized by Lehmer (1948) in his original definition of Jornada Mogollon during which he described brown ware pottery associated with pithouse sites as not having appeared in the southern Jornada Mogollon area until after A.D. 900. More recent investigations have resulted in considerable evidence indicating pottery was much earlier in this region (Anyon 1985; Batcho et al. 1985; O'Laughlin 1980; Hard 1983b; Miller and Stuart 1991; Moore 1996; Stuart 1990; Whalen 1980, 1981, 1994a). It appears then that pottery may have been introduced into this area as early as A.D. 200, and was well established shortly after.

Similar early brown ware occupations often consisting of shallow pithouse villages appear to underlie more typical ceramic components in almost all Southwestern regions including the Mogollon, Anasazi, and Hohokam spanning from at least A.D. 200 to about 550 (Reed et al. 1998; Stark 1995; Whittlsey et al. 1994; Wilson and Blinman 1991; Wilson et al. 1996), and probably represents a pan-regional adaptive strategy and material complex. The extremely conservative and long-lived nature of locally produced El Paso Brown and pithouse architecture in the southern Jornada Mogollon region has resulted in the assignment of an extremely long span to the Mesilla phase. This includes a beginning date at A.D. 200 and an ending date some time during the twelfth century, after which intrusive, decorated pottery types and El Paso Polychrome are common. Some studies have suggested changes in the range of characteristics of El Paso Brown produced during this long span (Whalen 1994b).

Another ceramic marker for the later part of the Mesilla phase is the occurrence of intrusive Mimbres white ware types (Aten 1972; Mera 1943; Lehmer 1948; Whalen 1980, 1981, 1994a). Mesilla phase occupations dating to the tenth century often have low frequencies of Mimbres Boldface Black-on-white while those dating to the eleventh and twelfth centuries may have some late Mimbres Classic Black-on-white. A similar marker is represented at sites in more northern regions of the Jornada Mogollon where Red Mesa Black-on-white occurs alongside plain brown wares at sites dating to the tenth century (Jelinek 1967; Levine 1997; Wiseman 1998).

Somewhat conflicting dating evidence relating to the beginning dates for early Jornada brown wares results from radiocarbon dates from various areas. These include a date in the A.D. 200s at contexts yielding radiocarbon dates at Deadmans Shelter in the Texas Panhandle (Hughes and Willey 1978). These contexts yielded 29 sherds classified as Jornada Brown Ware by Helene Warren that were interpreted as trade wares from the Jornada Mogollon, and appear to indicate widespread trade as well as representing one of the earliest dates for Jornada Brown Ware. The possibility of a somewhat later beginning date for Jornada Brown Wares at least in some areas of the Jornada may be reflected by the absence of ceramics at contexts dating between A.D. 450 and 500 at the

Sunset Archaic site located west of Roswell in the eastern foothills of the Sierra Blancas (Wiseman 1996a). At the Sunset site ceramics are absent in contexts yielding large numbers of flaked lithic artifacts and evidence of agriculture, thus indicating a post A.D. 500 date for the introduction of ceramics in at least some areas of the northern Mogollon.

Radiocarbon dates from more tentative contexts in the Carlsbad area also suggest occupations dating during the span of early brown wares as defined for other areas of the Jornada (Katz and Katz 1985b; Staley 1996a, 1996b). Katz and Katz (1985b) note radiocarbon dates of A.D, 776 and A.D. 906 from ceramic-bearing contexts. A total of eleven components from Brantley Reservoir were assigned to the Globe phase (A.D. 750 to 1150), which represents the time of heaviest exploitation of the project area. The Globe phase is initiated by the appearance of brown wares and ends with the appearance of decorated types. This is defined as a time of shifts from a riverine to an upland orientation. A wider range of subsistence activities is indicated, although there is no evidence of horticulture.

A number of dates falling within the span assigned to the Globe phase were also recovered from a number of features excavated during the Mescalero Plains Project associated with ceramics dating between A.D. 200 and 1100 east of Carlsbad (Hill 1996a, 1996b). This appears to fall in the early part of the Globe phase (A.D. 750 to 1200) as defined for the occupational sequence at Brantley Lake near Carlsbad (Katz and Katz 1985b). Also, east of Carlsbad is the Laguna Plata site, which yielded several structures but no evidence of agriculture, and appears to date between A.D. 1250 and 1350 (Runyon 1972).

The recovery of charcoal from almost all the features excavated at LA 29363 resulted in a large number of samples submitted for radiocarbon dating (Zamora, this volume). With the exception of two early dates from a roasting pit and a hearth reflecting an Archaic occupation, almost all the samples dated to a similar range, with median dates in the eighth and ninth centuries. These dates indicate an occupation sometime between A.D. 750 and 800 during the early Globe phase, or at the transition of Formative period 1 and 2 as previously defined. Therefore, ceramic distributions and associated radiocarbon dates thus far offer the strongest evidence I know of for a ceramic occupation at such an early date anywhere in the Jornada Mogollon other than Mesilla occupations in areas of the southern Jornada area along or near the Rio Grande.

Most of the types occurring at this site are those previously noted to occur at the earliest ceramic occupations in this area with the exception of the few very thin sherds resembling unpainted portions of El Paso Polychrome. It is likely that these should not be considered as El Paso Polychrome, but they belong to the range of sherd thickness for early El Paso Brown. This indicates some weaknesses in assigning thin unpainted brown wares to El Paso Polychrome.

Regional Trends

The fact that pottery associated with the Jornada tradition appears in the Carlsbad area indicates this area was not isolated from developments by Formative groups in both the mountains and lowlands to the west. The lack of evidence of agriculture in the Carlsbad and surrounding areas indicates that these groups may simply represent an extension of the Jornada Mogollon horticulture-based adaptation (Katz and Katz 1993). The time of occupation of this site falls about halfway through the Mesilla phase defined for areas of the southern Jornada to the east, and basic characteristics of the pottery are similar to those common in Mesilla phase occupations. Other early occupations in most areas of the Jornada Mogollon in southeastern New Mexico are so poorly dated and defined that is difficult to compare the material culture of these early ceramic complexes to that represented at LA 29363. The early 18 Mile phase defined for contemporaneous occupations along the Middle Pecos Valley north of Roswell appears to differ from the occupation at LA 29363 in both architecture and by the presence of some gray ware pottery (Jelenik 1967).

While basic forms, color, and surface treatments noted at this site are similar to those noted at Mesilla phase sites along the Rio Grande Valley, a wider range of pastes and temper are represented in the pottery from LA 29363, resulting in the recognition of a larger number of attributes types. Thus, while most early Mesilla phase sites are dominated by very similar pottery, almost all of which is classified as El Paso Brown, a range of characteristics was noted in the surface and pastes of brown ware pottery from LA 29363. This variation resulted in assignment of pottery from this site to a number of type categories including El Paso Brown (36.2 of all pottery), South Pecos Brown (36.2 percent), Jornada Brown (17.8 percent), El Paso Thin Polychrome? (3.8 percent), Jornada/South Pecos Brown (3.8 percent), and McKenzie Brown (2.1 percent). Tables 33-37 also indicate a close but not perfect relationship between the defined types and various attributes. Although relationship is circular, particularly for attributes such as temper, the independent recording of attribute traits provided for the documentation of expected differences. These included the much higher occurrence of unpolished

Table 37. Mean Vessel Thickness for Sherds from LA 29863

Ceramic Type	Mean	Number	Standard Deviation
Jornada Brown	6.2	50	1.2
El Paso Brown	5.4	99	.9
South Pecos Brown	5.2	92	.7
Jornada/South Pecos Brown	5.6	11	1.1
McKenzie Brown	4.7	6	.6
Thin Unpainted (El Paso)	3.8	11	.7
Total	5.4	269	1.0

interior and exterior surfaces for sherds assigned to El Paso Brown, and a higher mean thickness for sherds assigned to Jornada Brown. Refiring analysis indicates similar ranges of paste colors of sherds assigned to various regional groups.

This wide range of brown ware pottery types at this site may either reflect pottery produced at a number of dispersed areas in the Jornada Mogollon, variability within locally produced pottery, or a combination of both of these. It still has not been established whether pottery was produced in the Carlsbad Basin and other areas of the easternmost extension of the Jornada Mogollon, although the possibility of pottery in this area has been suggested (Wiseman 1998). Leslie (1979) notes several possible local varieties of Jornada Brown in the eastern extension. These varieties are widespread but more common in specific areas, and a correlation within each variety with the available local materials, especially clays and sandstone available for use as temper, is postulated (Leslie 1979). A southern area brown was also defined as a local variant of El Paso Brown found primarily in the Maroon Cliffs/Nash draw area (Leslie 1979). This variety is characterized by local red clay and sandstone temper from the Permian Formation, which results in a friable, easily weathered surface (Leslie 1979).

All of the pottery identified during the present study exhibited tempers, pastes, and surfaces similar to types known to have commonly been produced in either the El Paso area or in Sierra Blanca County (Wiseman 1998). Temper from these sherds appears to be derived from granite, aplite, and monzonite available from sources in these areas but not available in the Carlsbad area (Hill, this volume). Collections of clays and tempers from the Carlsbad area conducted as part of the present study failed to locate local examples of the temper sources. Petrographic analysis of 10 sherds resulted in the identification of five distinct temper groups that may seem to indicate several areas of origin (Hill, this volume). The most common group contained materials weathered from the Capitan Mountains. One sample reflects syenite available in the Sierra Blancas. One sample reflects granites from the Franklin Mountains in the El Paso area. Thus, it is likely that most, if not all, of the pottery from LA 29363 was produced in areas to the west and northwest. This is consistent with observations and interpretations of ceramics from other sites in the Carlsbad area, where the great majority, if not all of the pottery examined, has also been interpreted as having derived from other areas, particularly the Sierra Blanca locality (Hill 1996a, 1996b; Katz and Katz 1985b). The variability noted indicates vessels represented at LA 29363 may have been produced over a very wide area. Exchange of ceramic vessels with groups to the west could easily meet the demands for the small number of vessels in use during a given time.

Many of the scattered early ceramic sites probably represent seasonal occupations by distinct groups who either originated in or came in contact with areas of the west where this pottery was produced. These types of ties and seasonal movement of groups may ultimately have facilitated the movement of Jornada Brown Ware pottery over very large areas covering much of southeastern New Mexico and west Texas. One possibility is that these occupations do not represent typical Jornada Mogollon populations, but more mobile hunting and foraging groups scattered over much of the High Plains, some of which were closely interacting with the Jornada Mogollon. If this is the case, then interaction and relationships between Plain hunters and Southwest agriculturists postulated for later occupations (Spielmann 1991) may have begun earlier than often assumed.

Pottery Function

Data concerning both the characteristics and forms of pottery from LA 29363 provide information about the use of ceramic vessels at seasonal sites in southwest New Mexico. Presently, it is usually not possible to determine the general forms of vessels from brown ware body sherds based on location of polishing. While in some areas of the Southwest, combinations of sherd shape and location of polishing or painted decorations provide clues concerning associated vessel forms, this does not apply for Jornada Mogollon Brown Ware sherds. Examination of brown ware rim sherds from many Jornada Mogollon assemblages indicates that there was often no association between vessel shape and the presence or location of polishing. Attempts to recognize specific vessel forms were limited to rim and jar neck sherds exhibiting shapes characteristic of a particular form, and some sherds exhibiting distinct surfaces. These examinations indicate the presence of a variety of forms including bowls, seed jars, and necked jars. This indicates that undecorated brown ware vessels at this site appear to have been used for a wide range of activities including cooking, storage, and serving.

While some exterior sooting and fire clouding was noted, the lack of complete or partial vessels made it impossible to identify sooting patterns indicative of cooking. Still the presence of distinct pitting on interior surfaces indicates use in cooking (Skibo and Blinman 1999).

While most attention about the conservative nature of brown ware technology in areas of the Jornada region have usually focused on chronological concerns, the apparent lack of any significant change in surface forms over many centuries in this area may also have important functional implications. As previously indicated, ceramic assemblages and architectural forms from Jornada Mogollon sites are very similar to those noted for the first pottery-bearing occupations in the Mogollon Highlands, Hohokam, and Anasazi regions. The most obvious difference in occupations in the Jornada Mogollon dating from about A.D. 500 to A.D. 1100 and contemporary occupations in other regions in the Southwest is the lack of regionally specific developments in technology, painted decorations, and textured treatments. In contrast, pottery produced in the Jornada Mogollon area continued to be dominated by plain brown ware pottery similar to that associated with the earliest ceramic horizons.

This long consistency in ceramics produced by groups in Jornada Mogollon may reflect a more conservative adaptation by groups in this area. Based primarily on the examination of Mesilla phase sites, Whalen (1994b) argues for more continuity out of the Archaic through adaptive patterns supplemented by horticulture and pottery but with strong persistence of aspects of earlier Archaic adaptations, with some differences in overall seasonal strategies. Such continuity may largely reflect limitations imposed by desert environments of this area on agriculture. Similar patterns appear to be represented until the appearance of a short-lived agricultural adaptation after A.D. 1000.

Like El Paso Brown Wares, ceramics associated with the earliest Southwest occupations tend to be relatively rare, and the earliest pottery from these regions represents an undecorated polished brown ware produced with high-iron alluvial clays and often exhibiting a dark paste (Wilson et al. 1996; Whittlsey et al. 1994). A wide range of forms is associated with these early brown wares including bowls, seed jars, and necked jars. Such ceramics are often associated with groups that practice agriculture, but still are 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 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 Mogollon 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). Such a scenario is also in agreement with the low frequency of ceramics as compared with other artifacts, particularly flaked lithics.

PETROGRAPHIC ANALYSIS OF JORNADA BROWN WARE CERAMICS FROM THE CARLSBAD RELIEF ROUTE: LA 29363

David V. Hill

Ten Jornada Brown Ware sherds from LA 29363 were submitted for petrographic analysis. The ceramics were analyzed using a Nikon Optiphot-2 petrographic microscope. Each of the sherds was first examined and a description was made of the paste. A second examination of the sherd sample was conducted comparing the similarities and differences in the paste to one another. The sizes of natural inclusions and tempering agents were described in terms of the Wentworth Scale, a standard method for characterizing particle sizes in sedimentology. These sizes were derived from measuring a series of grains using a graduated reticle built into one of the microscopes optics. The ages of inclusions in the ceramics were estimated using comparative charts (Matthew et al. 1991; Terry and Chilingar 1955).

Analysis of the Ceramic Samples

Sample 8

The paste of this sherd is brown and slightly birefringent. The paste contains about 5 percent fine- sized quartz and feldspar grains that are likely natural inclusions in the clay. The paste was tempered using a crushed microcline granite. The granite consists of quartz, plagioclase and orthoclase with abundant microcline occurring in both rock fragments and as isolated mineral grains. The fragments of granite and the isolated mineral grains derived from them range in size from medium to very coarse and constitute 15 percent of the paste. While a few of the larger feldspar grains display some alteration to sericite and clay minerals, most of the feldspars have an unweathered appearance.

Sample 9

The paste of this sherd is a reddish brown and slightly birefringent. The paste contains about 15 percent inclusions. These inclusions, which consist primarily of quartz, orthoclase, and some plagioclase, range in size from fine to coarse. However, only a few grains can be classified as medium to coarse. It is likely that the inclusions represent natural materials in the ceramic body. The few larger rock fragments indicate that the source of the sediments in the clay was a porphyritic quartz monzonite, where orthoclase was the porphyritic mineral. The texture of the monzonite is anhedral granular. Also present in the paste are a few coarse-sized inclusions of altered biotite. Some of the larger monzonite grains are stained with hematite.

Sample 10

The paste of this sherd is a light brown color and is slightly birefringent. Sparse fine sands and brown biotite, much of which has altered to hematite, is naturally present in the ceramic paste. The vessel was tempered using a monzonite or quartz monzonite porphyry. Quartz is present in trace amounts as isolated mineral grains and in one rock fragment. The texture of the monzonite is subhedral granular. Finer grained monzonite fragments contain sparse magnetite with hematitic rims. A few of the larger monzonite fragments contain green hornblende. The feldspars display alteration to clay minerals and sericite. The monzonite fragments and isolated grains of orthoclase, plagioclase, and quartz account for about 15 percent of the paste and range in size from medium to very coarse in size.

Sample 11

The paste is a reddish brown color and is slightly birefringent. The paste contains about 30 percent inclusions. The majority of these inclusions are very fine to medium-sized. About 10 percent of the inclusions range between medium and coarse, with a few very coarse rock fragments present. These larger fragments consist of isolated mineral grains, primarily weathered orthoclase, and rock fragments. The rock fragments consist primarily of orthoclase with granophyric or micrographic texture. Some of these rock fragments also contain brown biotite that has altered to hematite and clay minerals. One rock fragment contains orthoclase with sparse magnetite cubes, weathered biotite, and epidote. Isolated mineral grains consist mostly of altered orthoclase, although a few grains of quartz, epidote, plagioclase and black opaque inclusions, probably altered hematite, are also present in the paste. The majority of the feldspars are highly weathered, often to the point of opacity. It is likely that all of the inclusions in the ceramic body represent materials naturally present in the source clay.

Sample 12

The paste of this sherd is a light yellowish brown color. The paste contains isolated mineral grains that are bimodally distributed in terms of size. The paste contains about 25 percent silt-sized to fine isolated mineral grains consisting of weathered feldspars and quartz. Medium to very coarse inclusions are also present. These larger inclusions consist of weathered orthoclase, microcline, plagioclase or some sparse quartz and make up about 10 percent of the ceramic body. Magnetite, brown biotite, usually altered to hematite, and clay mineral and green hornblende are occasionally present in rock fragments that consist primarily of subhedral granular orthoclase laths.

Sample 13

The paste of this sherd ranges from a dark brown to opaque black color. The body contains about 35 percent silt-sized to fine inclusions that consist of weathered feldspars and quartz with the feldspars predominating. Medium to very coarse inclusions makes up an additional 7 percent of the ceramic body. These inclusions consist of isolated mineral grains and rock fragments. The few rock fragments present consist of orthoclase with sparse amounts of quartz and plagioclase. The amount of orthoclase is also greater than that of the quartz and plagioclase. Many of the feldspars display granophyric texture. Sparse brown biotite, usually altered to hematite and clay minerals, is also present in the paste.

Sample 14

The paste of this sherd is a medium brown color and is slightly birefringent. The paste contains 35 percent isolated orthoclase grains with sparse microcline, plagioclase, and quartz. These isolated mineral grains range in size from fine to medium-sized. The few rock fragments present consist of anhedral granular masses of orthoclase or orthoclase and quartz or plagioclase. Some brown biotite is also present in the clay body and is usually altered to hematite and clay minerals.

Sample 15

The paste of this sherd is an orange-brown color. The paste was tempered using a intrusive igneous rock, classifiable as a syenite. This rock is characterized by the presence of plagioclase laths that enclose brown biotite and magnetite. Fragments of intrusive igneous rock make up about 30 percent of the ceramic body.

Sample 16

The paste of this sherd is a yellowish brown color. The paste contains about 20 percent silt-sized to fine feldspar and quartz sands. There are also opaque black inclusions present in trace amounts. Also present in the clay body is about 10 percent medium to very coarse isolated mineral grains dominated by orthoclase. A few grains of mesoperthite are also present. The orthoclase displays slight weathering.

Sample 17

The paste of this sherd is a yellowish brown color. The paste contains about 15 percent silt-sized to fine inclusions. Coarse to very coarse-sized mineral grains and a few rock fragments are present. The mineral grains are predominantly orthoclase, although some microcline and plagioclase are also present. The rock fragments consist of orthoclase with some perthritic texture. Also present are occasional magnetite cubes and brown biotite, usually altered to hematite. Sparse brown biotite is also dispersed throughout the paste. A single coarse-sized trachyite inclusion was also present.

Discussion

Samples 10, 12, 16, and 17 bear a strong resemblance to each other in terms of paste color and the presence of coarse-sized weathered feldspars. It is likely that these ceramics were derived from the same productive source. It is also likely that these sherds were produced using materials derived from deposits weathered from the Capitan pluton, based on their porphyritic texture observed in the samples as a bimodal size distribution of fine and coarse inclusions. While the Capitan pluton has been described as a granite, the eastern margin of the pluton has less overall quartz present than the western edge (Allen and MacLemore 1991).

Sample 9 was made using a clay body that contained monzonite. It is possible that this sherd also contained materials derived from the Capitan pluton, but from a different resource area than that used for Samples 10,12, 16, and 17.

Samples 11 and 13 also contain monzonite. Both of these sherds display granophyric texture. Granophyric texture is common on the western margin of the Capitan pluton (Allen and MacLemore 1991).

Sample 8 contains a microcline granite. Microcline granite has been reported in ceramics produced in the southern Hueco Bolson. The source of the granite lies in the Franklin Mountains (Hill 1991). However, little compositional work has been done with ceramics from further north in the Tularosa Basin where granites are also available. It is possible that more than one area could have produced ceramics that contain microcline granite.

Sample 15 was tempered using a syenite. Syenites are available in the Sierra Blanca area (Allen and Foord 1991).

CHIPPED STONE ATTRIBUTES

Philip R. Alldritt

Lithic artifacts found on LA 29362 and LA 29363 were indicative of activities undertaken by the former occupants. By looking at the attributes of each artifact (described in the methodology section), reduction strategies and techniques were recorded to give an overall view of the functional diversity of each site. From the survey and testing it became apparent that LA 29362, because of its location and quantity of lithic material, would most likely be determined to be a quarry site and was approached as such during excavation. Bedrock in the area was 3-5 centimeters below surface and many artifacts exhibited noncultural wear patterns from cattle or vehicles. During testing on LA 29363, thermal features indicated that at least a temporary camp existed, and the presence of ceramics suggested that some type of food storage was taking place. Excavation of LA 29363 was carried out with the hopes of at least some shallow storage pits or possible cooking pits which would suggest a seasonal occupational period for the site. Lithic artifacts recovered from both sites during testing warranted further investigation.

Methodology

Lithic artifacts were systematically collected by 1-by-1-m grid units from LA 29362 and LA 29363. They were then cleaned and analyzed for material type, material quality, artifact morphology, artifact function, dorsal cortex, portion, platform type, platform lipping, platform width, cortex type, dorsal scars, distal termination, thermal alteration, wear pattern, edge angle, and each artifact was measured for length, width, and thickness with calipers in millimeters. Each artifact was also examined with an 80x binocular microscope to identify retouch and wear patterns. Lack of diagnostic material for sites in this area has made it difficult to use other sites to compare data on any level. The artifacts recovered from both sites in this report are no exception as the material quality of the majority of the lithic artifacts was poor. Evidence of a temporary site use was established for LA 29363 and otherwise these sites have assemblages typical of sites in this immediate vicinity. Data produced by LA 29362 and LA 29363 were entered on an SPSS program and included all of the lithic attributes, field specimen numbers, grid location, depth and level. The SPSS program was utilized to organize the data and generate the tables.

Attributes used for analysis are described in the following discussion.

Material Type

A three-character code was given to classify most lithic material. The codes were set up so that major material groups fell into specific sequences of numbers and so that the sequences progressed from general material groups to specific named materials with known sources. Named materials with known sources were given individual codes. Gaps were left in the variable list to insert codes for local materials or to make other distinctions that might be desired.

Material Quality

Texture and material quality are subjective measures of grain size within material types. Within material types, the texture of individual artifacts was scaled from fine to coarse. There may be great variability in texture within material types with the exception of the glassy category, which in the Southwest applies only to obsidian and glass, that exhibit no range in grain size. Inclusions that do not affect flaking quality, like specks of different colored materials in Pedernal cherts, or dendrites in chalcedonies, were not considered flaws and were not coded as such. All materials have a texture and a quality, and therefore a "not applicable" code was not included for this attribute.

Artifact Function

A list of variable codes was used to classify each artifact by function, which categorizes and describes tools. Many artifacts did not have a function other than debris from core reduction. Biface flakes were determined by use of a polythetic set of conditions. If 70 percent of the conditions were met, the flake was considered a biface flake.

Dorsal Cortex

Cortex is measured in 10 percent increments on chipped stone artifacts. For flakes, this is the amount of cortex covering the dorsal surface. Cortex present on platforms is recorded elsewhere and was not included in this estimate. For other chipped stone artifacts, including angular debris, cores, and formal tools, the amount of cortex covering all surfaces was estimated and recorded.

Portion

This attribute refers to the part of the artifact that is represented. By definition, angular debris and cores are whole. It is impossible to tell whether these types of artifacts were fragmented during or after reduction. Flakes and formal tools can be whole or fragmented.

Flake Platform Types

This attribute records the point of impact on whole flakes or proximal fragments. Platforms that were modified to ease flake removal were separated from those that were not, and those types of modifications were recorded.

Platform Lipping

Platform lipping can be, but is not always an indication of soft-hammer reduction. While hard- hammer reduction can produce occasional examples of lipped platforms, a high percentage of lipped platforms in an assemblage in addition to a predominantly diffused bulb of percussion can suggest that most reduction was accomplished by use of a soft rather than hard hammer. A platform is considered to be lipped if the striking platform projects over the ventral surface of the flake. Lipping is an observable eversion, which overhangs the ventral surface; often, a concavity is created by the bulbar scar, which lies underneath the lip.

Platform Width

This attribute measures the width of the striking platform at the point of impact on whole or proximal fragments. Platforms were measured to one-tenth of a millimeter with a caliper to help determine qualities of material types.

Cortex Types

The type of cortex present can be a clue to its origin. A waterworn cortex suggests that it was transported by water and that its source was most likely a gravel or cobble bed while a nonwaterworn surface indicates that an artifact was obtained where it outcrops naturally.

Dorsal Scars

This attribute determines the presence of opposing scars on the dorsal surface on flakes only. The presence of scars or lack thereof may help in determining the definition of biface flakes and suggests a greater or lesser degree of reduction. It may also suggest which material types were selected for tool production.

Distal Termination

This category applies only to flakes and includes fragments as well as complete artifacts. By examining the distal termination of flakes and by comparing material quality and flake breakage with distal termination patterns, it is possible to make assumptions about material quality and reductive technology.

Thermal Alteration

Lithic materials are sometime modified by heating at high temperatures for several hours. This form of processing causes a realignment of the material's crystalline structure and can sometimes heal minor flaws like microcracks. Heat treatment is most often performed on cryptocrystalline materials like chert and can be very difficult to detect unless mistakes are made. While color change and increased luster (waxiness) are sometimes useful in determining whether an artifact has been thermally altered, they cannot be used with confidence unless the full range of colors and lusters are known.

Wear Patterns

The use of a tool or a piece of debitage or core as an informal tool can result in edge attrition, producing patterns of scarring indicative of the way in which the tool was used. Purposeful modification of an informal tool to improve its use performance is also included in this category, as long as the modification is marginal (extending less than one-third of the way across the artifact face).

Edge Angle

This is the angle at which opposing surfaces meet at an edge. In general it is recommended that only the edges of formal and informal tools be measured; this provides an accurate estimate of the range of angles that were preferred for use. Several measurements (3-5) were taken and averaged. Each angle was measured in degrees with a goniometer.

Raw Materials

Raw materials for LA 29362 and LA 29363 were collected from the area labeled the "Mescalero Plain" (Reeves 1972), which lies between the Pecos River

Valley and the Llano Estacado. This gently sloping feature consists of deep, sandy soils, which are covered by eolian sand, caliche, and gravel. These gravels contain chert, quartzite, and other siliceous materials probably derived from the Ogallala Formation. Hummock and dune areas are common. Many small sinks and playa lakes serve as water catchments. Whereas most of the material recovered from LA 29362 and LA 29363 had waterworn cortex, this suggests that a large water catchment area existed in a depressed area just south and west of LA 29362.

Chert, quartzite, silicified wood, and other materials exhibit waterworn cortex and can be assumed to be local. Waterworn cortex counts for LA 29362 were 7,374 and nonwaterworn were 415. Waterworn lithic counts for LA 29363 were 505 and nonwaterworn were seven. Nonlocal materials recovered included Tecovas chert and obsidian. The one example of obsidian collected exhibits some hazing and is probably from the Las Cruces area via the Jemez Mountains (Regge Wiseman, pers. comm. 1998). The Tecovas chert originates from Turkey, Texas, which is also an area of Alibates chert. Material qualities range from fine-grained chert to coarse-grained quartzite that were typed as chert. This illustrates not only which materials were being selected for tool reduction, but also the difficulty in detecting wear patterns on the quartzite. Also at LA 29362, 1,149 platforms out of chert, limestone, quartzite, rhyolite, igneous, and chalcedony and 2,264 distal terminations were broken in manufacture further demonstrating the poor quality of the materials available.

Platform widths were also taken on whole and proximal flakes to determine material quality. Out of 7,363 flakes collected, 513 platforms were collapsed and 102 were crushed, which represents a 5 percent loss in the total due to poor material quality (with some element of human error). Further, the distal terminations for LA 29362 show that, of the artifacts that had a termination, 2,264 were broken in manufacture and 629 had snap fractures for a total of 23.6 percent of the artifacts being incomplete due to poor material quality.

DESCRIPTION OF CHIPPED STONE DATA—TROJAN HILL

by

James A. Quaranta

Geologic Deposition of Materials

The debitage assemblage from Trojan Hill is comprised of 12,269 pieces of lithic debris of which the vast majority is miscellaneous chert (n = 6,485) and quartzite (n = 4,828), along with lesser amounts of the lithic materials listed in Table 38. Virtually all of these materials were geologically transported to the site as wash from the Ogallala Formation at least 200,000 years ago. They were subsequently covered by a stratum of caliche caprock, from which they more recently eroded outwardly. Virtually all of the lithic material at this hilltop site that has cortex exhibits waterworn cortex (95.5 percent), supporting this determination.

Table 38. Lithic Materials from LA 29362

	Number	Percent	Cumulative Percent
Chert	6637	54.1	54.1
Tecovas chert	10	.1	54.2
San Andres chert	59	.5	54.7
Chalcedony	101	.8	55.5
Silicified wood	40	.3	55.8
Obsidian	1	.0	55.8
Igneous	14	.1	55.9
Basalt	6	.0	56.0
Granite	1	.0	56.0
Red rhyolite	92	.7	56.7
Thunderbird rhyolite	18	.1	56.9
Limestone	21	.2	57.1
Siltstone	392	3.2	60.2
Quartzite	4876	39.7	100.0
Total	12269	100.0	100.0

Core Flake Materials—Knapping Properties

Where material types are represented by at least ten specimens, we can see that the highest mean value for whole-flake length is in quartzite, with a mean value of 26.75 mm. This material type also exhibits the largest deviations from its mean value (sd = 13.62). The largest mean length value for this material class is due, in all likelihood, to the larger size of the parent cobbles. The more variable flake length is most likely a manifestation of its inconsistent flaking properties. Previous observations on knapping quartzite from the Carlsbad area indicate that quartzite nodules have a tendency to shatter uncontrollably. Neither the skills nor tools of the knappers appeared to affect this propensity (Katz and Katz 1985b:59).

The lowest mean value for whole flake length is in the miscellaneous chert class (mean = 21.16, n = 1,958, sd = 10.47), where the reduced mean length is a likely manifestation of the smaller size of the parent material, i.e., chert cobbles tend to be smaller than quartzite cobbles on site. The tighter range around the mean value likely reflects its more consistent knapping properties.

An even tighter range of values about a class mean exists within the chert class that has been visually identified as San Andres chert. This material type may thus exhibit even more consistent flaking qualities, which would make it a likely material to be curated. The tighter range of values in San Andres chert whole flakes may be due, however, to a later stage of reduction represented. This would again seem to indicate that the San Andres chert was a more highly regarded chert. The sample size of San Andres chert is small (n = 26) so the relevance of these statements cannot be proven with any statistical confidence.

Silicified wood, utilized to a small extent (n = 14), had a mean length value falling between the San Andres and miscellaneous chert values. It also had a tight range about its mean, as did chalcedony flakes. Chalcedony whole flakes (n = 26) had the lowest mean length value (16.41 mm) of material types that are represented by at least 10 specimens. See Table 39 for tabulation of whole flake length mean and standard deviations for all material types.

Mean width and thickness values of whole flakes by material type exhibit similar patterns (Tables 40 and 41) to those viewed in Table 39. Generally, larger, more variable flake dimensions appear to correlate with the coarser-grained material types, and smaller, more consistent flakes are derived from materials that are fine grained. Casual observation of the material types on site would reveal that gravels of finer-grained materials are consistently smaller.

Material Type—Temporal Implications

The proposition that the use of high quality lithic materials is a characteristic of the earlier prehistoric periods was examined in a regional study of the

Table 39. Whole Flake Length (mm)

	Mean	Number	Standard Deviation
Chert	6637	54.1	54.1
Tecovas chert	10	.1	54.2
San Andres chert	59	.5	54.7
Chalcedony	101	.8	55.5
Silicified wood	40	.3	55.8
Obsidina	1	.0	55.8
Igneous	14	.1	55.9
Basalt	6	.0	56.0
Granite	1	.0	56.0
Red rhyolite	92	.7	56.7
Thunderbird rhyolite	18	.1	56.9
Limestone	21	.2	57.1
Siltstone	392	3.2	60.2
Quartzite	4876	39.7	100.0
Total	12269	100.0	100.0

Table 40. Whole Flake Width (mm)

	Mean	Number	Standard Deviation
Chert	17.64	1958	8.87
Tecovas chert	16.67	3	9.81
San Andres chert	8.19	26	5.57
Chalcedony	13.19	27	4.72
Silicified wood	17.29	14	6.76
Igneous	23.80	5	20.50
Basalt	11.00	4	4.69
Granite	31.00	1	.
Red rhyolite	25.59	29	11.08
Thunderbird rhyolite	17.80	5	7.50
Limestone	30.17	6	14.69
Siltstone	19.61	122	9.32
Quartzite	21.26	1072	10.96
Total	18.97	3272	9.80

Table 41. Whole Flake Thickness (mm)

	Mean	Number	Standard Deviation
Chert	6.84	1958	4.30
Tecovas chert	5.67	3	5.51
San Andres chert	688	26	2.57
Chalcedony	4.93	27	3.01
Silicified wood	6.71	14	3.65
Igneous	8.60	5	6.88
Basalt	2.50	4	1.00
Granite	13.00	1	.
Red rhyolite	9.90	29	4.85
Thunderbird rhyolite	8.005	5	3.39
Limestone	10.00	6	4.90
Siltstone	7.34	122	3.67
Quartzite	8.53	1072	5.10
Total	7.43	3272	4.62

Tularosa Basin (Carmichael 1986). In order to do this, Carmichael developed a lithic diversity index (LDI) where: LDI = number of chert colors /total types of lithic materials on site (Carmichael 1986). An initial investigation of a sample of the lithic population from LA 29362 (Trojan Hill) gives an LDI of 0.74 (where n = 220); it appeared in subsequent analysis that virtually all of the variability in chert color was subsumed within this sample. In Carmichael's 1986 study, difference of means tests showed Paleoindian and Archaic assemblages to be statistically different from one another and both to be statistically distinguishable from later prehistoric period assemblages, where there is an increase in coarser (nonchert) materials. The most statistically significant difference between adjacent time periods is between the Archaic and Mesilla periods, i.e., the pattern of decreasing lithic quality is most pronounced through the preceramic (Archaic) into the ceramic (Mesilla) periods. The mean LDI for the Mesilla is noted as 1.00; and after subdivision of this period, Carmichael notes a mean LDI of 0.90 for the "late" Mesilla phase.

The Trojan Hill LDI is quite low (0.74), and may indicate that this lithic scatter was formed subsequent to the introduction of pottery in the region (designated as the Globe phase). This supposition has some support in that the projectile point found was an arrowhead, a few pottery sherds were found, and radiocarbon-dated features, although not in direct association with excavations blocks, but on the hill, yielded Globe phase dates. The low lithic diversity index here is further highlighted considering the fact that color variation of chert nodules may be great even when from the same outcrop; this diversity could be reasoned to be especially great in geological secondary deposition, here a wash of Ogallala gravels, but the LDI is still quite low.

Material Type—Functional Implications

Of chert types being worked, the majority were from the immediate locale, but a fine-quality gray San Andres chert, not visible in the gravels, and a nonlocal chert visually identified as Tecovas, were encountered in the debitage assemblage, as was one small flake of obsidian (Fig. 70). These aspects, in regard to material type, attest to the site function as being somewhat more than simply a quarry. Additional aspects of the debitage assemblage from this lithic scatter will give credence to this interpretation, although undoubtedly the predominance of exposed, serviceable lithic materials from which to quarry was of prime consideration to the prehistoric occupants of this locale.

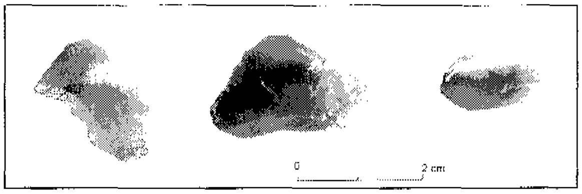


Figure 70. Fine quality material types; (a) chalcedony flake, (b) San Andres chert flake; (c) obsidian flake.

Spatial Disaggregation of Site Components and Functional Implications

Three block excavation areas were superimposed upon the most visibly dense clusters of artifacts on the hilltop: Area A, the most westerly block; Area B, the most easterly block; and Area C, the middle block (Fig. 4). Although there was some eolian deposition, essentially all recovered artifacts can be classed as surface finds, lying within a few centimeters of the caliche caprock. No natural stratigraphic break existed within the few centimeters of eolian deposition overlying the caliche and hence artifacts were grouped and contrasted according to block unit only, emphasizing horizontal rather than vertical stratigraphy of the site. In these analyses an attempt was made to examine this lithic scatter with regard to occupational or organizational variability and to move beyond the administratively useful functional taxon of limited-activity or special activity site, which disregards this variability. An attempt will be made to deconstruct aspects of LA 29362, and to examine and reconstruct the formation processes that formed this lithic scatter.

Flake Portions

In order to examine aspects of manufacturing technology between the most dense artifact clusters (i.e., excavation blocks) a chi-square test was performed between flake portions and areas of the site (Table 42). The chi-square value was significant at the 10 percent level. As can be seen from the table, the largest positive deviation from expected (16.04893) is found in Area C, whole flakes. Sullivan and Rozen (1985) state that debitage assemblages resulting from an emphasis on core reduction generally tend to be dominated by complete flakes and debris, while those produced during tool manufacture yield high percentages of proximal and distal flakes. It is suggested that although core reduction occurred in areas other than Area C, these relations are obscured due to the presence of other reduction stages represented. It seems probable that Area C, having more whole flakes than would normally be expected, in addition to its smaller overall assemblage size, was a locus of focused activity, principally if not entirely devoted to core reduction.

Table 42. Flake Portion/Area Associations

Observed		Whole	Proximal	Medial	Distal	Lateral	Row Total	Chi-square
	Area A	2824	2029	513	804	242	6412	
	Area B	285	210	55	73	28	651	
	Area C	101	44	12	32	3	192	
	Column Total	3210	2283	580	909	273	7255	
Expected								
	Area A	2837.012	2017.725	512.6065	803.3781	241.2786	6412	
	Area B	288.0372	204.8564	52.04411	81.56568	24.49662	651	
	Area C	84.95107	60.41847	15.34941	24.05624	7.22481	192	
	Column Total	3210	2283	580	909	273	7255	
Deviation								
	Area A	-13.0117	11.27484	0.393522	0.621916	0.721433		
	Area B	-3.03722	5.143625	2.955892	-8.56568	3.503377		
	Area C	16.04893	-16.4185	-3.34941	7.943763	-4.22481		
Contribution								
	Area A	0.059677	0.063003	0.000302	0.000481	0.002157	0.125621	
	Area B	0.032026	0.129148	0.167883	0.899531	0.501034	1.729622	
	Area C	3.03196	4.461652	0.73088	2.62316	2.470518	13.31817	
	Column Total	3.123663	4.653803	0.899064	3.523173	2.973709		
								15.17341

Significant at the 10 percent level

Table 43. Flake Portion (Chert)/Area Associations

Observed		Whole	Proximal	Medial	Distal	Lateral	Row Total	Chi-square Value
	Area A	1705	1120	229	425	114	3593	
	Area B	128	102	25	35	6	296	
	Area C	78	36	6	17	1	138	
	Column Total	1911	1258	260	477	121	4027	
Expected								
	Area A	1705.046685	1122.42215	231.9791408	425.5925006	107.9595232	3593	
	Area B	140.4658555	92.46784207	19.11100074	35.06133598	8.893965731	296	
	Area C	65.48745965	43.11000745	8.909858455	16.3461634	4.14651105	138	
	Column Total	1911	1258	260	477	121	4027	
Deviation								
	Area A	-0.046684877	-2.422150484	-2.9791408	-0.592500621	6.040476782		
	Area B	-12.46585548	9.532157934	5.888999255	-0.061335982	-2.893965731		
	Area C	12.51254035	-7.11000745	-2.909858455	0.653836603	-3.14651105		
Contribution								
	Area A	1.27825E-06	0.005226922	0.038258957	0.000824866	0.337972591	0.382284614	
	Area B	1.106301259	0.982633885	1.81467798	0.000107301	0.941653915	4.84537434	
	Area C	2.3907427	1.172632735	0.950326683	0.026153067	2.387677657	6.927532841	
	Column Total	3.497045237	2.160493542	2.803263619	0.027085234	3.667304163		
								12.1551918

Not significant at the 10 percent level

When this same analysis was restricted to chert, the null hypothesis of no association could not be disproved at a strong enough statistical confidence. However the strongest positive deviation from expected was once again in Area C, whole flakes (value = 12.51) following the pattern of the previous analysis (see Table 43). Restricting the analysis to quartzite material proved uninformative, likely due to its somewhat random flaking properties (Katz and Katz 1985b).

Dorsal Cortex

A wide variety of categories has been employed in the analysis of debitage presumed to have been produced by core reduction. Sullivan and Rozen (1985) explore the general methodological problems common to many of these nontool debitage taxa. Often three basic categories are subsumed within the overall typology: primary, secondary, and tertiary flakes. They state that debitage analyses employing reduction stage categories based on arbitrary division of cortex are compromised by the consequences of operational problems. Because the proportion of cortex that defines a specific debitage category is not standardized, primary or secondary flakes of one study could be classified as secondary or tertiary flakes in another.

It is felt that the method employed in this analysis regarding percentage of dorsal cortex goes toward addressing the criticisms mentioned above. The data as employed here, however, are intended only for intersite comparison. Percentages of dorsal cortex present were recorded for flakes in estimated 10-percent intervals; these small increments were unlikely to produce bias when the distributions are examined in regard to their cumulative percentages in each dorsal cortex class. Instead of employing the data in a categorical fashion with arbitrary cut-off points implicitly related to reduction stage, the data were ranked and each area's distribution was compared for its "fit" to the other areas.

A Kolmogorov-Smirnov goodness-of-fit test was performed comparing the dorsal cortex distribution for each area's flakes. No statistically significant difference between assemblages would imply that they were derived from the same parent population, i.e., a population of comparable dorsal cortex distribution and thus likely, one with similar lithic reductive processes represented. In like fashion, a significant difference would imply that the distributions were not derived from the same or comparable parent population, and would thus likely represent differing reductive processes.

Table 44 shows the cumulative percentages in each dorsal cortex class for flakes in Areas A, B, and C. There is no statistical difference between Area A and Area B, however the significant K-S values show Area C to be different from both Area A (0.1 percent level) and Area B (0.1 percent level). A visual inspection of the ogive (Fig. 71) gives a clear impression of the data.

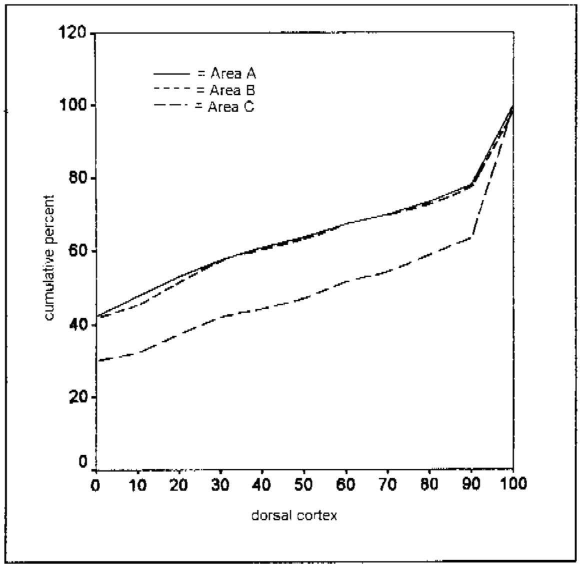


Figure 71. Ogive of dorsal cortex distributions.

Proportionally less of the Area C flake assemblage contains flakes with minimal amounts of dorsal cortex, or more clearly stated: Area C has proportionally more flakes with greater amounts of dorsal cortex. This would appear to indicate that earlier stages of the lithic reductive process are represented in this spatial cluster. Areas A and B have proportionally more flakes with less cortex than Area C, indicating further reduction occurring in these locales. The examination of this ranked data (dorsal cortex) lends support to previous interpretations based on the categorical data (flake portion).

Table 44. Kolmogorov-Smirnov Goodness-of-Fit Test for Cumulative Percentages in Cortical Classes by Area

Cortex	Area A	Area B	Area C
10	47.8	45.8	32.3
20	53.1	52.2	37.5
30	57.5	57.5	42.2
40	61.0	60.5	44.8
50	63.8	63.3	47.4
60	97.4	67.4	52.1
70	69.9	69.7	54.7
80	73.4	72.7	59.4
90	78.0	77.3	64.1
100	100.0	100.0	100.0
Number	6412	651	192

KS value significant at 0.1 percent level (Area C: Area A)
KS value significant at 0.1 percent level (Area C: Area B)

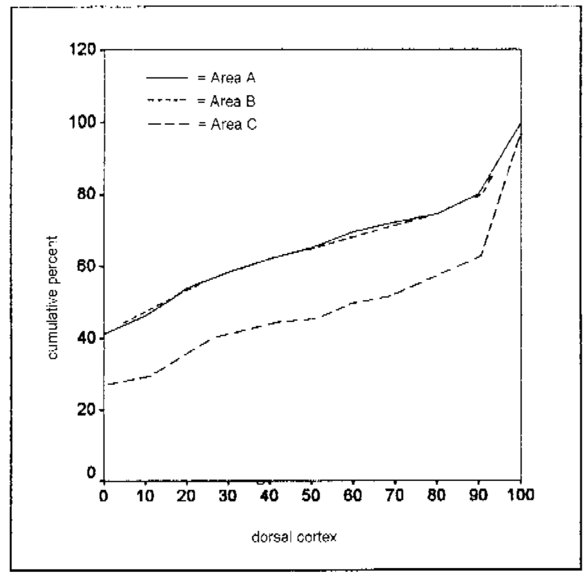


Figure 72. Ogive of dorsal cortex on chert flakes by area.

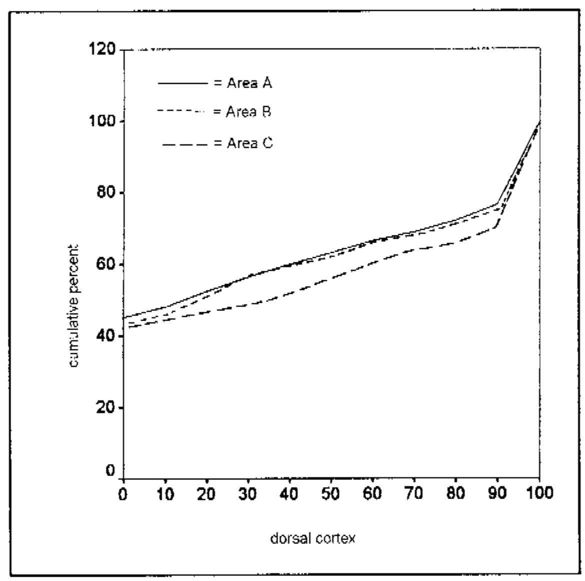


Figure 73. Ogive of dorsal cortex on quartzite flakes by area.

Table 45 treats the data in similar fashion but restricts the analysis to chert flakes. The same pattern is once again clearly demonstrated, with the Area C subassemblage significantly different from that of the other areas (C vs. A significant at the 0.1 percent level; C vs. B significant at the 0.1 percent level). Differences as large as these would only be arrived at by random processes one time out of every 1,000 trials. The ogive of this data set (Fig. 72) once again paints a clear visual picture of the distributions and highlights Area C's distinctness.

Table 46 and Figure 73 again treat the data in like fashion, this time restricting the analysis to quartzite flakes. Once more similar patterns are seen in the data set although the quartzite flake data set for Area C is markedly smaller than that of the other areas. The ogive of quartzite flake dorsal cortex percentage shows Area C to be visually distinct in the same manner as the chert flake data set and the data set of all flakes in all material classes. The K-S value derived from the table, however, only shows a statistically significant difference between Area C and Area A (1 percent level).

Table 45. Cumulative Percentages in Cortical Classes (Chert) by Area

Cortex	Area A	Area B	Area C
10	40.7	46.3	26.8
20	47.7	54.1	36.2
30	58.3	58.4	41.3
40	61.9	62.2	43.5
50	64.5	65.2	44.9
60	68.2	69.6	50.0
70	70.7	72.3	52.2
80	74.5	74.7	58.0
90	79.5	80.1	63.0
100	100.0	100.0	100.0
Number	3593	296	138

KS value significant at the 0.1 percent level (Area C: Area A)
KS value significant at the 0.1 percent level (Area C: Area B)

Table 46. Cumulative Percentages in Cortical Classes (Quartzite) by Area

Cortex	Area A	Area B	Area C
10	48.0	45.7	44.2
20	52.4	50.9	44.2
30	56.4	57.1	46.5
40	59.9	59.6	48.8
50	63.1	62.0	53.5
60	66.5	66.0	58.1
70	69.0	68.2	62.8
80	72.2	71.3	65.1
90	76.5	75.3	69.8
100	100.0	100.0	100.0
Number	2334	324	43

KS value significant at the 1 percent level (Area C: Area A)

Utilized Debris—Exotics

Additional support to the postulation that Area C activities were of limited scope and duration may be found in the fact that out of the three dense artifact clusters only Area C was devoid of utilized debris. No artifacts with use-wear or retouch were found in this excavation area. Neither was there found in this excavation area any lithic material that could be considered of nonsite origin. San Andres chert, chalcedony, rhyolite, and unidentified igneous materials were present in the other two artifact scatter areas but were absent in Area C. The San Andres chert is deduced to be of nonhilltop origin; it is uncertain whether the chalcedony, rhyolite, and igneous arrived on site geologically or culturally (Figs. 71-73). Area C also lacked the visually identified Thunderbird rhyolite and the obsidian found in Area A. Succinctly, 14 lithic material types were encountered in Area A, nine in Area B, and only four in Area C.

Shatter—Angular Debris

The Area C subassemblage had the highest interassemblage percentage of angular debris (45 percent), just marginally greater than that of Area B (43 percent), but ten more than that found in the Area A subassemblage (35 percent). Area A contained 83 percent of the total site's angular debris, obviously the main site locus of lithic reduction. The higher interassemblage proportion of shatter in Area C does not indicate that it was the area of most intensive core reduction on site. It simply adds credence to the previous assertion that activity in this locale was quite restricted, whereas other activities are in evidence in the other locales, most notably in Area A.

In experiments on the production of lithic debitage from stone tool manufacture (Pokotylo 1978), it was noted that the technical aspects of manufacturing a biface are substantially different from those of reducing a core. It is adduced that the blank is held in the hand whereas a core is seated on the ground, and this was the procedure employed in the experiment. More control is obviously achieved in the process of reducing a blank and less shatter is produced. In the experiment, 48 percent of the debitage from reducing a core was classed as shatter. This compares quite well with our percentage of angular debris from Area C and Area B (45 percent, 43 percent).

In the replicative knapping experiment of a blank, 22 percent of the debitage was classed as shatter. Area A of LA 29362 had 35 percent of its assemblage comprised of angular debris or shatter. The lesser interassemblage proportion of shatter in Area A *may* be indicative of this later stage of reduction accompanying primary core reduction in this locale. This was the only area on site in which bifacial tools were found (excepting a projectile point with an impact fracture in Area C).

Table 47. Platform Type/Material Type Associations

Observed		Cortical	Single Facet	Multifacet	Total	Chi-Square Value
	Chert	1605	957	487	3049	
	Quartzite	885	789	186	1860	
	Total	2490	1746	673	4909	
Expected						
	Chert	1546.55	1084.45	418	3049	
	Quartzite	943.45	661.55	255	1860	
	Total	2490	1746	673	4909	
Deviation						
	Chert	58.45	-127.45	69		
	Quartzite	-58.45	127.45	-69		
Contribution						
	Chert	2.209047557	14.97856287	11.38995215	28.57756258	
	Quartzite	3.621180243	24.55370342	18.67058824	46.8454719	
	Total	5.8302278	39.53226629	30.06054039		
						75.42303448

Significant at the .05 percent level

Platforms

It has been noted that ". . . more scars are expected on flake platforms at late stages [of reduction] as a result of platform preparation to better control flake removals . . ." (Pokotylo 1978). If it can be reasoned that multiple platform scars are indicative of greater reduction processes than either single facet platforms or cortical platforms, parallel reduction sequence patterns are in evidence between the site's areas. As common sense would indicate, the more coarse-grained materials should be used less than the finer-grained materials, and a statistical association does exist between platform types and material types (chi-square significant at the 0.05 level), with more single-facet platforms on quartzite flakes and fewer on chert flakes than would normally be expected (Table 47). This analysis, which aims to discriminate if an association exists between site areas and platform types (and ultimately reduction sequences), is thus restricted to the chert material class. This simplistic heuristic does not show any evidence of association between any of the three major platform types with excavation areas (Table 48).

Regarding all platform-remnant-bearing chert flakes, a small percentage of crushed platforms was found in Area A and in Area B (2 percent in both). No crushed platforms were found in Area C. "This fault occurs when the knapper delivers a blow to a sharp, acute platform. The platform being fragile, disintegrates . . . . Crushing is a problem more common toward the end of the thinning process . . ." (Lord 1993:35, 36). The absence of crushed platforms in Area C provides supporting evidence for the lack of late-stage reduction in this locale, whereas it appears

Table 48. Platform Type/Area Associations

Observed		Cortical	Single Facet	Multifacet	Total	Chi-Square Value
	Area A	1376	816	427	2619	
	Area B	110	76	33	219	
	Area C	61	35	14	110	
	Total	1547	927	474	2948	
Expected						
	Area A	1374.35	823.55	421.1		
	Area B	114.92	68.86	35.21		
	Area C	57.72	34.59	17.69		
Deviation						
	Area A	1.65	-7.55	5.9		
	Area B	-4.92	7.14	-2.21		
	Area C	3.28	0.41	-3.69		
Contribution						
	Area A	0.001980936	0.069215591	0.08266445	0.153860978	
	Area B	0.210636965	0.740336915	0.138713434	1.089687314	
	Area C	0.186389466	0.004859786	0.769706049	0.960955301	
	Total	0.399007368	0.814412293	0.991083933		
						2.204503593

Not significant at the 10 percent level

that some late-stage reduction is represented in Area A and in Area B.

Of additional note, the only abraded platforms observed were encountered in the Area A subassemblage (n = 6). Abrasion is a process in which a tool is used in the fashion of a file, often in order to consolidate a striking platform. Consolidation of the striking platform would be most needed as it became more acute, again indicating a manufacturing technique that evidences late stage reduction.

Flake Length

"Casual observation and controlled experimentation (e.g., Newcomer 1971) indicate that the size of waste flakes from the manufacture of bifacial points, knives, or large hand-axes will systematically decrease from the initial to final stages of manufacture as the emerging tool is reduced, thinned, and shaped. This underlying regularity suggests that the size distribution of waste flakes may be used to distinguish sequential stages of biface manufacture" (Stahle and Dunn 1982:85). In another study (Burton 1980) that examined ten measured, whole flake variables to characterize the reduction sequence of bifacial manufacture, it was found that one variable, mass or weight, accounted for 76 percent of the discrimination between flake categories from initial to final stages of reduction. Since weight is a direct expression of size, it would appear that simple flake size is adequate to characterize sequential stages of reduction. Simply, it would be expected that an assemblage of later stage lithic reduction would have proportionally more small flakes to large flakes than would an assemblage representing an earlier stage of lithic reduction.

Although both broken and whole flakes were included in the analysis of the Stahle and Dunn study (1982), which sought to fit a theoretical distribution that would model the various stages of bifacial reduction, in this much less detailed analysis only whole flakes were examined. What is being attempted here is simply an intrasite comparison employing a goodness-of-fit test between the flake length distributions of the three areas. As noted previously, a likelihood exists of an association between flake portions and the site's areas or lithic clusters. In order that these possible associations do not confound this analysis, only whole flakes were considered and the material class restricted to chert.

As in previous analyses, the distributions were divided into ranked classes. The cumulative percentages of flakes in each ranked class were tabulated for each area or lithic cluster. As mentioned previously, a significant K-S value would indicate the unlikeliness that the populations were derived from the same or a comparable parent population. If it is adjudged that the distributions are probabilistically not derived from the same parent distribution, it is likely that differing stages of lithic reduction are being observed.

Simple observation of Table 49 indicates that data do not show striking dissimilarities. However, the K-S values do show statistically significant differences between the distributions of whole chert flake length between Area A and Area B (2.5 percent level) and between Area A and Area C (10 percent level). Area A displays a statistically significant higher proportion of small whole chert flakes than the other areas. There is no discrimination between Areas C and B. (The mean value of chert flake length in Area A is 19.78, in Area B it is 20.7, in Area C it is 21.52.)

Examining chert whole flakes with regard to width in a like manner (Table 50), we can only statistically discriminate Area A from Area B (significant at the 10 percent level). Data on thickness of these flakes do not statistically discriminate between the populations of the three areas (Table 51).

Table 49. Cumulative Percentage in Length Classes (Whole Chert Flakes) by Area

Length (mm)	Area A	Area B	Area C
5	0.4	0.0	00.0
10	11.5	7.0	11.5
15	35.1	25.0	34.6
20	58.1	43.8	52.6
25	73.7	64.1	61.5
30	85.2	74.2	70.5
35	90.9	85.2	83.3
40	94.4	90.6	89.7
45	97.1	94.5	94.9
50	98.4	99.2	97.4
55	99.2	100.0	100.0
60	99.7		
Number	1705	128	78

KS value significant at the 2.5 percent level (Area A: Area B)
KS value significant at the10 percent level (Area A: Area C)

Table 50. Cumulative Percentages in Width Classes (Whole Chert Flakes) by Area

Width (mm)	Area A	Area B	Area C
5	1.5	0.8	1.3
10	22.6	10.2	16.7
15	49.0	43.0	50.0
20	70.4	63.3	67.9
25	84.2	75.0	80.8

30	92.0	89.8	88.5
35	96.0	96.1	94.9
40	97.5	100.0	97.4
45	98.8		100.0
50	99.5		
55	99.8		
60	99.9		
Number	1705	128	78

KS value significant at the10 percent level (Area A: Area B)

Table 51. Cumulative Percentages in Thickness Classes (Whole Chert Flakes) by Area

Thickness (mm)	Area A	Area B	Area C
1	1.4	1.6	0.0
2	9.3	7.0	5.1
3	21.5	14.1	20.5
4	34.7	24.2	28.2
5	47.4	38.3	41.0
6	58.4	52.3	57.7
7	66.5	60.9	69.2
8	74.7	64.8	75.6
9	80.1	75.0	76.9
10	85.2	77.3	79.5
11	88.4	83.6	83.3
12	90.6	83.6	88.5
13	92.0	86.7	91.0
14	93.9	92.2	93.6
15	95.5	95.3	98.7
16	96.1	96.1	98.7
17	96.8	97.7	98.7
18	97.7	98.4	98.7
19	98.0	98.4	98.7
20	98.5	100.0	100.0
Number	1705	128	78

KS values not significant at the 10 percent level

Cores

Throughout all site areas, 159 local chert, 91 quartzite, 12 siltstone, and 3 San Andres chert cores were found, as were 1 chalcedony core, 1 silicified wood core, 1 rhyolite core, and 1 limestone core. Of these, 229 were found in Area A, 28 in Area B, and 12 in Area C. Of all bifacial cores from excavated areas, 92.2 percent of the total were found in Area A. Forty-seven bifacial cores were found within Area A, as opposed to 1 from within Area B and 3 from within Area C. Considering the individual areas, 21 percent of the Area A core assemblage is comprised of bifacial cores (n = 47/229); 25 percent of the Area C core assemblage are of this type (n = 3/12); whereas only 4 percent of the cores from Area B (n = 1/28) are bifacial. Less strategic and less intensive lithic reduction appears to be a correlate of the Area B subassemblage.

The implication of a greater emphasis on bifacial reduction in Area A is that postulations concerning later stages of reduction in this locale gain substantiation. It appears that the knapping of blanks, as opposed to just cores, may be more greatly represented in Area A. It should be remembered that the analysis of shatter or angular debris presented similar indications.

Of note, four of the five selected bifacial cores bore signs of edge damage in the form of step fractures and or crushing along the bifacial edge. It is thus possible that these forms had often served as functional choppers.

For a visual display of the distributions of the core length data by area, stem and leaf plots are provided below for each excavation area in both the chert and quartzite materials. Measurements are in millimeters. The stems represent the ten values; the leaves represent the unit values (Table 52 and Table 53).

Technology-Behavioral Implications

Although the three lithic clusters exhibit different data patterning, it is clear that core reduction is the principal activity represented by the overall site debitage. The great many cores and tested cobbles attest to the site's primary function as that of a quarry. Eroded out from the caliche caprock, a multitude of serviceable lithic materials were readily available on the surface of the hill. These rounded cobbles, as previously stated, arrived as wash from the Ogallala Formation, at least 200,000 years ago. The most abundant natural and culturally altered materials on site are chert and quartzite.

It has also been observed that there is differential spatial patterning of the debitage with regard to stages of lithic reduction represented, and that other activities beyond core reduction are represented. Since activities beyond simple quarrying episodes are in evidence, which nonetheless appear to be subordinate activities, an embedded resource procurement strategy was likely employed by the site's inhabitants. The likelihood of an embedded strategy prompts further investigation of the lithic database.

In the nearby habitation site of Macho Dunes, we encounter both chert and quartzite materials visually identical to those found here (Trojan Hill). It appears that various lithic materials may have been transported away from Trojan Hill, although not in comparable proportions to those represented on the hilltop.

Table 52. Stem and Leaf Plot (Chert Core Length, mm)

Area A

1 5
2 1 3 6 7 8 8
3 1 1 2 2 2 2 3 3 4 4 4 4 5 6 6 6 7 7 7 7 8 8 9 9 9 9 9 9 9
4 0 0 0 0 0 0 0 0 0 1 1 1 2 2 2 2 2 3 3 3 3 4 4 4 4 4 5 5 5 6 6 6 6 7 7 7 8 8 9 9
5 0 1 2 2 2 3 3 3 3 4 4 5 5 5 5 5 5 6 6 7 7 7 7 8 8
6 0 1 3 3 5 6 6 7 7 7 7 8 9 9 9
7 1 2 4 4 6 7 8 8 8 9
8 0 1 4
9

Area B

1
2 2 5 8
3
4 1 1 3 5 6 9
5 0 3 4 5
6 5 6 8 9
7 6
8
9

Area C

1
2
3 0 0 5
4
5 9
6
7 0 2
8 0
9

Table 53. Stem and Leaf Plot (Quartzite Core Length, mm)

Area A

1
2
3 5 7 8 8
4 0 3 3 4 5 5 6 6 6 7 7 8 8
5 0 0 1 1 2 2 2 2 2 2 3 3 3 4 5 6 6 7 7 7 8 8 8 8 9 9
6 0 0 0 1 2 2 4 4 5 5 5 6 6 6 6 7 7 8
7 1 1 1 1 3 4 5 7 8 9
8 0 2 4 5
9 0 3 9
10 2

Area B

1
2 5
3
4 2 7 8
5
6 7
7 5 6
8
9
10

Area C

1
2
3
4
5
6
7 2 3 3
8
9 0
10

The ogive (Fig. 74) displays distribution data for flakes of all materials, for flakes of chert, and for flakes of quartzite regarding dorsal cortex cover. As can be seen, these distributions virtually overlie each other, implying that the degree to which a parent cobble was worked *was not* dependent upon material type. If large amounts of quartzite were not transported away but *were* worked on site as exhaustively as was the chert, then it is likely that this material served a vital function in the context of the prehistoric use of this site.

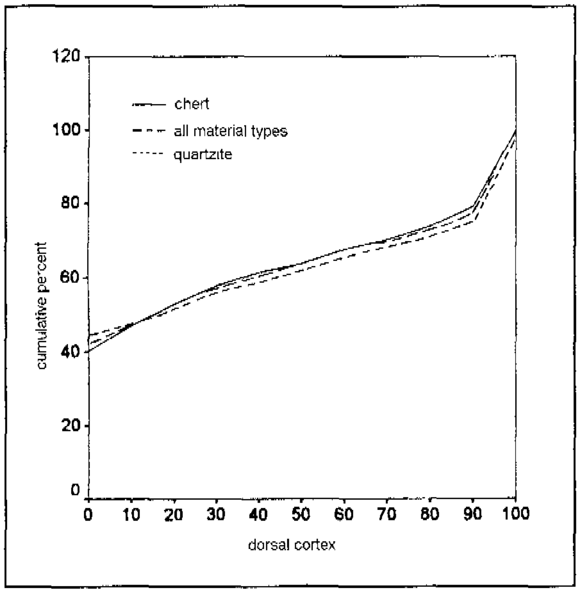


Figure 74. Ogive of distributions, flake data by material type.

A chi-square test (Table 54) showed that there was an association between material type and flake portion on the overall site (0.05 percent level). The material type that contributed most information was the quartzite. The flake portions that contributed the most information were medials, wholes, and laterals. Of these, only the medial and lateral flakes exhibit positive deviations from expected values in quartzite, i.e., more of those than normally expected.

What is likely represented in the numerical data is an aspect of lithic morphology/lithic technology that was appreciated during analyses but which was not amenable to incorporation into the existing typologies. What I believe is represented by the preponderance of lateral and medial quartzite flakes is a citrus core technology most manifest in this material. Many quartzite flakes that bore the diagnostic double-faceted ventral side with functional edge opposite to the cortical backing (wedge-shaped) were labeled as lateral flakes. (Most chert flakes that were labeled as lateral, on the other hand, appear to have been fractured at the platforms due to imperfections or errors in force and do not seem morphologically or technologically distinct. The majority of quartzite lateral flakes were morphologically distinct, conforming only to visual and descriptive information of flakes derived from bipolar pebble technologies (Goodyear 1974:74; Schiffer 1976:104-105,125; Cresson 1977:27; Stafford 1977:28). Many quartzite medial flakes also had two

Table 54. Flake Portion/Material Type Associations

Observed		Whole	Proximal	Medial	Distal	Lateral	Row Total	Chi-Square Value
	Chert	1958	1282	265	484	121	4110	
	Siltstone	122	86	25	35	8	276	
	Quartzite	1072	855	282	376	136	2721	
	Column Total	3152	2223	572	895	265	7107	
Expected								
	Chert	1822.811313	1285.56775	330.7893626	517.5812579	153.2503166	4110	
	Siltstone	122.407767	86.33009709	22.21359223	34.75728155	10.29126214	276	
	Quartzite	1206.78092	851.1021528	218.9970452	342.6614605	101.4584213	2721	
	Column Total	3152	2223	572	895	265	7107	
Deviation								
	Chert	135.1886872	-3.567750106	-65.7893626	-33.58125791	-32.25031659		
	Siltstone	-0.40776699	-0.330097087	2.786407767	0.242718447	-2.291262136		
	Quartzite	-134.7809202	3.897847193	63.00295483	33.33853947	34.54157873		
Contribution								
	Chert	10.02626055	0.009901338	13.08458107	2.178790027	6.786823957	32.08635694	
	Siltstone	0.001358361	0.00126218	0.349518806	0.001694961	0.51013006	0.863964369	
	Quartzite	15.05318501	0.017851221	18.1252323	3.243604379	11.75970063	48.19957354	
	Column Total	25.08080391	0.029014739	31.55933218	5.424089368	19.05665465		
								81.14989485

Significant at the .05 percent level

ventral sides with cortex on a lateral margin. As Solberger and Patterson (1976) point out, the mechanics of this technology are such that large amounts of unutilizable debitage are created, likely represented here by many block-like medial quartzite flakes. The statistics highlight associations that hint at this technology. A very large number of these flakes could not be properly assigned to a class that would reflect their morphology or the manufacturing technology. Many flakes bore attribute states that obfuscated their distinctness when incorporated into the existing typological framework. I believe that the numerical data *is* displaying a pattern related to citrus core-bipolar pebble technology, and that it is greatly *under*-representing the amount of these flakes and the manufacturing behavior that it represents.

Bipolar, citrus core technology was apparently used by the prehistoric inhabitants of Trojan Hill; but due to the above-mentioned operational problems, we cannot quantitatively assess the degree to which it was employed. We can investigate, however, the behavioral correlates of this manufacturing technology and its possible role in an embedded resource procurement strategy.

> Bipolar flaking is itself a means to an end. . . This results in either a ready-made cutting tool or a like-preform . . . Economy of time, energy and materials is the real issue here (not "true bipolar flaking"). . . Pebble resources and bipolar reduction skills provided the logical solution for the acquisition of workable materials, as well as a time and energy saving technique in lithic reduction.(Cresson 1977:27)

Cresson (1977) states that in the eastern United States, the archaeological record is overflowing with artifacts reduced from pebbles and that a high incidence of specific pebble (quartz, quartzite, sandstone) resource using groups predominate the cultural milieu. So much so, he states, that perfectly good and abundant natural lithic outcrops occurring within 60 to 80 km were neglected by some groups. In desert environments, which lack the usual features of lithic resource availability (as do coastal plains), cultural adaptation would mandate that use is made of every environmental resource, including pebbles.

It is accepted that bipolar reduction of cores is not a precisely controlled technique (as noted by Stafford 1977). Solberger and Patterson (1976) state that large amounts of unutilizable debris would be expected with this technology. Nonetheless, it is evident that some degree of control was attained, which yielded a recognizable lunate flake form, called Orange Peel Flakes (OPFs) by Stafford. Goodyear (1974) and Schiffer (1976) describe the manufacturing process of these flakes in some detail and state that one of the main advantages of this flake type is the natural cortical backing of this type of flake where the cortex is usually on the margin opposite the functional edge (Fig. 75). The natural backing supplied by the cortex would provide some comfort when using the flake as an implement for chopping or cutting. It would thus make a fair quality expedient tool.

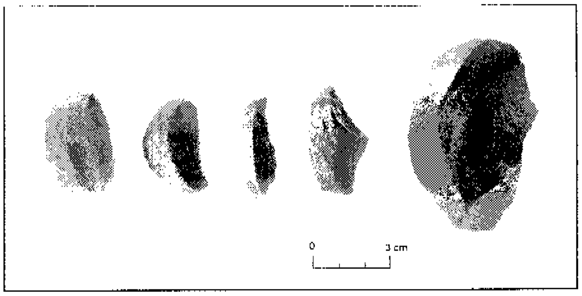


Figure 75. Orange peel flakes.

Bipolar technology may be characterized as less efficient than other technologies, as it produces much unutilizable debitage and many OPFs without the functional edge, nevertheless it can be technically advantageous. The desired flake form has a functional edge and has a natural backing that would facilitate its use in heavier jobs. These flakes would also tend to be larger than other flake types as they make use of the entire breadth of the cobble, again indicating tasks where a larger tool may be preferred. "It is obvious that removal of flakes from pebbles in this fashion will not accomplish any basic tasks of tool manufacture such as decortication or thinning . . ." (Goodyear 1974:74), so it would seem that the production of expedient tools may be a correlate of this technological behavior. Additionally, "Anyone interested in lithics, who has tried to reduce a quartz or quartzite pebble knows the considerable amount of time spent preparing the piece to be bifacially thinned" (Cresson 1977:27). Since this coarse-grained material does not exhibit the consistent conchoidal knapping properties of chert, it would not appear to be an efficient use of energy to attempt to reduce this material bifacially. The more rapid reductive technique, which achieves its use-applicability sooner regardless of greater waste outputs, would be the preferred technique for an expedient tool, especially if expediency is planned as part of an embedded strategy where suitable low-grade lithic material is readily available (Fig. 76).

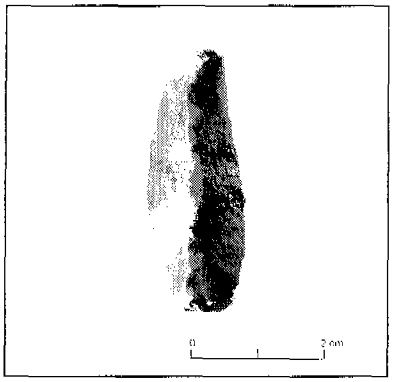


Figure 76. Diagnostic double-faced ventral side of orange peel flake.

Utilization of the Lithic Artifacts and Functional Interpretation

Across the site, 49 pieces of debitage were tabulated as having a culturally modified edge angle. Of these, 45 were simple core flakes that had been utilized by the prehistoric inhabitants to fulfill task requirements. Virtually all utilized debitage was noted in the fine-grained material, specifically chert. This is likely due to the clarity with which this material exhibits signs of ancient behavior, and surely over-represents activities associated only with this material. Utilization of coarse-grained materials, though expected, is often difficult to confidently discern. Nevertheless, a second look at some of the quartzite OPFs revealed what appeared to be use wear (examples are FS 435, FS 71, see Fig. 76). As mentioned, these larger, coarse-grained, though sturdier flakes would be more ideally suited to rougher tasks. As the site was evidently not occupied for extended occupations, it seems plausible that these rougher flakes formed part of the inventory of materials needed for plant-gathering as part of an embedded strategy on this "quarry" site.

The smaller chert flakes were less suited to these implied rough tasks. Their size and weaker functional edges made them ill-suited to tasks that required more brawn. Nevertheless, there is concrete evidence that small chert flakes were employed in site tasks. No utilized flakes at all were found in Area C, as stated previously. In Area B, four utilized flakes were found, as was the projectile point that manifested an impact fracture. Possibly, this indicates that a meat package was processed here. In this terrain the likely hunting strategy is forager-style hunting. This may, thus, also represent one component of an embedded resource acquisition strategy.

Area A displayed the most site activity of all areas.

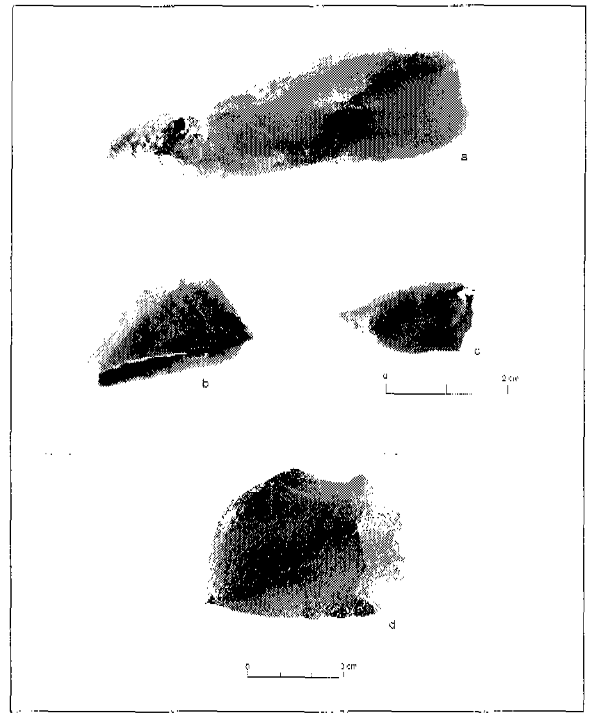


Figure 77. Utilized artifacts from Trojan Hill; (a-b) scrapers, (c) scraper/graver.

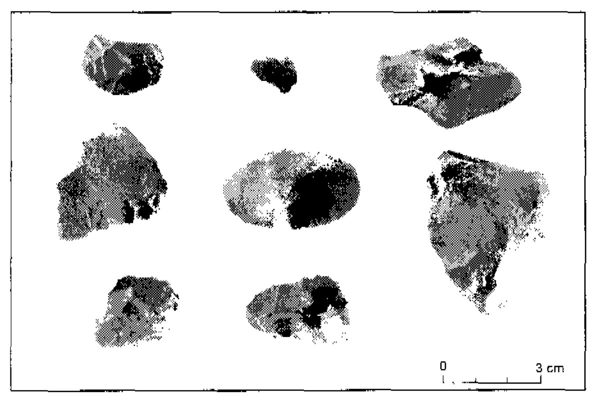


Figure 78. Biface artifacts from Trojan Hill.

In addition to the greater numbers of cores reduced here, the largest amount of utilized debris was recovered from this cluster (Figs. 77 and 78). The 45 pieces of utilized debris appear to peripherally ring an area some 15 m wide. If this pattern is reflecting cultural transformations, and the formation of the lithic scatter here was formed over a brief time period, an hypothesis could be formed that states people were engaged in other task activities peripheral to the primary core reduction area and were occupied by these tasks at a safe distance from the flying shatter of primary core reduction.

Virtually all utilized debris on site manifested unidirectional edge wear (Fig. 79). This is usually taken to indicate the transversal movement of the artifact while engaged in the task that left these traces. This movement is normally associated with scraping activities. It is possible that either plant or animal (or both) materials were scraped with this movement. Forty-two of these artifacts with unidirectional edge wear have edge angles associated with heavy duty cutting or scraping activities, according to the edge angle framework, postulated by Wilmsen (1970:70-71). Only five of the utilized artifacts had edge angles that could indicate butchering within Wilmsen's framework. The heavy-duty scraping evidenced through the chert artifacts, coupled with the functional implications and probable edge wear of the quartzite OPFs, and the crushing and step fractures (i.e., possible use-wear) along the bifacial margin of some cores provide strong clues that site activities at Trojan Hill encompassed a range of activities, likely as part of an embedded resource procurement strategy.

Tools

No tools were encountered in the Area C assemblage. Only Area A and Area B contained artifacts that could be classed as formal tools. Area A contained three bifaces: FS 30, a late-stage quartzite biface (43-by-26-by-15 mm); FS 117, an early-stage quartzite biface (58-by-49-by-21 mm); and FS 232, a middle-stage chert biface (55 -by-42-by-20 mm). Area B also contained three bifaces: FS 540, a middle-stage chert biface (26-by-19-by-9 mm); FS 551, an early-stage chert biface (33-by-22-by-11 mm); and FS 742, another early-stage chert biface (30-by-24-by-8 mm). Additionally, a small projectile point was encountered in Area B, in the same 1-by-1-m grid unit as the early-stage biface FS 742. The stem of the projectile point was broken. The distal end also was broken, manifesting an impact fracture.

Hammerstones

Remarkably, only seven hammerstones were identified from the site. These all derived from Area A. Five were quartzite; two were chert.

One-hundred-fifty-nine tested cobbles were collected from the site. These are cobbles from which up to two flakes had been removed, as though the material was tested for suitability and cobbles that appear to have been intentionally broken in half. It is surmised that many of the cobbles with only one small flake removed were expediently used hammerstones that had been misclassified.

Of note, the specimens that were classified correctly evidently bore sufficient signs of battering and were derived from the area with the most intensive

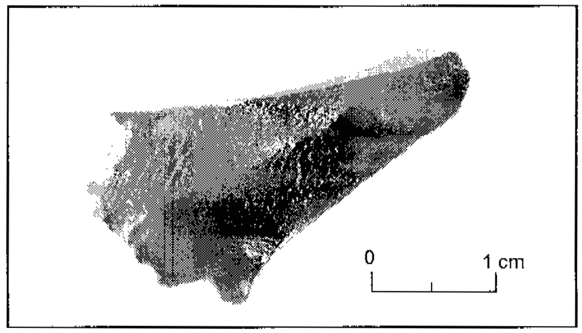


Figure 79. Bidirectional retouch flake from Trojan Hill.

reduction, Area A.

Conclusions

The preponderance of exposed serviceable lithic materials was evidently of prime consideration to the prehistoric occupants of Trojan Hill. The very large number of cores attests to the main site function as being that of a quarry. No area on site had a flake assemblage dominated by late-stage lithic reduction characteristics. However, differential spatial patterning was evident between the site areas' subassemblages. Statistically significant differences in the assemblages were found that indicated organizational and occupational variability within the site.

Flake portions were seen to be related to site area. The Area C assemblage had a greater proportion of whole flakes, which is often taken to be related to primary core reduction. This area also manifested a greater proportion of highly cortical flakes than the other areas, with the same technological implications. Area C had the smallest overall assemblage, and lacked nonlocal lithic materials, as were found in the other site areas. Area C was also devoid of utilized debris, as opposed to Area A and Area B. No crushed or abraded flake platforms were encountered in this locale. The implications of these data appear to indicate that, although an early reduction stage focus is manifest site-wide, this area had a particularly limited activity regimen.

More reduction occurred in Area A than elsewhere on site, as attested to by its larger overall assemblage and large number of cores. However, a more well-rounded activity regimen is noted for this area than for the other areas, especially Area C. Area A had the lowest angular debris to flake ratio of all site areas. Ratios of the other areas were similar to those obtained in replicative work for primary core reduction. The ratio obtained from Area A approached that of blank reduction from replicative experiments. Less focus on simply the earliest reduction stage is noted in this area.

The assemblage from this area appears to indicate reduction along a greater continuum than in the other areas. Both crushed and abraded flake platforms were encountered in the Area A assemblage, often taken to be related to late stage lithic reduction. The distributions of whole chert flakes between the site areas also indicated that Area A was unique in that it had a significantly greater proportion of small flakes than elsewhere on site. Area A also exhibited the largest diversity of high quality lithic materials and had a great number of utilized flakes in its assemblage.

The Area B flake assemblage was significantly less cortical than that of Area C. The chert whole flake assemblages between Area B and Area A, regarding length and thickness, were also seen to be significantly different. The Area B assemblage did not have as great a proportion of small thin flakes as did Area A. Some exotics were found in Area B, but not the full range as found in Area A. An equal proportion of crushed platforms were found in Area B as in Area A, although no abraded platforms were noted. Four utilized flakes were recovered in this locale, as opposed to 45 in Area A and 0 in Area C. Most importantly, an arrowhead with an impact fracture was found within 1 m of a utilized flake in Area B. The possibility that a meat package had been processed here is likely.

If the procurement of raw material is usually embedded in the collection of subsistence items in low-energy groups (Binford 1977), then the mobility strategies of these groups would affect the encounter of raw materials. Data from Trojan Hill indicate that subsistence activities had occurred on this "quarry" site. Procurement of lithics were apparently embedded within subsistence item acquisition or processing. Forty-nine pieces of utilized debitage were recovered. Virtually all of these had edge angles indicative of heavy-duty cutting or scraping. Bifacial cores and the lunate orange peel flakes bore evidence of possible use-wear as well.

The obvious, primary site function was for lithic procurement. Nonetheless, subsistence activities were in evidence and aspects of the lithic technology point to a planned expedient flake technology, where either unretouched core flakes or lunate, orange peel flakes served task needs without further modification. Expedient technologies tend to be associated with low tool replacement costs. This site obviously had low tool replacement costs. A residential camp that had this site within its foraging radius would also have low tool replacement costs and would likely have an expedient technology represented, as well. One such site within the foraging radius (LA 29363) will be treated later.

The planned expediency and the dearth of nonlocal lithic debitage seems to point to a somewhat low level of mobility within the mobility continuum. The low lithic diversity index value obtained for the overall site implied both this and that occupation likely occurred subsequent to the introduction of pottery in the region. Additional lines of evidence also indicate this.

Intra-assemblage data indicate organizational variability within the site, likely related to occupational episodes. Palimpsest occupations would only lead to higher LDI values, being a ubiquity index, and would not bias the index to imply low levels of mobility. The low LDI is seen to be indicative of decreased mobility during the period of site occupation.

It is exceedingly remote that intrasite differences in the assemblage compositions of Trojan Hill could have arisen through noncultural transformation processes, field methods, or contemporaneous, spatially contiguous activities. Artifact scatters form in modules and these abut one another spatially rather than overlap (Camilli 1989). Disaggregating the LA 29362 artifact scatter, by the occupational episodes and organizational variability, allows for greater interpretive potential in addressing the issues of prehistoric economic systems. A possibly related component of this system is the nearby Globe phase site, LA 29363, to be treated later.

DESCRIPTION OF CHIPPED STONE DATA—MACHO DUNES

Geologic-Cultural Deposition of Materials

The lithic debitage assemblage of Macho Dunes was comprised of 1,230 pieces of debris, 75 percent of which was in the nonspecific chert class. Quartzite comprised 20.8 percent of the assemblage and siltstone 2.3 percent. The remaining 1.9 percent of the assemblage encompassed small quantities of both fine-grained and coarse-grained materials (Table 55). The lithic materials appear to be of a local origin. The variation in the cherts appears to be similar to that which is subsumed within the sample population from the nearby Trojan Hill site. The quartzite and siltstone also appear to be visually identical to that on the aforementioned hilltop site. These materials may have been transported from that locale to Macho Dunes, but that is difficult to ascertain. The materials are, however, evidently derived from the same geological formation. As in the assemblage from Trojan Hill, virtually all materials with cortex are waterworn (98.6 percent).

All of the lithic debris on Macho Dunes had been culturally transported to this locale. Although the two sites treated in this report are in close proximity, they occupy different geological strata. Macho Dunes is situated on the Mescalero Pediment and is characterized by a lack of lithic material.

Table 55. Lithic Material from LA 29363

	Number	Percent	Cumulative Percent
Chert	922	75.0	75.0
Tecovas chert	1	.1	.1
San Andres chert	2	.2	.2
Chalcedony	10	.8	.8
Silicified wood	2	.2	.2
Basalt	5	.4	.4
Red rhyolite	1	.1	.1
Limestone	3	.2	.2
Siltstone	28	2.3	2.3
Quartzite	256	20.8	20.8
Total	1230	100.0	100.0

Core Flake Material—Knapping Properties

Only the material types of chert and quartzite are represented by at least ten whole flake specimens (n = 271 and 270, respectively). Chert has a lower mean length and smaller standard deviation (sd) than quartzite (chert: x = 15.78 mm, sd = 9.76; quartzite: x = 22.83 mm, sd = 15.28). This very likely reflects differences in the sizes of the parent cobbles and aspects of material quality. Chert cobbles tend to be smaller and have more consistent fracturing properties, as discussed in the previous lithic analyses of Trojan Hill. Descriptive statistics regarding length, width, and thickness by material types are found in Tables 56, 57, and 58.

Of note, the mean length values for whole quartzite and chert flakes are lower at this site (22.83 mm, 15.78 mm, respectively) than they are at Trojan Hill (26.75 mm, 21.16 mm). Materials had apparently been brought to Macho Dunes in a reduced state.

Material Type—Temporal and Mobility Implications

As performed in the Trojan Hill analyses, the lithic diversity index for this assemblage was tabulated, with a sample size of 200. The Macho Dunes' LDI equaled 0.94. This value coincides well with the mean LDI value obtained for "late" Mesilla phase sites in the Tularosa Basin of 0.90 (Carmichael 1986:104). The temporal implications of the LDI, in this case, are well supported through radiocarbon determinations of the site's features.

The lithic diversity index was primarily designed as an aid in identifying preceramic components. It was soon noted that this index might also function in measuring the relative mobility of adaptive systems. Carmichael (1986:187) suggested that the progressive decrease in LDI values through time reflected decreasing mobility of the groups producing the sites. The deposited by-products created through resharpening of curated tools by highly mobile peoples would contribute to high LDI values due to the juxtaposition of materials collected in different areas. Reduced mobility or reduced curation of bifaces would lead to low LDI values. The LDI obtained from the Macho Dunes assemblage, as well as corroborating temporal evidence, appears to reflect this relatively low level of mobility. A degree of sedentism is noted for the site by the habitation structures and small storage features, and it appears that r-selected flora were utilized, which would indicate that a "collector" strategy is represented rather than a more nomadic "forager" pattern. The lithic and feature data are corroborative in this respect.

Table 56. Whole Flake Length (mm)

	Mean	Number	St. Dev.
Chert	15.78	271	9.76
Chalcedony	11.75	4	2.63
Basalt	9.00	2	2.83
Red rhyolite	40.00	1	.
Siltstone	18.50	6	11.45
Quartzite	22.83	70	15.28
Total	1720	354	11.42

Table 57. Whole Flake Width (mm)

	Mean	Number	St. Dev.
Chert	13.61	271	8.06
Chalcedony	10.75	4	1.71
Basalt	8.00	2	1.41
Red rhyolite	28.00	1	.
Siltstone	15.00	6	8.81
Quartzite	19.80	70	11.03
Total	14.84	354	9.03

Table 58. Whole Flake Thickness (mm)

	Mean	Number	St. Dev.
Chert	4.20	271	3.49
Chalcedony	3.00	4	2.16
Basalt	1.50	2	.71
Red rhyolite	9.00	1	.
Siltstone	4.67	6	3.08
Quartzite	6.00	70	4.37
Total	4.55	354	3.73

Core Flakes—Behavioral Implications

Flake Portions (Macho Dunes versus Trojan Hill)

A contingency table contrasts the core flake portions of the assemblage from Macho Dunes with that of the nearby Trojan Hill site. These two sites appear to be functionally distinct, although they may have operated as components of a single system. A chi-square test was performed to investigate whether any association existed between the flake portions and the sites (Table 59). The chi-square test revealed an association significant at the 2.5 percent level. The flake portion that contributed the most information to the chi-square statistic was the distal portion from the Macho Dunes site. The corresponding positive deviation indicates that more distal flakes are encountered here than would normally be expected. Sullivan and Rozen (1985) state that debitage assemblages produced during tool manufacture generally yield high percentages of distal and proximal flake fragments, whereas core reduction produces more whole flakes.

The second largest contributor to the total chi-square lies in the lateral flake class, where there are less than would normally be expected from Macho Dunes. The preponderance of lateral flakes at Trojan Hill, many of which appear to be lunate orange peel flakes, has already been discussed in the previous analyses of Trojan Hill. These flakes are correlated with initial stages of reduction. (Coinciding with that, we find more whole flakes than expected at Trojan Hill as well, also related to primary reduction.)

The medial portion at Macho Dunes is the third most significant contributor to the total chi-square value. The corresponding positive deviation indicates that more of these flakes are found at Macho Dunes than would normally be expected. A higher proportion of broken flakes is likely related to the mechanical failure of thin flakes that separate into several pieces during biface or tool manufacture (Speth 1975:13). It appears that the relatively greater proportion of lateral flakes, often OPFs, and whole flakes, is indicative of core reduction being of primary importance on Trojan Hill, as ample evidence has already indicated, whereas the relatively greater proportion of broken flakes from Macho Dunes may imply a greater emphasis on tool manufacture and late-stage reduction.

Table 59. Flake Portion/Site Associations

Observed		Whole	Proximal	Medial	Distal	Lateral	Row Total	Chi-Square Value
	LA29362	3272	2312	586	920	274	7364	
	LA29363	354	258	79	132	22	845	
	Column Total	3626	2570	665	1052	296	8209	
Expected								
	LA29362	3252.754781	2305.454988	596.5476916	943.7115361	265.5310026	7364	
	LA29363	373.2452187	264.5450116	68.45230844	108.2884639	30.46899744	845	
	Column Total	3626	2570	665	1052	296	8209	
Deviation	LA29362	19.24521866	6.545011573	-10.54769156	-23.71153612	8.468997442		
	LA29363	-19.24521866	-6.545011573	10.54769156	23.71153612	-8.468997442		
Contribution	LA29362	0.113866082	0.018580791	0.186496065	0.595772038	0.270115041	1.184830017	
	LA29363	0.992319319	0.161927742	1.625274585	5.192029926	2.353996642	10.32554822	
	Column Total	1.106185401	0.180508533	1.81177065	5.787801964	2.624111683		
								11.510378

Significant at the 2.5 percent level

Table 60. Flake Portion (Chert)/Site Associations

		Whole	Proximal	Medial	Distal	Lateral	Row Total	Chi-Square Value
Observed	LA29362	1911	1258	260	477	121	4027	
	LA29363	257	196	56	84	10	603	
	Column Total	2168	1454	316	561	131	4630	
Expected	LA29362	1885.644924	1264.634557	274.8449244	487.9367171	113.9388769	4027	
	LA29363	282.3550756	189.3654428	41.15507559	73.06328294	17.06112311	603	
	Column Total	2168	1454	316	561	131	4630	
Deviation	LA29362	25.35507559	-6.634557235	-14.84492441	-10.93671706	7.06112311		
	LA29363	-25.35507559	6.634557235	14.84492441	10.93671706	-7.06112311		
Contribution	LA29362	0.340933677	0.034806379	0.801804076	0.245137896	0.437598307	1.860280335	
	LA29363	2.276848953	0.232446581	5.354668347	1.637098352	2.922401958	12.42346419	
		2.617782631	0.26725296	6.156472423	1.882236248	3.360000264		
								14.283745

Significant at the 1 percent level

A similar analysis was conducted where the material was restricted to chert in order to verify that the patterns observed were not a manifestation of differing material proportions on the two sites (Table 60). Once again the chi-square value indicated a high probability of association between flake portions and the sites (significant at the 1 percent level); similar patterns were observed in the data. More medial flakes than expected were encountered in the Macho Dunes assemblage, more lateral and whole flakes than expected were encountered in the Trojan Hill assemblage. The implications, again, of these associations may be that more tool manufacturing or late-stage reduction was occurring at Macho Dunes, as opposed to more core reduction at Trojan Hill.

Flake Dimensions (Macho Dunes versus Trojan Hill)

If the higher proportion of broken flakes at Macho Dunes is related to mechanical failure of thinner flakes, as Speth (1975:13) would postulate, then a significant difference in thickness of flakes should be discernible between the two sites. To investigate this, a Kolmogorov-Smirnov goodness-of-fit test was run on the chert whole-flake thickness distributions (Table 61). As expected, a significant difference (.01 percent level) was discerned. Further tests were also run on the length and width distributions of these chert whole-flakes (Tables 62 and 63), which again evidenced statistically significant differences between the two site populations, at the same significance level (0.01 percent). The data indicate that chert flakes from Macho Dunes are thinner, shorter, and narrower, than chert flakes from Trojan Hill.

The lithic material from Macho Dunes is visually identical to that found on Trojan Hill. Nevertheless, similar materials might be encountered elsewhere in the vicinity that would be derived from the same geologic formation and would have undergone similar depositional processes. These parent cobbles would then likely be of similar dimensions to the cobbles found on Trojan Hill. So, even if the materials were not transported from Trojan Hill to Macho Dunes, the differences in their thickness, length, and width distributions should indicate that a later stage of reduction is represented at Macho Dunes. As noted previously, casual observation and controlled experiments have indicated that waste flakes systematically decrease in size from initial to final stages of manufacture (Newcomer 1971). The ranked continuous data, of flake length, width and thickness, along with the categorical data of flake portion, corroborate inferences that core reduction was not a principal focus of activity at this site. Later stages of reduction or tool manufacture were the focus of the lithic industry on Macho Dunes.

Table 61. Chert Flake Thickness

Thickness (mm)	Macho Dune Percent	Trojan Hill Percent
5	75.6	46.5
10	92.3	84.3
15	99.6	95.6
20	99.6	98.7
25	100.0	99.8
30		99.9
35		99.9
40		100
Number	271	1958

KS value significant at the .01 percent level

Table 62. Chert Flake Length

Length (mm)	Macho Dunes Percent	Trojan Hill Percent
5	3.0	3.0
10	32.8	11.1
15	63.1	34.4
20	77.5	56.8
25	86.3	72.5
30	91.1	83.9
35	94.8	90.0
40	95.9	93.8
45	97.4	96.8
50	99.3	98.3
55	100.0	99.3
60		99.7
65		99.9
70		99.9
80		99.9
85		100.0
Number	271	1958

KS value significant at the .01 percent level

Table 63. Chert Flake Width

Width (mm)	Macho Dunes Percent	Trojan Hill Percent
5	10.0	1.4
10	46.9	21.6
15	65.7	48.7
20	80.4	69.9
25	91.1	83.4
30	95.6	91.6
35	98.9	95.9
40	98.9	97.6
45	99.6	98.9
50	100.0	99.5
90		100.0
Number	271	1958

KS value significant at the .01 percent level

Dorsal Cortex (Macho Dunes versus Trojan Hill)

As further proof that the industries of the two sites had different emphases, the dorsal cortex percentages of the flake populations were examined. The ogives of the dorsal cortex distributions from Trojan Hill indicated that all materials from that site were equally worked. This was not the case on Macho Dunes, as will be discussed. This analysis was thus restricted to the chert material class.

Observation of the cumulative percentage of each site's distribution, in regard to cortex class (Table 64 and the accompanying ogive, Figs. 80 and 81), reveal that Macho Dunes has a proportionately greater amount of flakes with minimal cortex. (Tool manufacturing by-

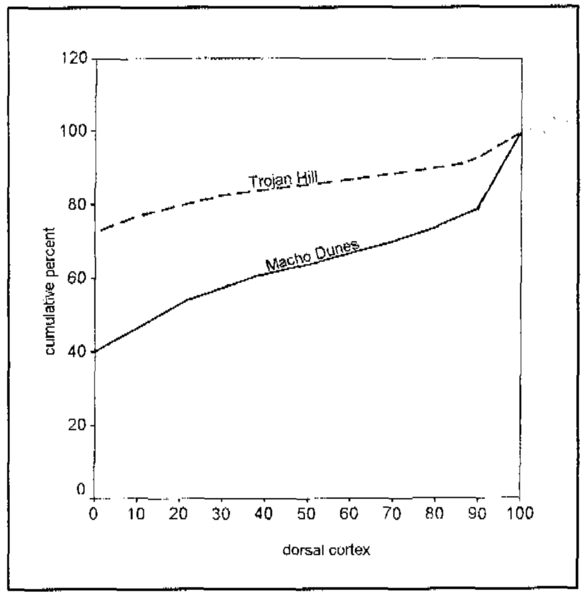


Figure 80. Ogive of dorsal cortex distribution by site.

products as opposed to those produced through primary core reduction would be expected to have less cortex.) The greatest difference between the two sites is in the "0 percent dorsal cortex class"; 40.2 percent of the chert flake assemblage from Trojan Hill lies within that class, as opposed to 72.8 percent of the chert flake assemblage from Macho Dunes. A Kolmogorov-Smirnov test further indicated that the difference between these populations was significant (0.01 percent level). A difference such as that would only occur by chance in 1 trial in 1,000.

Strong evidence is advanced that, although the same lithic materials were utilized, the flake populations from the two sites are truly distinct. This is

Table 64. Cumulative Percentages of Chert Flakes in Cortical Classes by Site

Cortex	Trojan Hill	Macho Dunes
0	40.2	72.8
10	47.0	77.4
20	53.0	80.2
30	57.8	83.1
40	61.5	84.8
50	64.0	86.4
60	67.7	87.2
70	70.3	88.4
80	74.0	90.4
90	79.2	92.6
100	100.0	100.0
Number	4110	646

KS value significant at the .01 percent level

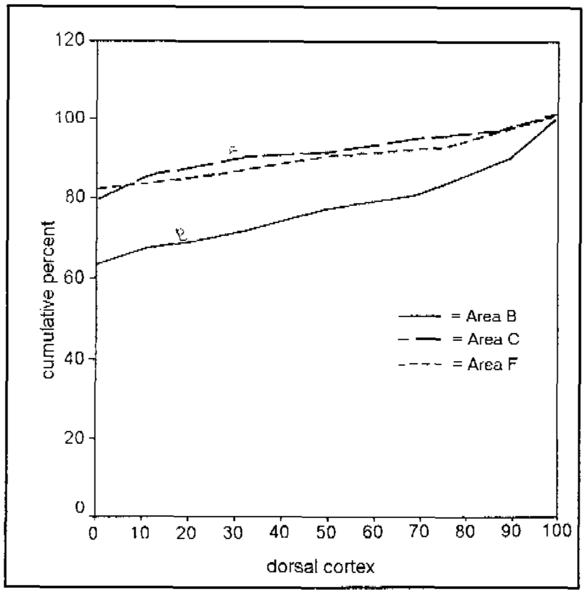


Figure 81. Ogive of dorsal cortex by area.

well illustrated by the dorsal cortex data, as well as by the data concerning flake dimensions and flake portions.

Platform Types (Macho Dunes versus Trojan Hill)

An investigation of the main extant platform types had previously been undertaken on the chert flakes from Trojan Hill. That analysis could find no association between the platform types and the artifact clusters within that site. A similar analysis was undertaken between these two related sites, and in this instance the probability of an association existing between the flake platform types and the sites was significant (0.05 percent level; chi-square value 51.34, 2 = df). The values from Table 65 indicated that there were fewer cortical platforms and more single-facet platforms than would normally be expected at Macho Dunes. This evidence again points to a later stage of reduction occurring at Macho Dunes than at Trojan Hill.

Table 65. Platform Type/Site Associations

Observed		Cortical	Single Facet	Multifacet	Total	Chi-Square Value
	Trojan Hill	1547	927	474	2948	
	Macho Dunes	127	177	78	382	
	Total	1674	1104	552	3330	
Expected	Trojan Hill	1481.967568	977.354955	488.6774775	2948	
	Macho Dunes	192.0324324	126.645045	63.32252252	382	
	Total	1674	1104	552	3330	
Deviation	Trojan Hill	65.03243243	-50.35495495	-14.67747748		
	Macho Dunes	-65.03243243	50.35495495	14.67747748		
Contribution	Trojan Hill	2.853785306	2.59437114	0.440839521	5.888995967	
	Macho Dunes	22.02345309	20.02148199	3.402080911	45.44701599	
	Total	24.8772384	22.61585313	3.842920432		
						51.33601196

Significant at the .05 percent level

Intrasite Assemblage Comparisons

The lithic data amply demonstrate intersite differences between Macho Dunes and Trojan Hill. Although lithic materials are overwhelmingly local in both instances, clear differences are seen in the characteristics of the assemblages, as outlined above. These aspects relate to reduction stages and implicitly to site functions. A further attempt will now be made to examine the spatial and organizational variability *within* the Macho Dunes site. Areas chosen for block excavation were where either topographic features or surface manifestations of cultural materials indicated a likelihood of encountering prehistoric cultural remains. These block excavation areas are those used in this intrasite assemblage analyses. Time constraints did not allow further manipulation and subdivision of the data sets. Nonetheless, these excavation areas do display differences in their components, which, together with the lithic data may aid in understanding the organizational and occupational variability of the site.

Core Flakes

Flake Portions

As an initial step in examining the spatial variability within the site, a contingency table was set up that contrasted the assemblages of the chert flake portions by the six areas. A chi-square test was performed on this data, which was significant (2.5 percent level), indicating an association existing between the portions

Table 66. Chert Flake Portion/Area Associations

		Whole	Proximal	Medial	Distal	Row Total	Chi-Square Value
Observed	Area A	20	13	2	5	40	
	Area B	66	35	12	14	127	
	Area C	23	25	4	7	59	
	Area D	67	41	10	30	148	
	Area E	39	29	7	7	82	
	Area F	42	53	21	21	137	
	Column Total	257	196	56	84	593	
Expected	Area A	17.33558179	13.22091062	3.777403035	5.666104553	40	
	Area B	55.04047218	41.97639123	11.99325464	17.98988196	127	
	Area C	25.56998314	19.50084317	5.571669477	8.357504216	59	
	Area D	64.14165261	48.91736931	13.97639123	20.96458685	148	
	Area E	35.53794266	27.10286678	7.743676223	11.61551433	82	
	Area F	59.37436762	45.28161889	12.9376054	19.40640809	137	
	Column Total	257	196	56	84	593	
Deviation	Area A	2.664418212	-0.220910624	-1.777403035	-0.666104553		
	Area B	10.95952782	-6.976391231	0.006745363	-3.989881956		
	Area C	-2.569983137	5.49915683	-1.571669477	-1.357504216		
	Area D	2.858347386	-7.917369309	-3.976391231	9.035413153		
	Area E	3.462057336	1.897133221	-0.743676223	-4.615514334		
	Area F	-17.37436762	7.718381113	8.062394604	1.593591906		
Contribution	Area A	0.409511749	0.003691236	0.836331607	0.078306934	1.327841526	
	Area B	2.182235097	1.159462097	3.79379E-06	0.88489508	4.226596068	
	Area C	0.25830339	1.5507394	0.443340179	0.220498566	2.472881535	
	Area D	0.127376665	1.281441289	1.131314011	3.894123526	6.434255491	
	Area E	0.337268848	0.132794604	0.071420125	1.834010269	2.375493846	
	Area F	5.084157733	1.315620079	5.024284228	0.130860649	11.55492269	
	Column Total	8.398853481	5.443748705	7.506693944	7.042695024		
							28.391991

Significant at the 2.5 percent level

of the flakes and the different site areas (Table 66). The flake portion that contributed the most information to the total chi-square value was the whole flake category. Area F and Area B contributed almost exclusively to the chi-square information within this class. Area F exhibited a lack of these flakes whereas Area B exhibited more of these flakes than would normally be expected.

Flake Length

Chert flake length data have been weakened somewhat by reducing it to categorical form for importation into a chi-square contingency table (Table 67). The data have been grouped into interval classes (less than or equal to 1 cm, 1.1 cm to 2 cm, 2.1 cm to 3 cm, greater than 3 cm) and examined with regard to the site areas. Patterns were again observed which mirrored those of the other data sets. The chi-square value obtained through the table was significant (0.05 percent level), indicating a probability of an association existing between length class and site area. The area that contributed the most information was Area B, with negative deviations in the smallest length class and positive deviations in the largest flake length class. Area F, the second most important area, only had a

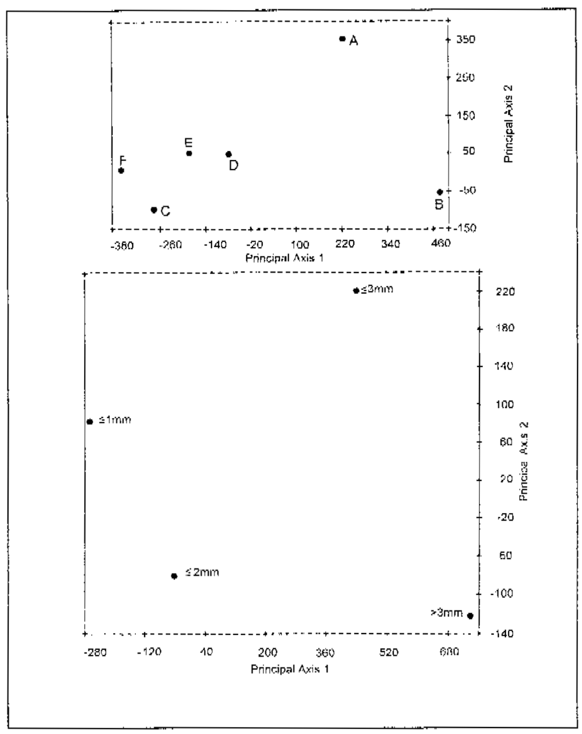


Figure 82. Scatter plot of correspondence analysis flake length data.

positive deviation in the smallest flake length class. In other words, there were more large flakes than would normally be expected from Area B and more small flakes than would normally be expected from Area F.

These same patterns are discernible in the graphic display of output from the correspondence analysis (Fig. 82), which was performed on the length data. In the correspondence analysis of chert whole flake length, 84.9 percent of the total inertia was reflected in the first principal axis. Along this axis, the variable "less than or equal to 1 cm" has the lowest value (-278) and plots at the extreme left of the graphic, the variable "greater than 3 cm" has the highest value (728) and plots at the extreme right of the graphic.

Considering the excavation areas, it is observed that the two largest absolute contribution values to the first axis are from Area B and Area F (579, 233). These are the most noteworthy areas regarding flake length. The other areas have low values and do not contribute that much information. In terms of the variable space, we observe that Area F plots to the extreme left, and Area B to the extreme right in Figure 82 (Table 68). Area F is dominated by small flakes, Area B by large flakes.

Of the chert whole flake population from Area B, 18.2 percent is subsumed within the "less than or equal to 1 cm" length class whereas 45.2 percent of the chert whole flake population from Area F is within that length class. The difference in these populations is statistically significant. A Kolmogorov-Smirnov test indicates that this difference is significant at the 5 percent level (Table 69).

The difference in the flake length populations (whole chert flakes) between Area B and Area F likely reflects aspects of the behavior of the site's inhabitants use of the landscape. Both areas may exhibit palimpsest occupations; nevertheless, prehistoric behaviors focused in Area F were evidently related to the small features (hearths, small pits, roasting features). No evidence of any large-scale feature was found in this area; no large storage features or structures were found. Activity here was apparently focused around the thermal features. The relative preponderance of small flakes in Area F may reflect either their suitability for food preparation tasks or later stage flint knapping/tool maintenance activities centered around these thermal features.

Area B, in contrast, exhibited evidence of more varied activities. Here habitation structures were found, along with other feature types, and virtually all of the ground stone artifacts from the entire site and most of the ceramics were derived from this locale. A wider range of activity regimens appears to have occurred in Area B than in Area F. The lithic data support these inferences from feature type and artifact type diversity. Less specialized activity regimens are in evidence around the main habitation locus, Area B.

Table 67. Length Class (Whole Chert Flakes)/Area Associations

		Area A	Area B	Area C	Area D	Area E	Area F	Row Total	Chi-Square Value
Observed	0-10 mm	17	30	26	68	32	71	244	
	10-20 mm	14	63	29	63	37	56	262	
	20-30 mm	6	22	2	14	10	8	62	
	> 30 mm	3	16	4	4	4	4	35	
	Column Total	40	131	61	149	83	139	603	
Expected	0-10 mm	16.18573798	53.00829187	24.68325041	60.29187396	33.5854063	56.24543947	244	
	10-20 mm	17.37976783	56.91873964	26.50414594	64.73963516	36.06301824	60.3946932	262	
	20-30 mm	4.112769486	13.46932007	6.271973466	15.32006633	8.533996683	14.29187396	62	
	> 30 mm	2.32172471	7.603648425	3.540630182	8.648424544	4.817578773	8.067993367	35	
	Column Total	40	131	61	149	83	139	603	
Deviation	0-10 mm	0.814262023	-23.00829187	1.316749585	7.708126036	-1.585406302	14.75456053		
	10-20 mm	-3.379767828	6.081260365	2.495854063	-1.739635158	0.936981758	-4.394693201		
	20-30 mm	1.887230514	8.530679934	-4.271973466	-1.320066335	1.466003317	-6.291873964		
	> 30 mm	0.67827529	8.396351575	0.459369818	-4.648424544	-0.817578773	-4.067993367		
Contribution	0-10 mm	0.040963387	9.986767659	0.070243158	0.985459617	0.074839444	3.870483696	15.02875696	
	10-20 mm	0.657248744	0.649728505	0.235030682	0.046746178	0.024344463	0.319785188	1.93288376	
	20-30 mm	0.865995292	5.402833979	2.909731266	0.11374462	0.251835782	2.769943121	12.31408406	
	> 30 mm	0.198153281	9.271696407	0.059599737	2.498472483	0.138749169	2.051138279	14.21780936	
		1.762360704	25.31102655	3.274604844	3.644422897	0.489768858	9.011350285		
									43.493534

Significant at the .05 percent level

Table 68. Correspondence Analysis of Flake Length Data Decomposition of Inertia by Principal Axis

Principal Axis	Inertia	Age	Cumulative Age
1	0.095528	84.99	84.99
2	0.012514	11.13	96.12
3	0.004362	3.88	100.00
	0.112404		

Units Related to First Two Principal Axes

Unit	Quality	Mass	Inertia	1st Axis	Cor	Ctr	2nd Axis	Cor	Ctr
Area A	992	78	113	220	297	39	336	695	704
Area B	998	257	507	464	971	579	-78	27	124
Area C	995	89	78	-282	809	74	-135	186	131
Area D	406	261	46	-89	398	21	12	8	3
Area E	930	152	51	-182	870	52	48	60	28
Area F	973	163	205	-369	967	233	-28	6	10

Variables Related to First Two Principal Axes

Unit	Quality	Mass	Inertia	1st Axis	Cor	Ctr	2nd Axis	Cor	Ctr
<,= 1mm	961	331	254	-278	897	268	74	64	146
<,= 2mm	842	455	55	-56	226	15	-92	616	306
<,= 3mm	978	132	280	436	800	264	206	178	448
> 3mm	966	82	411	728	939	454	-124	27	100

KEY:
Quality quality of representation
Mass mass of the point
Inertia inertia in full space
Cor relative contribution
Ctr absolute contribution

Table 69. Percentage of Whole Chert Flakes < or = 1 mm by Site Area

	Percent of Whole Chert Flakes < or = 1 mm by Site Area	Number
Area A	35.0	20
Area B	18.2	66
Area C	39.1	23
Area D	32.8	67
Area E	41.0	39
Area F	45.2	42

Dorsal Cortex

In order to gain an appreciation of the similarities of the subassemblages with regard to dorsal cortex cover, a correspondence analysis was conducted on the chert flakes (Table 70). This technique was chosen due to the simplicity of the data manipulation, the ease of the interpretation, and time constraints.

The table of decomposition of the inertia by the principal axes reveals that most of the variability (70.32 percent of the inertia) can be explained and displayed through the first two axes. The table relating the variables to these first two principle axes indicates that most of the variables are well represented on the two dimensional plot. The "0 percent cortex class" is the most well-represented variable point in two-dimensional space (noted through high-quality and mass values). This variable also has the largest relative contribution to the first principal axis. The largest spatial separation of variable points along this axis in two-dimensional space is between low dorsal cortex cover groups (20 percent, 0 percent, 10 percent) and high dorsal cortex cover groups (80 percent and 90 percent). This indicates that a plot of the units (i.e., excavation areas) along the first axis should discriminate fairly well between the assemblages that could be classed as highly or minimally cortical. The largest spatial separation of units along the first axis is between Area B (+359) and Areas C and F (-267,-202).

Since distances in the multidimensional space of a correspondence analysis are arrived at through calculation of a chi-square metric, an examination of the related chi square contingency table was undertaken. This table (Table 71) has conjoined variable groups in order to make the sparse table more robust. The chi square value arrived at through this table (27.21, 15 df) is significant (5 percent level) indicating that there is an association existing between the cortical groups and the excavation areas. The area that contributes the most information to the chi-square value is Area B, which exhibits the largest table contribution in the 90 percent to 100 percent cortical category, corresponding with a positive deviation from the expected value here. The next largest contributing area is Area F, which has negative deviations in all classes except for the 0 percent to 20 percent cortical class, where it has a high positive deviation. This same pattern is observed for Area C. The chi-square table, related to the correspondence analysis tables and plots, clarifies the observed relationships between the areas. The Area B chert flake assemblage is more associated with highly cortical flakes than that of Area C or Area F. These two latter areas have assemblages with minimal dorsal cortex cover.

Additionally, Kolmogorov-Smirnov goodness-of-fit tests were performed on the Area B, C and F distributions (Table 72), which had appeared noteworthy from the correspondence and chi-square analyses (Table 71, Fig. 83). Statistically, the differences between Area B and the other two assemblages are significant: Area B vs. Area C (5 percent level), Area B vs. Area F (2.5 percent level). No significant difference was noted between the dorsal cortex distributions between Areas C and F, only between these areas and Area B. The ogives of Areas B, C, and F (Fig. 81) provide a graphic display of these data which highlight the above findings. Area B is distinct from Area F and Area C. The implications of this distinctness will be treated shortly.

Table 70. Correspondence Analysis of Cortex Data Decomposition of Inertia by Principal Axes

Principal Axis	Inertia	Percentage	Cumulative Percentage
1	0.046202	50.66	50.66
2	0.017930	19.66	70.32
3	0.014405	15.79	86.11
4	0.009621	10.55	96.66
5	0.003044	3.34	100.00
	0.091203		

Units Related to First Two Principal Axes

Unit	Quality	Mass	Inertia	1st Axis	Cor	Ctr	2nd Axis	Cor	Ctr
Area A	48	66	116	87	47	11	8	0	0
Area B	967	217	330	359	929	606	-73	-73	64
Area C	541	101	167	-267	474	156	101	101	57
Area D	734	247	88	8	2	0	154	154	328
Area E	246	138	94	-88	124	23	87	87	58
Area F	977	231	204	-202	505	204	-195	-195	491

Variables Related to First Two Principal Axes

Unit (Percent)	Quality	Mass	Inertia	1st Axis	Cor	Ctr	2nd Axis	Cor	Ctr
0	970	728	62	-86	963	117	-7	7	2
10	180	48	26	-63	80	4	-70	100	13
20	241	25	68	-243	238	32	-29	3	1
30	184	32	102	62	13	3	226	172	89
40	707	17	80	510	592	93	225	115	47
50	938	17	67	585	930	123	54	8	3
60	921	7	90	365	108	19	-1002	813	371
70	680	12	51	21	1	0	-523	679	177
80	855	20	166	796	831	273	-137	25	21
90	992	23	137	708	930	252	-183	62	43
100	585	73	151	231	283	84	239	302	232

KEY:

Quality	quality of representation	Cor	relative contribution
Mass	mass of the point	Ctr	absolute contribution
Inertia	inertia in full space		

Table 71. Chert Flake Cortex/Area Associations

		0-20 percent	30-50 percent	60-80 percent	90-100 percent	Row Total	Chi-Square Value
Observed	Area A	32	4	2	2	40	
	Area B	90	11	8	20	129	
	Area C	55	1	2	5	63	
	Area D	116	11	3	19	149	
	Area E	68	8	2	5	83	
	Area F	122	4	4	7	137	
	Column Total	483	39	21	58	601	
Expected	Area A	32.14642263	2.595673877	1.397670549	3.860232945	40	
	Area B	103.672213	8.371048253	4.507487521	12.44925125	129	
	Area C	50.63061564	4.088186356	2.201331115	6.079866889	63	
	Area D	119.7454243	9.668885191	5.206322795	14.37936772	149	
	Area E	66.70382696	5.386023295	2.900166389	8.009983361	83	
	Area F	110.1014975	8.890183028	4.787021631	13.22129784	137	
	Column Total	483	39	21	58	601	
Deviation	Area A	-0.146422629	1.404326123	0.602329451	-1.860232945		
	Area B	-13.67221298	2.628951747	3.492512479	7.550748752		
	Area C	4.369384359	-3.088186356	-0.201331115	-1.079866889		
	Area D	-3.745424293	1.331114809	-2.206322795	4.62063228		
	Area E	1.296173045	2.613976705	-0.900166389	-3.009983361		
	Area F	11.8985025	-4.890183028	-0.787021631	-6.221297837		
Contribution	Area A	0.000666935	0.759776441	0.259575311	0.896439842	1.916458529	
	Area B	1.803081099	0.825629847	2.706084789	4.579697653	9.914493388	
	Area C	0.377074611	2.332793601	0.018413503	0.191799018	2.920080732	
	Area D	0.117150223	0.183254491	0.934990101	1.484783134	2.720177948	
	Area E	0.025186929	1.268630647	0.2793976	1.131088471	2.704303647	
	Area F	1.285853189	2.689921003	0.129392155	2.927439292	7.032605639	
	Column Total	3.609012986	8.06000603	4.32785346	11.21124741		
							27.20812

Significant at the 5 percent level

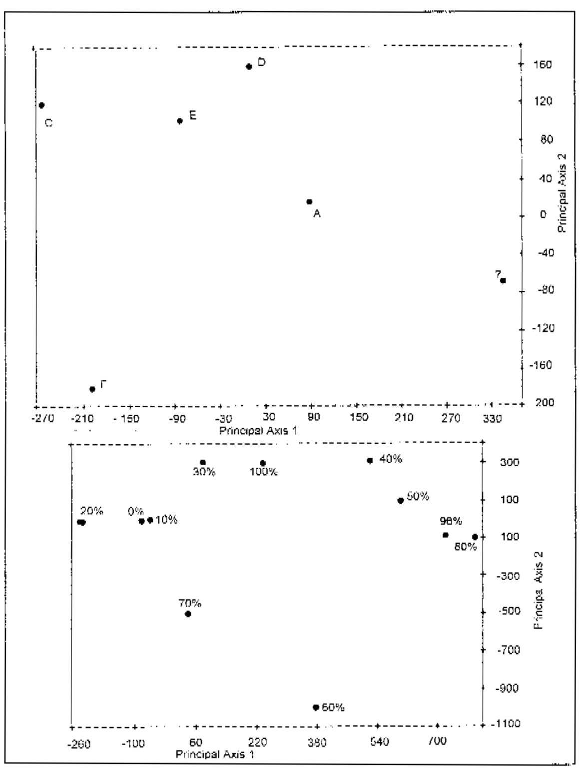


Figure 83. Scatter plot of correspondence analysis of cortical data.

Table 72. Cumulative Percentages of Chert Flakes in Cortical Classes, by Area

Percent Cortex	Area B percent	Area C percent	Area F percent
0	63.4	82	79.1
10	67.2	85.2	84.9
20	68.7	90.2	87.8
30	71	90.2	89.9
40	74	91.8	89.9
50	77.1	91.8	90.6
60	78.6	91.8	92.1
70	80.2	91.8	94.2
80	84.7	91.8	95
90	90.1	91.8	96.4
100	100	100	100
Number	131	61	139

KS value significant at the 5 percent level (Area B: Area C)
KS value significant at the 2.5 percent level (Area B: Area

Platform Type

An examination was undertaken on the subassemblages within Macho Dunes with regard to the categorical data of platform type. A chi-square analysis contrasting platform types (cortical, single facet, and multifacet)

Table 73. Platform Type/Area Associations

		Area A	Area B	Area C	Area D	Area E	Area F	Row Total	Chi-Square Value
Observed	Cortical	11	33	12	33	18	20	127	
	Single facet	11	46	20	37	21	42	177	
	Multifacet	9	14	9	15	13	18	78	
	Column Total	31	93	41	85	52	80	382	
Expected	Cortical	10.30628272	30.91884817	13.63089005	28.2591623	17.28795812	26.59685864	127	
	Single facet	14.36387435	43.09162304	18.9973822	39.38481675	24.09424084	37.06806283	177	
	Multifacet	6.329842932	18.9895288	8.371727749	17.35602094	10.61780105	16.33507853	78	
	Column Total	31	93	41	85	52	80	382	
Deviation	Cortical	0.693717277	2.081151832	-1.630890052	4.740837696	0.712041885	-6.596858639		
	Single facet	-3.363874346	2.908376963	1.002617801	-2.384816754	-3.094240838	4.931937173		
	Multifacet	2.670157068	-4.989528796	0.628272251	-2.356020942	2.382198953	1.664921466		
Contribution	Cortical	0.046694203	0.317748359	0.195130498	0.795336458	0.029326983	1.636228717	3.020465219	
	Single facet	0.787785408	0.196294685	0.052914788	0.144404657	0.397369912	0.65619842	2.23496787	
	Multifacet	1.126368987	1.311006601	0.047149888	0.319821847	0.534467714	0.169693919	3.508508955	
	Column Total	1.960848598	1.825049645	0.295195174	1.259562963	0.961164608	2.462121057		
									8.763942044

Not significant at the 10 percent level

with site areas was performed (Table 73). This analysis could discern no association between the major platform types and the site areas. By extrapolation, no area had an association related to a reduction stage, as could be evidenced through the variable platform type. As previously detailed, the site as a whole does not have a lithic assemblage with an emphasis on primary-stage lithic reduction. Nor does it appear to have had an emphasis on very late stages of reduction, as multifaceted platforms were not highly represented, nor were exhausted tools found. This appears to hold true for all of the individual site areas. Variations within the lithic subassemblages of Macho Dunes appear to represent differences of degree rather than differences related to major stages in reduction between the site areas.

Platform Width

A correspondence analysis was employed to initially investigate the relationships between the chert flake populations of the site areas with regard to platform width (Fig. 84). The data were weakened somewhat by reducing the continuous data to a categorical form. Nonetheless, even with this reduction of the strength of the data, notable patterns are evident.

The first two principal axes in this analysis contain 79.53 percent of the total inertia, indicating that most of the variation in the data set will be well represented on two-dimensional plots. The table relating the variables to the axes indicates that the variables contributing the most information to the first principal axis are the less than or equal to 1 mm class and the greater than or equal to 5 mm class (the most extreme classes). The intermediate class widths do not exhibit such large

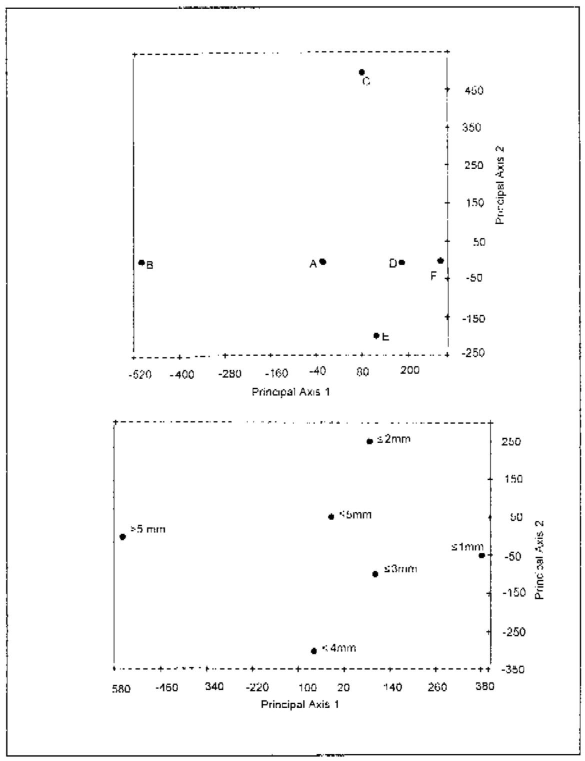


Figure 84. Scatter plot of correspondence analysis of platform width.

relative nor absolute contributions to this axis, nor do they contribute as much inertia to the full variable space. Simply, the first axis displays the most information regarding platform width. The largest flake platforms plot to the extreme left of the graphic display (highest negative values along the x-axis), the smallest platforms plot to the extreme right (highest positive values along the x-axis).

Area B has a very high negative x-axis coordinate in relation to the other units (-517). It is spatially the most separated along this axis from the other points, and is related to platform widths greater than or equal to 5 mm. Area F plots at the other extreme of the graphic display (+275), more closely related to platform widths less than or equal to 1 mm, the most different from Area B along this axis.

The variable that contributes the most information to the second axis is the 1.1 mm-2.0 mm class, as can be observed from the data on Table 74 and its accompanying graphic. The spatial unit that lies farthest away from the other variables along this axis is Area C (+454).

Examining the distributions of Area B, Area F, and Area C with regard to their cumulative percentages in each platform width class with a Kolmogorov-Smirnov goodness-of-fit test (Table 75), we see that the patterns observed in the correspondence analysis plots are valid. No statistical significance is noted between Area C and Area F, as in the cortex data. Statistical significance is noted, however, between the distributions of Area B and Area C (2.5 percent level) and between Area B and Area F (.0.01 percent level).

Area B's distinctness, especially in regard to Areas C and F, is highlighted through these investigations of platform width. Strikingly, these data mirror those of the flake portion data, the flake dimension data, and the cortex data. Clear patterns are evident.

Table 74. Correspondence Analysis of Platform Width Data Decomposition of Inertia by Principal Axes

Principal Axis	Inertia	Percentage	Cumulative Percentage
1	0.086712	58.75	58.75
2	0.030663	20.78	79.53
3	0.020048	13.58	93.11
4	0.009149	6.20	99.31
5	0.001015	0.69	100.00

Units Related to First Two Principal Axes

Unit	Quality	Mass	Inertia	1st Axis	Cor	Ctr	2nd Axis	Cor	Ctr
Area A	11	76	62	-24	5	0	-28	7	2
Area B	992	230	420	-517	990	709	-19	1	3
Area C	913	108	168	66	19	5	454	894	724
Area D	739	222	57	167	734	72	-14	5	1
Area E	536	139	122	103	83	17	-242	453	265
Area F	684	225	170	275	679	197	-25	5	4

Variables Related to First Two Principal Axes

Unit	Quality	Mass	Inertia	1st Axis	Cor	Ctr	2nd Axis	Cor	Ctr
<,= 1mm	898	205	215	366	866	317	-71	32	33
<,= 2mm	877	276	135	61	52	12	244	825	538
<,= 3mm	394	183	73	87	131	16	-124	263	92
<,= 4mm	497	98	147	-76	26	7	-323	471	332
<,=5mm	41	66	37	-39	18	1	43	22	4
> 5mm	966	171	394	-573	966	647	-9	0	0

KEY:

Quality quality of representation
Mass mass of the point
Inertia inertia in full space
Cor relative contribution
Ctr absolute contribution

Table 75. Cumulative Percentages of Chert Flakes in Platform Width Classes, by Area

	Area B Percent	Area C Percent	Area F Percent
<= 1 mm	8.5	18.2	31.5
<= 2 mm	31.9	65.9	56.5
<= 3 mm	47.9	75.0	78.3
<= 4 mm	58.5	79.5	83.7
<= 5 mm	64.9	86.4	89.1
number	94	44	92

KS value significant at the 2.5 percent level (Area B: Area C)
KS value significant at the .01 percent level (Area B: Area F)

Material Type

The main lithic material type that was utilized throughout the site was non-specific chert. Area B, however exhibited the lowest percentage of this material type. Area B's artifact assemblage was comprised of 64.1 percent of this material type. The other areas had chert percentages between 73.1 percent and 85.3 percent (Area C, with a well-defined structure, had the second lowest percentage, 73.1). The Area B subassemblage had the highest percentage of quartzite material: 30.2 percent. Evidently, tasks in this area did not require fine-grained material as much as in other site areas. This again points to more rounded activity regimens occurring in this locale.

Shatter/Angular Debris

Ratios of shatter to flakes by excavation areas are presented in Table 76 for all material types, for chert, and for quartzite. Area F exhibits a very high flake ratio in both the conjoined material group and the chert. This is likely due to an emphasis on tool maintenance or later-stage reduction focused around the thermal features, as previously indicated by small whole-flake length data. Area E exhibits similarly high ratios in all classes. This may be due to the limited activity evidenced here as well, which is similar to that of Area F. Area E is somewhat spatially separated, presents a later radiocarbon date on its single thermal feature than those of most of the dated features of the main site locus, and likely represents an ephemeral campsite area.

Area B presents the lowest angular debris to flake ratio in both the conjoined and chert groups. It also has a very low quartzite flake to angular debris ratio. Apparently, earlier stages of reduction, in relation to other site areas, are in evidence here, as indicated by the preponderance of shatter. This is part of the more rounded activity regimen of this locale. Area C, which also had a well-defined habitation structure with a central hearth, exhibits similar ratio patterning. Again, this may be indicative of more rounded activities focused around living quarters.

A chi-square contingency table (Table 77), with counts of chert and quartzite angular debris and flakes, indicates an association existing between the classes and the excavation areas (0.05 percent level). The most significant row variable is quartzite angular debris, the most important column variable is Area B. Area B exhibits more quartzite shatter than would normally be expected, having a very high positive deviation from the expected value. The next most important row variable is chert flake, which exhibits the highest positive deviation in Area F, closely followed by Area E. The chi-square data support the initial inspection of the above ratio data and the conclusions drawn from them, notably concerning Area B, Area F, and Area E.

Cores

Twenty-three cores in total were obtained from the site. No area was devoid of a core (Fig. 85). The area with the most cores was Area B (n = 9). Eight of these were chert. None of these were classed as either unifacial or bifacial cores and hence could not be conceived as blanks. Of the three cores found in Area F, all of which were chert, one was classed as unifacial and one was classed as bifacial. These characteristics imply a planned strategy of flake removal and they could conceivably be designated as blanks. This again ties into the interpretation that limited, later-stage lithic reduction occurred in the Area F locale, focused around small, thermal features. Less specialized lithic reduction occurred in the vicinity of the households, Area B. Less specialized lithic reduction occurred here, with less planning of flake removal evident on the cores.

Table 76. Angular Debris to Flake Ratio

	All Material	Chert	Quartzite
Area A	1:2.7	1:2.5	1:2.2
Area B	1:1.6	1:1.8	1:1.3
Area C	1:1.7	1:1.9	1:1.1
Area D	1:2.8	1:2.9	1:2.6
Area E	1:3.6	1:3.6	1:4.0
Area F	1:3.8	1:4.1	1:2.5

Tools

Formal tools were virtually absent from Macho Dunes. One end-side scraper of San Andres chert, however, was encountered directly outside of the deep brush structure in the northeast corner of Area B (FS 377,

Table 77. Angular Debris and Flake/Area Associations

		Area A	Area B	Area C	Area D	Area E	Area F	Row Total	Chi-Square Value
Observed	Chert Angular	16	73	32	51	23	34	229	
	Chert Flake	40	131	61	149	83	139	603	
	Quartzite. Angular	5	44	7	14	3	11	84	
	Quartzite Flake	11	56	7	37	12	28	151	
	Column Total	72	304	107	251	121	212	1067	
Expected	Chert Angular	15.45267104	65.24461106	22.96438613	53.86972821	25.96907216	45.4995314	229	
	Chert Flake	40.68978444	171.8013121	60.46954077	141.8491097	68.3814433	119.8088097	603	
	Quartzite Angular	5.668228679	23.93252109	8.423617619	19.76007498	9.525773196	16.68978444	84	
	Quartzite Flake	10.18931584	43.02155576	15.14245548	35.52108716	17.12371134	30.00187441	151	
	Column Total	72	304	107	251	121	212	1067	
Deviation	Chert Angular	0.54732896	7.755388941	9.035613871	-2.86972821	-2.969072165	-11.4995314		
	Chert Flake	-0.689784442	-40.80131209	0.530459231	7.150890347	14.6185567	19.19119025		
	Quartzite Angular	-0.668228679	20.06747891	-1.423617619	-5.760074977	-6.525773196	-5.689784442		
	Quartzite Flake	0.810684161	12.97844424	-8.142455483	1.47891284	-5.12371134	-2.001874414		
Contribution	Chert Angular	0.019386227	0.921854796	3.555170931	0.152875098	0.339457238	2.906386468	7.895130759	
	Chert Flake	0.011693416	9.689955496	0.004653368	0.360490333	3.125149013	3.074079311	16.26602094	
	Quartzite Angular	0.07877762	16.82663136	0.240595813	1.67906568	4.470578391	1.939728288	25.23537715	
	Quartzite Flake	0.064499798	3.915246945	4.378390372	0.061574219	1.533103273	0.133575027	10.08638963	
	Column Total	0.174357061	31.3536886	8.178810483	2.25400533	9.468287915	8.053769093		
									59.482918

Significant at the .05 percent level

Fig. 86). On the floor of this same structure a highly modified projectile point was encountered. The modified shape of this artifact implies that it no longer served its original function but was likely intended for scraping activities.

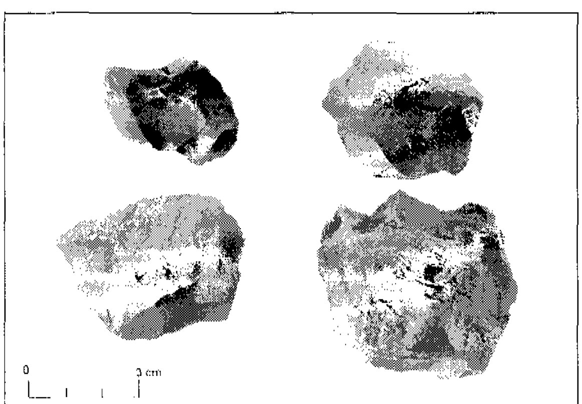


Figure 85. Cores from Macho Dunes.

The remaining two lithic tools encountered on site were derived from Area F. These were a late-stage biface of chert, and a middle-stage biface of siltstone. Neither of these exhibited evidence of use-wear.

Conclusions

Intrasite Assemblage Variability

Macho Dunes had spatially separated artifact modules likely related to different occupational episodes in many of the cases, and often expressing organizational variability. The simple angular debris to flake ratio within the major material types has highlighted that Area F had a preponderance of chert flakes as opposed to angular debris of any material. Considering the great number of thermal features here, this may be indicative of tool maintenance or late stage reduction occurring around hearths. Area E had a similar ratio to that obtained from Area F. This area had only one thermal feature and probably represents an ephemeral campsite locale, where a similar stage of lithic reduction was represented. In contrast, Area B, which had well-defined habitation structures had the lowest angular debris to flake ratio. Area C also had a well-defined structure and manifested a similar ratio of shatter to that found in Area B. A significant chi-square value had corroborated that evidence and examination of the contingency table had indicated a preponderance of quartzite angular debris in Area B. This coarser grained material had the lowest replacement cost and was probably suitable to the more general site tasks, focused around the living quarters.

Area B was the area with the most cores on site. No unidirectional or bifacial cores were encountered there. Strategic reduction of cores does not appear to be represented here, but a more generalized form of reduction, possibly on an "as needed" basis. Of the three cores encountered in Area F, one was unidirectional and one bifacial, indicating a more strategic plan of flake removal, likely related to the thermal features there.

The probability of an association existing between the portions of the flakes and the site areas was also significant. Area B again stood apart with more whole flakes than would normally be expected, as did Area F with less of these than would normally be expected. High proportions of whole flakes are taken to be related to the earlier stages of reduction.

Chert, whole flake length, was also seen to be related to site area. Again the pattern indicates more advanced reduction occurring in the Area F locale where there was a preponderance of small flakes. A significant difference was noted between this area's length distribution and that of Area B.

Data on flake cortex cover also noted a significant difference between Area B and Area F. A significant difference was also discerned between Area B and Area C. Paralleling this evidence was the platform width data of chert flakes. Again significant differences were seen between Area B and Area F and between Area B and Area C.

Area B's uniqueness is highlighted through these investigations. A generalized activity regimen is represented through the debitage by a greater breadth in the reduction sequence continuum than in other areas. In special contrast is Area F, with a more narrow range of reduction represented. The reduction of blanks or tool maintenance activities are behavioral correlates of the debitage from this area, where thermal features are most manifest.

Palimpsest occupation is probable in Area F. Nonetheless, with its distributional data indicating more narrow, later stage lithic reduction, functional implications still seem clear. The debitage is related to the thermal features. Later stage controlled flaking, producing smaller pieces of debitage with little cortex present, is represented here, either due to the communal aspect of knapping around a fire or due to the necessity of small, sharp flakes in food preparation tasks related to the features.

The distributional differences between the assemblages of Area B and Area C may be less related to functional implications than to temporal ones. Both areas represent habitation locales. These areas have the highest proportions of quartzite material. This cruder

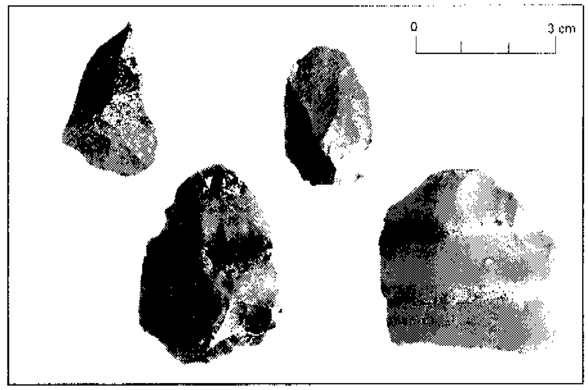


Figure 86. Tools from Macho Dunes.

material may be seen to be related to the more generalized activities that would occur within the vicinity of a household. However, with significant differences noted between their distributions of cortex cover and platform width, it may be that occupational variability is represented. Additional nonlithic evidence points to the same conclusion.

Area A and Area E likely represent ephemeral use of this landscape. Both areas are focused around a single thermal feature, bedrock hearths, and have small lithic assemblages dominated by small chert flakes. Statistically significant differences between these assemblages and those of the other areas could not be detected due to the small sample sizes. Area D contributed little information to most of the analyses. The area was not especially high in artifact count and was of such a large size that multiple prehistoric artifact modules likely obscured relations.

The salient data of these analyses point to a likely functional difference in the use of the landscape, notably between Area B and Area F. Additionally, the significantly different distributional data between Area B and Area C imply a temporal difference between these two habitation loci. Other areas (notably A and E) also likely represent different occupational episodes although the lithic data alone cannot discern this.

The simplistic examination of the major extant platform types by area has not shown any valid association. No area was dominated by primary reduction (which would be noted by a preponderance of cortical platforms) as opposed to very late stage reduction (where multifaceted platforms would be more evident). Generally, the lithic assemblage of the site lies within an intermediate range of the reduction continuum. Unretouched flakes were likely the desired tool form as there was a lack of other tool types, and only four bifacial reduction flakes encountered. Specialized, diverse tool forms are generally not seen to be required by hunter-gatherers engaged in subsistence activities in low-altitude desert environments (Torrance 1983). This appears to be the case for LA 29363, Macho Dunes. Retouch on lithic artifacts was noted in only four instances (the projectile point, the scraper, and the two bifaces). Use-wear was apparent on only four flake specimens, and may have been due to the lack of heavy-duty activities occurring on site. Hunters and gatherers in environments such as this are primarily dependent upon small animals and plants. Nelson (1991:12-25) presents data suggesting stone tools were not necessarily required to hunt or process small game. This postulation, coupled with a low- energy cost of acquiring lithic materials, presupposes to a degree that an expedient flake technology will be most represented. Easily acquired, serviceable lithic materials were well within the foraging radius of this site (for example, Trojan Hill). It is thus inferred that expedient, unretouched flakes served most tool needs at this site. The lack of visible use-wear may indicate nonintensive use of individual flakes; subsistence tasks that might have utilized lithic materials may not have been intensive enough to manifest indisputable use-wear. Additionally, O'Connell (1977) noted that stone tools in these environments were primarily for maintenance activities rather than for subsistence activities. Subsistence activities would be most in evidence around habitation structures.

Maintenance activities, such as the cutting and shaping of wood, might occur in more direct association with procurement of this material.

Within the site, flake tools were likely the norm and reduction seems to have been within the intermediate range of the continuum. Contrasting this site to the nearby Trojan Hill site we have seen differences.

Intersite Assemblage Variability

The examination of flake portions has shown a significant difference between the sites. Proportionately more whole flakes, associated with primary reduction, occurred at Trojan Hill, as did lateral flakes, which again may be related to this stage (OPFs). More medials were derived from Macho Dunes than would normally be expected, likely related to the breakage of thinner flakes from a later reduction stage.

Flake dimensions also statistically corroborated this line of evidence. The population of whole chert flakes from Macho Dunes was thinner, shorter, and narrower than that from Trojan Hill, although the lithic materials appeared visually identical.

The data on cortex distributions again pointed to the same conclusions, where a significant difference was noted between the populations of the two sites. The Macho Dunes assemblage had significantly fewer pieces of chipped stone with cortex present than that from the nearby quarry site, Trojan Hill.

The simplistic examination of extant platform types, which could not discriminate an association between types (implicitly related to major reduction stages) within the Macho Dunes' site areas has, however, noted a significant probability of association between platform types and the two sites. Macho Dunes had fewer cortical platforms than Trojan Hill and more single-faceted platforms than would normally be expected.

In general, the Macho Dunes lithic assemblage represents a noticeably later stage of reduction than that from Trojan Hill, although the lithic materials appeared visually identical. Materials at Trojan Hill are generally derived from that locale; those obtained from Macho Dunes had evidently been culturally transported to the site. Macho Dunes did not exhibit evidence of heavy-duty activities occurring on site, as could be evidenced through the lithic materials. In contrast, a great number of unidirectionally utilized flakes were encountered with edge angles indicative of heavy-duty scraping activities from the nearby Trojan Hill site. Additionally, quarrying episodes are in evidence on Trojan Hill, which likely formed only one aspect of an embedded resource procurement strategy there.

The lithic diversity index for Macho Dunes obtained a value that indicated occupation dating to the Globe phase. Radiometric data had substantiated this index by placing the habitation loci within the same time period. Apparently, Macho Dunes and possibly the nearby Trojan Hill site were occupied during the Globe phase. However, temporal association cannot be determined.

MACHO DUNES GROUND STONE

James A. Quaranta

The ground stone assemblage from Macho Dunes was comprised of 65 artifacts. Five sandstone types have been differentiated, somewhat subjectively, due to the presence of various inclusions and the color of the binder. Differential degradation due to the elements or heat and the uptake of coloration from the soil were confounding factors. There was also some overlap in grain size categories within the subjectively arrived at types. Nevertheless, two major types were noted in equal proportions. Twenty-four specimens were of a somewhat dense reddish sandstone that obtained much of the red coloration from the binder. This type appears visually identical to that which is found in outcrops nearby, most notably at the Mississippi Potash Mines along U.S. 62/180. Within this material type, the ratio of specimens with fine-sized grains to medium-size grains was 2.18:1. Twenty-four specimens of another sandstone type had a yellow ochre-colored binder and appeared somewhat more friable. The grain size distribution within this material type had a ratio of 1.62:1 in fine-grained to medium-grained specimens. Small numbers of artifacts were encountered in the other three differentiated sandstone types. Additionally, quartzite was used to a small extent (n = 2) as was limestone/dolomite (n = 1).

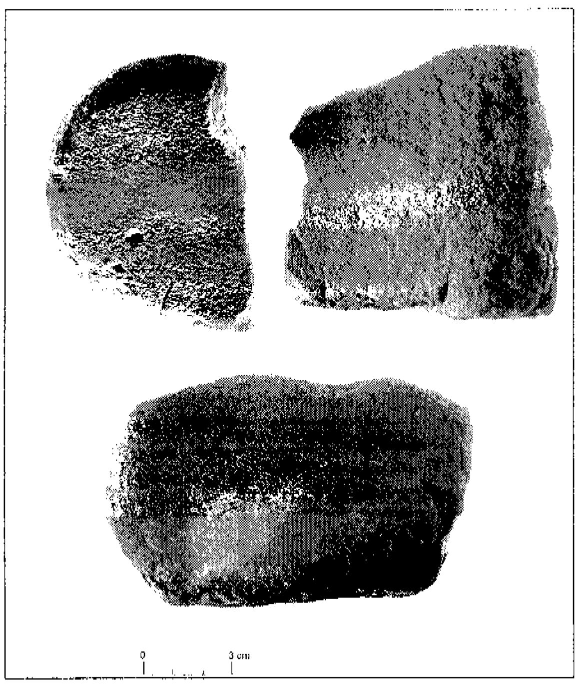


Figure 87. Metate fragments from Macho Dunes.

Grain size was determined with the aid of an American/Canadian Stratigraphic Card. Grain size throughout all artifact categories was either fine or medium-grained, with about two-thirds of all artifacts in the fine-grained category. Manos were represented in all material classes except for the limestone/ dolomite. Metate fragments were represented in all of the five sandstone types (Fig. 87). In manos there was a 4:1 ratio of fine to medium-grained materials; in metates the ratio was slightly less than 2:1. The preponderance of smaller grain size in mano specimens may have functional implications. The finer grained sandstone materials also seem to have greater compaction of the grains and less binder between them. The implication of this is that greater use life was possible from this material than from less consolidated materials. This is important for manos which are said to exhibit a much faster wear rate than metates, about four times that of metates. Texture is thus seen to be an important characteristic related to the durability of ground stone artifacts. Durability of manos seems to be a factor in the selection of the sandstone type.

Different characteristics are sought in metates where use-wear does not seem to be a prime element in the expenditure of these items. It is the maintenance of these items rather than the use of these which generally appears to remove metates from their original systemic context. Restoring the rough surface of metates, by pecking with a hammerstone, seems to have been common practice, as evidenced through ethnographic research and the archaeological record. It may also have played a role in creating the very fragmentary nature of many ground stone assemblages such as this one, as it is at this stage that most breakage occurs. FS 333, for example, shows a furrow of pecking near and paralleling the fracture line where the artifact broke. Pecking was noted in many instances on the surfaces of the grinding stones. Due to the degradation of much of the sandstone material, and the difficulty of ascertaining pecking on coarser materials, quantification of this technique seems unjustified. Nonetheless, pecking was in evidence on ground stone from this site. A higher proportion of the metates than the manos was comprised of the coarser materials, as previously mentioned. These coarser grained materials would not need to be repecked as often and would be less subject to the breakage that appears more related to maintenance than to the use of the objects (Schlanger

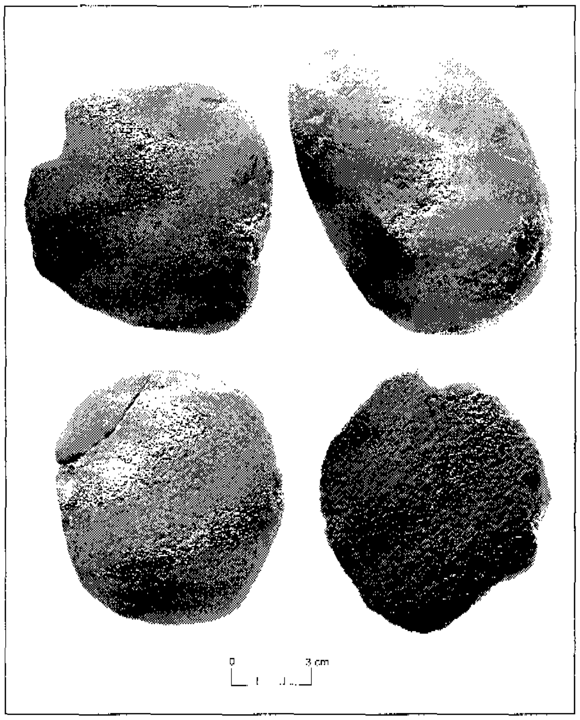


Figure 88. One-hand manos from Macho Dunes.

1991:462). It is quite likely then that the prehistoric inhabitants of this site had a predilection for the coarser grained sandstones to be used for their metates and the finer grained sandstones for their manos.

All manos from Macho Dunes were of a one-handed type (Fig. 88). The majority of mano specimens (40.6 percent, n = 13) were derived from the reddish sandstone, which is visually identical to that from the most local outcrop. The mean length, width, and thickness values for whole specimens are as follows: 9.67 cm, 7.44 cm, 3.75 cm. Length of manos has been seen to have subsistence correlates. Hard's (1990:141) study identified a strong correlation between the degree of agricultural dependence and average mano length. The patterning in his data indicates that the average length of manos is smaller than 19 cm for groups with low agricultural dependence (0-20 percent of the diet). As can be seen from the whole mano length data from this site, the mean length is substantially smaller than that proposed as the cut off point for low or absent agricultural dependence. The absence of economic pollen grains or phytoliths noted from the scans of slides derived from artifact washes may be substantiating this mano length data. It is unlikely that cultigens were a focus of the grinding activity here and may not have been present at all.

Within manos, 73.0 percent had production inputs that displayed less than 50 percent modification from their parent forms. Generally, they were shaped into a rounded or oval plan-view shape without modifying their cross section except through use wear. (Plan view of manos: 47.1 percent circular, 35.3 percent oval, 5.9 percent subrectangular, 11.9 percent irregular.)

No whole metates were found. All were created from tabular sandstone. It appeared that 22 of the 32 (69.0 percent) were derived from slabs less than or equal to 5 cm in thickness. Five appeared to be derived from thicker slabs, 5 to 10 cm thick; the preform thickness of the remaining five could not be deduced, beyond that they were derived from tabular sandstone. Within metate fragments, 54.5 percent displayed the same slight production input (<50 percent modification, 33.3 percent indeterminate modification, 3.0 percent no modification, 9.1 percent greater than 50.0 percent modification).

Tabular sandstone was available to the site inhabitants and required little production input. Grinding, pecking, and flaking were utilized to shape the ground stone artifacts. Although production inputs were low, energy costs of acquisition were obviously high enough that materials were substantially recycled. Many artifacts had a secondarily utilized surface: 13 artifacts had a secondary use-surface functionally indicative of a one-hand mano, 3 indicative of a nondifferentiated metate, 1 of a basin metate, 1 of a slab metate, and 8 had a secondarily used side of indeterminate function. Four of the seventeen whole manos had cross sections that were designated as "airfoil shape," which implies substantial use-wear. Two whole manos had a convex-concave profile, the side with the concavity derived from the artifact's primary use as a metate before fragmentation and recycling into a one-hand mano, another had an irregular-concave profile for the same reason. At least five manos recovered from the site had evidently served as metates before fragmentation and recycling. Manos and metates that are broken during maintenance may be stored for some future use, put to some other use immediately or kept in use as grinding tools (Schlanger 1991:463). The ground stone assemblage from Macho Dunes appears to be similar in these regards; the ground stone artifacts do not appear to have been discarded immediately after breakage.

Ethnographic and experimental evidence suggest that one-hand manos are designed for generalized pounding work, pigment grinding, and food-grinding tasks that employ a "short, often circular grinding motion with the pressure exerted into the body of the mano" (Lancaster 1986:182) as well as being used for hide working (Adams 1988). Many artifacts bore striations visible under the binocular microscope indicative of this type of movement, in which 76.0 percent of the striations were classed as crescent-like or circular. Considering only the manos, 81.0 percent of these artifacts with visible striations had crescentic or circular striations. All manos were of the one-hand variety and were likely used in a rotary or pseudo-rotary fashion as evidenced by the striation patterning, and as Lancaster (1986) states, is the general motor movement employed. This striation patterning has been noted as indicative of an emphasis on the grinding of wild foodstuffs as opposed to cultigens. Of the metate fragments that had striations, 81.0 percent bore crescent-like or circular striations. The only other striation patterning visible on the artifacts was that which was classed as random. These, too, may have been related to a rocking, pseudo-rotary use but often had striations superimposed so that it was difficult to ascertain the individual stria.

The depths of the grinding areas of the metate fragments were measured when feasible. The nondifferentiated metate fragments had a mean depth of 1.51 cm. The mean depth of those that had been designated as basin metate fragments had a mean depth of 2.43 cm. An artifact that had been designated as a lapidary stone had a concavity of 0.9 cm.

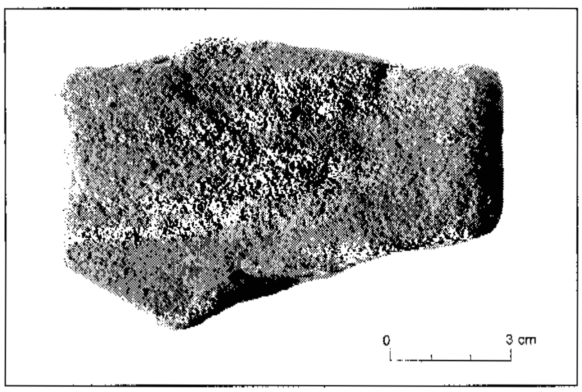


Figure 89. Metate fragment with limonite pigment.

Two fragments, one from a metate and one which had been designated as an indeterminate fragment, had adhesions. On the metate fragment, which had been found in the deepest structure in Area B, a chunk of limonite pigment was found (Fig. 89). Opposite surfaces of this slab had been utilized as a metate or palette. The pigment is adhered to the secondarily used side at the impact point of fragmentation of the artifact. This item may or may not have been used for the grinding of vegetal matter previously, but it is likely that at least by the time of fragmentation it had been relegated to nondomestic duty. It was quite thin and evidently had a precarious potential use-life at the time it was used for crushing the pigment. The white sandstone material of this metate/palette is also the most friable and weakest of all the sandstone types (Fig. 90).

In addition to the ochre encountered on the ground

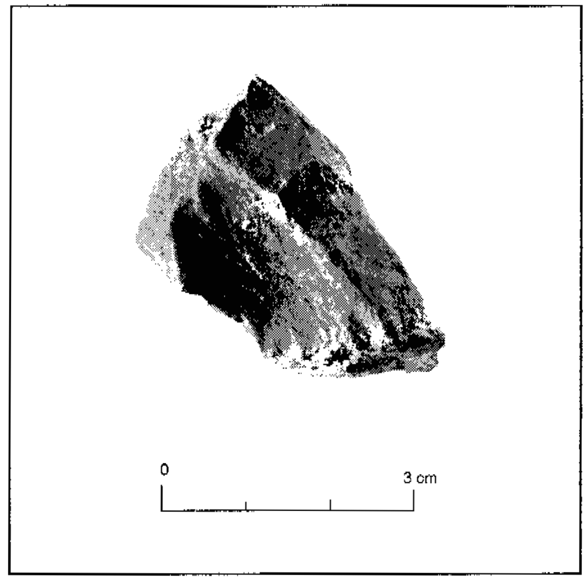


Figure 90. Limonite pigment.

stone artifact, three more pieces of mineral pigment were found, which would likely be classed geologically as limonite. One piece (Fig. 91) measured 30-by-20-by-17 mm. This piece was found within the deep brush structure in Area B, where the palette with the pigment adhesion was found. It exhibited a 2 mm concavity in a roughly 15 mm square area; two other areas on the

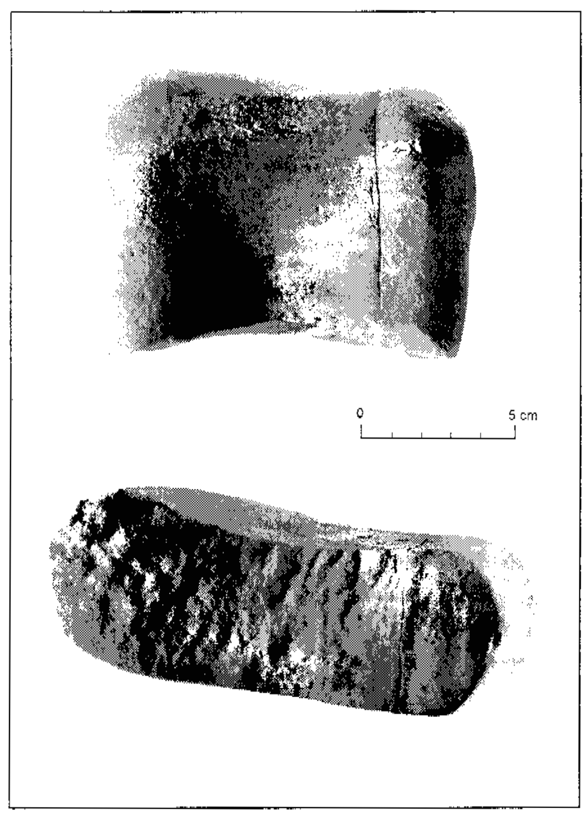


Figure 91. Metate-palette from Macho Dunes.

surface of this mineral pigment appear to show grinding where the pigment was not gouged but ground onto a surface (16-by-13 mm; 7-by-7 mm).

Another chunk of mineral pigment (FS 604) found just outside of the same structure, appeared slightly harder and had a yellow and black banded hard rind. The piece of pigment measured 43-by-27-by-13 mm. It seemed to have a more friable, redder interior that was mostly removed from a gouge. It measured 34-by-17-by-12 mm.

One further chunk of mineral pigment was found on site (FS 72) and had a slightly different aspect. It seemed harder and more orange. Limonite mineral concretions are found in the soils of this region; however, the close association with features, the presence of pigment on ground stone, and the gouging and grinding evident on the minerals themselves attest to the prehistoric use of these minerals on this site.

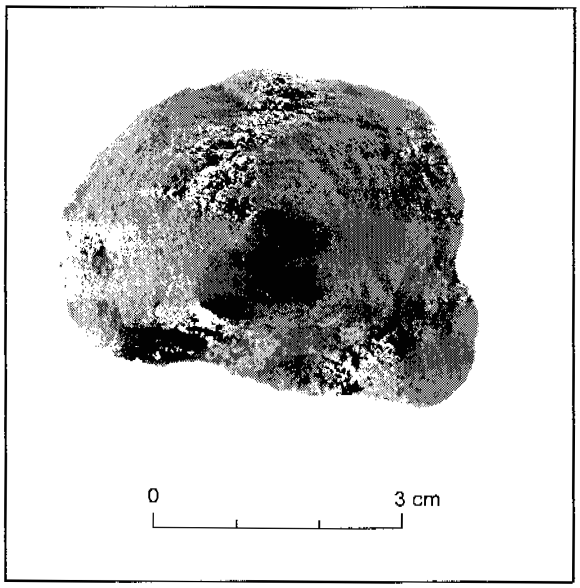


Figure 92. Resin on metate fragment.

The other ground stone fragment with an adhesion was classed as indeterminate but was in all likelihood part of a metate. It appears that this fragment was secondarily used as a hearth stone, as heat-related changes in the form of differential reddish coloring and crazing appear on the artifact. Camilli et al. (1988:8-26) report finding mano and metate fragments in hearths and roasting pits where they evidently functioned as heat-retaining elements. Along with the heat-related changes, the artifact bore a 1-cm-sq patch of carbonized resin (Fig. 92). The extant grinding area on this artifact measures about 1 cm sq. The adhesion is not on this surface, but rather it is on a fragmented side of the artifact. Evidently, the mucilage that had adhered to the stone is related to the cooking of vegetal matter rather than to the grinding of any vegetal material.

Subsistence evidence was sought through an examination of the pollen and phytolith assemblages from the surfaces of the grinding stones. Six artifacts had been washed to retrieve pollen and phytoliths from the interstices of the grinding surfaces. The washing and collection was performed in-house; the extraction was performed by Texas A & M University. The analysis was performed by Dr. Richard Holloway of Quaternary Services. After extraction of the first two samples, it was decided to proceed only with the phytolith extraction from the remaining four samples. Both the pollen and the phytolith assemblages were judged to be in poor condition and it was deemed unlikely to retrieve countable assemblages.

The phytolith assemblages showed evidence of deterioration. Due to this deterioration, the likelihood of obtaining an accurate interpretation was seen to be minimal. No economic taxa (i.e., corn or cucurbits) were seen to be present. The assemblages appeared to consist entirely of grass phytolith assemblages. Although this is not quantified data, the evidence may be pointing again to a lack of dependence on cultigens and a focus on wild food-stuffs, as both mano length and striation patterning seem to indicate.

As mentioned above, virtually all of the ground stone artifacts from this site were composed of sandstone. Various sandstones outcrop in Eddy and Lea counties. The presence of various types and the recycling of these materials may be indicative of the mobility strategies of the prehistoric site inhabitants. Although sandstones outcrop slightly beyond the foraging radius, material acquisition costs were great enough that substantial recycling of materials was practiced and materials other than the most local ones were present. These facts may indicate that this site was part of a seasonal round. Materials from somewhat distant areas apparently arrived at the site in a recycled form. Additionally, virtually all of the ground stone materials on site bore evidence of extensive use-wear. It is exceedingly doubtful that a site in this environment could bear permanent or long-term human occupation. Therefore, the extensive use-wear on the ground stone artifacts and the recycling of these may speak to some degree of site reoccupation. Grinding stones from regularly reused sites should be more extensively shaped than those from sites that were used fortuitously. Metates from rock shelters, for instance, appear to be generally unshaped, whereas virtually all metate edge fragments from LA 29363 were shaped and smoothed. This initial production input may be related to a planned site reoccupation and intended curation of these materials.

Curation of ground stone is expected when site reuse is anticipated. Curation refers to a "strategy of caring for tools and tool kits that can involve advanced manufacture, transport, reshaping and caching . . . [but] need not include all of these dimensions" (Nelson 1991:62). It appears that all of these dimensions are, however, represented from the ground stone assemblage from Macho Dunes.

Under conditions of anticipated reuse of a site (i.e., part of a seasonal round), grinding tools would be used to the point of being expended. Additionally, ground stone artifacts are often seen as site furniture (Binford 1979; Camilli 1989) and are often left in their systemic context or cached. Interestingly, much of the ground stone material recovered from this site comes from within the pits of the burned brush structures. Possibly that is because these artifacts were left in their systemic context. This may be true to some degree of the artifacts encountered in the structure from Area C (5 artifacts), and possibly from the trenched structure in Area B (10 artifacts), where some relations are obscured due to the trenching. But strikingly, 23 ground stone artifacts were recovered within the structure in the northeast corner of Area B! This is an enormous quantity to be in systemic context in a structure that measures less than 3 m in diameter. Furthermore, although the structure was evidently burned, heat-related changes did not appear evident on the artifacts. It would be supposed that the limonite pigment would be blackened, at least, if it had undergone burning within the structure. This was not the case. These lines of evidence give support to the hypothesis that this structure, subsequent to burning, was used to cache ground stone materials. Perhaps this method of caching materials in a burned context served to mark the cache pit, and combated somewhat the strong eolian processes that could have hidden the materials were they simply left on the surface.

Evidence is advanced that supports a planned reoccupation of LA 29363, likely as part of a seasonal round. The caveat which must be addressed is that the size of objects influences their visibility and hence the likelihood that they would be scavenged prehistorically or taken by modern collectors, biasing our sample. Grinding tools are often large enough to be quite visible on sites, making them subject to recycling and reuse whether this reuse was anticipated or not. The hypothesis advanced of planned reoccupation, nevertheless, has fairly strong support in the contextual data of the 23 stone artifacts and the 2 pieces of ground pigment retrieved from the brush structure in Area B.

MACHO DUNES FAUNA

Susan M. Moga

A variety of species were identified in the small faunal assemblage from LA 29363. The site was divided into six excavation units (Areas A to F), which includes structures and features. The fauna recovered from each of these units will be described in the text.

Methodology

A complete analysis was performed on the 413 bones recovered from the Carlsbad Relief Route faunal assemblage. The bone was dry brushed for cleaning and information was recorded by coded variables. The variables included site, field specimen (FS) and lot numbers; count, taxon, element, side and portion, age of the animal, environmental, animal and thermal alterations, and evidence of human processing or modification of the bone.

Identification of the bone was made by utilizing the OAS comparative collections. Sources on New Mexico fauna (Bailey 1971; Findley et al. 1975; Degenhardt et al. 1996) were consulted to determine which species inhabited the area. Descriptions are provided for the fauna represented in the assemblage.

Taxa Recovered

The bulk of the assemblage consists of desert cottontail and woodrats. A variety of species occur in the assemblage (Table 78), but some species are represented by only one fragmented element. Each taxon is supplied with a description, common name, count, and minimum number of individuals (MNI).

Indeterminate Taxa. Unidentifiable small mammal remains encompassed 17.4 percent (n = 72) of the faunal assemblage. The bones were either so minute or severely fragmented that they could not be identified to specific species and were size categorized. The majority of this group, 80.6 percent, were mature individuals, and 8.4 percent were immature. These elements consist of long bones, blade fragments, one rib, and a few vertebrae. Only six bones were represented in the small to medium, medium, and medium to large unidentifiable mammal categories.

***Spermophilus variegatus* (rock squirrel).** A mature innominate was the only squirrel in the assemblage. These animals prefer to inhabit rocky terrain and nest beneath boulders. They rarely hibernate in southern New Mexico and the young are born in spring (Findley et al. 1975:125-126).

Table 78. Taxa Recovered from LA 29363

Taxon	Common Name	Frequency	Percent
Small Mammal	Jackrabbit or smaller	72	17.4
Small to Medium Mammal	Dog or smaller	3	.7
Medium Mammal	Porcupine to dog size	1	.2
Medium to Large Mammal	Dog or larger	1	.2
Large Mammal	Wolf or larger	1	.2
Spermophilus variegatus	Rock squirrel	1	.2
Dipodomys ordii	Ord's kangaroo rat	6	1.5
Peromyscus sp.	Mice	9	2.2
Onychomys leucogaster	Northern grasshopper mouse	5	1.2
Neotoma sp.	Woodrats	85	20.6
Erethizon dorsatum	Porcupine	5	1.2
Small Rodent	Small rodent	15	3.6
Medium to Large Rodent	Medium to large rodent	2	.5
Sylvilagus audubonii	Desert cottontail	151	36.6
Lepus californicus	Black-tailed jack rabbit	23	5.6
Canis latrans	Coyote	1	.2
Canis lupus	Gray wolf	1	.2
Taxidea taxus	Badger	3	.7
Bos/Bison	Cow or bison	1	.2
Small Bird	Small bird	1	.2
Medium Bird	Medium bird	2	.5
Eggshell	Eggshell	8	1.9
Bueto sp.	Broad-winged hawks	1	.2
Pseudomys sp.	Sliders	3	.7
Terrapene ornata	Ornate box turtle	2	.5
Sauria	Lizards	1	.2
Salienta	Frogs and toads	1	.2
Bufonidae	True toads	6	1.5
Mussel	Mussel	2	.5
Total		413	100.0

***Dipodomys* cf. *ordii* (Ord's kangaroo rat).** The kangaroo rat inhabits a variety of geographic zones and is extremely common throughout New Mexico. Their pelage varies with soil color and their physical size increases in the northern and eastern parts of the state. Their breeding season appears to vary between counties (Findley et al. 1975:174-175). Two mature and one juvenile individuals are represented by portions of a scapula, tibia, cranium, and mandible.

***Peromyscus* sp. (mice).** New Mexico provides a habitat for eight types of *Peromyscus,* four of which are distributed throughout Eddy County: *Peromyscus eremicus* (cactus mouse), *Peromyscus maniculatus* (deer mouse), *Peromyscus leucopus* (white-footed mouse), and *Peromyscus boylii* (brush mouse). The only distinguishing differences between species is the shape and length of their tails and pelage color, which often changes with seasons (Findley et al. 1975:201-215). The internal skeletal structure is even more difficult to differentiate, therefore, these species were recorded as *Peromyscus sp.* Nine bone fragments: cranial, mandible and long bones, possibly from three individuals, one mature and two juveniles were noted in the assemblage.

***Onychomys leucogaster* (northern grasshopper mouse).** Common throughout New Mexico, the grasshopper mouse is often associated with Ord's kangaroo rat (Findley et al. 1975:227). Five bone fragments of one mature grasshopper mouse was identified.

***Neotoma* sp. (woodrats).** Two woodrat species are known to coexist in the Carlsbad area, the *Neotoma micropus* (Southern plains woodrat) and *Neotoma albigula* (white-throated woodrat), (Findley et al. 1975:241). The only distinguishing difference between the two species is in the first upper molar (M1) (Hoffmeister and De La Torre 1960:477). Some of the woodrats in the assemblage are quite large in size and more robust than the specimens in the OAS comparative collection. None of the woodrat species are known to hibernate, and more than one litter is raised in a season (Bailey 1971:180). Five mature individuals and three juveniles are represented in the assemblage. Thirty vertebrae (35.3 percent) were the largest number of elements recovered, along with twelve (14.1 percent) cranial fragments, eleven mandibles (12.9 percent), several long bones, and various other fragmented elements. Only five (5.9 percent) woodrat bones revealed evidence of animal alteration; four (4.7 percent) exhibited rodent gnawing and one (1.2 precent) displayed a carnivore puncture mark.

***Erethizon dorsatum* (porcupine).** Porcupines reside in almost every habitat in New Mexico (Findley et al. 1975:273). Breeding season occurs from September through November, and birthing has been recorded in late April to early May, and some as late as August (Dodge 1982:358-359). Two long bones from one mature individual and three innominate fragments from a juvenile were in the assemblage.

***Rodentia* (rodents).** Fifteen small rodent bones and two medium to large-sized rodent bones were collected but were too fragmented to identify to a specific species and were classified according to size. These rodents range in age from young to juvenile and mature.

***Sylvilagus audubonii* (desert cottontail).** The cottontail encompasses the largest number of bones (n = 151 or 36.6 percent) collected in the assemblage. Cottontails are distributed throughout the southwest and their breeding season varies with increasing latitude. Gestation period ranges from 25 to 35 days, with a litter size of approximately three to five individuals (Chapman et al. 1982:94). At this extremely high rate of reproduction, the human population is provided with a renewable meat and pelt resource. Approximately four to five mature individuals, two immature, and one juvenile are represented. A large number (n = 22 or 14.6 percent) of cranial fragments and vertebrae (n = 38 or 25.2 percent) along with a diversity of other body parts reveal a valuable role in the subsistence practices of the local inhabitants. Only three bones exhibit breakage attributed to processing, two are burned, and thirteen provide evidence of animal alterations.

***Lepus californicus* (black-tailed jackrabbit).** Jackrabbits are found throughout New Mexico in regions that propagate succulent vegetation (Findley et al. 1975:93-94). There is also a relationship between latitude and litter size: the lower the latitude, the longer the breeding season (Chapman 1982:129). There were fewer jackrabbits than cottontails recovered. Only two immature long bones from one individual and a variety of bone fragments from one mature individual were recovered. None of the jackrabbit bones exhibit processing, animal or thermal alterations, but four bones showed environmental changes.

***Canis latrans* (coyote).** Coyotes are found in a wide variety of habitats in New Mexico, but most commonly in the grasslands (Findley et al. 1975:281). A proximal portion of a mature radius was the only coyote remnant retrieved. Whether the animal was taken for its pelage, utilized as a food source, or the element was carried to the site by a scavenger is unknown.

***Canis lupus* (gray wolf).** Known to have ranged throughout New Mexico until the end of the nineteenth century, the gray wolf was eliminated to protect domestic livestock (Findley et al. 1975:283-284). A complete ulna with heavy evidence of rodent gnawing was in the assemblage, but like the coyote radius, its utilization is unknown.

***Taxidea taxus* (badger).** Distributed over the state, the badger is more numerous in valleys, which are inhabited by their prey, ground squirrels and prairie dogs. Hibernation is unlikely in the lower valleys of New Mexico and breeding season occurs in early summer, with an offspring rate of four to five young (Bailey 1971:343-345). With only three vertebrae, it is difficult to determine its usage.

***Bos/Bison* (cattle/bison).** A maxillary molar from a cow or bison was recovered from Level 1, which consists of a maximum depth of only 10 cm, so the tooth could have been from a contemporary incident and was enveloped in the churned-up soils. Alternatively, the tooth is historic and is the remain of a cow or small-sized bison. The dentition of these species are similar and it is difficult to distinguish between them, even when evaluating their variability in size. Bison had been recorded as a common sighting on the Eastern Plains of New Mexico in historic times (Findley et al. 1975:335).

***Aves* (birds).** One small bird coracoid fragment and two medium-sized bird long bones, a juvenile humerus and a long bone fragment from a mature individual that were only 25 to 50 percent present, could be identified as bird.

Eggshell. Eight fragments of eggshell were collected and the specimens were severely fragmented.

***Buteo* sp. (broad-winged hawks).** A portion of a carpometacarpus closely resembled hawks native to New Mexico, but could not be matched to a species. This group is characterized by their broad wings, wide tails, and soaring movements (Ligon 1961:63).

***Pseudomys* sp. (sliders or cooters).** Two species that reside in the lower Pecos River drainages, *Trachemys scripta* (slider) and *Pseudemys gorzugi* (western river cooter), are commonly mistaken for one another (Degenhardt et al. 1996:102-103). A plaston fragment and two marginal carapace fragments were so similar to the above species, they could not be distinguished. Whether these turtles were utilized for their meat or their shells for ornamentation, such as rattles, is uncertain.

***Terrapene ornata* (Ornate box turtle).** Found along the lower Pecos River drainage, box turtles are also known to occupy a variety of habitats, including grasslands with suitable soils for burrowing (Degenhardt et al. 1996:104-105). Two carapace fragments were identified and both are void of human processing.

***Sauria* (lizards).** With hundreds of lizard species occupying various habitats throughout New Mexico and the lower Pecos River drainage, one mature fragmented mandible, was difficult to assign to a specific species. It is doubtful this specimen was utilized as a food source.

***Salienta* (frogs and toads).** A fragmented radio-ulna, void of any alterations, was noted in the assemblage. Because a variety of frog and toad species inhabit the area, further identification was impossible.

Bufonidae (true toads). Four toad species occupy the Pecos River drainage: *Bufo cognatus* (Great Plains toad), *Bufo debilis* (green toad), *Bufo punctatus* (red-spotted toad), and *Bufo speciosus* (Texas toad). The elements from this taxa are comparable to the family Bufonidae, but not to the species level. One vertebrae fragment, three innominate fragments, and two fragmented femurs represent one mature and one immature individual. These creatures are most likely intrusive and not a segment of the prehistoric diet.

Unionidae (freshwater mussels). Only two minute pieces of mussel shell were recovered from the site. Three species, *Crytonaias tampicoensis*, *Popenaias popei, and Lampsilis teres,* have been recorded from the Rio Grande in New Mexico and are expected to occur in the Pecos River (Murray 1985:A-24). These fragments could belong to any of the above species. If there were a larger number of shells, we could assume these mussels were being consumed, but the shell may have been used for ornamentation.

Provenience Divisions

The Macho Dunes site was divided into six separate excavation areas, A to F. In Area A bedrock was just below the surface of this unit. It produced 78 lithic artifacts and one sherd, but was completely void of faunal materials.

Area B exposed three structures and had three bones. A jackrabbit cervical vertebrae was recovered approximately 6 m west of Structure 1. A turtle carapace fragment was collected from a pit (Feature 3) in the southeast quad of Structure 2, and a jackrabbit ulna on the northwest exterior of Structure 3, a brush structure.

Area C contained the highest number of faunal materials among the five areas. Located between large sand dunes, this structure was offered some protection from the elements. Two hearths were excavated in this area, but only three of the 351 bones (85.0 percent) collected revealed evidence of burning. A wide variety of creatures (Table 79), all small in stature, were either consumed or utilized to some extent at this seasonal campsite. Desert cottontails, which were abundant in the area, yielded the largest number of bone (n = 131 or 37.3 percent), and the amount of energy spent to capture them was probably minimal. Woodrats (n = 81 or 23.1 percent) and other unidentifiable small mammals (n = 60 or 17.1 percent) were also high in numbers and easily accessible for consumption.

Table 79. Frequencies by Areas at LA 29363

Taxon	Area B		Area C		Area D		Area E		Area F	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Small mammal			60	17.1	11	23.9				
Small to medium mammal			3	.9						
Medium mammal			1	.3						
Medium to large mammal			1	.3						
Large mammal			1	.3						
Rock Squirrel					1	2.2				
Ord's kangaroo rat			6	1.7						
Mice					1	2.2			8	72.7
Northern grasshopper mouse			5	1.4						
Woodrats			81	23.1	4	8.7				
Porcupine			5	1.4						
Small Rodent			15	4.3						
Medium to large rodent			2	.6						
Desert cottontail			131	37.3	18	39.1			2	18.2
Black tailed jackrabbit	2	66.7	14	4.0	7	15.2				
Coyote					1	2.2				
Gray wolf			1	.3						
Badger			3	.9						
Cow or bison			1	.3						
Small bird					1	2.2				
Medium bird			1	.3	1	2.2				
Eggshell			8	2.3						
Broad-winged hawks					1	2.2				
Sliders			3	.9						
Ornate box turtles	1	33.3	1	.3						
Lizards			1 .3%	.3						
Frogs and toads			1	.3						
True toads			6	1.7						
Mussel shell							2	100.0		
Total = 413	3	100.0	351	100.0	46	100.0	2	100.0	11	100.0

Several features were located outside the structure in Area D, including three thermal features. Surprisingly, only 1 bone out of the 46 collected from this area, was recorded as lightly scorched. Nineteen unaltered bones were retrieved from a posthole (Feature 62). Once again, the cottontails (n = 18 or 39.1 percent) and small mammals (n = 11 or 23.9 percent) dominate the faunal artifacts recovered from this area.

Area E contained a hearth, situated directly on the bedrock, with fire-cracked rock scattering the immediate vicinity. Only two mussel shell fragments were collected from this 44-by-60-m surface-stripped unit. It is possible these thermal units were utilized for purposes other than food processing.

Fifteen features were recorded in Area F, seven thermal features, six storage pits, and two postholes, which may have been utilized as drying racks. Faunal counts in this area are minor: a partial skeleton of a mouse, two cottontail bones, and one small mammal element.

Taphonomy

Taphonomic variables are nonhuman processes that affect the condition of biological remains (Lyman 1994:1). Some of these variables include bone alteration by animals and the environment, which were noted in the Carlsbad faunal assemblage. Animal alterations involve gnawing, puncture marks, or scatology. Scatological bones are those that have been passed through the digestive tract of an animal. The stomach acids produce a smooth polished surface and round the edges of the bone. Only seven (1.7 percent) bone fragments appear to be scatological, five cottontail, one small mammal, and one small to medium-sized mammal. A maxillary molar from a cow or bison revealed a carnivore puncture mark. Rodent gnawing encompasses 3.1 percent (n = 13 bones) of the assemblage. A mature gray wolf ulna exhibits extreme gnawing over the course of the element and gnawing was also noted on one small mammal, four woodrats, and seven cottontail bone fragments.

Weathering results when bone has been environmentally altered through moisture, sun exposure, or temperature. The degree of weathering depends upon the amount of exposure time, but the rate of decomposition will vary between environmental regions (Marshall 1989:19-20). Only nine elements exhibit a range of weathering, two through prolonged exposure to the sun, one had pitting, four were exfoliated, and two through root damage.

Splitting can result from environmental pressures, such as ice, water, or soil weight upon the bones. Trampling upon bone by humans or large animals, such as cattle, will also produce longitudinal splits (Marshall 1989:19-21). Nearly all the bone displayed some degree of splitting or fragmentation through environmental factors. Only three bones in the assemblage appear to be altered through human endeavors.

Processing

Processing is observed through burning, breakage, and butchering of an animal for consumption, personal adornment, or utilitarian purposes. Only four bones in this assemblage exhibited two degrees of burning, light (tan/brown) and graded (tan to black). The light (tan/brown) burning can result when meat is roasted on the bone. Graded burning occurs when a portion of meat is removed from the bone and if this barren bone is thermally exposed, it becomes blackened. Excessive heat carbonizes the collagen in the bone and the element turns black. Continuous heat will oxidize the carbon and bone will become chalky, white, or calcined (Lyman 1994:384-385). This process usually takes place after the meal is consumed and the refuse is tossed into the fire.

Breakage and fracturing of bone can occur during the cooking process from the extraction of grease and marrow (Marshall 1989:16), a process which can produce a variety of fractures, such as transverse, spiral, or longitudinal on long bones depending on the method utilized. Not all fracturing is human induced, much of it can be from environmental factors, as noted in the taphonomy section of this text. Only three of the 413 bones in the assemblage exhibit intentional breakage. A tibia with a longitudinal break, a humerus with a spiral fracture, and a cut off portion of an innominate, all of which are desert cottontail bones, and the largest taxon in the assemblage.

Butchering as defined by Lyman (1994:294) is "the human reduction and modification of an animal carcass into consumable parts." This process provides evidence of cut marks, gouges, and scratch marks from stone tools upon the bone. This assemblage was void of any intentional butchering processes as well as evidence of tool manufacturing.

Summary

The small number (n = 413) of bone recovered from the Carlsbad site supports the hypothesis of a seasonal camp. The majority of the animals (n = 322 or 78.0 percent) are mature in age, with a drastic drop inthe number of juveniles (n = 44 or 10.7 percent), and only 21 (5.1 percent) are immature. The presence of immature jackrabbits, cottontails, woodrats, and various rodents suggests the season of the campsite to be from late spring to late summer.

It is possible the inhabitants may have relied more heavily on vegetal food gathering and processing rather than fauna. Or, the fauna acquired for consumption could have been tossed into the stewpot and the meal remnants disposed of outside the excavation area. Even though the number of bones collected was small, the range of taxa was diverse. The highest frequency of bone from a single taxon is desert cottontail (n = 151), then woodrats (n = 85), and unidentifiable small mammal (n = 72). The remaining 26 taxa produced between 9 and 15 fragments each and some categories were as low as only one element per taxon.

The same variety of taxa and low numbers of bone in this assemblage is comparable to the two extensive excavations near Carlsbad, at the Brantley Dam and Reservoir Project, conducted by Gallagher and Bearden (1980:156) and Katz and Katz (1985a:A-135). Small numbers of desert cottontail, jackrabbit, woodrats, rodents, turtle, and shell were found along with a variety of burned ring middens or mescal pits. The purpose for this type of seasonal camp was for the gathering and procurement of mescal plants, which may have been the function of the Carlsbad site.

BOTANICAL ANALYSES AT MACHO DUNES (LA 29363)

Pamela J. McBride and Mollie S. Toll

Introduction

Flotation analysis was used to investigate plant resources exploited in the eighth and ninth centuries A.D. at Macho Dunes, east of Carlsbad, New Mexico. This extensive seasonal base camp includes remains of 5 brush structures and 35 thermal and storage features spread over nearly 5 ha of sand dunes. The site location provides habitation and workspace protected from prevailing winds by a high ridge on the north. A total of 41 flotation samples taken from 31 proveniences in Areas B-F offer insight into the local plant food products collected, processed, and consumed. Carbonized wood from 38 flotation samples and 30 radiocarbon samples provide quantification of several taxa from the abundant local woody vegetation exploited for fuel.

Macho Dunes is situated in an ecotonal area where Chihuahuan Desertscrub from the south intergrades with the lower, drier reaches of Desert Grassland to the north (Dick-Peddie 1993:107). A remarkable diversity and density of shrubs characterize vegetation in the immediate environs of LA 29363 (Toll and McBride 1997). Many shrub specimens are robust (as tall as 2 m, and 3-4 m in diameter). *Rhus microphyllum* (little-leaf sumac) appears to be dominant and specimens of this taxon are truly glorious here. The significant presence of *Juniperus monosperma* (one-seed juniper) is characteristic of the upper elevational limits of Chihuahuan Desertscrub (Brown 1994:175). Several other shrub components of the local vegetation are characteristic of either Desert Grassland or Chihuahuan Desertscrub. Of these, *Prosopis glandulosa* var. *Torreyana* (honey mesquite) is abundant. Scattered *Atriplex canescens* (four-wing saltbush), *Acacia constricta* (whitethorn acacia), *Yucca elata* (soapweed yucca), *Gutierrezia* sp. (snakeweed), and *Mimosa biuncifera* (wait-a-bit) form the balance of the shrubs observed growing in the immediate site area.

Herbaceous plants included members of the composite family such as *Zinnia acerosa* (desert zinnia), *Machaeranthera tanacetifolia* (tansy aster), *Hymenopappus* sp. (wooly white), *Dyssodia acerosa* (needleleaf dogweed), and *Parthenium incanum* (mariola). *Croton* sp. (doveweed), *Dithyrea wislizenii* (spectacle pod), *Erigonum annuum* (wild buckwheat), *Solanum elaegnifolium* (nightshade), and the introduced species, *Peganum harmala* (African rue) were also part of the herbaceous understory. *Bouteloua curtipendula* (sideoats grama), *Muhlenbergia* sp. (muhly grass), *Setaria* sp. (bristle grass), *Sporobolus cryptandrus* (sand dropseed), and *Scirpus* sp. (sedge) were some of the grasses and grass-like plants found growing on the site.

Methods

The 39 soil samples collected during excavation were processed at the Museum of New Mexico's Office of Archaeological Studies by the simplified "bucket" version of flotation (see Bohrer and Adams 1977). Flotation soil samples averaged 2.8 liters in volume, ranging in size from 0.4 to 7.1 liters. Each sample was immersed in a bucket of water, and a 30-40 second interval allowed for settling out 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 had dried. Each sample was sorted using a series of nested geological screens (4.0, 2.0, 1.0, and 0.5 mm mesh), and then reviewed under a binocular microscope at 7-45x.

Flotation data are reported as the number of seeds per liter of the original soil sample. Samples completely empty of floral remains (FS 209 from Area B, and FS 732 from Area F) are not listed in the tables of flotation results. To aid the reader in sorting out botanical occurrences of cultural significance from the considerable noise of post-occupational intrusion, data in tables are sorted into categories of "Cultural" (all carbonized remains) and "Noncultural" (unburned materials, especially when of taxa not economically useful, and when found in disturbed contexts together with modern roots, insect parts, scats, or other signs of recent biological activity).

Charcoal specimens taken for radiocarbon dating were examined by snapping each piece to expose a fresh transverse section, and identified at 45x. All charcoal from each sample was identified and separated by taxon with the exception of very small fragments of charcoal that were impossible to identify. Identified charcoal from each taxon was weighed on a top-loading digital balance to the nearest tenth of a gram and placed in labeled foil packets. 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.

Charcoal from the 4-mm and 2-mm screens of flotation samples was identified, to a maximum of 10 pieces from each screen size. Each piece was identified in the same manner as radiocarbon wood specimens. Wood data were reported separately for flotation and radiocarbon specimens, as specimen size often has a significant effect on species composition.

Results

Area B

Samples were examined from all three structures, and two extramural pits associated with Structures 1 and 2 (Tables 80-82). Storage Pit 9 (FS 54 and 55) yielded the greatest number of charred seeds including purslane, goosefoot, carpetweed, juniper, and an unidentified seed. Documented economic uses of weedy annuals like goosefoot and purslane seeds abound in the ethnographic literature. Castetter (1935) describes the use of these seeds as a ground meal, either eaten as gruel or combined with other food such as corn meal and made into cakes. Carpetweed may have been boiled as a potherb, similar to the widespread use of goosefoot leaves (Kirk 1970:50). The presence of juniper seed fragments in Pit 9 could be an artifact of using branches for fuel (cones or berries charred along with the wood). It is less likely that these seeds derive from processing the fleshy cones for food, as aromatic resins generally relegate these structures to use as medicine, seasoning, or starvation food (Robbins et al. 1916:39-40; Reagan 1928:158; Swank 1932:50; Castetter 1935:31-32). Goosefoot, purslane, and mollugo (carpetweed) are the dominant charred seed species from other proveniences in Area B as well, with juniper occurring in one other sample (Pit 3 in Structure 2).

Juniper and mesquite wood were recovered in similar percentages by weight in flotation samples; both were identified in every sample from Area B (Tables 83a and 83b). A wood that compares favorably with Mexican crucillo (a member of the buckthorn family) comprised 7 percent of the Area B sample by weight; recovery was restricted to Storage Pits 9 and 10. A small amount (<1 percent) of unknown nonconifer wood was recovered from the general fill of Structure 2. The distribution of radiocarbon sample wood is close to that of flotation wood with mesquite having a slightly higher percentage of total weight than juniper (Tables 84a and 84b).

Table 80. Flotation Results, Area B, Structure 1, LA 29363 (Macho Dunes)

Feature	Hearth		Storage Pits				X-M Pit
FS No.	FS 335	FS 336	Pit 9 FS 54	Pit 9 FS 55	Pit 10 FS 58	Pit 3 FS 346	Pit 6 FS 144
Cultural:							
Chenopodium (Goosefoot)				0.5	1.5		
Portulaca (Purslane)			3.0	3.6		0.5	
Mollugo (Carpetweed)				11.8			
Unidentifiable				0.5			
Juniperus (Juniper)				1.8		0.5	
Total Cultural TAXA	0	0	1	5	1	2	0
Total Cultural SEEDS	0	0	3.0	18.2	1.5	1.0	0
Noncultural:							
Cryptantha (Hiddenflower)	0.4	0.5			2.5		1.8
Euphorbia (Spurge)	0.4	1.0					0.3
Mollugo (Carpetweed)	0.8						
Unknown 9183		1.0					0.3
Unidentifiable							0.3
Dicot leaf							+
Total Noncultural TAXA	3	3	0	0	1	0	5
Total Noncultural SEEDS	1.6	2.5	0	0	2.5	0	2.7

Data expressed as seeds per liter of original soil sample.

Table 81. Flotation Results, Area B, Structure 2, LA 29363 (Macho Dunes)

Feature	Fill 171 N/ 221 E	Fill 180 N/221 E	Fill 180 N/ 220 E	Pit 3	X-M Pit
FS No.	FS 223	FS 378	FS 396	FS 346	FS 265
Cultural: Chenopodium (Goosefoot)			0.7		
Portulaca (Purslane)		0.2	0.5	0.5	
Mollugo (Carpetweed)	0.2	0.3			
Unidentifiable			0.2		
Juniperus (Juniper)				0.5	
Total Cultural TAXA	1	2	3	2	0
Total Cultural SEEDS	0.2	0.5	1.4	1.0	0
Noncultural: Chenopodium (Goosefoot)		0.2			
Cryptantha (Hiddenflower)	1.2	0.5			
Euphorbia (Spurge)	0.2	0.2			
Mollugo (Carpetweed)	0.5	0.5			
Juniperus (Juniper)					0.4
Total Noncultural TAXA	4	4	0	0	1
Total Noncultural SEEDS	2.1	1.4	0	0	0.4

Table 82. Flotation Results, Area B, Structure 3, LA 29363 (Macho Dunes)

Feature	Fill	Fill	Fill	Fill	Hearth
FS No.	FS 169	FS 170	FS 602	FS 610	FS 605
Cultural: Chenopodium (Goosefoot)		0.2	1.2		
Portulaca (Purslane)					0.7
Mollugo (Carpetweed)				0.5	
Platyopuntia (Pricklypear)		0.2			
Total Cultural TAXA	0	2	1	1	1
Total Cultural SEEDS	0	0.4	1.2	0.5	0.7
Noncultural: Chenopodium (goosefoot)	0.2		0.4	0.5	
Cryptantha (Hiddenflower)	0.6	0.4			
Euphorbia (Spurge)	0.2				
Mollugo (Carpetweed)	1.7	5.1	1.6	6.8	1.4
Portulaca (Purslane)	0.9	1.3		0.5	
Compositae (composite family)					0.7
Unknown 9183	0.6	0.7			
Unidentifiable	0.2			0.5	
Dicot leaf	++				
Setaria (Bristle grass)	1.1				
Sporobolus (Dropseed)	2.6	0.9	0.4		
Gramineae (Grass family)	0.2				
Leguminosae (Bean family)		0.2			
Juniperus (Juniper)				0.5	
Rhus (Sumac)	0.4				
Total Noncultural TAXA	12	6	3	5	2
Total Noncultural SEEDS	8.7	8.6	2.4	8.8	2.1

Table 83a. Species Composition of Flotation Wood Charcoal, Area B, Structure 1, LA 29363 (Macho Dunes)

Feature	Hearth		Storage Pit 9		Storage Pit 10	Storage Pit 3	X-M Storage Pit 6
FS No.	FS 335	FS 336	FS 54	FS 55	FS 58	FS 346	FS 144
CONIFERS: Juniperus (juniper)	19/0.2	14/0.1	11/0.2	6/0.1	4/0.1	2/<0.1	18/0.4
NONCONIFERS: Atriplex/Sarcobatus (saltbush/greasewood)			1/<0.1		1/<0.1		
cf. Condalia (Mexican crucillo)				5/0.2	3/0.1		
Prosopis (mesquite)	1/<0.1	6/0.1	1/<0.1	9/0.3	12/0.4	18/0.5	2/<0.1
Totals	20/0.2	20/0.2	13/0.2	20/0.6	20/0.6	20/0.5	20/0.4

Table 83b. Species Composition of Flotation Wood Charcoal, Area B, Structures 2 and 3, LA 29363 (Macho Dunes)

Structure	Structure 2				Structure 3			Total Area B	
Feature	General fill			X-M pit	Hearth				
FS No.	FS 223	FS 396	FS 378	FS 265	FS 605	FS 602	FS 610	Weight	%
CONIFERS: *Juniperus* juniper	10/0.2	13/0.5	16/0.2	10/0.2	3/<0.1	19/0.1	11/0.1	2.4	52%
NONCONIFERS: Atriplex/Sarcobatus saltbush/greasewood								<0.1	<1%
cf. *Condalia* Mexican crucillo								0.3	7%
Prosopis mesquite	8/0.1	7/0.1	4/0.1	10/0.1	17/0.2	1/<0.1	5/<0.1	1.9	41%
Unknown non-conifer	2/<0.1							<0.1	<1%
Totals		20/0.6	20/0.3	20/0.3	20/0.2	20/0.1	16/0.1	4.6	100%

Table 84a. Species Composition of Charcoal Submitted for C-14 Analysis, Area B, Structure 1, LA 29363

Area or Structure	Area B	Structure 1								
Context	General fill	Floor			Pit 5	Pit 2	Pit 3		General Fill	
FS No.	FS 287	FS130	FS 131	FS 211	FS 140	FS 226	FS 345	FS 347	FS 330	FS 341
CONIFERS: Juniperus (juniper)	0.5	0.7		1.1	0.9	3.3	0.3	1.4	1.1	0.8
Unknown conifer		0.1						<0.1		
NONCONIFERS: Prosopis (mesquite)	0.2	3.5	4.0	0.7		2.8	5.3	7.3	2.7	1.6
Totals	0.7	4.3	4.0	1.8	0.9	6.1	5.6	8.7	3.8	2.4

Table 84b. Species Composition of Charcoal Submitted for C-14 Analysis, Area B, Structures 2 and 3, LA 29363

Structure	Structure 2				Structure 3?	Structure 3							Total Area B	
Feature	General fill						Pot Rest 6	Pot Rest 7	Pit 1	Pit 8	Pit 27		Weight	%
FS No.	FS 373	FS 382	FS 383	FS 395	FS 409	FS 629	FS 266	FS 428	FS 427	FS 434	FS 292	FS 554		
CONIFERS:														
Juniperus (juniper)	2.3	2.6	1.1	1.8	8.5		0.2	0.3	2.3	0.8	1.2	0.4	31.6	40%
Unknown conifer													0.1	<1%
NONCONIFERS:														
Atriplex/Sarcobatus saltbush/greasewood			<0.1		<0.1					<0.1			<0.1	<1%
cf. Condalia	<0.1	0.2	0.1	0.3	1.0								1.6	2%
Mexican crucillo											<0.1			
Prosopis (mesquite)	2.0	2.5	1.4	3.0	3.6	0.7				0.1	1.9	1.8	45.1	58%
Unknown nonconifer #1			<0.1										<0.1	<1%
Unknown nonconifer # 2												<0.1	<0.1	<1%
Unknown nonconifer # 3			<0.1										<0.1	<1%
Totals	4.3	5.3	2.6	5.1	13.1	0.7	0.2	0.3	2.3	0.9	3.1	2.2	78.4	100%

Area C

One sample examined from extramural Pit 11 (FS 170) contained the only charred prickly pear seed recovered from the project (Table 85). The fruits or *tunas* of several genera of prickly pear were eaten raw or boiled by many Native American groups (Castetter 1935:35). Goosefoot is the only other charred taxon that was identified in samples from the Structure 4 hearth, the south half of extramural Pit 41, and Pit 11. Mesquite was the dominant wood taxon identified in flotation samples from Area C (Table 86). Small percentages of juniper and unknown nonconifer were recovered. The remaining 23 percent was comprised of probable Mexican crucillo wood, which was recovered solely from the extramural hearth and storage pit. Percentages of radiocarbon wood taxa display the same distributions as the flotation wood (Table 87).

Table 85. Flotation Results, Area C, Extramural Hearths and Pits near Structure 4, LA 29363 (Macho Dunes)

Feature	Hearth			Pit 40	Pit 41
Taxa	FS 76	FS 77	FS 78	FS 820	FS 1018-1025
Cultural:					
Chenopodium (Goosefoot)	0.8	1.1	0.6		0.6
Total Cultural TAXA	1	1	1	0	1
Total Cultural SEEDS	0.8	1.1	0.6	0	0.6
Noncultural:					
Boerhaavia (Spiderling)					2.8
Chenopodium (Goosefoot)	0.4				0.6
Euphorbia (Spurge)	0.4				
Mollugo (Carpetweed)	10.2	1.1	1.2	1.0	0.6
Portulaca (Purslane)	1.1				
Unidentifiable				0.5	1.7
Dicot leaf		+			+
Setaria (Bristle grass)		1.1			
Sporobolus (Dropseed)	0.8		6.0	0.5	
Gramineae (Grass family)					0.6
Total Noncultural TAXA	5	3	2	3	8
Total Noncultural SEEDS	12.9	2.2	7.2	2.0	7.5

Table 86. Species Composition of Flotation Wood Charcoal, Area C, LA 29363 (Macho Dunes)

Feature	Extramural hearth, immediately adjacent to Structure 4		Structure 3 general fill		X-M Storage Pit 40	X-M Hearth S ½	X-M Hearth N ½	Totals	
FS No.	FS 76	FS 77	FS 169	FS 170	FS 820	FS 1018-1022	FS 1023-1025	Weight	Pct.
CONIFERS: Juniperus (juniper)	3/0.1	1/<0.1	5/<0.1	1/<0.1	4/<0.1			0.1	2%
NONCONIFERS: cf. Condalia Mexican crucillo					16/0.1	9/0.1	19/0.9	1.1	23%
Prosopis (mesquite)	17/1.0	18/0.4	13/0.1	16/1.1		10/0.9	1/<0.1	3.5	73%
Unknown nonconifer		1/<0.1	2/<0.1	3/<0.1		1/0.1		0.1	2%
Totals	20/1.1	20/0.4	20/0.1	20/1.1	20/0.1	20/1.1	20/0.9	4.8	100%

Table 87. Species Composition of Charcoal Submitted for C-14 Analysis, Area C, LA 29363

Feature	Pit Structure 4 fill	Storage pit 40	Hearth (Pit 41)		Totals	
FS No.	FS 168	FS 819	FS 1020	FS 1021	Weight	Pct.
CONIFERS: Juniperus (juniper)	0.2	<0.1	0.3		0.5	1%
NONCONIFERS: cf. Condalia (Mexican crucillo)		1.1	4.8	3.7	9.6	18%
Prosopis (mesquite)	5.5		7.5	28.2	41.2	79%
Unknown nonconifer #1	0.2	<0.1			0.2	<1%
Unknown nonconifer #2			0.5		0.5	1%
Totals	5.9	1.1	13.1	31.9	52.0	100%

Area D

Posthole 62 produced charred goosefoot, purslane, juniper, an unidentified seed, and three unidentified fruits (Table 88). Charred goosefoot was recovered from two other pits, and Thermal Pit 51 yielded a charred juniper seed fragment as well. Juniper charcoal was recovered in all five flotation samples from Area D (Table 89). Trace amounts (<1 percent) of saltbush/greasewood, mesquite, and unknown nonconifer were also identified. The samples examined from Posthole 62 had only two small fragments of juniper and one of mesquite, representing debris rather than allowing for any identification of the post itself.

Table 88. Flotation Results, Area D Extramural Features, LA 29363 (Macho Dunes)

Feature	Posthole 62	Pit 60		Pit 51	Pit 28	Pit 50
FS No.	FS 738-741	FS 825	FS 828	FS 1225	FS 1306	FS 1314
Cultural: Chenopodium (Goosefoot)	1.6		0.6	0.6	2.5	
Portulaca (Purslane)	1.3					
Unidentifiable	1.3					
Juniperus (Juniper)	1.3			0.3		
Total Cultural TAXA Total Cultural SEEDS	3 5.5	0 0	1 0.6	2 0.9	1 2.5	0 0
Noncultural: Cryptantha (Hiddenflower)	0.3					
Mollugo (Carpetweed)	0.7	4.1	1.8	0.3		
Portulaca (Purslane)		0.4	1.2	0.6		
Dicot leaf						+
Sporobolus (Dropseed)	0.3	0.4	2.9	0.3		
Total Noncultural TAXA **Total Noncultural SEEDS**	3 1.3	3 4.9	3 5.9	3 1.2	1 2.5	1 0

Table 89. Species Composition of Flotation Wood Charcoal, Area D, LA 29363 (Macho Dunes)

Feature	Posthole #62 of possible ramada	Pit 60		X-M Thermal Pit 51	X-M Thermal Pit 50	Total Area D	
FS No.	FS 738-741	FS 825-827	FS 828-829	FS 1225	FS 1314	Weight	Pct.
CONIFERS: Juniperus (juniper)	2/<0.1	20/0.1	20/<0.1	15/0.2	20/<0.1	0.3	100%
NONCONIFERS: Atriplex/Sarcobatus (saltbush/greasewood)				2/<0.1		<0.1	<1%
Prosopis (mesquite)	1/<0.1			3/<0.1		<0.1	<1%
Unknown nonconifer	1/<0.1					<0.1	<1%
Totals	4/<0.1	20/0.1	20/<0.1	20/0.2	20/<0.1	0.3	100%

Area E

Two samples from the hearth were analyzed and charred goosefoot, purslane, and dropseed grass seeds were recovered (Table 90). Although dropseed grass grains are very small, the positive qualities of abundant seed production and the retention of the grains by the plant after maturation (preventing their loss before harvesting [Doebley 1984]) may have made dropseed grains a valuable resource. Mesquite was the dominant wood burned in the two isolated hearths in Area E (Table 91). A small amount of juniper (5 percent) was also recovered.

Table 90. Flotation Results from Extramural Features, Areas E and F, LA 29363 (Macho Dunes)

Area	Area E		Area F		
Feature	Hearth	Hearth	Pit 32	Pit 29	Pit 28
FS No.	FS 531	FS 533	FS 732	FS 1205	FS 1306
Cultural:					
Chenopodium (Goosefoot)	0.8	1.8		0.9	2.5
Cheno-am (Goosefoot-pigweed)	0.4				
Portulaca (Purslane)	2.7	3.9			
Unidentifiable		1.3			
Sporobolus (Dropseed)	0.8	0.3			
Total Cultural TAXA	4	4	0	1	1
Total Cultural SEEDS	4.7	7.3	0	0.9	2.5
Noncultural:					
Cryptantha (Hiddenflower)					2.5
Mollugo (Carpetweed)	3.9	1.8		0.9	
Portulaca (Purslane)	2.4			2.2	
Setaria (Bristle grass)		0.5			
Juniperus (Juniper)	+ twig				
Total Noncultural TAXA	3	2	0	2	1
Total Noncultural SEEDS	6.3	2.3	0	3.1	2.5

Table 91. Species Composition of Flotation Wood Charcoal, Area E, LA 29363 (Macho Dunes)

Feature	Isolated Hearth	Total Area E		
FS No.	FS 531	FS 533	Weight	Percent
CONIFERS: Juniperus (juniper)	5/<0.1	4/0.1	0.1	5%
NONCONIFERS: Prosopis (mesquite)	15/0.8	16/1.0	1.8	95%
Totals	20/0.8	20/1.1	1.9	100%

Area F

Charred goosefoot seeds were recovered from five of the nine samples yielding cultural remains (Tables 90 and 92). Other charred economic taxa include purslane, juniper, and carpetweed. Mexican crucillo was identified in four of the eight pits excavated in Area F, comprising 27 percent by weight of the total flotation wood from the area (Table 93). Mesquite, the dominant wood type by weight, was identified in all but two of the pits, while juniper was recovered from all pits except the roasting pit (Pit 31). A small percentage (<1 percent) of unknown nonconifer was also present in Pit 29 and Pit 32. Mesquite was also the dominant wood taxon identified in radiocarbon samples, followed by juniper and Mexican crucillo (Table 94).

Table 92. Flotation Results, Area F Extramural Features, LA 29363 (Macho Dunes)

Feature	Storage Pit	Hearths				Roasting Pit	
	Pit 24	Pit 26	Pit 27		Pit 34	Pit 31	
FS No.	FS 188	FS 633	FS 552	FS 555	FS 1211	FS 1114	FS 1115
Cultural:							
Chenopodium (Goosefoot)	0.2	0.5		0.6			
Portulaca (Purslane)		0.3	0.5				
Mollugo (Carpetweed)			0.5				
Unidentifiable	0.2						
Juniperus (Juniper)		0.3	0.5				
Total Cultural TAXA	2	3	3	1	0	0	0
Total Cultural SEEDS	0.4	1.1	1.5	0.6	0	0	0
Noncultural:							
Cryptantha (Hiddenflower)						+	
Mollugo (Carpetweed)	0.7	0.3				1.2	2.3
Portulaca (Purslane)							0.6
Setaria (Bristle grass)	0.5					0.4	
Sporobolus (Dropseed)					7.8		
Gramineae (Grass family)	0.2						
Total Noncultural TAXA	3	1	0	0	1	3	2
Total Noncultural SEEDS	1.4	0.3	0	0	7.8	1.6	2.9

Table 93. Species Composition of Flotation Wood Charcoal, Area F, LA 29363 (Macho Dunes)

Feature	Pit 29	Pit 28	Storage Pit	Thermal Features			Pit 34	Pit 32	Roasting Pit		Total Area F	
			Pit 24	Pit 27	Pit 27	Pit 26			Pit 31	Pit 31		
FS No.	FS 1205	FS 1306	FS 188	FS 552	FS 555	FS 633	FS 1211	FS 732	FS 1114	FS 1115	Weight	%
CONIFERS: Juniperus (juniper)	6/<0.1	11/0.1	16/0.3	4/0.1	11/0.1	13/0.4	16/0.1	5/<0.1			1.1	30%
NONCONIFERS: cf. Condalia (Mexican crucillo)		9/<0.1	2<0.1			7/1.0	1/<0.1				1.0	27%
Prosopis (mesquite)	5/<0.1		2/<0.1	16/1.0	9/0.2		3/<0.1	5/<0.1	20/0.2	15/0.2	1.6	43%
Unknown non-conifer	2<0.1							1/<0.1			<0.1	<1%
Totals	13/<0.1	20/0.1	20/0.3	20/1.1	20/0.3	20/1.4	20/0.1	11/<0.1	20/0.2	15/0.2	3.7	100%

Table 94. Species Composition of Charcoal Submitted for C-14 Analysis, Area F, LA 29363

Feature	General fill		Thermal pit 27	Thermal pit 26	Thermal pit 29	Storage pit 30	Storage pit 28	Total Area F C-14	
FS No.	FS 629	FS 734	FS 554	FS 632	FS 1206	FS 1009	FS 1513	Weight	Pct.
CONIFERS: Juniperus juniper		0.3	0.4	0.4	0.1	0.2		1.4	23%
NONCONIFERS: cf. Condalia Mexican crucillo		0.3		0.1		<0.1	0.2	0.6	10%
Prosopis mesquite	0.7	0.3	1.8	0.2	0.3	0.5		3.8	61%
Unknown non-conifer #1		<0.1	<0.1	0.3				0.3	5%
Unknown non-conifer #2		0.1						0.1	<1%
Totals	0.7	1.0	2.2	1.0	0.4	0.7	0.2	6.2	99%

Table 95. Ubiquity of Carbonized Plant Remains by Area.

Area	B			C	D	E	F	Total Site
Location	Interior		X-M	X-M	X-M	X-M	X-M	
Number of Samples	7	7	2	4	6	2	9	
Context	fill	features	features	features	features	features	features	
Cultural: Chenopodium (Goosefoot)	3	2		3	4	2	4	18/37= 0.49
Cheno-am (Goosefoot-pigweed)						1		1/37= 0.02
Portulaca (Purslane)	2	4			1	2	2	11/37= 0.30
Mollugo (Carpetweed)	3	1					1	5/37= 0.14
Unidentifiable	1	1			1	1	1	5/37= 0.14
Sporobolus (Dropseed)						2		2/37= 0.05
Juniperus (Juniper)		3			1		2	6/37= 0.16
Platyopuntia (Pricklypear)	1							1/37= 0.02
Total Cultural #TAXA [a] Ubiquity	5 10/7=1.4	5 11/7=1.6	0 0	1 3 /4=0.75	4 7/6=1.2	5 8/2=4.0	5 10/9=1.1	
[b] Density	4.2/7=0.6	22.4/7=3.2	0	2.5/4=0.6	9.5/6=1.6	12/2=6.0	4.5/9=0.5	55.1/37= 1.5

[a] total occurrences ÷ number of samples.
[b] total number of seeds/liter ÷ number of samples.

Table 96. Summary of Wood Utilization by Area and Provenience Category

Area		Area B		Area C		Area D		Area E		Area F		Total Site	
Taxa		g	%	g	%	g	%	g	%	g	%	g	%
Juniper	Float	2.4	52	0.1	2	0.3	100	0.1	5	1.1	30	4.0	26
	C14	31.6	40	0.5	+					1.4	23	33.5	29
	Total	34.0	54	0.6	+	0.3	100	0.1	5	2.5	25	37.5	28
Saltbush/ greasewood	Float	+	+			+	+					+	+
	C14	+	+									+	+
	Total	+	+			+	+					+	+
Mexican crucillo	Float	0.3	7	1.1	23					1.0	27	2.4	16
	C14	1.6	3	9.6	21					.6	10	11.8	10
	Total	1.9	4	10.7	21					1.6	16	14.2	11
Mesquite	Float	1.9	43	3.5	73	+	+	1.8	95	1.6	43	8.8	58
	C14	25.7	54	41.2	77					3.8	61	70.7	60
	Total	27.6	53	44.7	77	+	+	1.8	95	5.4	55	79.5	60
Unknown non-conifer	Float	+	+	0.1	2	+	+			+	+	0.1	+
	C14	+	+	0.7	1					.4	6	1.1	+
	Total	+	+	0.8	1	+	+			.4	4	1.2	+
∑	Float	4.6	100	4.8	100	.3	100	1.9	100	3.7	100	15.3	100
	C14	58.9	100	52.0	100					6.2	100	117.1	100
	Total	63.5	100	56.8	100	0.3	100	1.9	100	9.9	100	132.4	100

+ <0.1g or 1%

Discussion

Seeds of weedy annuals dominate the floral assemblage from all areas of the site (Table 95). Flotation sample remains were fairly uniform across the site, with low frequencies of the same weedy annuals and juniper occurring in samples from all areas. An exception was the recovery of a prickly pear seed from Area C, representing the only example of perennial plant use that cannot be tied to fuel wood use. Grasses were surprisingly scarce. Charred dropseed grass was also limited to Area C of the site.

Fuel wood selection focused on mesquite and juniper in all areas of Macho Dunes (Table 96). Mexican crucillo put in a significant appearance in Areas B, C, and F, where more wood specimens were available for analysis. Minor amounts of saltbush and an unknown nonconifer species were noted in several areas of the site.

Unfortunately for purposes of comparison, research at some similar sites at nearby Brantley Reservoir did not include floristic analyses (Gallagher and Bearden 1980; Katz and Katz 1985a). For this reason, Macho Dunes is compared to sites that are farther afield, but that are still located in Chihuahuan desertscrub or grassland communities (Table 97). Purslane and goosefoot are the most widespread weedy seed species recovered, occurring at four or five out of eight sites. Weedy annuals like goosefoot and purslane have the adaptive advantage of proliferating in the disturbed ground around habitation sites, agricultural fields, and middens, making them a readily available resource. Their seeds have been recovered from a wide array of prehistoric assemblages throughout the Southwest. 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).

Evidence for perennial plant use in this selection of Chihuahuan desert sites consists mainly of hedgehog cactus, mesquite, and prickly pear cactus seeds. Agave, yucca, sotol, and beargrass have more restricted archaeological distributions, primarily at Wind Canyon (located on the eastern slope of the Eagle Mountains; Bohrer 1994) and Ratscat (on the upper alluvial slopes of the San Andres Mountains; Toll 1983). The two sites are situated in close proximity to stands of agave and sotol in the foothills, as opposed to the other six sites that are located in dunal areas. Carlsbad Relief is the only project where juniper seeds were recovered, probably due to the localized availability of this excellent fuel wood resource.

White Sands is the only archaeological context where corn was identified from the early ceramic period (Toll 1986). This is somewhat surprising as the site was defined as a temporary procurement camp and evidence of cultigens would be more likely to show up at more permanently occupied sites like the Fort Bliss sites (Ford 1977). Two species of grasses, identified in low frequencies, were limited to the Tularosa and Carlsbad Basin areas (Toll 1983, 1986). Singular appearances of flame flower, evening primrose, mallow, sunflower, spurge, and sumpweed suggest localized exploitation of these taxa, in a minor economic role (Bohrer 1994; Toll 1986; Wetterstrom 1978; Scott and Toll 1987).

Wood analysis was possible at five of the eight sites reviewed in Table 97, and a comparison of species composition is presented in Table 98. Ratscat has the most diverse wood assemblage with seven taxa identified. Oak and piñon were the most common woods present at Ratscat, two taxa absent from the record at other sites. These taxa would have been available in the San Andres foothills, in close proximity to Ratscat. Mesquite is the dominant wood type at the five other sites where occupants could take full advantage of this dense wood, which provides "a bed of hot, slow burning coals" (Ford 1977:200). Saltbush comprised a third of the wood assemblage at White Sands and Sunland Park, and a very minor part of the assemblages at Macho Dunes and Ratscat.

Summary

Analysis of 41 flotation samples and 30 radiocarbon samples from Macho Dunes provides evidence for the use of three weedy annual taxa (purslane, goosefoot, and carpetweed), dropseed grass, and prickly pear cactus for food. Fuel woods were dominated by two locally abundant taxa with excellent burning qualities: mesquite and juniper. Mexican crucillo (identified tentatively) and saltbush were also represented from the local flora, but there was no evidence in the charcoal assemblage of utilization of little-leaf sumac.

Several vegetative historians chronicle a continuing expansion of Chihuahuan Desert Scrub into former grassland territory (e.g., Brown 1994:169; York and Dick-Peddie 1969) so that we can expect Globe phase vegetation at Macho Dunes to lean closer to grassland dominants than the species composition today. The current vegetative community is clearly ecotonal, with more affinities to grassland than desert scrub.

Table 97. Charred Remains of Economic Plant Taxa from Formative Period Sites in the Chihuahuan Desert Biotic Community

Taxa	Macho Dunes	Ratscat[1]	White Sands[2]	Sunland Park[3]	Fort Bliss	Wind Canyon[6]		NAHO-St. Theresa[7]
Location	Carlsbad Basin	Western Tularosa Basin	Tularosa Basin	El Paso Area	Hueco Bolson	Eagle Mountains (appx. 100 miles SE of El Paso)		Mesilla Bolson
					4:84M[4]	3:739, 4:132[5]		
PERENNIALS								
mesquite		+	+	+		+		
juniper	+							
hedgehog cactus			+	+		+	+	
pricklypear	+		+	+		+	+	
agave		+					+	
yucca						+		
sotol							+	
beargrass							+	
GRASSES								
panic grass		0						
dropseed	+		+					
WEEDY ANNUALS								
carpetweed	0						0	
flame flower							+	
goosefoot	0		+			+ (cheno-ams)	+	
pigweed			+					+
purslane	+		+		+		+	+
mallow			+					
sunflower						+		
spurge								+
sumpweed							+	
evening primrose							+	
CULTIVARS								
corn			0					
Total Taxa	6	3	9	3	1	6	11	3

[1]lithic/ceramic scatter with hearths; masonry structure (Toll 1983)
[2]temporary procurement camp with hearth, fire-cracked rock scatters (Toll 1986)
[3]campsite (Toll 1993)
[4]hamlet (Ford 1977)
[5]small village (3:739); medium village (4:132; Wetterstrom 1978)
[6]Feature 14 (AD 1020) (Bohrer 1994)
[7] III-3SE:Feature 1A and III-21NW:Sample 6, Feature 8 (Scott and Toll 1987)

Table 98. Utilized Wood from Formative Sites in the Chihuahuan Desert Biotic Community

Site	Macho Dunes	Ratscat[1]	White Sands[2]	Sunland Park[3]	Fort Bliss[4]	NAHO- St. Theresa[5]
Location	Carlsbad Basin	Western Tularosa Basin	Tularosa Basin	El Paso Area	Hueco Bolson 4:84M	Mesilla Bolson
CONIFERS: Juniperus (juniper)	24%	4%				
Pinus edulis (pinyon)		18%				
Unknown conifer		11%				
NONCONIFERS: Atriplex (saltbush)	<1%	<1%	35%	33%		
cf. Condalia Mexican crucillo	16%					
Larrea (creosotebush)		4%	<1%			
Populus/Salix (cottonwood/willow)				<1%		
Prosopis (mesquite)	59%	<1%	65%	67%	100%	100%
Quercus (oak)		32%				
Unknown nonconifer	1%	32%	<1%		<1%	
Totals	100%	101%	100%	100%	100%	100%

[1] lithic/ceramic scatter with hearths; masonry structure (Toll 1983)
[2] temporary procurement camp with hearth, fire-cracked rock scatters (Toll 1986)
[3] campsite (Toll 1993)
[4] hamlet (Ford 1977)
[5] III-3SE:Feature 1A and III-21NW:Sample 6, Feature 8 (Scott and Toll 1987)

Macho Dunes shares with other Formative period sites of the Desert Grassland-Desert Scrub zones a predominance of goosefoot and purslane among economic weedy annuals in the cultural assemblage. Perennials vary considerably according to local abundance. Mesquite food remains have never been recovered in abundance in these archaeological sites, and are frequently absent even where mesquite is the predominant fuel wood (for instance at 4.84 M and St. Theresa, as well as Macho Dunes; see Table 98). Prickly pear and hedgehog cacti are low frequency but widespread, in contrast to remains of the leaf succulents (agave, yucca, and sotol), which are concentrated in foothill habitats.

PALYNOLOGICAL ANALYSIS

Richard Holloway

Methods and Materials

Phytolith Extraction Methods

Ten grams of soil were subsampled and placed in beakers where the carbonates were removed using hydrochloric acid. The samples were rinsed, screened through 150 μ mesh screen and a series of short centrifugations were initiated in order to remove acids and facilitate the removal of clay particles. This step is necessary since phytoliths smaller when 2-3 μ are rarely identifiable or valuable. The samples were sonicated using a Delta D-9 sonicator for a period not exceeding 30 seconds and several short centrifugations were performed.

The residues were transferred to glass 100 ml tubes and Schulze's solution (42 percent nitric acid and potassium chlorate) was added to the samples. The samples were placed in a boiling water bath for about 2-3 hours or until all organic traces had been removed. The samples were centrifuged and rinsed until neutral, and then rinsed with 5 percent KOH to remove any additional humates. After additional rinsing, the residue was transferred to a 300 ml tall glass beaker, and the samples were fractionated in a water column. This fractionation resulted in a separation of particles into a 3-25μ and a 25-150μ-size range. The residues were transferred to 15 ml tubes and as much water as possible was removed in preparation for heavy density separation. Zinc bromide (S.G. 2.38) was added to the samples and centrifuged at high speed for 10 minutes. The lighter, phytolith fraction was collected and this step was repeated. Very few phytolith specimens were present from these samples.

The phytoliths were rinsed and transferred to absolute ethanol for curation. A single drop containing phytoliths was added to a cover slip and it was allowed to dry. A drop of Meltmount adhesive (refractive index 1.539) was added to the cover slip and a permanent slide was then made.

Pollen Extraction Methods

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

From each pollen sample submitted, 25 grams (g) of soil were subsampled. Prior to chemical extraction, three tablets of concentrated *Lycopodium* spores (batch #307862, Department of Quaternary Geology, Lund, Sweden; 13,500 ± 500 marker grains per tablet) were added to each subsample. The addition of marker grains permits calculation of pollen concentration values and provides an indicator for accidental destruction of pollen during the laboratory procedure.

The samples were treated with 35 percent hydrochloric acid (HCl) overnight to remove carbonates and to release the *Lycopodium* spores from their matrix. After neutralizing the acid with distilled water, the samples were allowed to settle for a period of at least three hours before the supernatant liquid was removed. Additional distilled water was added to the supernatant, and the mixture was swirled and then allowed to settle for 5 seconds. The suspended fine fraction was decanted through 150μ-mesh screen into a second beaker. This procedure, repeated at least three times, removed lighter materials, including pollen grains, from the heavier fractions. The fine material was concentrated by centrifugation at 2,000 revolutions per minute (RPM).

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

The samples were dehydrated in glacial acetic acid in preparation for acetolyis. Acetolysis solution (acetic anhydride: concentrated sulfuric acid in 9:1 ratio) following Erdtman (1960) was added to each sample. Centrifuge tubes containing the solution were heated in a boiling water bath for approximately 8 minutes and then cooled for an additional 8 minutes before centrifugation and removal of the acetolysis solution with glacial acetic acid followed by distilled water. Centrifugation at 2,000 RPM for 90 seconds dramatically reduced the size of the sample, yet from periodic examination of the residue, did not remove fossil palynomorphs.

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

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

A drop of the polliniferous residue was mounted on a microscope slide for examination under an 18-by-18 mm cover slip sealed with fingernail polish. The slide was examined using 200x or 100x magnification under an Aus-Jena Laboval 4 compound microscope. Virtually no pollen grains were recovered from the two samples extracted. A single grain of *Pinus* was present but was in such pristine condition that it likely represented modern contamination.

Discussion

After extracting only two samples each of pollen and phytolith material, Texas A & M University advised me of the extremely poor shape of the assemblages. In their opinion, there was little likelihood of obtaining countable phytolith or pollen assemblages from the continued extraction of samples. After examining the pollen residue from these two samples, it was decided to proceed only with the phytolith extractions for the remaining four samples submitted as a test. There was virtually no pollen present in these residues. A scan of one slide indicated only a single *Pinus* grain was present on the entire slide. This grain was in such good condition, that I suspect it was a modern contaminant. No pollen was present from the other pollen extraction.

The phytolith residues were likewise in very poor condition. The phytolith concentrations on the slide were very low and I anticipated that standard counts of 300-500 specimens would be difficult, if not impossible to obtain from these slides. Additionally, the phytoliths showed strong evidence of deterioration, which was likely due to the local soil chemistry. However, given the high degree of deterioration, which had occurred to these assemblages, the likelihood of obtaining an accurate interpretation from these assemblages was minimal. Based on this information, I advised that no further analysis be conducted on these samples. Since this was the first set of samples, I also suspected that recovery was not likely to improve by the processing and extraction of additional samples. Therefore, none of the other samples was processed.

While in many areas of the arid Southwest, phytoliths are thought to preserve better than pollen assemblages, phytoliths are not indestructible. The deterioration and destruction of pytoliths appears to be correlated with high pH values of the sediments and the presence of free iron and aluminum oxides (Pearsall 1988). Wilding et al. (1977) and Pease (1967) have both reported on a phytolith pH solubility curve. Basically, these authors suggest that the biogenic silica go back into solution under conditions of higher pH, which is usually accompanied by the presence of carbonates within the assemblage. While the pH from the study area is not significantly higher than from other archaeological sites, it probably falls in the range of 8-9. Severe deterioration of phytolith assemblages generally occurs at pH levels above 9.0. However, the soil conditions from the project area would likely be sufficient to weather the assemblages. Thus, it is likely that the local soil conditions have acted in this instance to significantly alter the phytolith assemblages. It should be remembered, however, that not all soil conditions with pH values between 8-9 would result in deteriorated phytolith assemblages. For this reason, analysis of these types of artifacts should be continued in order to individually assess the potential for phytolith recovery.

DATING THE CARLSBAD SITES

Yvonne R. Oakes

While the lack of large, in-depth block studies for southeastern New Mexico is discouraging, a number of small-scale excavations producing site data that are increasing our knowledge of the region far beyond what existed even 15 years ago. Until recently, the dating of southeastern New Mexico sites was almost a fortuitous occurrence, considering the dunal environment and often wind-blown site surfaces. Today, because of improved archaeological methodology, excavators are opening up broader areas of sites and taking potentially datable samples from the small hearths and pits that frequently occur. The Carlsbad Relief Route project opened up large areas of the two excavated sites, finding roasting pits, hearths, storage pits, and brush structure floors that allowed for recovery of abundant datable materials.

Twenty radiocarbon dates were obtained from Macho Dunes (LA 29363), ranging from the Middle Archaic to ca. A.D. 1000 (Table 99). Several archaeomagnetic samples were also taken from the site, but the loose, sandy composition of the soil did not allow for valid dates. No cultural features were present at Trojan Hill (LA 29362) to yield absolute dates; however, two nearby hearths produced dates of cal A.D. 1000-1055 within a 1-sigma range and an intercept date of A.D. 1025 and cal A.D. 1150-1245 in a 1-sigma range and an intercept date of A.D. 1195. However, these may or may not be associated with the occupation at Trojan Hill. The four pieces of ceramics on the extensively excavated site likely do not correlate with its use as a quarry source.

The radiocarbon dates for Macho Dunes indicate periodic reuse of the site area through time (Table 100). Today the environment is dunal; however, an abundance of mesquite, little-leaf sumac, and other desertic vegetation is more plentiful on the site than in surrounding areas and botanical analyses indicate it may have been like this through time. The Pecos River is also within easy walking distance (6 km), which may have been an additional factor in site selection. Reuse of site areas is not at all uncommon in southeastern New Mexico as seen in Figure 93. Eighty-three available regional radiocarbon dates were plotted for the specific periods that Macho Dunes was occupied. Besides Macho Dunes, several areas that exhibit consistent reoccupation through time include Brantley Reservoir (Gallagher and Bearden 1980; Katz and Katz 1985a), the WIPP site area (Lord and Reynolds 1985;

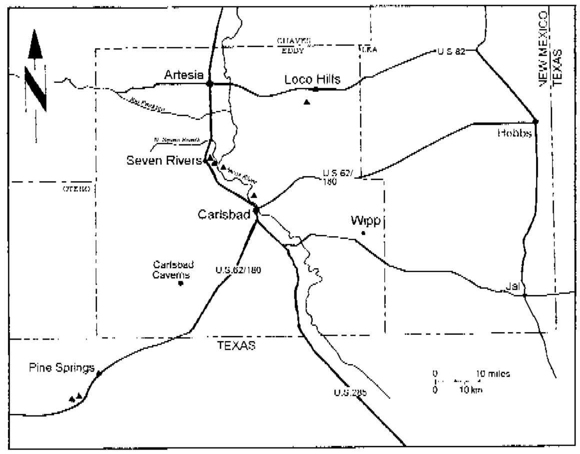


Figure 93a. Middle Archaic (3000-2100 B.C.) radiocarbon dates.

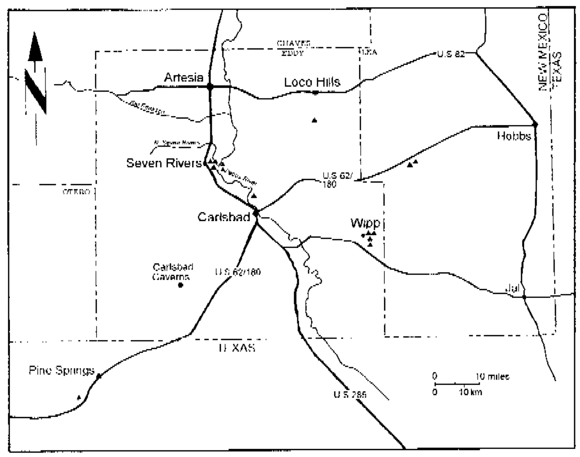


Figure 93b. Late Archaic (400-1 B.C.) radiocarbon dates.

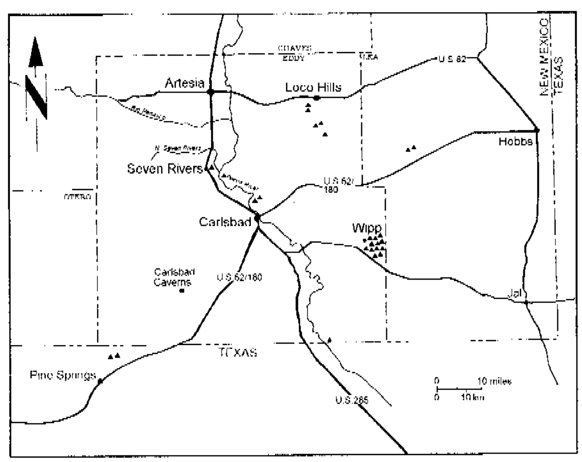


Figure 93c. Early Globe (A.D. 650-750) radiocarbon dates.

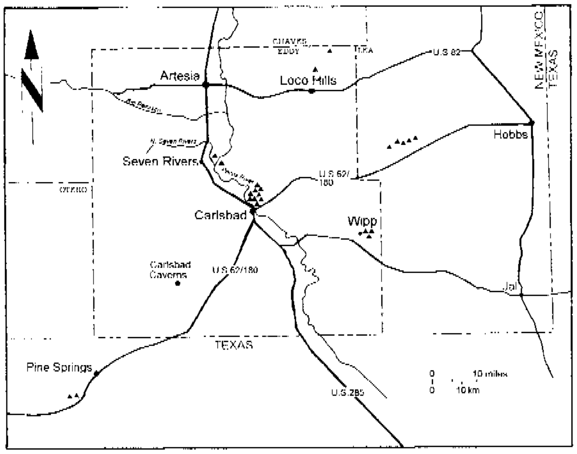


Figure 93d. Middle Globe (A.D. 750-800) radiocarbon dates.

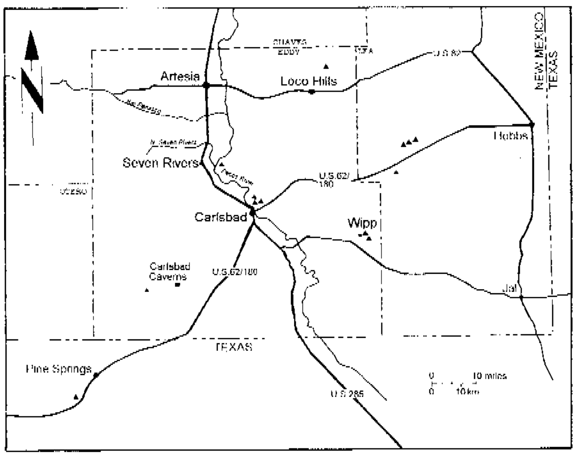


Figure 93e. Late Globe (A.D. 950-1000) radiocarbon dates.

Staley et al. 1996), the southern Guadalupe Mountains (Miller 1994), and the Loco Hills area (Oakes 1982, 1985).

While the number of dates are expectedly less for the Middle Archaic period between 3000 and 2200 B.C., occupation even at this time is spread throughout the Carlsbad Basin and surrounding areas (Fig. 93a-c). Katz and Katz (1993:113) previously suggested a gap in occupation between 3200 and 1700 B.C. but this seems to have been filled in by our data and that of others in the region. We can only speculate that the excavation of broader areas of sites will greatly increase the total of dated sites, including the Middle Archaic. Most dated sites in Figure 93c-e relate to the Early and Middle Globe phases but, because of the low sample size, may or may not correspond to actual population counts at that time.

Macho Dunes is an extensive site with discrete utilized surfaces spread out over the landscape. The radiocarbon dates come from many different locales on the site. The Middle Archaic date of cal 2570-1950 B.C. with an intercept date of 2280 B.C. is derived from Roasting Pit 31 in Area F. No ceramics were associated with this feature. A Late Archaic date of cal 235 B.C.- A.D. 75 with an intercept of 210 B.C. is from a single hearth at the wind-scoured crest of the site ridge in Area A. No other cultural features were nearby; however, an El Paso Brown and a South Pecos Brown sherd were found 10 m downslope to the north and south of the hearth, but presumably not associated.

Formative period sites usually are identified by having ceramics in correspondence. Hearth 51 in Area D and Thermal Pit 34 in Area F are the two earliest Formative period features on the site, dating between A.D. 650 and 720. They are located on opposite sides of the road and Hearth 51 has 5 El Paso Brown sherds within 5-6 m but their relationship to the hearth cannot be confirmed. Thermal Pit 34 is in a 77-sq-m area that contains 12 pits of various types including roasting pits, hearths, thermal pits of unknown use, and possible storage pits. In this area, 39 sherds were also recovered. Thirteen of these were within 4 of the pits. A contour plot was generated showing locations and area of concentration of the sherds (Fig. 94). The spatial patterning indicates no sherds can be directly associated with Thermal Pit 34, which dates to cal A.D. 660-760 (1-sigma deviation) with an intercept date of A.D. 670. Therefore, it does not appear that pottery was present on the site in the Early Formative period (Early Globe phase). A very mobile subsistence pattern is suggested for this time period at Macho Dunes with only Hearth 51 and Thermal Pit 34 present. It is actually possible that Late Archaic hunter-gatherer adaptations have persisted to this time on this particular site and these cultural features are not representative of the Formative period at all, but rather Late Archaic.

Table 99 suggests a hiatus of perhaps 100 years on the site between A.D. 660 and 750. However, between approximately A.D. 750 and A.D. 800, Macho Dunes experienced its greatest period of occupation. Nine C-14 dates from seven different cultural features were obtained. Five of these are from the four dated brush structures, suggesting an encampment of enough duration for occupants to have needed brush structures with hearths for shelter.

Brush Structure 1 in Area B is the earliest feature dated to the Middle Globe phase (A.D. 750-820) with an intercept date of A.D. 760 and a 1-sigma range of cal A.D. 680-790. Two other dates for this feature (Table 99) are from storage pits and not considered as reliable as hearth dates. One date overlaps the A.D. 760 date and the other is over 100 years later. Twelve ceramics are present within Structure 1; five brown

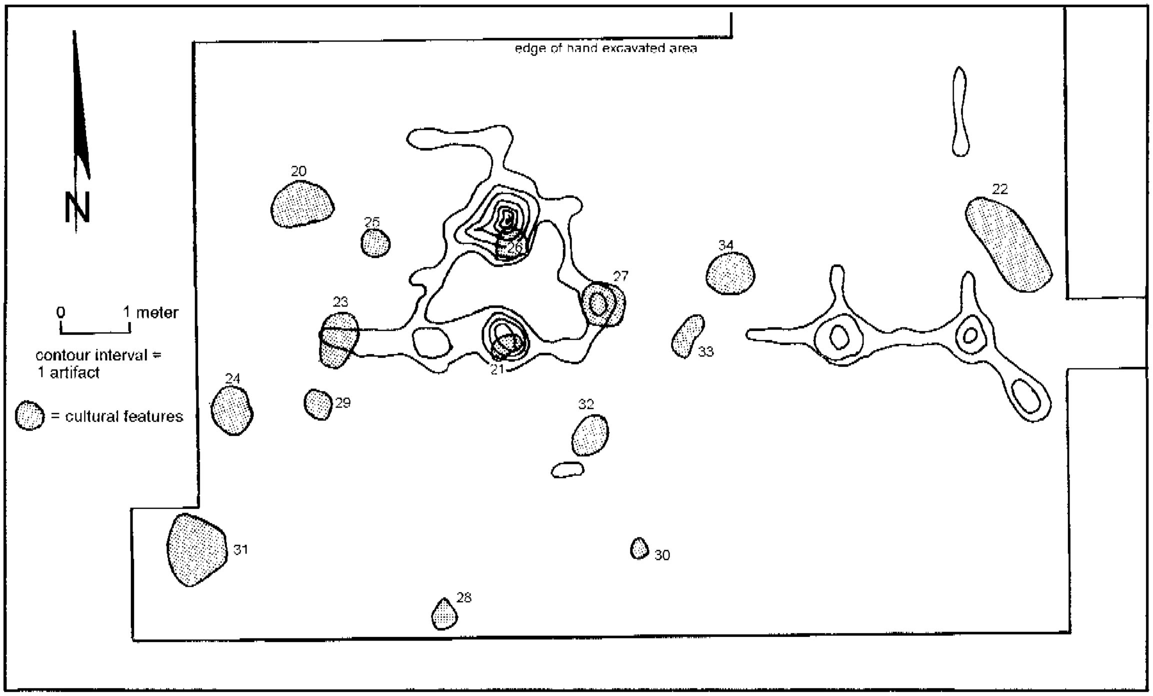
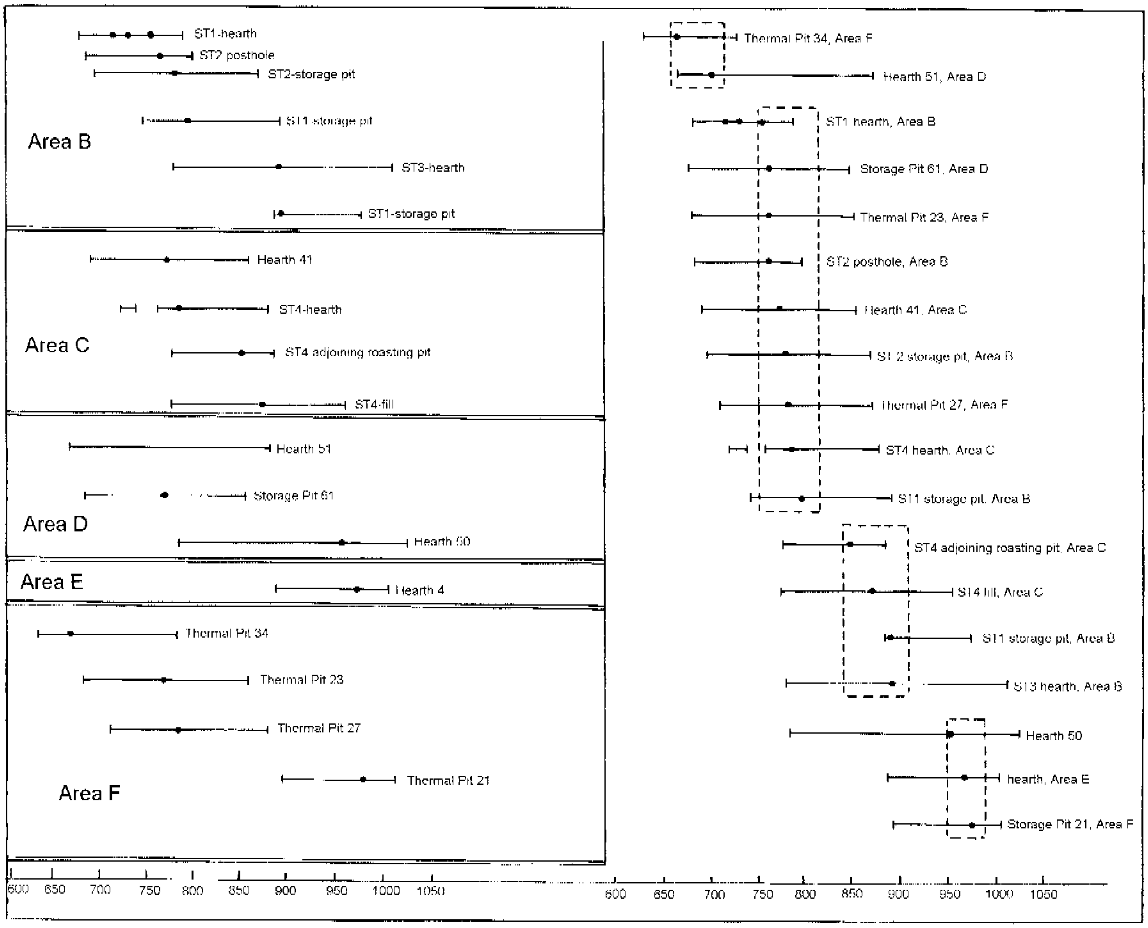


Figure 94. Cultural features in Area F with locations of ceramics plotted in one-frequency contours.

Table 99. C-14 Dates for Carlsbad Project

Area	Beta Number	Age B.P.	Calibrated 1-Sigma	Calibrated 2-Sigma	Intercept	Context
A	116523	2160±70	355-290 B.C. 230-75 B.C.	380 –5 B.C.	185 B.C.	Hearth
B	110984	1240±60	A.D. 695-880	A.D. 665-960	A.D. 785	Pit Structure 2 Storage Pit
B	110985	1150+60	A.D. 885-980	A.D. 770-1010	A.D. 890	Pit Structure 1 Storage Pit
B	110986	1220±80	A.D. 695-895	A.D. 660-995	A.D. 800	Pit Structure 1 Storage Pit
B	110988	1140±60	A.D. 775-1015	A.D. 865-985	A.D. 895	Pit Structure 3 Hearth
B	110989	1280±50	A.D. 680-790	A.D. 660-880	A.D. 720 A.D. 735 A.D. 760	Pit Structure 1 Hearth
B	110990	1287±50	A.D. 685-800	A.D. 665-885	A.D. 770	Pit Structure 2 Post hole
C	110987	1210+50	A.D. 775-885	A.D. 690-970	A.D. 855	Pit Structure 4 Roasting Pit
C	110995	1230±50	A.D. 720-735 A.D. 760-880	A.D. 680-905 A.D. 920-950	A.D. 790	Pit Structure 4 Hearth
C	110997	1260±50	A.D. 690-855	A.D. 665-885	A.D. 775	Hearth 41
D	110996	1270+60	A.D. 680-855	A.D. 655-890	A.D. 770	Storage Pit 61
D	111000	1290±70	A.D. 665-880	A.D. 640-890	A.D. 705	Hearth 51
D	111001	1120±130	A.D. 780-1025	A.D. 660-1205	A.D. 960	Pit 50
E	110992	1100+60	A.D. 885-1005	A.D. 800-1300	A.D. 975	Hearth
F	110991	1090±60	A.D. 890-1010	A.D. 885-1035	A.D. 980	Storage Pit 21
F	110993	1270±60	A.D. 680-855	A.D. 655-890	A.D. 770	Thermal Pit 23
F	110994	1240+50	A.D. 705-875	A.D. 675-895	A.D. 785	Thermal Pit 27
F	110998	3830±110	2575-1945 B.C.	2460-2165 B.C. 2065-2060 B.C.	2280 B.C.	Roasting Pit 31
F	110999	1350±100	A.D. 630-780	A.D. 540-890	A.D. 670	Thermal Pit 34

Table 100. Formative Period C-14 Dates Ordered by Area and by Time



ware types are represented. The nearby Brush Structure 2 also dates to this same phase at cal A.D. 685-870 with intercept dates at A.D. 770 and 785. Fourteen sherds of three different types were found in association. As a result of the relationship of sherds with these structures, we can conclude that by A.D. 760 at a minimum, ceramics were present at Macho Dunes.

In Area D, Pit 61 (possibly a small storage pit) is the only feature in the area of this time period at cal A.D. 680-850 with an intercept of A.D. 770. Five other pits and Brush Structure 5 are nearby, however. Only eight ceramics representing four brown ware types are present. No sherds are associated with Pit 61; most seem to correspond with the roasting pit directly to the northeast and with two other small pits. In Area F, two thermal pits (23 and 27) located 4 m apart date to this A.D. 750-800 time frame with intercept dates of A.D. 770 and 785. Both pits contained ceramics with a few sherds also scattered close by.

In Area C, two more cultural features are dated to A.D. 750-800, Hearth 41 and Brush Structure 4. Hearth 41 is isolated from habitation units and only 1 sherd was recovered at a 3-m distance. Brush Structure 4, approximately 15 m south of Hearth 41, contained 12 sherds of 4 different types. It has a date of cal A.D. 760-880 with an intercept at A.D. 790.

There is a slight gap in C-14 dates between A.D. 800 and 850. Four dates are subsequently reported between A.D. 850 and 800. Of these, three are rejected. They are from Structures 1 and 4 but were retrieved from fill, a storage pit, and an adjoining roasting pit. Radiocarbon data from better proveniences in these features suggest these two units are earlier than A.D. 800. However, there is only one C-14 date for Structure 3 in Area B, from a hearth, and it has an intercept date of A.D. 895 with a 1-sigma range of cal A.D. 780-1015. If this date is correct, there would have been a subsequent habitational occupation at this time period on the site, indicating repeated reuse of a specific living area on the site.

A minor post-A.D. 950 utilization of Macho Dunes is represented by three radiocarbon dates in Areas D, E, and F, all derived from small hearths or pits. In Area D, Hearth 50 has a post-A.D. 950 date of cal A.D. 780-

1025 with the intercept at A.D. 960. Hearth 50 is near Hearth 51 (with an earlier date and no ceramics) and also has no ceramics in the immediate vicinity. The hearth could easily have been interpreted as preceramic, if the C-14 date were lacking. In Area E, a single hearth was found on the crest of a low ridge. No sherds were in the area and without the radiocarbon date of cal A.D. 885 to 1005 and an intercept of A.D. 975, again, the hearth could have been thought to have been preceramic. In Area F, Pit 21 lies in a locale of multiple pits of various dates. This pit dates to cal A.D. 890-1010 with an intercept of A.D. 980. It did contain two different types of brown ware sherds.

In conclusion, the recovery of 20 radiocarbon dates from the multicomponent site of Macho Dunes is significant because a large number of samples were retrieved from what is often an unproductive environment. The implication that the various dates represent six different occupational periods from Middle Archaic to the Late Globe phase (2300 B.C. to A.D. 980) is also very important. The pattern of repeated occupation of a single locale is evident, not only at Macho Dunes, but in several other areas of southeastern New Mexico mentioned previously. It is now up to future research to ask why consistent reuse of some places occurred. What were the resources or reasons that drew people century after century to a particular place? This phenomenon may actually be more prevalent here than in other areas of New Mexico where two or maybe three different occupations overlap, but in the southeast, there often seems to be five or six separate reoccupations of a single area (Staley et al. 1996:256). Therefore, dating of numerous features on a site is an important consideration during excavations in order to isolate the various components potentially present.

The range of dates obtained allowed for a determination of when ceramics first appeared on the site, which was about A.D. 750. The minor occupation of Macho Dunes in the later A.D. 600s did not associate with any pottery. And the latest dates for the site, around A.D. 968, do not include any black-on-white or corrugated pottery. These findings are somewhat different than what is normally thought of as the extent of ceramic occupations in the region. Katz and Katz (1993) indicate ceramics may begin as early as A.D. 500 and black-on-white pottery can show up by A.D. 750. Neither of these expectations were true for Macho Dunes. Were site occupants so localized in their adaptations that trade with makers of black-on-white ceramics did not occur or were they basically still maintaining an Archaic lifestyle with only a minimum amount of pottery, as has been elsewhere suggested (Oakes 1982:46; Stuart and Gauthier 1983:268; Sebastian and Larralde 1989:92)?

SYNTHESIS
by
Dorothy A. Zamora

The main objective for data recovery at LA 29362 and LA 29363 along the Carlsbad Relief Route was to answer questions on settlement and subsistence behavior in the north end of the Trans-Pecos culture area and to place our sites within the cultural sequence outlined by Paul and Susana Katz (1985a).

LA 29362, Trojan Hill

During the testing phase, Trojan Hill was thought to have been an Archaic manifestation; however, the excavations provided evidence that the site is an extensive lithic procurement area. There is no evidence that the site was occupied by only one distinct group of people, but rather through lithic analyses, by different occupations through time.

Trojan Hill covers an extensive area and consists of lithic artifacts that suggest primary reduction and tool manufacturing activities. Not all of the site was collected; however, the sample recovered was substantial (N = 12,269 artifacts). There was a wide range of material being used. Chert (54.7 percent) and quartzite (39.7 percent) were the most commonly utilized material type. Core flakes (60.0 percent) dominate the assemblage, but there are all stages of manufacture. With such a large number of artifacts recovered, there is a relative small number of formal tools (.5 percent) in the assemblage, which includes utilized debitage (n = 51), hammerstones (n = 8), and core-hammerstones (n = 1).

The absence of hearths and storage pits made it very difficult to place the site into a specific time period or phase. The absence of these features did not permit us to collect samples for macrobotanical analysis, also the lack of fauna on the site leaves the question of subsistence and foraging pursued unanswered. As the site consists mostly of lithic debitage, there is no real evidence of when the site was utilized. Doleman (1992) states that if a site was used during the Archaic period, the artifact assemblage should reflect resource-specific procurement and processing activities. It does not seem as though the lithic artifact assemblage can dispute or agree with this statement. The assemblage is generally typical of all periods and phases of southeastern New Mexico.

There are, however, distinctions between the areas (A-C) of excavations. Area A contained most of the artifacts, which included the majority of the exotic materials and variety of reduction techniques. This area also contained most of the smaller thinning flakes and cores, suggesting that much of the production of flakes was taking place in this area. Area C, however, contained all local materials and did not have any utilized artifacts as found in the other areas, suggesting a limited activity regimen (Quaranta, this volume).

Four Playas Incised ceramics from the same vessel were recovered from one unit in Area A. Wilson (this volume) believes that this a isolated incident, a possible pot drop by people passing through. However, this is evidence that people were present on the site during A.D. 1400 to A.D. 1500s. Also, two hearths found near the site could possibly be associated with Trojan Hill and their dates place its occupation during the Formative period.

LA 29363, Macho Dunes

The purpose of data recovery at Macho Dunes was to investigate problems posed by the environment, such as the acquisition of subsistence items. These specific environmental variables in the Carlsbad region include (1) season of availability, (2) quantity of biomass, (3) accessibility of resources, and (4) density of participation population.

Specific questions relevant to the site are (1) site chronology, (2) site function, (3) subsistence, (4) site exchange or mobility, and (5) chronological comparisons with other sites in the area.

Site Chronology

Macho Dunes dates mostly to the Formative period, and was occupied between A.D. 670 and A.D. 950. However, two Middle Archaic components are present in Areas A and F. The Archaic date of 380 B.C. to 5 B.C., intercept date of 185 B.C in Area A is from a small hearth, which is located on top of a low rise and has been built into the outcropping bedrock. The other Archaic date was retrieved from Area F in a large, shallow roasting pit (31) dating 2460 B.C. to 2165 B.C. and 2065 B.C. to 2060 B.C. with an intercept date of 2280 B.C. It was isolated to the west away from the cluster of features under a sand dune. However, the dates from the radiocarbon samples suggests that Macho Dunes was most frequently used during the Globe phase, with minor activity both earlier and later.

Site Function

It appears clear that Macho Dunes was a seasonal camp used for gathering wild resources. Although each structure contained interior hearths, the fauna and ethnobotanical data suggest that the site was occupied during the late spring to early fall. It is possible that the weather may have been cool during these times, explaining the interior hearths in the structures.

The faunal remains recovered from the site was that of small rodent species. There was a lack of small to large mammals implying that the inhabitants were relying more on vegetal food gathering than on hunting.

The ceramics from Macho Dunes are all brown wares and their low frequency suggests they may be associated with groups who are fairly mobile and rely on wild food resources (Wilson and Blinman 1991). Mauldin et al. (1998) state that in the central Hueco Bolson, use of ceramics was to hold reconstituted stored grains and they were used in sites occupied during the winter and early spring months when stored food was in greater demand. A more sedentary group would produce more decorative pottery and textured vessels. Wilson (this volume) states that sedentary lifestyles result in an increased distinction of decoration, paste, and form between utility and painted wares, reflecting specialized activities. Wilson further states that these activities, such as boiling and serving corn, reflect the increase reliance on agriculture, where more mobile groups use general vessels such as plain brown wares. The ceramic assemblage exhibited attributes generally related to cooking (Wilson, this volume). There is no evidence of vessel production on the site. However, there has been evidence of pottery production in some areas of southeastern New Mexico (Hill 1996a).

The chipped stone assemblage implies that wild food gathering was being performed at Macho Dunes. Although there was a lack of formal tools, the tools (n = 4) recovered exhibited expedient use. One was a reworked chert projectile point with a concave base that has an Archaic-like appearance. The other is an chert end-side scraper. The projectile point seems to be evidence of curation. The tip was reworked and reused for other tasks besides hunting. The end-side scraper was probably used on vegetal items. Included in the formal tool category was a chopper probably used in cutting thick vegetation. None of the tools exhibited heavy use implying that they were being expediently used and then discarded.

The fair number of ground stone from the site included mostly fragmented manos and metates; however, the wear patterns on the surfaces exhibited circular striations, suggesting wild resources were being processed rather than corn. The number of ground stone artifacts indicates the site was a seasonal camp of some duration.

Subsistence

In the desert land in southeastern New Mexico, the vegetation is very sparse. Macho Dunes seems to be somewhat of an exception to that generality. Today the vegetation on the site consists of several species, including little-leaf sumac, one seed juniper, mesquite, four-wing saltbush, white thorn acacia, yucca, snakeweed, wait-a-bit, desert zinna, tansy aster, wooly white, dogwood, doveweed, buckwheat, nightshade, and African rue. The grasses present on the site are sideoats grama, muhly, bristle, sand dropseed, and sedge.

The flotation samples that were collected from features produced purslane, carpetweed, goosefoot, and dropseed grass. The most common fuel wood used was mesquite and juniper; however, there was minor use of Mexican crucillo and four-winged saltbush. None of these are domesticates, suggesting that only procurement of wild food resources was pursued on the site. Ethnobotanical samples also yielded no evidence of domesticates on the site.

The data from the fauna imply that food gathering, not hunding, was the main function on the site. The remains contained mostly small animals, of which 59.6 percent were rabbit and 29.8 percent rodent; the rest were indeterminate fragments. None of the bones exhibited burning and there is no evidence from the fauna that indicates animal processing.

Site Exchange and Mobility

At Trojan Hill, seven flakes of Tecovas chert were found. They all seemed to have come from the same artifact in Area A. It is possible that this material was curated by someone passing through. There is no evidence of tool manufacture or utilization of the Tecovas chert. A single flake of Tecovas chert was also recovered from Area D at Macho Dunes. These few occurrences would not suggest trade; however, it does mean that this material type was brought in from some other place, such as Texas, since it is not available in the area or in southeastern New Mexico. One other exotic material, a small piece of obsidian, was found on the site; however, because it was only one stone artifact it is likely that no significant trade or exchange was going on at the time the site was occupied.

Mobility is defined by Hitchcock (1982:258) as "the movement of the co-resident group, including both producers and dependent, from one location to another." Nonsedentary life is more broadly defined as a short-term residence in a number of locations (Whalen 1994a). Whalen also states that mobile people are perceived as gatherers that collect and cook food without the assistance of ceramic vessels and who live in small groups and maintain an egalitarian social culture.

Mobility patterns are being studied more and more by Southwestern archaeologists. Cordell and Plog (1979), for example, found that food production does not completely replace food collecting and mobility continues in some areas into the late prehistoric periods. Wills and Windes (1989) state that the Basketmaker III period in the San Juan Basin has basically a semi-agricultural adaptation, but relies heavily on wild resources. In the San Simon area of Arizona, Late Formative period sites are seasonally mobile occupations (Gilman 1986, 1991; Minnis and Wormser 1984). Lightfoot's (1984) excavations at the Duncan site, a Late Formative occupation, recovered ceramics, grinding implements, and various features; however, the analysis indicated a seasonal occupation. In the Palomas Drainage of West Texas and the south-central Rio Grande Valley in New Mexico, Nelson (1984) believes there was residential mobility during the Late Formative period in these desert regions.

It has been suggested that populations were highly mobile, moving in and out of their regions in seasonal rounds (Carmichael 1981, 1983; Lekson 1988). Hard (1983b), however, argues for a biseasonal round for some the Formative period. As Whalen (1994) points out "Formative period populations of the deserts of South-Central New Mexico and Western Texas relied heavily on mobility to cope with the region's harsh conditions."

At Macho Dunes it is evident that the site was not occupied year round, but seasonally. The ceramics present were brought in by site occupants, no ceramic production occurred on the site. The lithic artifacts were also transported, possibly from the nearby procurement site of Trojan Hill. The ground stone artifacts were small enough that they were probably portable implements and were carried from site to site until they were no longer functional and then discarded.

Several structural remains were found on the site along with both interior and exterior features. The shallowness of the structures would imply that the buildings were possibly hut-like and made of brush. There were only a few postholes present; however, rodent activity was very heavy. Structure 2 had an interior posthole almost in the center of the unit. In Area C, Structure 4 had three postholes, but they were clustered in the southwest corner (Fig. 36). In Area D, three postholes were found north of Structure 5. This area may have served as an exterior activity area with a ramada-type structure present.

The interior hearths found on the site would suggest that the site was occupied during the cold months; however, the outside thermal features in Areas A, D, E, and F would also suggest use during warmer weather. The fauna recovered indicate that the site was occupied during the late spring to late summer. The botanical data suggests summer to early fall. However, the multiple dated occupations of the site would allow for use during serveral different times of the year.

The lithic diversity index (LDI) for the site implies, at first glance, that Trojan Hill is more sedentary and less mobile (Quaranta, this volume). However, there are other considerations to be taken into account. If this is a quarry site where materials are being procured, then the diversity of the materials is not going to be great. Also, location of the site affects the results of the LDI, because material availability here is low and the materials with the best quality are going to be selected.

At Macho Dunes, the LDI is higher than at Trojan Hill. It would seem as though the LDI for Macho Dunes should have been lower. However, because this is a seasonal habitation, it is very difficult to use the LDI results, since all the materials were brought in from other sources. The structures and external storage and thermal pits would imply at least a seasonal habitation. These are not the types of features associated with long-term occupation. Whalen (1994a) associates cache pits with highly mobile people, large extamural pits with seasonally mobile groups and intramural storage rooms with sedentary people.

The small assemblage of cultigens recovered from Macho Dunes indicates that subsistence was based on gathered wild resources. Harsh environmental conditions also probably played a role in mobility strategies in the area (Whalen 1994a). Because of these conditions, productivity of desert seed-bearing plants is dependent on the rainfall pattern (Whalen 1994a) and people need to search out where these resources are available. This adaptation is not part of a sedentary lifestyle, but one of mobile people whose subsistence relies on food gathering. Johnson (1989) also states that mobility was the major strategy to cope with local difficulty or take advantage of distant opportunities.

Chronological Comparisons with Other Sites in the Area

There is not much excavation data from large sites in southeastern New Mexico. Work by Gallagher and Bearden (1980) and Katz and Katz (1985a) in the

Brantley Reservoir area produced sites ranging from the Middle Archaic to the historic Seven Rivers phase. The ceramics recovered consisted of mostly brown wares such as El Paso Brown, Jornada Brown, and South Pecos Brown. El Paso Polychrome, Chupadero Black-on-white, Gila Polychrome, Lincoln Black-on-red, Three Rivers Red-on-terracotta, Seco Corrugated, and Corona Corrugated made up a total of 15.0 percent of the ceramic assemblage. It seems as though the earlier type sites from the Brantley Reservoir project are also commonly found at Macho Dunes.

Oakes (1985) tested six sites located in a dunal environment in the Hackberry Lake area. The setting consisted of many hummocks and blowouts with high artifact density. However, the vegetation on the sites was very different. Instead of little-leaf sumac, mesquite, and one-seed juniper, the vegetation consisted of mostly shin oak and mesquite that were the main food resources for these sites. There was no evidence of shin oak past or present on Macho Dunes; however, mesquite was present and was being used for fuel wood.

The lithic artifacts from all of these sites consisted of mostly core flakes and angular debris. However, several tools were found such as scrapers, bifaces, choppers, hammerstones, and utilized cobbles. The most commonly used materials were chert, quartzite, and chalcedony.

The ground stone on regional sites consisted of one-hand manos and metates. The metates were mostly indeterminate fragments, but there were some slab and basin metates among the assemblage. All the grinding implements were made from sandstone.

Dates from 19 radiocarbon samples ranged from ca. 2280 B.C. to A.D. 980 with most falling between A.D. 700 to A.D. 900. Staley et al. (1996) had dates from 1015 to 780 B.C. to A.D. 1545 at the Mescalero Sands project located 52.3 km (32.5 miles) east of the project area. The majority of the ceramics were brown wares; however, there was a broad variety of painted wares corresponding to the C-14 dates. The lithic debitage consisted of mostly core flakes and shatter with a large number of bifaces. Like the material from Macho Dunes the predominant types were chert and quartzite. Tecovas and Edwards chert, although in small, quantities, were present on some of the sites. The ground stone consisted of slab and basin metates with many indeterminate metate fragments. The manos were all fragmented and were not placed into categories of one-hand or two-hand manos. Most of the grinding implements were sandstone, but there was also basalt, conglomerate, dolomite, and quartzite.

Conclusions

In comparing these sites with Macho Dunes it is not surprising that brown ware ceramics dominate the assemblages. There is more ceramic variety during the later time periods, as would be expected. The lithic artifacts on sites in the area consist mostly of chert and quartzite debitage; however, more formal tools were present on the WIPP sites tested by Oakes (1985) and the Mescalero Sands sites tested by Staley et al. (1996). Chalcedony was present in larger quantities at Hackberry Lake (Oakes 1985) and at the Mescalero Sands sites (Staley et al. 1996) than at Macho Dunes. Although chalcedony is available, it is a minor material type for Macho Dunes. Site habitants at other localities are using it more. It is evident that most lithic debitage is from local sources, with the exception of Edwards Plateau chert and Tecovas chert, which are nonlocal.

The ground stone from Macho Dunes consisted of mostly one-hand manos and basin metate fragments that exhibited circular striations. There were many indeterminate fragments with circular striations. At Hackberry Lake the ground stone consisted of one-hand manos and basin and slab metates. The majority of the artifacts were indeterminate. The Mescalero Sands sites contained mostly ground stone fragments, but there were metates identified as slab and basin. All the manos were fragmented and not placed into categories. Ground stone was made of sandstone at all the sites, except at the Mescalero Sands sites where other materials were present.

The grinding implements within the Carlsbad area seem to be all small fragments that have been used to their maximum potential. Because ground stone material is so scarce, they are used to a point where they are no longer usable. They are like exhausted cores, where flakes cannot be taken off of the parent material any further. When a mano becomes inoperable, it is sometimes used for another task, such as a sharpening tool for the metates. Some metates are recycled as manos and sometimes as hearth stones. Manos are also used as hearth stones.

In comparing Macho Dunes with other sites it seems as though it falls within the category of a temporary or seasonal camp. What makes LA 29363 so different is the fact that shallow brush structure remains are present. There are recorded sites in the region that contain hearths, storage pits, and roasting pits; however, none have recorded structures, except for the Brantley Reservoir project.

Each structure contains an interior hearth with several pits. Postholes are present, but are scarce, making it difficult to find any patterning. But why are there interior hearths in the structures that are supposed to be occupied during the late spring to early fall? There could be several scenarios. Perhaps the climate was much cooler during the Globe phase than it is today, or maybe the structures were protection from the stifling heat that is common today. It is likely that the site was occupied at different times of the year by different peoples. It may have served as a camping spot by people passing through throughout the year and also served as a place where wild food resources were collected during the late summer and early fall months.

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APPENDIX 1. ANALYSIS CODING FORMS

Ceramic Analysis Attribute and Variable Codes
Carlsbad Relief Route Project

Site Number

Site number is recorded on the upper right corner of analysis form.

F.S. Number

Point Provenience Number

Lot Number

Consecutive numbers are assigned to lines within an F.S. group. This number links data line with ceramics.

Temper

Identification based on microscopic examination.

0	Not examined
2	Indeterminate
3	None
4	Medium small to relatively large angular white to light gray and occasional clear angular igneous quartzite and feldspar fragments (leucocratic igneous or granite) along with rare small black fragments within or outside lighter fragments.
5	Very small sugary white temper that may be clear, dull white, or black, and larger fragments tend to be very crystalline or sugary in appearance.
6	Dominated by relatively large, angular white fragments along with large round clear fragments.
7	Medium sub-angular to sub-rounded white, gray, and reddish fragments of about the same size. May still be variation of leucocratic rock.
8	Dominated by medium sized clear sand rounded grains along with angular white fragments.
9	Dark angular, sherd or rock (Chupadero Black-on-white temper)
10	Light sherd
11	Schist
12	Large angular white and possible schist
13	Large gray feldspars

Ceramic Type

Jornada Mogollon Brown Wares

2101	Jornada Plain Brown Body
2102	Jornada Plain Brown Rim
2103	Very thin polished unpainted, similar to sherds described having derived from El Paso Polychrome
2104	Brown Ware with smudged interior
2202	Red Slipped Brown
2207	Three River R/T
2302	Chupadero B/W (solid designs and side lines)
2303	Chupadero B/W (hatchured
2304	Chupardero solid and hatchured
2305	Chupadero B/W Indeterminate design
2310	Unpainted probably from Chupadero B/W
3103	Indeterminate Non-local Textured (possibly plains, possibly Corona
4102	Corona Corrugated

Wiseman Brown Ware Categories

1	Jornada
2	El Paso
3	South Pecos
4	Jornada South Pecos
5	McKenzie
6	El Paso Polychrome

Paste Color (Recorded for interior and exterior surfaces)

1	Dark gray to black cross section but oxidized on one surface
2	Dark gray to black cross section
3	Brown or reddish throughout
4	Oxidized red or brown on outside dark gray or black on outside
5	Red and gray streaks
6	White to light gray
7	White and dark streaks

Pigment (Recorded for interior and exterior surfaces)

1 None
2 Mineral black
3 Mineral red
5 Organic
6 White clay
7 Mineral and white clay
8 Indeterminate

Manipulation (Recorded for interior and exterior surfaces)

1 Plain unpolished
2 Plain slightly polished or smoothed
3 Plain heavily polished
4 Plain unpolished with striations
5 Surface missing
6 Surface worn
7 Indeterminate textured
8 Indented Corrugated

Slip (Recorded for interior and exterior surfaces)

1 None
2 Red slip
3 Smudged
4 White slip

Form

1 Indeterminate body polished both sides
2 Bowl rim
3 Bowl body as determined by a much higher degree of polishing or paint on the interior surfaces.
4 Jar body
5 Cooking/Storage jar rim
6 Cooking/Storage jar neck
10 Indeterminate
11 Seed Jar Rim
12 Indeterminate due to missing surface
13 Indeterminate handle

Modification

1 None
2 Indeterminate
3 Drilled hole
4 Reshaped vessel based on modified rim
10 Sooted both sides
11 Sooted interior
12 Sooted exterior
13 Naturally worn and shaped
14 Both sides sooted

Sherd Count

Sherd Weight

Vessel Number

Rim Radius

In mm

Comments

LITHIC ANALYSIS ATTRIBUTES AND VARIABLE CODES
CARLSBAD RELIEF ROUTE PROJECT

Material Type

000	unknown
001	chert, undiff.
002	Pedernal chert
003	Tecolote chert
004	Washington Pass chert
005	Brushy Basin chert
006	Baldy Hill chert
007	Alibates chert
008	Tecovas chert
009	clastic chert
010	San Andres chert
011	Santa Fe chert
012	Hueco chert
080	chalcedony, undiff.
100	silicified wood, undiff.
101	Zuni wood
200	obsidian
201	Jemez, generic
202	Polvadera Peak
203	Grants Ridge
204	Red Hill
205	Antelope Wells
206	Mule Creek
300	igneous, undiff.
310	nonvesicular basalt
320	vesicular basalt
330	granite
340	rhyolite
342	andesite
400	sedimentary, undiff.
410	limestone
420	sandstone
430	siltstone
440	mudstone
450	shale
500	metamorphic, undiff.
510	quartzite, undiff.
530	quartzitic sandstone
540	schist
541	serpentine
542	micaceous schist
600	mineral, undiff.
610	turquoise
620	azurite
621	malachite
630	quartz crystal
631	massive quartz
632	mica
633	gypsum
634	calcite
635	selenite
640	galena
641	hematite
650	coal
651	jet
660	fossil, undiff.
661	crinoid stem
670	concretion, undiff.
671	concretion, sandstone
672	concretion, hematite
999	other

Material Texture and Quality

1	glassy
2	glassy and flawed
3	fine-grained
4	fine-grained and flawed
5	medium-grained
6	medium-grained and flawed
7	coarse-grained
8	coarse-grained and flawed

Artifact Morphology Categories

00	indeterminate
01	angular debris
02	core flake
03	biface flake
04	resharpening flake
05	notching flake
06	bipolar flake
07	blade
08	hammerstone flake
09	channel flake
10	potlid
11	strike-a-light flake
20	tested cobble
21	core, undiff.
22	unidirectional core
23	bidirectional core
24	multidirectional core
25	pyramidal core
30	cobble tool, undiff.
31	cobble tool, unidirectional
32	cobble tool, bidirectional

40 uniface, undiff.
41 uniface, early stage
42 uniface, middle stage
43 uniface, late stage
50 biface, undiff.
51 biface, early stage
52 biface, middle stage
53 biface, late stage
90 reworked tool, undiff.
91 reworked early-stage uniface
92 reworked middle-stage uniface
93 reworked late-stage uniface
94 reworked early-stage biface
95 reworked middle-stage biface
96 reworked late-stage biface
100 unworked cobble

Artifact Functional Categories

001 utilized debitage
002 retouched debitage
003 utilized/retouched debitage
004 flake tool
010 hammerstone
011 chopper
012 plane
013 axe
014 pecking stone
015 hoe
016 maul
017 tchamahia
050 drill
051 graver
052 spokeshave (notch)
053 denticulate
075 core-chopper
076 scraper-graver
077 chopper-hammerstone
078 core-hammerstone
080 strike-a-light fling
081 gun flint
090 unutilized angular debris
091 unutilized flake
092 unutilized core
093 unutilized cobble tool
100 uniface, undifferentiated
101 end scraper
102 side scraper
103 end/side scraper
104 thumbnail scraper
150 biface, undifferentiated
151 knife
152 Cody knife
200 unidentified projectile point
201 unidentified large projectile point
202 unidentified small projectile point
203 unidentified stemmed projectile point
204 unidentified large stemmed projectile point
205 unidentified small stemmed projectile point
206 unidentified corner-notched projectile point
207 unidentified large corner-notched projectile point
208 unidentified small corner-notched projectile point
209 unidentified side-notched projectile point
210 unidentified large side-notched projectile point
211 unidentified small side-notched projectile point
212 unidentified fluted point
220 unidentified Paleoindian projectile point
221 Clovis point
222 Folsom point
223 Midland point
224 Plainview point
225 Firstview point
226 Jimmy Allen point
227 Meserve point
228 Agate Basin point
229 Hell Gap point
230 Belen point
231 Milnesand point
232 Eden point
233 Scottsbluff I point
234 Scottsbluff II point
235 Frederick point
300 unidentified Archaic projectile point
301 Jay point
302 Bajada point
303 San Jose point
304 Armijo point
305 En Medio (Basketmaker II) point
306 Chiricahua point
307 San Pedro point
308 Augustin point
309 Pelona point
400 Basketmaker III point
401 Pueblo side-notched point
402 Mogollon side-notched point
500 Athabaskan side-notched point
600 eccentric
601 three side noches
900 fire-cracked rock

Dorsal Cortex

Estimate in 10 intervals

Flake Platform Type

00	not applicable
01	cortical
02	cortical and abraded
03	single facet
04	single facet and abraded
05	multifacet
06	multifacet and abraded
07	retouched
08	retouched and abraded
09	abraded
10	collapsed
11	crushed
12	absent

Portion

0	indeterminate fragment
1	whole
2	proximal
3	medial
4	distal
5	lateral
6	collapsed platform

Dimensions

length by width by thickness, weight, or both

Cortex Type

0	not applicable
1	waterworn
2	nonwaterworn
3	indeterminate

Platform Lipping

0	not applicable
1	present
2	none present

Wear Patterns

00	not applicable
01	unidirectional utilization
02	bidirectional utilization
03	unidirectional retouch
04	bidirectional retouch
05	rounding
06	rounding and 01
07	rounding and 02
08	rounding and 03
09	rounding and 04
10	noncultural edge damage
11	birdirectional retouch and abrasion
12	battering
13	rotary
14	unidirectional retouch and wear
15	unidirectional retouch and battering
16	bidirectional retouch and battering
17	bidirectional retouch and wear
18	abraded for platform preparation
19	abrasion
20	unidirectional wear and working edge abraded
21	serrated denticulate
22	unidirectional retouch and bidirectional wear
23	bidirectional wear and working edge abraded
24	bidirectional retouch and unidirectional wear
25	unidirectional retouch and abrasion
50	biface edge
51	uniface edge
52	projectile point blade edge
53	projectile point base edge
54	drill shaft edge
55	biface edge, abraded for platform preparation
56	hopper edge
57	strike-a-light flint edge
58	gunflint edge

Thermal Alteration

00	not applicable
01	potlids, ventral surface
02	potlids, dorsal surface
03	potlids, other surface
04	crazed
05	crazed and 01
06	crazed and 02
07	crazed and 03
08	crazed and 04
09	potlids, ventral and dorsal surfaces
10	potlids
11	color change

Distal Termination

0	not applicable
1	feather
2	hinge
3	step
4	absent, snap fracture
5	obscured, cultural alteration
6	obscured, noncultural alteration
7	broken in manufacture

8	outrepassé
9	axial
10	plunging

Edge Angle

in 1 degree increments

Edge Shape

00	not applicable
01	concave
02	convex
03	concave-convex
04	straight
05	serrated
06	projections
07	irregular
08	semiregular
09	regular

GROUND STONE ANALYSIS ATTRIBUTES AND VARIABLE CODES
CARLSBAD RELIEF ROUTE PROJECT

Material Type

000	unknown
001	chert
100	silicified wood
200	obsidian
300	igneous undifferentiated
310	nonvesicular basalt
320	vesicular basalt
330	granite
340	rhyolite
400	sedimentary undifferentiated
410	limestone
420	sandstone
430	siltstone
440	mudstone
450	shale
500	metamorphic undifferentiated
510	quartzite undifferentiated
530	quartzitic sandstone
540	schist
541	serpentine
600	mineral undifferentiated
610	turquoise
620	azurite
621	malachite
630	quartz crystal
631	massive quartz
632	mica
633	gypsum
634	calcite
635	selenite
640	galena
641	hematite
650	coal
651	jet
660	fossil undifferentiated
661	crinoid stem
670	concretion undifferentiated
671	concretion, sandstone
672	concretion, hematite
999	other

Material Texture and Quality

1	glassy
2	fine-grained
3	medium-grained
4	large-grained

Preform Morphology

0	indeterminate
1	rounded cobble
2	core
3	chunky and angular
4	flattened cobble
5	slab, not further specified
6	slab, thick (10 cm+)
7	slab, thin (5-10cm)
8	slab, very thin (<5 cm)

Production Input

0	indeterminate
1	none (natural form)
2	slightly modified (< 50percent area)
3	mostly modified (50-99percent)
4	fully shaped

Shaping

0	indeterminate
1	none
2	grinding
3	flaking
4	pecking
5	grinding and flaking
6	grinding , flaking, pecking
7	flaking and pecking
8	grinding and pecking
9	other
10	incised

Weight or Dimensions

Dimension Complete?

0	no
1	yes

Ground Surface Measurement

Mano Cross Section Form

0	indeterminate
1	biconvex
2	convex-concave
3	dome, one flat side
4	subrectangular

5	square or rectangular
6	wedge
7	loaf
8	irregular, one flat side
9	irregular, one concave side
10	irregular, one convex side
11	diamond
12	triangle
13	airfoil
14	trapezoidal

Metate Depth

Plan View Outline Form

0	indeterminate
1	circular
2	oval
3	subrectangular
4	irregular
5	square
6	rectangular
7	subtriangular
8	wedge
9	other regular form

Photo/Illustrate

0	no
1	yes

Flaked Surface or Margin Present

0	no
1	yes

Heat

0	indeterminate
1	none
2	reddened
3	fractured
4	crazed
5	2, 3
6	2, 4
7	3, 4
8	2, 3, 4
9	other
10	blackened

Use Number

Portion

0	indeterminate
1	whole
2	end fragment
3	medial fragment
4	edge fragment
5	internal fragment
6	corner
7	corn(s) only missing

Function

000	indeterminate fragment
001	indeterminate
002	polishing stone, pottery
003	polishing stone, plaster
004	abrading stone
005	shaft straightener
006	shaped slab
007	jar cover
011	anvil
012	pounding stone
013	palette
014	lapidary stone
015	mortar
016	comal
020	hammerstone
030	mano
031	one-hand mano
040	two-hand mano
041	two-hand mano, trough
042	two-hand mano, slab
043	two-hand mano, loaf-shaped
050	metate
051	metate, basin
052	metate, trough
053	trough, ends open
054	trough, ends closed
055	trough, one end open
056	metate, slab
060	maul
061	maul, notched
062	maul, grooved
067	mining tool
070	axe
071	axe, notched, 1
072	axe, notched, 2
073	axe, notche, 3
074	axe, chipped, notched
075	axe, grooved
076	axe, ¾ grooved
077	axe, grooved, full
078	axe, grooved, spiral
080	hoe
081	hoe, notched

082	hoe, grooved
083	tchamahia
090	cylindrical tool
091	pestle
092	paint stone
100	ornament
101	pendant
102	bead
103	pipe
111	cloudblower
120	concretions, crystals, and minerals

Ground Surface Cross Section

0	indeterminate
1	flat
2	concave
3	convex
4	grooved
5	irregular
6	faceted
7	other

Ground Surface Sharpening

0	no
1	yes

Ground Surface Texture

0	not applicable
1	indeterminate
2	coarse
3	moderate
4	fine
5	polished

Primary Wear

0	indeterminate
1	none
2	striations
3	pitting
4	edge damage
5	bevelling
6	battering
7	polishing
8	grooving
9	grinding
10	other

Secondary Wear
(Codes follow primary wear)

Alterations

0	indeterminate
1	none
2	drilled
3	incised
4	grooved
5	notched
6	2, 3
7	2, 3, 4
8	2, 3, 4, 5
9	2, 4
10	2, 4, 5
11	2, 5
12	3, 4
13	3, 4, 5
14	3, 5
15	4, 5

Adhesions

0	indeterminate
1	none
2	pigment stains
3	inorganic, other
4	gum or pitch
5	organic, other

Striation

0	none
1	length
2	width
3	circular
4	random
5	1, 2
6	indeterminate
7	transverse (axes)

FAUNAL ANALYSIS ATTRIBUTES AND VARIABLE CODES
CARLSBAD RELIEF ROUTE PROJECT

Certainty (record only if uncertain)

1	fairly certain
2	less certain

Taxon

Unknowns

1	unknown small
2	unknown
3	small mammal/med – lrg bird
5	unknown mammal
10	small mammal
15	small to medium mammal
18	medium mammal
20	medium to large mammal
30	large mammal (sheep to deer size)

Mammalia Mammals

35	very large mammal (larger than deer)
40	**Marsupialia (marsupials)**
41	*Didelphis virginiana* (Virginia opossum)
50	Insectivora (insectivores)
51	Soricidae (shrew family)
52	*Sorex cinereus* (masked shrew)
53	*Sorex vagrans* (vagrant shrew)
54	*Sorex nanus* (dwarf shrew)
55	*Sorex merriami* (Merriam's shrew)
56	*Sorex pulustris* (water shrew)
57	*Notiosoex crawfordi* (desert shrew)
60	**Chiropteria (bats)**
61	Phyllostomatidae
62	*Choeronycteris mexicana* (long tongued bat)
63	*Leptonycteris sanborni* (Sanborn's long-nosed bat)
64	Vespertilionidae
65	*Myotis velifer* (cave bat)
66	*Myotis yumanensis* (Yuma myotis)
67	*Myotis lucifugus* (little brown myotis)
68	*Myotis auriculus* (southwestern myotis)
69	*Myotis evotis* (long-eared myotis)
70	*Myotis thysanodes* (fringed myotis)
71	*Myotis volans* (long-legged myotis)
72	*Myotis californicus* (Calif. myotis)
73	*Myotis leibii* (small-footed myotis)
74	*Lasionycteris noctivagans* (silver haired bat)
75	*Pipistrellus hesperus* (western pipistrelle)
76	*Eptesicus fucus* (big brown bat)
77	*Laisurus borealis* (red bat)
78	*Lasiurus cinereus* (hoary bat)
79	*Lasiurus ega* (southern yellow bat)
80	*Euderma maculatum* (spotted bat)
81	*Idionycteris phyllotis* (Allen's big eared bat)
82	*Plecotus townsendii* (Townsend's big eared bat)
83	*Antrozous pallidus* (pallid bat)
84	Mollossidae (Molossid bats)
85	*Tadaria brasilinensis* (Brazilian free-tailed bat)
86	*Tadarida femorosacca* (pocketed free tailed bat)
87	*Tadarida macrotis* (big free tailed bat)
88	*Eumops perotis* (western mastiff bat)
90	**Dasypodidae (armadillos)**
91	*Dasypus novemcinctus* (nine-banded armadillo)

Rodentia (rodents)

100	Sciuridae
101	small Sciuridae (small squirrel)
102	large Sciurdae (large squirrel or prairie dog)
103	*Eutamias minimus* (least chipmunk)
104	*Eutamias dorsalis* (cliff chipmunk)
105	*Eutamias quadrivittatus* (Colorado chipmunk)
106	*Eutamias cinereicollis* (gray collared chipmunk)
107	*Eutamias canipes* (gray-footed chipmunk)
108	*Marmota flaviventris* (yellow-bellied marmot)
110	*Ammospermophilis leucurus* (white-tailed antelope squirrel)
111	*Spermophilus sp.* (ground squirrels)
112	*Spermophilus tridecemlineatus* (thirteen-lined ground squirrels)
113	*Spermophilis mexicanus* (Mexican ground squirrel)
114	*Spermophilis spilosoma* (spotted ground squirrel)
115	*Spermophilis variegatus* (rock squirrel)
116	*Spermophilus lateralis* (golden mantled ground squirrel)
117	*Cynomys sp.*
118	*Cynomys ludovicianus* (black-tailed prairie dog)
119	*Cynomys gunnisoni* (Gunnison's prairie dog)

120 *Sciurus sp.* (tree squirrels)
121 *Sciurus aberti* (Abert's squirrel)
122 *Sciurus niger* (fox squirrel)
123 *Sciurus arizonensis* (Arizona gray squirrel)
124 *Tamiasciurus hudsonicus* (red squirrel)
125 Geomyidae (pocket gophers)
126 *Thomomys umbrinus* (southern pocket gopher)
127 *Thomomys bottae* (Botta's pocket gopher)
128 *Thomomys talpoides* (northern pocket gopher)
129 *Geomys bursarius* (plains pocket gopher)
130 *Geomys arenarius* (desert pocket gopher)
131 *Pappogeomys castanops* (yellow-faced pocket gopher)
132 *Perognathus sp.* (pocket mice)
133 *Perognathus flavus* (silky pocket mouse)
134 *Perognathus flavescens* (plains pocket mouse)
135 *Perognathus hispidus* (hispid pocket mouse)
136 *Perognathus intermedius* (rock pocket mouse)
137 *Perognathus penicillatus* (desert pocket mouse)
138 *Perognathus baileyi* (Bailey's pocket mouse)
139 *Perognathus nelsoni* (Nelson's pocket mouse)
140 *Dipodomys ordii* (Ord's kangaroo rat)
141 *Dipodomys spectabilis* (banner-tailed kangaroo rat)
142 *Dipodomys merriami* (Merriam's kangaroo rat)
143 *Castor canadensis* (beaver)
144 Cricetidae
145 *Reithrodontomys sp.* (harvest mice)
146 *Reithrodontomys montanus* (plains) or fulvescens (fluvous)
147 *Reithrodontomys megalotis* (western harvest mouse)
148 *Peromyscus sp.*
149 *Peromyscus crinitis* (canyon mouse)
150 *Peromuscus eremicus* (cactus mouse)
151 *Peromyscus maniculatus* (deer mouse)
152 *Peromyscus leucopus* (white-footed mouse)
153 *Peromyscus boylii* (brush mouse)
154 *Peromyscus pectoralis* (whte-ankled mouse)
155 *Peromyscus truei* (pinon mouse)
156 *Peromyscus difficilis* (rock mouse)
157 *Baiomys taylori* (norhtern pygmy mouse)
158 *Onychomys leucogaster* (northern grasshopper mouse)
159 *Onychomys torridus* (southern grasshopper mouse)
160 *Sigmodon hispidus* (hispid cotton rat)
161 *Sigmodon fulviventer* (tawny-bellied cotton rat)
162 *Sigmodon ochrognathus* (yellow-nosed cotton rat)
163 *Neotoma sp.* woodrats
164 *Neotoma micropus* (southern plains woodrat)
165 *Neotoma albigula* (white-throated woodrat)
166 *Neotoma stephensi* (Steven's woodrat)
167 *Neotoma mexicana* (Mexican woodrat)
168 *Neotoma cinerea* (bushy-tailed woodrat)
169 *Clethrionomys gapperi* (southern red-backed vole)
170 *Phenacomys intermedius* (heather vole)
171 *Microtis sp.*
172 *Microtis pennsylvanicus* (meadow vole)
173 *Microtis montanus* (montane vole)
175 *Microtis mexicanus* (Mexican vole)
176 *Microtis longicaudus* (Long-tailed vole)
177 *Microtis ochrogaster* (prairie vole)
178 *Ondatra zibethicus* (muskrat)
179 *Muridae* (old world rats and mice)
180 *Rattus rattus* (black rat)
181 *Rattus norvegicus* (Norway rat)
182 *Mus musculs* (house mouse)
183 *Zapus princeps* (western jumping mouse)
184 *Erethizon dorsatum* (porcupine)
185 *Myocastor coypus* (nutria -not native to North America)
187 small rodent
188 medium to large rodent

190 **Lagomorpha (lagomorphs)**
191 *Ochotona princeps* (pika)
200 Leporidae (hares and rabbits)
201 *Sylvilagus sp.* (cottontails)
202 *Lepus sp.* (jack rabbits)
203 *Sylvilagus floridanus* (eastern cottontail)
204 *Sylvilagus nuttallii* (Nuttall's cottontail)
205 *Sylvilagus audubonii* (desert cottontail)
206 *Lepus americanus* (snowshoe hare)
207 *Lepus townsendii* (white-tailed jack rabbit)
208 *Lepus californicus* (black-tailed jack rabbit)
209 *Lepus callotis* (white-sided jack rabbit)

300 **Carnivora (carnivores)**
301 small carnivore (weasel to skunk)
302 medium carnivore (badger to canid)
303 large carnivore (wolf to bear)
310 Canidae

311 *Canis sp.*
312 *Canis latrans* (coyote)
313 *Canis familiaris* (dog)
314 *Canis lupus* (gray wolf)
315 *Vulpes vulpes* (red fox)
316 *Vulpes velox* (swift fox)
317 *Vulpes macrotis* (kit fox)
318 *Urocyon cinereoargenteus* (gray fox)
319 small canid (fox)
320 Ursidae (bears)
321 *Urdus americanus* (black bear)
322 *Ursus arctos* (grizzly bear)
328 Procyonidae (racoon, ringtail, coati)
329 *Bassariscus* astutus (ringtail)
330 *Procyon lotor* (racoon)
331 *Nasua nasua* (coati)
333 *Martes americana* (marten)
334 *Mustela erminea* (ermine)
335 *Mustela frenata* (long-tailed weasel)
336 *Mustela nigripes* (black-footed ferret)
337 *Mustela vison* (mink)
339 *Gulo gulo* (wolverine)
340 *Taxidea taxus* (badger)
350 skunk sp.
351 *Spilogale gracilis* (western) or *putorius* (eastern spotted skunk)
352 *Mephitis mephitis* (striped skunk)
353 *Mephitis macroura* (hooded skunk)
354 *Conepatus mesoleucus* (hog-nosed skunk)
360 *Lutra canadensis* (river otter)
370 Felidae
371 *Felis concolor* (mountain lion)
372 *Felis rufus* (bobcat)
373 *Felis onca* (jaguar)
374 *Felis domesticus* (domestic cat)
400 **Artiodactyla (artiodactyla)**
401 small artiodactyl (domestic sheep to white-tailed deer size)
402 small-medium artiodactyl (deer, pronghorn, mountain sheep size)
403 large artiodactyl (elk or bison size)
404 *Dicotyles tajacu* (collared peccary)
405 small to medium artiodactyl
408 Cervidae
409 *Cervus elaphus* (elk)
410 *Odocoileus sp.*
411 *Odocoileus hemionus* (mule deer)
412 *Odocoileus virginianus* (white-tailed deer)
420 *Antilocapra americana* (pronghorn)
438 Bovidae
439 *Bos tarus* (cattle)
440 *Ovis canadensis* (mountain sheep)
450 *Bison bison* (bison)
451 *Bos/Bison*
470 *Ovis aires* (domestic sheep)
471 *Ovis/Capra* (domestic sheep or goat)
472 *Capra hircus* (domestic goat)
475 *Sus scrofa* (domestic pig)
480 *Equus sp.*
481 *Equus asinus* (burro)
482 *Equus caballus* (horse)

Aves (birds)
487 small bird
488 medium bird
489 large bird
490 medium to large bird
491 very large bird
500 Aves

Gaviiformes (loons)
501 Gaviidae (loons)
502 *Gavia immer* (common loon)

Podicipediformes (grebes)
503 Podicipedidae (grebes)
504 *Podicepes sp.* (common grebes)

Pelicaniformes (pelicans and allies)
509 *Pelicanus erythrorhynochos* (white pelican)
510 *Phalacrocrorax auritus* (double-crested cormorant)

Ciconiiformes (herons, storks, and allies)
511 Ardeidae (herons and bitterns)
512 *Ardea herodias* (great blue heron)
513 *Butorides virecens* (green heron)
514 *Casmerodius albus* (common egret)
515 *Leucophoyx thula* (snowy egret)
516 *Nycticorax nycticorax* (black-crowned night heron)
517 *Ixobrychus exilis* (least bittern)
518 *Botaurus lentiginosus* (American bittern)
519 Ciconiidae (storks and wood ibises)

Anseriformes (swans, geese and ducks)
522 *Olor sp.* (swans)
524 *Branta canadensis* (Canada goose)
525 *Anser albifrons* (white-fronted goose)
526 *Chen hyperborea* (snow) or caerulescens (blue goose)
527 ducks
528 *Dendeocygna bicolor* (fulvous tree duck)
529 Anatinae (surface-feeding ducks)
530 *Anas sp.*
531 *Anas platyrhynchos* (mallard)
532 *Anas diazi* (Mexican duck)
533 *Anas strepera* (gadwall)

534 *Anas acuta* (pintail)
535 *Anas carolinensis* (green-winged teal)
536 *Anas discors* (blue-winged teal)
537 *Anas cyanoptera* (cinnamon teal)
538 *Mareca americana* (American widgeon)
539 *Spatula clypeata* (shoveler)
540 *Aix sponsa* (wood duck)
541 *Aythyinae* (diving ducks)
542 *Aythya americana* (redhead)
543 *Aythya collaris* (ring-necked duck)
544 *Aythya valisineria* (canvasback)
545 *Aythya marila* (greater scaup)
546 *Aythya affinis* (lesser scaup)
547 *Bucephala calangula* (goldeneye)
548 *Bucephala albeola* (bufflehead)
549 *Melanitta deglandi* (white-winged scooter)
550 *Oxyura jamaicensis* (ruddy duck)
551 *Lophodytes cucullatus* (hooded duck)
552 *Mergus merganser* (common merganser)
553 *Mergus serrator* (red-breasted merganser)

Falconiformes (vultures, hawks, falcons)
554 *Cathartes aura* (turkey vulture)
555 Accipitridae (kites, hawks, and eagles)
556 *Accipiter sp.* (short-winged hawks)
557 *Accipiter gentilis* (goshawk)
558 *Accipiter striatus* (sharp-shinned hawk)
559 *Accipiter cooperii* (Cooper's hawk)
560 *Buteo sp.* (broad-winged hawks)
561 *Buteo jamaicensis* (red-tailed hawk)
562 *Buteo playpterus* (broad-winged hawk)
563 *Buteo swainsoni* (Swainson's hawk)
564 *Buteo albonotatus* (zone-tailed hawk)
565 *Buteo lagopus* (rough-legged hawk)
566 *Buteo regalis* (ferruginous hawk)
567 *Buteo nitidus* (gray hawk)
568 *Parabuteo unicinctus* (Harris hawk)
569 *Buteogallus anthracinus* (black hawk)
570 Aquila chrysaetos (golden eagle)
571 *Haliaetus leucocephalus* (bald eagle)
572 *Circus cyaneus* (marsh hawk)
573 *Pandion haliateus* (osprey)
574 Falconidae (caracara and falcons)
575 *Caracara cheriway* (caracara)
576 *Falco mexicanus* (prairie falcon)
577 *Falco peregrinus* (peregrine falcon)
578 *Falco femoralis* (aplomado falcon)
579 *Falco columbarius* (pigeon hawk)
580 *Falco sparverisu* (sparrow hawk)

Galliformes (grouse, pheasants, turkeys and allies)
581 Tetraonidae (grouse and ptarmigan)
582 *Dendragapus obscurus* (blue grouse)
583 *Lagopus leucurus* (white-tailed ptarmigan)
584 *Typanuchus pallidicinctus* (lesser prairie chicken)
585 *Pediocetes phasianellus* (sharp-tailed grouse)
586 *Centrocercus urophasianus* (sage grouse)
587 Phasianidae (quail, partridges, and pheasants)
588 *Colinus virginianus* (bobwhite)
589 *Callipepla squamata* (scaled quail)
590 *Lophortyx gambelii* (Gambel's quail)
591 *Cyronyx montezumae* (harlequin quail)
592 *Phasianus colchicus* (ring-necked pheasant)
593 *Alectoris graeca* (chukar partridge)
594 *Meleagris gallopovo* (turkey)

Gruiformes (cranes, rails and allies)
595 *Grus americana* (whooping crane)
596 *Grus canadensis* (sandhill crane)
597 Rallidae (rails, gallinules, coots)

Galliformes
598 Galliforms

Charadriiformes (shorebirds, gulls, and allies)
602 Charadriidae (plovers)
609 Scolopacidae (sandpipers, snipes, curlews, godwits etc.)
631 Recurvirostridae (avocets and stilts)
634 Phalaropodidae (phalaropes)
637 Laridae (gulls and terns)

Columbiformes (pigeons, doves and allies)
646 Columbidae (pigeons and doves)
647 *Columbia fasciata* (band-tailed pigeon)
648 *Columba liva* (rock dove, domestic pigeon)
649 *Zenaida asiatica* (white-winged dove)
650 *Zenaidura macoura* (mourning dove)
651 *Ectopistes migratorius* (passenger pigeon)
652 *Columbigallina passerina* (ground dove)
653 *Scardafella inca* (Inca dove)

Psittaciforimes (parrots, macaws and allies)
654 Psittacidae (parrots)
655 *Rhyncopsitta pachyrncha* (thick-billed parrot)
656 *Ara sp.* (macaws)
657 *Ara militaris* (military macaw)
658 *Ara macao* (scarlet macaw)

Cuculiformes (cuckoos, roadrunners and allies)
659 Cuculidae (cuckoos, roadrunners and ani)
660 *Coccyzus americanus* (yellow-billed cuckoo)

661 *Geococcyx californianus* (roadrunner)
662 *Crotophaga sulcirostris* (groove-billed ani)

Strigiformes (owls)
663 Stigidae and Tytonidae (owls)
664 *Tyto alba* (barn owl)
665 *Otus asio* (screech owl)
666 *Otus flammeolus* (flammulated owl)
667 *Rubo virginianus* (great horned owl)
668 *Glaucidium gnoma* (pygmy owl)
669 *Micrathene whitneyi* (elf owl)
670 *Speotyto cunicularia* (burrowing owl)
671 *Strix occidentais* (spotted owl)
672 *Asio otis* (long-eared owl)
673 *Asio glammeus* (short-eared owl)
674 *Aegolius acadicus* (saw-whet owl)

Caprimulgiformes (whip-poor-will and allies)
675 Caprimulgidae (goat-suckers)
676 *Caprimulgus vociferus* (whip-poor-will)
677 *Phalaenoptilus nuttallii* (poor-will)
678 *Chordeiles minor* (common nighthawk)
679 *Chordeiles acutipennis* (lessser nighthawk)

Apodiformes (swifts and hummingbirds)
680 Apoidae (swifts)
683 Trochilidae (hummingbirds)
684 Trogonidae (tragons)

Coraciiformes (kingfishers, hornbills and allies)
685 Alcedinidae (kingfishers)

Piciformes (woodpeckers, toucanss, and allies)
688 Picidae (woodpeckers)
689 Colaptes auratus (yellow or red-shafted flicker)

Passeriformes (small perching birds)
703 Tyrannidae (tyrant flycatchers)
725 Alaudidae (larks)
726 *Eremophila alpestris* (horned lark)
727 Hirundinidae (swallows)
736 Corvidae (jays and allies)
737 *Perisoreus canadensis* (gray jay)
738 *Cyanocitta cristata* (blue jay)
739 *Cyanocitta stelleri* (Steller's jay)
740 *Aphelocoma coerulescens* (scrub jay)
741 *Aphelocoma ultramarina* (mexican jay)
742 *Pica pica* (magpie)
743 *Corvus corax* (common raven)
744 *Corvus cryptoleucus* (white-necked raven)
745 *Corvus brachyrynchos* (common crow)
746 *Gymnorhinus cyanocephala* (pinon jay)
747 *Nucifraga columbiana* (Clark's nutcracker)
748 Paridae (chickadees and allies)
749 Sittidae (nuthatches)
752 Troglodytidae (wrens)
755 Mimidae (mocking birds and thrashers)
763 Turdidae (thrushes, solitares and bluebirds)
764 *Turdis migratorius* (robin)
766 Sylviidae (gnatcatchers and kinglets)
767 Motacillidae (pipits)
768 Bombycillidae (waxwings)
769 Sturnidae (starlings)
770 Vireonidae (vireos)
771 Parulidae (wood warblers)
772 Ploceidae Passer domesticus (house sparrow)
773 Icteridae (blackbirds, orioles, and meadowlarks)
774 Thraupidae (tangers)
775 Fringillidae (grosbeaks, finches, towees and sparrows)
776 Passeriformes

Domestic Bird
777 *Gallus gallus* (domestic chicken)
778 chicken-like

Reptiles
780 Reptiles
781 Testudinata (turtles and tortoises)
782 Chelydridae (snapping, muck,. and mud turtles)
783 *Chelydra serpentina* (snapping turtle)
784 *Kinosternon sp.* (musk and mud turtles)
785 *Kinisternon flavescens* (yelllow mud turtle)
786 *Kinosternon sonoriense* (Sonora mud turtle)
787 Emydinae (box and water turtles)
788 *Clemmys marmorata* (western pond turtle)
789 *Chrysemys sp.* (painted turtles)
791 *Chrysemys picata* (painted turtle)
792 *Pseudomys sp.*
794 *Pseudomys scripta* (pond slider)
795 *Pseudomys concinna* (cooter)
796 *Terrapene sp.* (box turtles)
798 *Terrapene ornata* (western box turtle)
799 Trionychidae (softshell turtles)
800 *Trionyx sp.* (softshell turtles)
801 *Trionyx spiniferus* (spiny softshell)
802 *Trionyx muticus* (smooth softshell)
810 Squamata (lizards and snakes)
811 Sauria (lizards)
820 Ophidia (snakes)
825 Colubridae (nonvenomous snakes)
830 *Heterodon nasicus* (western hognose snake)
835 *Coluber sp.* (racers)
840 *Lampropeltis sp* (kingsnake)

841	*Lampropeltis pyroelana* (Sonora mountain kingsnake)
850	Viperidae (venomous snakes)
851	*Crotalus sp.* (rattlesnakes)
852	*Crotalus atrox* (western diamondback rattlesnake)

Amphibians

860	Amphibian
861	Urodela (salamanders)
862	*Ambystoma tigrinum* (tiger salamander)
870	Salienta (frogs and toads)
871	Scaphiopus (spade-foot toads)
880	Bufonidae (true toads)
890	Ranidae (true frogs)

Fish

900	Osteichthyes (fish)
901	Salmonidae (salmon, trout, etc.)
910	Catostomidae (suckers)
911	*Itiobus bubalusr* (small mouth buffalofish)
920	Cyprinidae (minnows)
930	Ictaluridae (catfish)
940	Centrarchidae (sunfish)
950	Percidae (perch)
960	Serranidae (bass)

Mussel and Shell

997	snail
998	mussel or shell

Articulation

1	yes
2	probably
3	same individual
4	pieces of the same bone

Element

0	complete

Indeterminate fragments

1	indeterminate element
2	indeterminate fragment
3	long bone fragment
4	flat bone fragment
5	cancellous tissue

Skeletons

50	complete skeleton
51	most of a skeleton
52	partial skeleton

Mammals and general

90	antler
91	horn core
92	horn sheath
100	cranium
160	mandible
170	indeterminate tooth (maxillary or mandible?)
180	hyoid
200	vertebra
201	atlas
202	axis
203	cervical vertebra
204	c3
205	c4
206	c5
207	c6
208	c7
210	thoracic vertebra
211-224	T1-T12
225	lumbar vertebra
226-232	L1-L7
233	sacral vertebra
235	caudal vertebra
236	sacrum
240	sternum
241	manubrium
243	rib
244	ossified cartilage
245	clavicle
246	scapula
247	innominate
248	pelvis
300	humerus
301	radius
302	ulna
303	radio-ulna
304	carpal
305	scaphoid
306	lunar
307	scapholunar
308	pisiform
309	cuneiform
310	unciform
311	trapezoid-magnum
315	metacarpal
316	metacarpal 1
317	metacarpal 2
318	metacarpal 3
319	metacarpal 4
320	metacarpal 5
322	manus –first phalanx
323	manus –second phalanx
324	manus -third phalanx
330	femur
331	patella

332	tibia
333	fibula
334	tibiofibula
335	tarsal
336	astragalus (tibial tarsus)
337	calcaneum (fibular tarsus)
338	cuneiform
339	navicular
340	cuboid
341	naviculocuboid
342	lateral malleous
345	metatarsal
346	metatarsal 1
347	metatarsal 2
348	metatarsal 3
349	metatarsal 4
350	metatarsal 5
352	pes –first phalanx
353	pes – second phalanx
354	pes –third phalanx
355	sesamoid
356	baculum
357	carpal or tarsal
359	vestigial phalange/ass. hoof core
360	metapodial
361	vestigial metapodial
362	phalanx
363	first phalanx
364	second phalanx
365	third phalanx

Specialized Elements:

600	coracoid
601	furculum
602	carpometacarpus
603	pollex
606	digit II. phalanx I
607	Digit III
608	Digit II. phalanx II
609	Specialized wing phalanx
610	sysacrum
611	tibiotarsus
612	tarsometatarsus
613	muscle splint
615	phalanx (1)
616	phalanx (2 or 3)
619	ungual phalanx. claw
620	urostyle
621	sygostyle
650	fused calcaneum/astragalus
660	suprascapula
700	basipterygium
701	modified vertebra
702	trunk vertebra
711	fused lumbar
712	fused thoracic
720	carapace
730	plastron
731	epiplastron
732	entoplaston
733	hyoplastron
734	xiphiplastron
799	Bivalur
800	fish axial
863	Pectoral fin
866	Abdominal vertebra
867	Caudal vertebra
878	dorsal rib
879	Ventral rib
883	Dorsal fin
884	Anal fin
885	Caudal fin
886	Ultimate vertebra
887	Penultimate vertebra
888	Epural

Element Side

0	Not applicable
1	indeterminate
2	axial
3	right
4	left

Completeness

0	not applicable
1	indeterminate
2	complete
3	more than 75 percent complete
4	50-75 percent complete
5	25-50 percent complete
6	less than 25 percent complete

Fragmentation

0	complete (analytically)
1	fragment
2	shaft fragment
3	end fragment
4	lateral
5	medial
6	anterior
7	posterior
8	superior
9	inferior
10	process
13	cancelous

Cranium

16	antler base or junction

20	enamal
21	root
50	case fragment
51	vault
52	anterior vault
53	posterior vault
54	occipital region
55	basioccipital
56	face/frontal
57	parietal
60	sphenoid
70	temporal region
71	petrosa
72	auditory bulla
73	aditory bulla fragment
75	zygomat
80	frontal region
81	orbital region
82	maxilla
83	maxillary fragment
84	maxillary incisor
85	maxillary canine
86	maxillary premolar
87	maxillary molar
88	maxillary molar/ premolar fragment
89	anterior maxilla (brouse pad.)
90	palate/palatine
95	nasal
96	max and case frag.

Mandible

100	ascending ramus
101	coronoid process
102	mandibular condyle
103	horizontal ramus
104	mandibular dentition
105	mandibular incisor
106	mandibular canine
107	mandibular premolar
108	mandibular molar
109	mandibular molar premolar fragment
110	mandibular symphysis
111	body fragment
112	ramus and most of body
113	symphysis fragment
114	ramus fragment
115	body fragment tooth sockets present
116	body and ramus fragment

Vertebrae

120	body
121	arch
122	process
123	body and arch fragment
124	arch and body fragment
125	body fragment
126	arch fragment
127	spinous process
128	transverse process
129	articular facet
130	epiphysis

Innominate

140	ilium
141	ilium fragment
142	ischium
143	ischium fragment
144	acetabulum
145	acetabulum fragment
146	pubis
147	ilium and acetabulum
148	ilium, acetabulum and ischium
149	acetabulum and ischium
150	acetabulum and pubis
151	ischium and pubis
152	acetabulum, ischium and pubis
153	pubic symphysis
154	½ ilium and ½ ischium
155	½ ilium, ½ ischium and ½ pubis
156	ilium fragment and acetabulum fragment
157	ischium and acetabulium fragment
158	pubis fragment
160	glenoid
161	blade fragment
162	neck
165	glenoid fragment

Long Bones

220	proximal
221	proximal and 1/3 shaft
222	proximal and 2/3 shaft
223	proximal and shaft
224	proximal shaft fragment
225	proximal fragment
226	proximal fragment –lateral or anterior
227	proximal fragment –medial or posterior
228	proximal epiphysis
229	proximal epiphysis fragment
230	distal
231	distal and 1/3 shaft
232	distal and 2/3 shaft
233	distal and shaft
234	distal shaft fragment
235	distal fragment
236	distal fragment – lateral
237	distal fragment –medial
238	distal epiphysis
239	shaft (2/3+)

240	shaft split lengthwise
241	shaft split –proximal and medial
242	shaft split –proximal and lateral
243	shaft split –proximal and anterior
244	shaft split –proximal and posterior
245	shaft split –distal and medial
246	shaft split –distal and lateral
247	shaft split –distal and anterior
248	shaft split –distal and posterior
249	shaft split –medial portion
250	shaft split –lateral portion
251	shaft split –anterior portion
252	shaft split –posterior portion
270	epiphysis fragment

Specialized Elements

Cranium

[bird]

300	jugal
301	quadrate
302	quadratojugal
305	supraoccipital
306	beak
307	dentary
308	sclerotic ring

Carapace

600	nuchal scute
601	nuchal bone
602	neural
603	marginal
604	pygal
605	suprapygal
606	costal
607	pleural
609	unidentified carapace
610	platron

Plastron

611	epiplastron/humeral
612	entoplastron
613	hypoplastron
615	xiphiplastron

Fish

Cranium

801	Vomer
802	Ethmoid
803	Pre-frontal
804	Frontal
805	Sphenotic
806	Parietal
807	Epiotic
808	Supraoccipital
809	Pterotic
810	Opisthotic
811	Exoccipital
812	Basioccipital
813	Parasphenoid
814	Basisphenoid
815	Prootic
816	Pterosphenoid
818	Symplectic
819	Quadrate
820	Ectopterygoid
821	Palatine
822	Entoptergoid
823	Metapterygoid
824	Preoperculum
825	Operculum
826	Suboperculum
827	interoperculum -
828	Articular
829	Angular
830	Dentary
831	Maxilla
832	Premaxilla
841	Basibrachial
842	Hypobrachial
843	Ceratobrachial
844	Epibrachial
845	Suspensory pharyngobrachial
846	Gill raker
847	Sagitta (otolith)
848	SO1 (Lachrymal)
849	SO2 (Jugal)
850	SO3 (Suborbital stay)
851	SO4
852	SO5
853	SO6
854	Nasal
855	Tabular
856	Posttemporal
857	Supracleithrum
858	Postcleithrum
859	Cleithrum
860	Hypercoracoid
861	Hypocoracoid

Mandible

817	Hyomandibular
833	Interhyal
834	Epihyal
835	Ceratohyal
836	Basihyal
837	Hypohyal
838	Glossohyal

839	Urohyal
840	Brachiostegal

Axial

862	Actinost
864	Basipterygium
865	Pelvic fin
868	Centrum
869	Neuropophyses
870	Neural spine
871	Neural arch
872	Haemopophyses
873	Haemal spine
874	Haemal arch (and haemal canal)
875	Prezygapophyses
876	Postzygapophyses
877	Parapophyses
880	Pterygiophore
881	Lepidotrichium
882	Actionotrichium
889	Hypural plate 5
890	Urostyle

900 egg shell

Age

0	not applicable
1	indeterminate young
2	fetal/neonate
3	immature
4	juvenile (2/3+ size)
5	mature

Age Criteria

0	not applicable
1	epiphysial fusion
2	porous
3	compact
4	size
5	deciduous dentition/tooth eruption
6	permanent dentition/tooth eruption

Environmental Alteration

0	not applicable
1	indeterminate
2	none
3	pitting/corrosion
4	sun bleached
5	checked/exfoliated
6	root etched
7	polished/rounded

Environmental alteration degree

0	not applicable
1	light
2	medium
3	heavy

Animal Alteration

0	not applicable
1	indeterminate
2	absent
3	carnivore gnawing
4	carnivore tooth puncture
5	3 and 4
6	scatological
7	scat?
8	rodent gnawing
9	possibly agent?

Animal alteration location

0	not applicable
1	indeterminate
2	proximal
3	distal/inferior
4	ends/edge
5	shaft
6	projections
7	body
10	entire specimen
11	arch
12	posterior

Burning type

0	not applicable
1	indeterminate
2	none
3	light scorched (tan/brown)
4	heavy charred (black, gray)
5	calcine (white)
6	brown/black
7	black/calcine

Burning location

0	not applicable
1	indeterminate
2	even, entire specimen
3	discontinuous, entire specimen
4	proximal
5	distal
6	end(s)
7	shaft
8	projection/margin
9	interior or exterior only

Boiling/cooking brown

1	present (color and round)
2	possible (color no rounding)

3	rounding
5	waxy

Processing

0	not applicable
1	indeterminate
2	none
10	cuts, unspecified
11	transverse cuts
12	longitudinal cuts
13	oblique cuts
14	random cuts
19	shallow scooped out area
20	process removed
30	grooved
31	grooved/cut off
40	impact fracture
41	spiral fracture
42	snap break
50	sawn
51	portion cut off
52	chop
53	chop and cuts
55	abrasion
58	cut and snap
59	diagonal break
60	longitudinal break
61	transverse break
65	13 and 40
66	split
70	scrapes- long parallel scratches
75	bone flake
80	peel
90	end hacked off

Processing Location

0	not applicable
1	proximal
2	distal
3	medial
4	lateral
5	ends
6	margins
7	midshaft
8	process
9	surface (eg. cranial fragment)
10	proximal shaft
11	distal shaft
12	body
15	neck
20	anterior
21	superior
22	posterior
23	interior
24	inferior
25	arch
30	diagonal shaft cut off
31	horn
32	base
40	acetabulum
99	indeterminate

Modification

0	not applicable
1	indeterminate
2	manufacturing debris –split
3	manufacturing debris-cuts or grooves
4	manufacturing debris –polish/striations
5	drilled
6	tool –piercing
7	tool –bead or tube
8	tool –ornament
9	tool –use defined
10	tool –scraper/spatulate
11	tool –other
12	tool fragment
15	non-tool
25	edge wear/ flaked
40	pigment
99	possible modification

Comments

1	yes
2	biology
3	flotation

APPENDIX 2. LEGAL DESCRIPTION

LA 29362 (Trojan Hill)

Legal Description: [redacted]

Elevation: 990.60 m (3,250 ft).

UTM Coordinates: [redacted].

NMSHTD Station [redacted]

LA 29363 and LA 79978 (Macho Dunes)

[redacted]

Elevation: 989.07 m (3,245 ft).

UTM Coordinates: [redacted].

NMSHTD Station: [redacted]