MUSEUM OF NEW MEXICO

OFFICE OF ARCHAEOLOGICAL STUDIES

Laguna Gatuna: Excavations at LA 120945, Lea County, New Mexico

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ADMINISTRATIVE SUMMARY

Between March 8 and March 19, 1999, the Office of Archaeological Studies, Museum of New Mexico, excavated a portion of LA 120945 for the Bureau of Land Management, United States Department of the Interior. The portion of the site within the existing U.S. 62/180 highway right-of-way was adversely impacted by the placement of a fiber optic cable by Craig Enterprises, working for General Telephone and Electronics. This report describes the excavation at LA 120945.

LA 120945 is a transitional Late Archaic-Eastern Jornada Mogollon resource-procurement site. Excavation of the site yielded discarded prehistoric artifacts, but no features.

MNM Project 41.673 (Laguna Gatuna)
Bureau of Land Management Cultural Resource Use Permit 21-8152-99-14
Bureau of Land Management Fieldwork Authorization Permit 21-29-20-98-W

CONTENTS

FIGURES

INTRODUCTION

LA 120945 is in Lea County, approximately halfway between Carlsbad and Hobbs, New Mexico, on Bureau of Land Management land (Fig. 1 and Appendix 12). At the southern end of the Laguna Gatuna salt lake, it is on a southwest-facing slope of a large unnamed arroyo that drains into the lake. The site was recorded in 1997 (Martin 1997) as a large artifact scatter (320 by 330 m) containing burnt caliche, fire-cracked rock, and "hundreds" of thermal features.

In November 1998, the Carlsbad District of the Bureau of Land Management requested an assessment of LA 120945 because of damage caused by the installation of a fiber optic line. The site was inspected by personnel from the Office of Archaeological Studies, and both a damage assessment and a data recovery plan were developed. The affected portion of LA 120945 was recommended for data recovery.

The portion of the site bisected by the fiber optic cable trench originally measured 4 by 320 m. Upon excavation this area was reduced to 7 by 21 m, an area of 147 sq m (Fig. 2). This smaller area was the only portion of the recorded site area where artifacts occurred within the highway right-of-way. Eleven surface artifacts accounted for an artifact density of 0.07 artifacts per square meter. Most of the surface artifacts were in an area of site modification caused by the installation of the fiber optic line. The only intact portion of the site proved to be the remaining portion of a large coppice dune that had been cut by the fiber optic line. No artifacts were found outside of this concentration during the excavation.

The data recovery plan and subsequent archaeological data recovery efforts were performed by the Office of Archaeological Studies, Museum of New Mexico. The principal investigator was Yvonne R Oakes. The project director was Peter Y. Bullock. Field assistants were Marcy Snow, Laura Rick, Tess Fresquez, and Phil Alldritt. The report was edited by Tom Ireland, and graphics were drafted by Ann Noble.

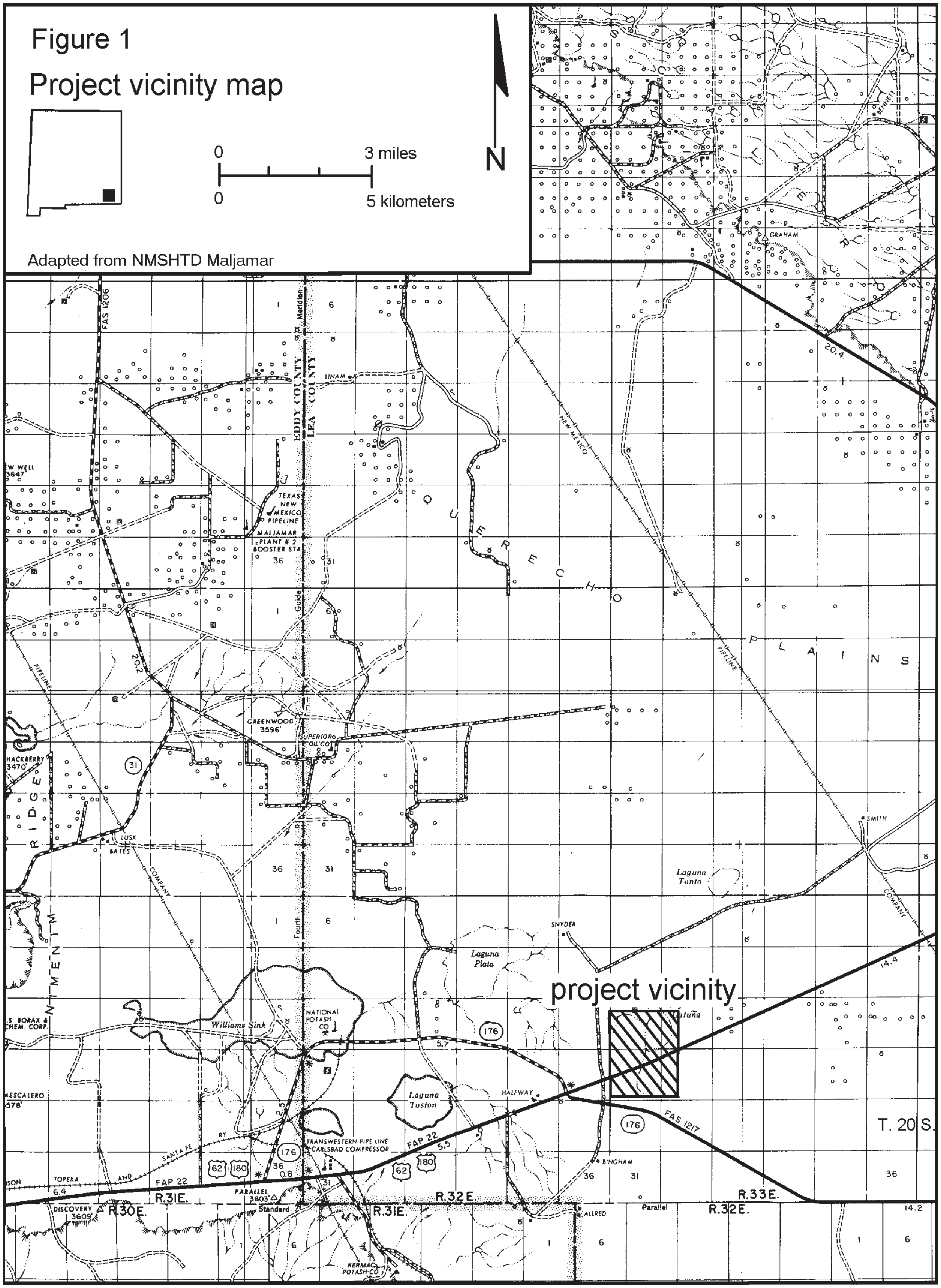

Figure 1

Project vicinity map

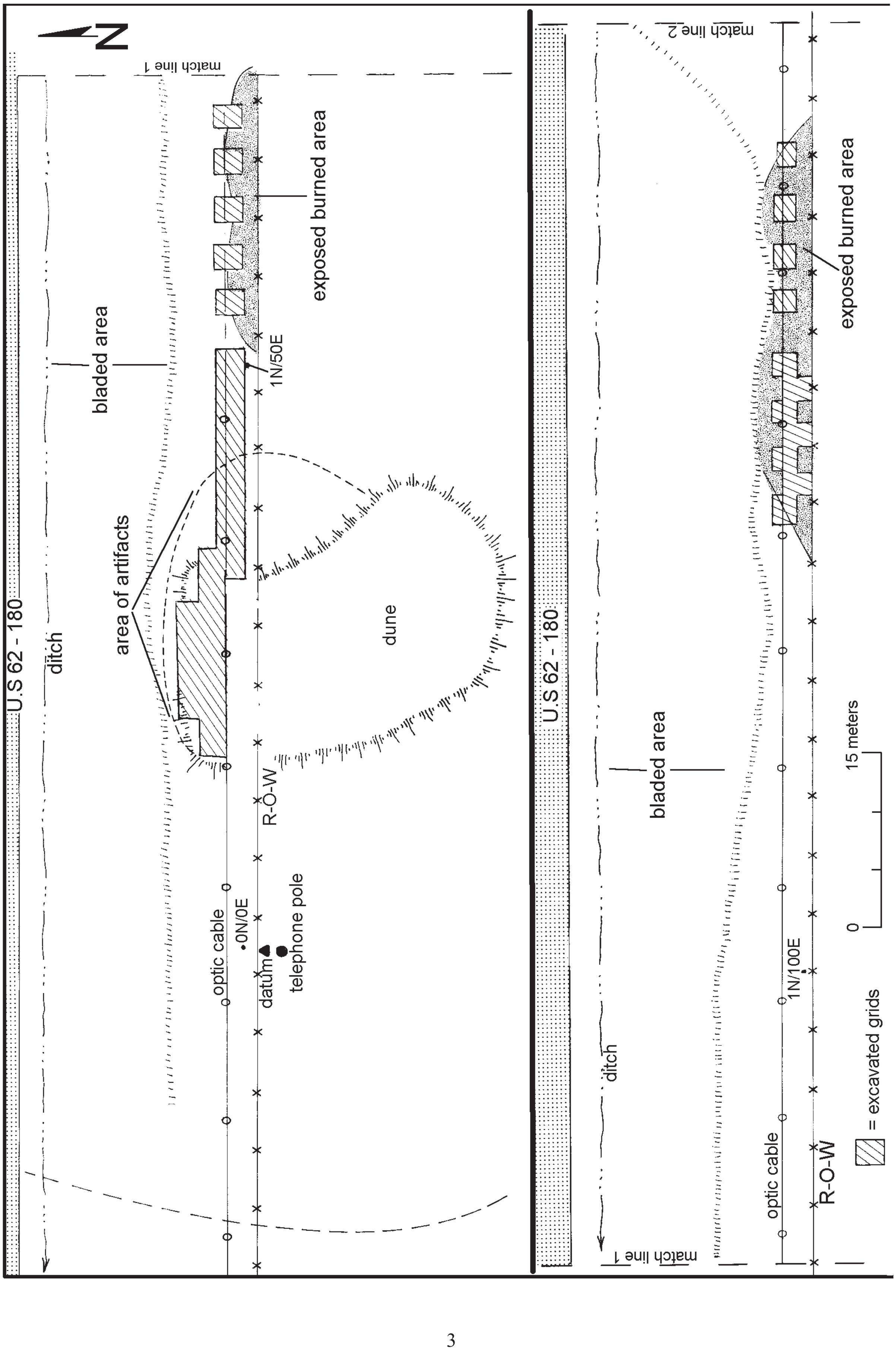

Fig. 2. Original LA 120945 site map.

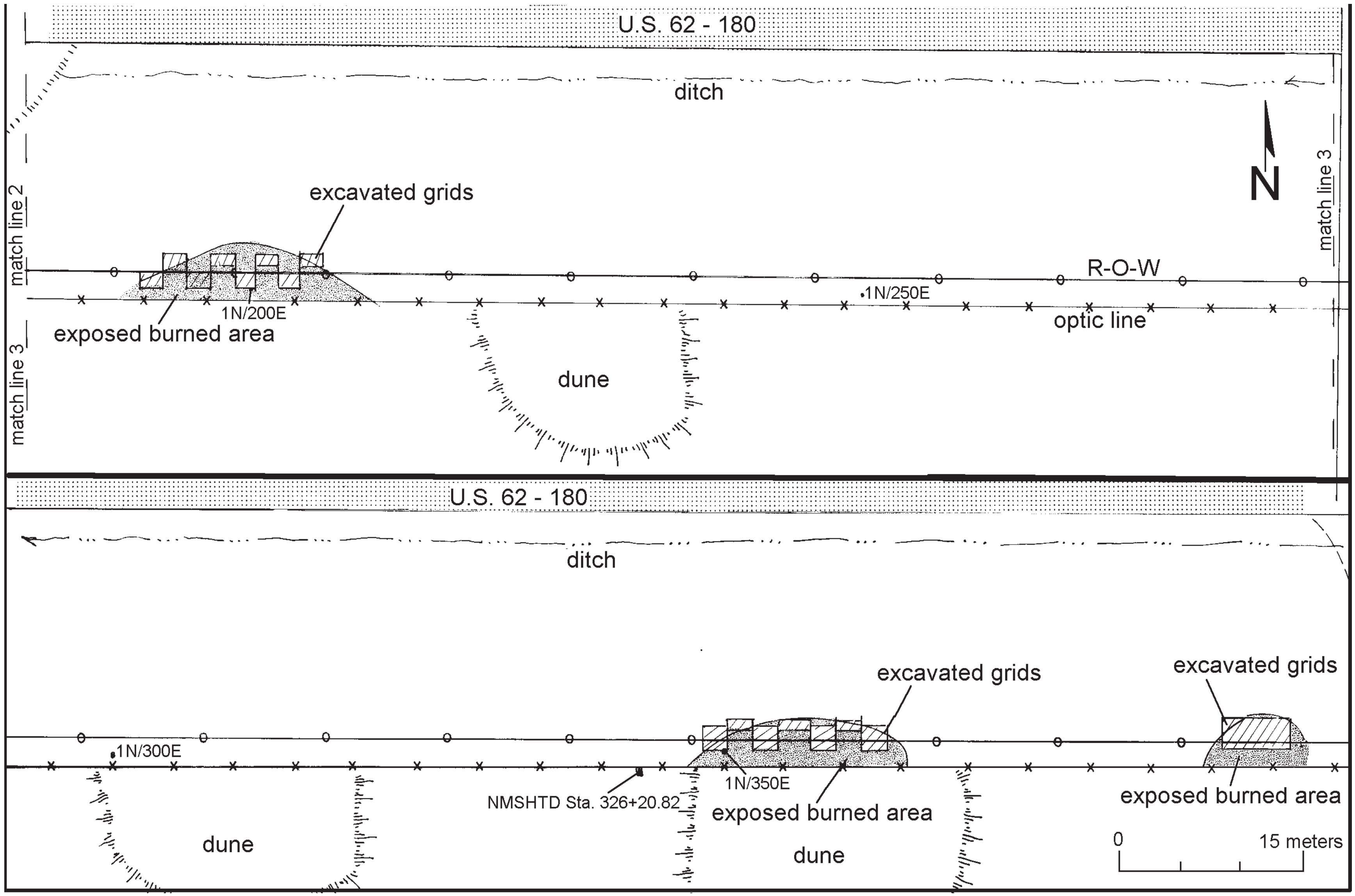

Fig. 2 (continued). Original LA 120945 site map.

BACKGROUND

Environment

LA 120945 is within the southern part of the Great Plains physiographic province, dissected lowland below and west of the Ogallala formation of the Llano Estacado escarpment. Local topology is the result of Pleistocene erosion and deposition, making this an area of piedmont where the fluviatile mantel is missing (Fenneman 1931:8; Leonard et al. 1975:5).

Geology

LA 120945 is east of the Pecos River in an extension of the Querecho Plain known as the Laguna Valley (Nicholson and Clebisch 1961). The Laguna Valley is a former Pleistocene watercourse that once extended in an arch from the Pecos River in the west, east through the project area, and then south through Monument Draw into Texas (Calzia and Hiss 1978, fig. 1).

Geologically this area is a subdivision of the Mescalero Plain and is underlain by well-developed beds of caliche. Bedrock is comprised of Permian age sediments, including limestone, sandstone, shale, dolomite, and gypsum in an area known as the Delaware Basin (Adams 1969; Hawley 1986:27). This is an area of collapsed basins resulting from cavern systems and subsidence resulting from the solution of the underlying Permian deposits (Hawley 1993:3).

The general site area was considerable warmer and moister during the Pleistocene period (Axelrod 1985; Leonard et al. 1975:17). Prehistoric water availability, in the form of both an increased number of seeps and springs and increased spring flow, was more plentiful than currently. The Capitan Reef formation of the Permian age defines the southern edge of the Laguna Valley and also forms the southern edge of the Capitan aquifer. This formation also blocks subsurface water flow to the south, forcing it to the surface as a series of springs and seeps (Nicholson and Calesch 1961; Adams 1969; Anderson et al. 1978, fig. 1; Anderson and Powers 1978, fig. 1; Lambert 1978, fig. 1).

For a short period during the Pleistocene, Laguna Valley formed the main channel of the Pecos River. In the Quaternary period the Pecos River was diverted and redirected south by episodal changes in precipitation runoff, stream discharge, erosion, and sedimentary deposition tied to hemispheric glacial changes (Hawley 1993:3). This was further affected by a series of collapsed basins similar to the San Simon Swale, created by dissolved underlying salts (Adams 1969:93; Anderson et al. 1978:48).

Laguna Gatuna, just north of the site area, is one of a series of lakes originally formed by substrata bedrock collapse caused by continued underground stream flow after the diversion of the Pecos River south to its present course (Hawley 1993:3). Mollusk fossils indicate that Laguna Gatuna and the other salt lakes in the area were all originally aquifer-fed freshwater lakes. Water levels in the area of Laguna Gatuna were at least 25 ft higher than at present (Leonard et al. 1975:11), with lake discharge flowing eastward and south through Monument Draw (Davis 1989; Nicholson and Clebisch 1961:9).

With increasing desiccation, these lakes turned into groundwater ponds with ever-increasing alkalinity (Nicholson and Clebisch 1961:57; Leonard et al. 1975:16). Lacking exterior water discharge points, these lakes are now self-contained drainage basins. The trend toward higher alkali levels continues to this day, and the natural alkali content is augmented by brine from potash mine tailings (Hawley et al. 1993:33).

While there are no perennial streams in Lea County at this time, large quantities of ground water are present in Laguna Valley from the Capitan aquifer (Nicholson and Clebisch 1961:6; Leonard et al.1975:7), but very little of the water table is present at the modern ground surface. The water table is currently at a minimum depth of 10 ft in most areas of the Laguna Valley (Nicholson and Clebisch 1961:51). Although the water table has been dropping over the last century, groundwater still comes to the surface in the area of the salt lakes as a series of springs leaking from the Capitan aquifer (Davis 1989). Laguna Gatuna is currently at least partially spring-fed. Laguna Plata, the next lake to the west, is currently fed by at least 12 springs (Nicholson and Clebisch 1961:60).

Soils in the area of LA 120945 are fine-textured sandy Paleorthids-Haplargids. These are highly carbonate (Katz and Katz 1993), thin sandy surface soils. Caliche, sandstone, and shale are exposed in eroded areas. Currently used primarily for grazing, these soils are fertile when irrigated (Maker et al. 1974). The trend in Lea County has been, however, to withdraw land from cultivation, reducing the areas of irrigation. Most of the general site area is covered with dune sand with coppice dunes present on the site itself. Portions of this are stable or semistable; however, active drifting does occur in many locales (Nicholson and Clebisch 1961:9).

Climate

Prehistoric plant remains show a much moister, warm, humid climate resembling that of south Texas and northeastern Mexico, until 8,000 years ago. Although overall summer temperatures were cooler during this period, winter temperatures were warmer, and there was less seasonal temperature fluctuation through the year. A lack of freezing winter temperatures resulted in a subtropic regional climate. This subtropical climate was followed by a steady decrease in moisture that continues today. In time, seasons became much more pronounced, with colder winters and hotter summers (Axelrod 1985).

Prehistorically there was an increase in precipitation in the A.D. 1000s, recorded across large areas of the Southwest. This was caused by a northward shift in the jet stream, allowing warmer moisture-bearing air masses to move north in a trend that peaked by A. D. 1100. The trend reversed between A. D. 1100 and 1200 as the jet stream moved south, allowing the return of northern cool dry air (Knight 1982:51; Pazzaglia and Wells 1990:429).

Currently the local climate is characterized as semiarid (Leonard et al. 1975; Tuan et al. 1973), usually dry and sunny, with hot summers and mild winters (Tuan et al. 1973, fig. 78). The lack of physical barriers on the southern plains allows abrupt changes in temperature, rainfall, and wind direction to occur (Leonard et al. 1975:5). Annual precipitation ranges from 13.1 inches at Carlsbad to 15.7 inches at Hobbs. Snow provides only 10 to 13 percent of the total precipitation in this area of southeastern New Mexico. The wettest months are July and August. The winter months are the driest at lower altitudes (Gabin and Lesperance 1977:390). However, yearly rainfall is erratic (Leonard et al. 1975:5).

Yearly temperatures for the project area range from 0 to 110 degrees F. There is an average 30-degree difference between day and night temperatures (Gabin and Lesperance 1977:390-391). The first frost generally occurs at the end of October, and the last frost generally occurs in the first week of April (Tuan et al. 1973:86). The number of frost-free days averages 210; however, the length of the growing season averages 310 days (Smith 1920:272-273).

Flora and Fauna

Vegetation in the general site area is part of the desert grassland biome (Castetter 1956). Native vegetation is sparse and is comprised predominately of short and medium grasses and forbs. Except for mesquite, few native trees exist except along watercourses (Leonard et al. 1975:5). The vegetation of this region has been relatively stable for the last 2,000 years despite some fluctuations in moisture (Davis 1989).

Severe overgrazing has altered the local environment (Leonard et al. 1975:17), aiding the spread of invasive species such as mesquite (Castetter 1956:263). An additional occurrence has been the spread of active sand dunes (Melton 1940; Nicholson and Clebisch 1961:9; Reeves 1965).

The general site area is home to the suite of Chihuahuan desert fauna, from deer, antelope, and coyote to numerous species of birds and rodents. Historically bison were known in this area prior to being overhunted in the 1800s (Nicholson and Clebisch 1961:23).

Cultural History

A complete cultural history is beyond the scope of this report. This discussion is limited to the Puebloan period. The reader is referred to Stuart and Gauthier (1981) and Sebastian and Larralde (1989) for a more detailed synthesis of Lea County area prehistory and history.

Evidence of Puebloan use of the Carlsbad area is abundant. The majority of sites are located to the north in the Roswell area, where several Pueblo sites with residential architecture have been recorded. A number of sites with residential architecture have been excavated in the Carlsbad-Hobbs area, but few by professional archaeologists (Stuart and Gauthier 1981).

The Late Archaic period was followed by the Mesilla phase of the Jornada Mogollon, which appears throughout southeastern New Mexico between A.D. 650 and A.D. 700. Little difference distinguishes these Jornada Mogollon sites from those of the preceding Late Archaic. The primary difference is the occurrence of ceramics on Jornada Mogollon sites. The vast majority of these ceramics are connected by temper to the Sierra Blanca region of south-central New Mexico. This similarity of site structure has remained problematic, largely because of the lack of any other defining differences between the cultural periods represented.

Whether this sudden widespread appearance of Jornada Mogollon sites is the result of regional population increase tied to the adaptation of maize or a byproduct of climatic factors is not known. However, this Jornada Mogollon appearance does coincide with a slightly moister climatic interlude that seems to occur at this time throughout both the Great Plains and southern High Plains (Davis 1989).

A local Pueblo traditional sequence is documented for the middle Pecos River Valley by Jelinek (1967). This tradition seems to develop in the late A.D. 800s out of the Jornada Mogollon. Anasazi or Anasazi-derived ceramics appear in the middle Pecos River Valley after A.D. 900 with the development of the Mesita Negra phase (Jelinek 1967:64-65). The presence of these structural sites suggests the gradual spread of sedentary subsistence based on maize agriculture to the east from the centers of both the Mogollon and Anasazi traditions.

The eastern limits of this probably marginal area appear to have been the Pecos Valley (Jelinek 1967:145-147). These developmental sequences continue until the termination of the Roswell phase in the lower middle Pecos Valley between A.D. 1300 and 1400, and the termination of the Late McKenzie phase in the upper middle Pecos Valley after A.D. 1300 (Jelinek 1967:65-67).

A number of Pueblo sites are present in the Roswell area, north of the project area, however, which do not fit into Jelinek's chronology. Some of these sites fit better in the Eastern Jornada Mogollon sequence developed for eastern New Mexico and West Texas (Corley 1965; Leslie 1979). The three phases in this sequence (Querecho, Maljamar, and Ochoa) roughly correspond to the Mesilla, Doña Ana, and El Paso phases of the Jornada Mogollon (Leslie 1979).

These sites include Bloom Mound, southwest of Roswell, generally assigned to the Lincoln phase (Kelley 1984); the Henderson site (Rocek and Speth 1986); and Rocky Arroyo (Wiseman 1985). Other structural sites that also contain ceramics are harder to assign to any of the existing chronologies (Wiseman 1981, 1991). A Jornada Mogollon-related cultural sequence for the Sierra Blanca region was developed by Kelley (1984). A summary of the various regional Jornada Mogollon sequences outside of the Pecos Valley area is available in Levine (1997) and Farwell et al. (1991). In eastern New Mexico, however, prehistoric Puebloan sites with brown utilitarian wares are considered Jornada Mogollon rather than Anasazi, because Anasazi utilitarian wares are generally gray (Lehmer 1948).

It is apparent that the general site area was actively exploited by Puebloan groups in a variety of ways. Seasonal use of wild-plant and animal resources is evident from a growing number of habitation sites excavated in the region (Bullock 1997, 1999). Short-term use-areas, reflecting a number of activities, are also now known to be more common in the general area than previously believed (Wiseman 1996).

The occasional occurrence of other ceramic types indicates both regional trade and possible use of the Roswell area by Puebloan groups from western New Mexico, northern Mexico, and the Galisteo Basin. Although a variety of Pueblo sites have been found (Speth 1983), most Pueblo occupation of the area appears to end with the Ochoa phase, A.D. 1350-1450 (Leslie 1979).

A different specialized regional adaptation has been suggested for the Carlsbad region by Katz and Katz (1993). In their model, using the Apaches as an analogous example, Puebloan peoples adapted to an Archaic hunting and gathering lifestyle dictated by the environment (Sebastian and Larralde 1989). The Jornada Mogollon (or Formative period) sequence developed for this adaptation is comprised of four phases.

The Globe phase (A.D. 750-1150) is distinguished by the appearance of ceramics in the area. Habitations move away from the river valleys during this period of time, and substantial structures are in use. During this phase the bow and arrow come into use (Zamora and Oakes 1999).

Regional populations continue to spread out across the landscape and away from the river valleys during the Oriental phase (A.D. 1150-1450). Regional contacts multiply, and ceramic assemblages diversify with the occurrence of nonlocal decorated pottery such as Chupadero Black-on-white, Three Rivers Red-on-terracotta, and El Paso Polychrome (Farwell et al. 1991; Wiseman 1996).

The Phoenix phase, A.D. 1450-1540, and the Seven Rivers phase, A.D.-post 1540, are defined only on the basis of projectile point styles (Katz and Katz 1993; Zamora and Oakes 1999). Versions of this sequence have been applied to sites in the Carlsbad-Lea County area (Oakes 1985; Wiseman 1996; Zamora 2001).

Other archaeologists have applied alternative models. One alternative model is based on the mixed farming and hunting economies of the northern Great Plains (Bullock 1999). In Bullock's model, sedentary Puebloan groups from the Sierra Blanca area followed a seasonal pattern similar to that of the Pawnee and Mandan of the northern Great Plains. These groups spent the period of the year between planting and harvest on extended group hunting trips on the plains. The main difference between these two regions was a combined focus in eastern New Mexico on hunting and gathering.

RESEARCH DESIGN

The research design guiding the data recovery effort is derived primarily from the recovery plan for LA 120945 developed by Zamora and Oakes (1999).

Previous research in the Carlsbad area has focused on patterns of seasonal wild-plant exploitation. Following a Texas-based Plains Indian model, attention has focused on the burnt rock middens that occur in this area of New Mexico. This has resulted in the application of a hunter-gatherer model for this area, using the Mescalero Apaches as an ethnographic example (Katz and Katz 1993; Wiseman 1996; Zamora and Oakes 1999).

An elaborate classification system for sites was developed by Wills (1988:54-55) based on the Mescalero Apache model. Sites were separated by the perceived range and intensity of activities pursued. A simplified version of this site differentiation was proposed by Sebastian and Larralde (1989), but only for the Archaic period.

This version separates sites into single-use, as part of a serial foraging subsistence system, and multiple-use, with overlapping sites that functioned as seasonally reused winter (and possibly summer) camps (Sebastian and Larralde 1989:56). Correlations should be recognizable between ecotone edge area localities, where large varieties of plant and/or animal foodstuffs occur, versus single ecotone areas, which produce large qualities of a single harvestable plant or species of animal (Epp 1984).

None of these hunter-gather scenarios, however, account for the substantial pithouse villages and pueblo roomblocks that occur within the region (Sebastian and Larralde 1989; Stuart and Gauthier 1981).

An alternative theory, supported by Sebastian (1989), suggests that these sites actually represent more than one culture. In this model, a sedentary culture and a hunter-gather culture have become lumped together due to trade-based cross-cultural ties, resulting in a variety of site forms containing various types of ceramics.

While these theories may make sense at the site level, when applied on a regional scale, their limited conceptual views of cultural adaptation seem simplistic and naive. Subsistence is rarely an either/or proposition. Rather it is the utilization of a range of resources, differing only in the direction of its emphasis.

If we consider the Eastern Jornada Mogollon as a sedentary Puebloan people whose form of subsistence was modified to compensate for living on the edge of the plains, a better comparison would be with other sedentary groups living in similar circumstances (Jelinek 1967). Thus, a better analogy for the Eastern Jornada Mogollon may be groups such as the Mandan, Hidatsa, and Pawnee on the eastern edge of the northern plains (Bullock 1999). These sedentary groups utilized a mixed economy, having an agricultural-based subsistence that was supplemented with specialized food procurement in the form of regular seasonal hunting or gathering forays onto the plains (Blaine 1990; Willey 1966).

Originally LA 120945 was believed to be a pit structure village site affiliated with the eastern Jornada Mogollon (Zamora and Oakes 1999). It was also felt that the site could represent a specific stage of subsistence, or landscape use, based on the perceived intensity of its occupation. The large number of thermal features believed to be present were considered proof of specialized hunter-gather food procurement (Martin 1997). Excavation revealed this was not the case. LA 120945 proved to be comprised of a small single-component sherd and lithic scatter with no associated cultural features of any kind.

The focus of the data recovery efforts (made in consultation with the Carlsbad BLM archaeologists) was therefore to examine LA 120945 in the context of a short-term resource procurement area. Of particular interest was the age of the site relative to a prehistoric prairie fire at this locale. Focus was also directed toward regional environmental change as evidenced by the fire and the associated, earlier buried and burned ground surface.

With this in mind, the data recovery effort and analysis at LA 120945 focused on identification, dating, and resource utilization issues. Although this did not change the substance of the previous research design, it did redirect emphasis toward site cultural identification, the range of site activities and their relationship to site function, and an assessment of how the site relates to the earlier ground surface and both the ecotone and fire represented by the prehistoric burnt surface.

The goals and expectations of the data recovery effort were as follows:

1. Determination of a site's utilization and structure is dependent on an ability to assign the site a cultural affiliation. This is usually accomplished through the use of diagnostic artifacts, although it has been demonstrated that a site's cultural affiliation can sometimes be determined even when diagnostic artifacts are absent (Bullock 1996). Both diagnostic ceramic and lithic artifacts from LA 120945 will allow the site to be assigned a cultural affiliation.

2. Site structure can be determined based on the presence and absence of differing suites of activities at a specific location. Identification of the range of the

site's activities should aid in determining the site's function and cultural affiliation.

On-site activities at LA 120945 can be understood through the artifacts present. Patterns of behavior may become apparent when a site's artifact assemblage is put into a regional context. Artifact analysis will focus on the presence and range of artifacts recovered from the site, and the activities that they represent.

Faunal, pollen, and macrobotanical remains were recovered from LA 120945. These remains were analyzed for species represented, anatomical portion, age, condition, and frequency to determine dietary information. This information includes the question of wild-plant versus cultigen (domesticated plant) use. This analysis can also reveal information about the general prehistoric environment, including changes in vegetation availability and ecotone composition through time.

The ceramic assemblage from LA 120945 was analyzed to produce data that aided in the identification of local verses nonlocal pottery. This was accomplished through the study of tempers present and through petrographic analysis. Both local and intrusive pottery may be identified on the basis of paste, surface finish, and design elements. The frequencies of intrusive ceramic types should provide information about the regional social and economic organization. Ceramics from LA 120945, when compared to ceramic assemblages from other Jornada Mogollon sites in the Carlsbad area to the west, may enable the establishment of a relative date for LA 120945, as well as relative dates between sites within the Jornada Mogollon cultural continuum.

The lithic assemblage of the site was analyzed for the presence of diagnostic artifacts and both formal and expedient tools. Special attention was given to four "marker" attributes, specifically the ratio of debitage to tools (including utilized debitage), and the percentages of flakes, cores, and bifaces within the assemblage. Two trends tend to occur through time, an increase in both the ratio of debitage to tools and in the percentage of flakes within an assemblage, coupled with a corresponding decrease in the percentages of both cores and bifaces (Bullock 1996). The range of lithic tools present is indicative of at least some of the activities that have taken place. The types of grinding implements present may also correspond to either gathered or cultivated plants.

Social and economic organization, including the extent of a population's mobility and evidence of exchange, are indicated by the presence of exotic, nonlocal goods and materials within the artifact assemblage. The presence of lithic materials that have specific source areas may confirm or supplement the data obtained from the petrographic study of the pottery.

3. Dating of both LA 120945 and the buried ground surface where it is located will provide information on the temporal relationship between the two, as well as the possible relationship between the site and the prairie (or grass) fire that occurred on the buried ground surface.

The date of a site also allows its integration into a study of regional use and environmental adaptation. The site's position within both the local and the regional cultural can also be determined through the ability to accurately date the site's occupation. The focus of dating will be the use of both C-14 radiocarbon dating and archaeomagnetic dating. Relative dating through the use of the site's ceramic assemblage can serve as a cross-check for other dating techniques.

Changes in settlement patterns, community organization, and other aspects of cultural development are dependent on an ability to date individual sites. Differences in resource procurement may indicate cultural change through time. However, this may also reflect discreet populations, different cultural affiliation, or even seasonality of settlement. Establishing a date for LA 120945 should aid in refining the suggested dates for the ceramic period phases in the Carlsbad area, and enable the placing of the site within the Carlsbad-area cultural continuum.

Archaeomagnetic and radiocarbon (C-14) dating will be used to date the episode of the prehistoric prairie fire. Macrobotanical and pollen data will be used to determine the fuel responsible for the prairie fire, and through this identification extrapolate the past environment. Any relative date derived from the ceramic artifacts will be used to determine the temporal relationship between the buried ground surface, its related prairie-fire episode, and site use. While each dating technique can provide some useful information, it is the sum of data from a combination of both relative and precise dating techniques that should allow the site to be placed in its correct regional time period.

EXCAVATION METHODS

The first goal of the excavation was to collect surface artifacts within the right-of-way. This was accomplished by setting up a 1 by 1 m grid system across the right-of-way. A site datum was established as 0N/0E with an arbitrary elevation of 1 m. Grid numbers were assigned to the southwest corner of each unit. Each grid unit was examined for surface artifacts, which were collected and bagged by grid. A total of 1,560 sq m was inspected and the surface artifacts collected.

Following the surface collection, surface stripping took place, beginning in the area of artifact occurrence. Surface stripping removed the top 10 cm of soil to expose cultural features and deposits. In addition, areas of the site within the right-of-way exhibiting evidence of burning (burnt soil, oxidized soil, pieces of burnt caliche, or fire-cracked rock) were surface stripped to find cultural features and deposits. When artifacts were recovered from a stripped grid unit, additional 10 cm levels were hand dug until culturally sterile soil was reached. The area surface stripped totaled 197 sq m. No cultural features were found through surface stripping.

Auger tests were then hand dug in each of the surface-stripped grid units. These auger tests totaled 192 and were dug to a depth of 30 cm, or until culturally sterile soil was reached. No cultural material or deposits were found in any of the auger tests.

A different procedure was followed in excavating the stratified dune that had been cut during the laying of the fiber optic cable. The exposed profile was drawn and photographed. Then the portion of the dune within the right-of-way was excavated by natural strata until culturally sterile soil was reached. Excavation of the dune confirmed the presence of a sherd and lithic artifact scatter on a buried ground surface. No cultural features were found within this area of the site; however, the newly revealed stratigraphy of the dune was profiled, photographed, and described on field journal forms.

All of the dirt excavated at LA 120945 was sifted through 1/8-inch screen mesh. All artifacts were collected in paper bags that were labeled with vertical and horizontal provenience information.

Site fill was described on field journal forms and grid forms. The forms included excavated depth in centimeters below site datum, information about soil color and texture, and artifact types and density. Soil colors were described using Munsell color notation.

After excavation was completed, the site was mapped with a transit and stadia rod, including the limit of the excavation, location of auger tests, and cultural features. Lastly, once work was completed, the excavation was left open at the direction of the BLM.

All collected artifacts and samples were taken to Office of Archaeological Studies laboratories at the Museum of New Mexico in Santa Fe. There, all collected artifacts were cleaned, counted, and sorted by material type (lithic, bone, etc). All artifacts were rebagged, and all provenience information was transferred to the new bags. The artifacts, depending on type, were then analyzed in house or sent to specialized professional experts to be analyzed. Pollen, flotation, and radiocarbon (C-14) samples were also sent to specialized professionals for analysis. All analysis was conducted following approved methods and procedures.

Ceramics were analyzed by C. Dean Wilson, while petrographic analysis of ceramics was conducted by David V. Hill. Faunal remains were analyzed by Nancy J. Akins. Macrobotanical remains recovered from flotation samples and charcoal were analyzed by Mollie S. Toll and Pam McBride. Richard C. Holloway analyzed the pollen samples. The geomorphology of LA 120945 was studied by Glenn Greene of Stratigraphic Services. I analyzed lithic artifacts and ground stone following procedures outlined in the OAS analysis handbooks. Archaeomagnetic dating of the site was conducted at the Archaeomagnetic Laboratory at the Office of Archaeological Studies. Radiocarbon samples were analyzed by Beta Analytic, Inc.

FINDINGS AND CONCLUSIONS

The data recovery efforts at Laguna Gatuna (LA 120945) focused on the cultural affiliations, site structure, subsistence, and resource procurement represented at the site. Also investigated were the prehistoric environment of the area and the role that prairie fire may have played in local environmental change. Radiocarbon (C-14) and archaeomagnetic samples were used in combination with lithic artifact and ceramic data to aid in determining cultural affiliation at the site level. The range of site activities and their relationship to site structure or function are based on artifact, pollen, and macrobotanical analyses. Subsistence and resource-procurement patterns in the Laguna Gatuna area were examined by inferences derived from the assembled data sets.

Although the precise dating of the Laguna Gatuna site was not one of the primary goals of the original research design (Zamora and Oakes 1999), precise dates not only aid in the assessment of site use-life, population movements, settlement patterns, and community organization, but also provide insight into any connection between the site and the burning episode (prairie or grass fire) known to have taken place.

Stratigraphy

Because of earlier site modification caused by trenching for the fiber optic cable, the remaining portion of the bisected dune was the only area of the site within the right-of-way that contained both a cultural deposit and intact stratigraphy. Excavation defined five strata within the dune. These were assigned consecutive numbers that were used in the excavation notes and site drawings. No intact cultural strata were found within the existing highway right-of-way outside of the immediate area of this dune.

Stratum 1 is a fine, tan, culturally sterile, sandy, eolian deposit. This stratum comprises a large portion of the upper dune material and makes up the topsoil layer across most of the site. The depth of Stratum 1 ranges from 1 to 35 cm.

Stratum 2 is a fine, pinkish tan, dense, eolian deposit. Located directly below Stratum 1 in the area of the dune, this culturally sterile stratum represents an earlier dune episode. It ranges in thickness from 5 to 30 cm.

Stratum 3 is an uneven charcoal lense that acts as a demarcation line between the earlier buried ground surface and the later deposits. Although there was some discussion over whether or not this was really charcoal and not organic material (see Appendix 1), charcoal was collected from this stratum and used for radiocarbon (C-14) dating. This stratum represents a prehistoric episode of prairie fire. The charcoal that marks this stratum occurs as a constant nonuniform presence between Strata 2 and 4 and is visible for acres in areas of erosion and arroyo cuts. Artifacts are not actually present within this stratum but occur directly beneath it. Stratum 3 varies in depth from 1 to 12 cm.

Stratum 4 is a sandy, dark brown loam. This material, directly below Stratum 3, is a prehistoric A horizon, directly below the earlier ground surface represented by Stratum 3. Some areas of Stratum 4 exhibit evidence of oxidation from the fire represented by Stratum 3. The leaching of charcoal is also apparent within this stratum. No artifacts are present within Stratum 4, which is culturally sterile. The thickness of this stratum varies from 24 to 55 cm in depth.

Stratum 5 is a fine, reddish-yellow silty sand. This stratum also contains flecks of caliche and is culturally sterile.

The recorded stratigraphy can be coordinated with the geomorphology report by Glen Greene (see Appendix 1). Greene found that Stratum 2 actually has a remnant soil B horizon that postdates the site occupation (the associated A horizon had been removed by erosion). Stratum 3 was found by Greene to be a prehistoric ground surface: the discolored area below the charcoal stain is the prehistoric A horizon associated with site use. Stratum 4 is the prehistoric B horizon, also associated with site use.

One interesting and unusual aspect of LA 120945 is the presence of buried soils (Figs. 3-5). A geomorphologic description and analysis of these buried soils was prepared for this project by Glen S. Greene of Stratigraphic Services in Santa Fe (see Appendix 1). Recognition of buried soils is often problematic at archaeological sites. Not only do they seldom occur, but visually some can easily be mistaken for cultural deposits, as was the case at LA 120945. This is particularly true when they are only exposed in small areas, or when they actually occur in conjunction with archaeological materials.

This site is a perfect example of how problematic this type of situation can be. At LA 120945, the buried soil of Stratum 3 was first interpreted as a cultural deposit. Glen Greene (see Appendix 1) suggested that this soil formed a buried A horizon that had not burned. He felt that what had been considered charcoal was simply decaying organic surface material. Yet upon excavation, charcoal was definitely recovered from the flotation samples collected from Stratum 3, indicating that the soil had indeed experienced an episode of burning prior to being buried.

The criteria used to recognize buried soils, the most important of which are color and the sharpness of soil-

Figure 3. Burned soil surface, looking southeast.

Figure 4. Burned soil layer in eroded area, looking northwest.

Figure 5. Burned soil layer in eroded area, looking east.

historic prairie or grass fire is present along the top of this stratum as a constant, although uneven, presence.

Above this is a stratum of sandy loam material that is slightly lighter in color. This material is the remaining relic B horizon of a second, later (younger) paleosol. Also the product of a substantial period of stabilized soil conditions, the A horizon of this paleosol was removed by eolian erosion. This continuing eolian erosion also created the coppice dunes currently in the site area. At LA 120945 this is characterized by a thick deposit of pink sand that covers the buried soil strata under a large coppice dune.

horizon boundaries, are the same as those used to recognize and describe surface soils. A and B horizons tend to be darker than other soil deposits, even when they are not buried. The boundaries are also sharper between buried A and B horizons than between geologic layering, making them more definite and easier to recognize. However, differences between soil horizons and soil bedding must be discernable if a differentiation between soil horizons is to be made. And because most organic material does not persist in buried A horizons, the buried B horizon usually must also be visible (Birkeland 1974).

Desert soil surfaces tend to be more difficult than other soils to define when they are buried. There are number of reasons for this. For one, these soils tend to be weakly developed. The amount of humus and other organic matter that is incorporated into the soil is usually limited by the erratic rainfall, strong oxidizing conditions at the surface, and strong winds. Other weakly developed desert soils tend to be young soils resulting from erosional deposition. These soils have weakly developed horizons due to the limited leaching and accretion that occurs in desert environments (Bridges 1970).

In the case of LA 120945, the exposed buried soils were particularly complex. Two buried paleosols are exposed at the site. The dark brown, sandy loam material originally believed to be a cultural deposit is in fact a buried A horizon. This well-developed horizon represents a period of stable conditions long enough for organic soil development to a depth of 34 cm. The surface of this stratum is the ground surface utilized during the prehistoric use of LA 120945. Charcoal from a pre-

One unique feature of the buried paleosols at Laguna Gatuna is the charcoal along the top of the buried A horizon. Burnt organic material tends to persist within the archaeological (and in this case the geological) record for considerably longer periods of time than nonburned organic material. Not only does this charcoal increase the visibility of the paleosol surface (the break between the buried A horizon and the succeeding eolian deposit), it also increases our ability to obtain an accurate date for this surface when it burned.

The well-developed buried A and B soil horizons reflect two periods of long-term environmental stability punctuated by at least two environmental events. The first one was a short-term environmental event in the form of a major grass fire. This was followed by a major environmental shift toward a dryer (and presumably warmer) climate characterized by eolian deposition, and seasonal alluvial erosion that continues to the present.

The Role of Fire in Grassland Environments

Fire plays an important role in grassland environments because it is instrumental in both the establishment and the maintenance of grasslands (Axelrod 1985; Collins 1990). Grasslands generally are created through a combination of fire (in the form of lightning strikes) and terrain. Fires first enable the spread of grassland and then aid in its continued existence by restricting any subsequent colonization by woody plants and trees (Axelrod 1985). Grass fires are considered the most thorough method of restricting this ecological succession in grassland (Zwolinski 1990).

Excessive organic litter (dead plant material) in grasslands tends to inhibit grass and seed yields by reducing soil temperatures (Wright and Bailey 1982). This in turn aids in the germination of seeds from woody shrubs, cactus, and trees, enabling them to gain a foothold and spread in grassland areas. Grass fires halt this spread of nongrass plant species by killing them and increasing the vigor of grasses through the removal of this organic litter (Biggs and Knapp 1995; Cox et al. 1990; Howe 1995; Wright 1990). When unassisted by man, grass fires tend to occur in grasslands every five to ten years, usually after a one-to-three-year period of drought. Lightning serves as the main form of grass fire ignition, its effectiveness increasing with aridity (Wright 1990).

Terrain is another major determinant of both grassland development and grass fire effectiveness. Most grasslands are present in areas of flat or low rolling hills. This is essential because of the need for fires to spread across the landscape as part of grassland rejuvenation. In contrast, broken terrain provides protection for woody plants by restricting the spread of fire. Even within grasslands, pockets of rocky broken ground will inhibit fires and support brush and stands of trees. Historically, grass fires on the plains often burned for hundreds of miles when driven by seasonal winds over relatively flat terrain (Pyne 1986).

Desert grasslands are a more delicate version of the grassland ecosystem, with wider swings in their recovery capabilities because of the more common feature of severe droughts. During normal to wet years, most desert grassland grass species can tolerate fire with little long-term effect. However, increased vulnerability during drought years decreases the ability of grass to recovery (Wright 1990). Although it can eliminate woody shrubs, cactus and young mesquite, fire seldom has a directly beneficial effect on grass during periods of drought. It is after the period of drought ends that recovery usually takes place (Wright and Bailey 1982).

The ability of vegetation to recover from wild fires is determined to a large extent by two factors: intensity and seasonality. Fires of short duration or low intensity leave unburned subsurface organic fuel (Zwolinski 1990), because the fire tends to travel through the upper grass canopy (Baker 1990). In contrast, high-intensity fires usually consume all available organic material present (Zwolinski 1990). Many plant species have a particularly hard time recovering from high-intensity fires. In contrast, late-season C4 (or warm weather) grasses tend to recover particularly well from fire. These species of grasses dominate North American plains grassland areas that experience periodic grass fires (Howe 1995).

The seasonality of grass fires also plays an important part in plant recovery. This is particularly true with regard to the persistence of forbs within the ecosystem. These nongrass weedy plants tend to recover with less tenacity than grasses, particularly the warm-weather grass species common to the plains (Howe 1995). Vegetation recovery is far slower with fires that take place in the spring or summer than with grass fires that occur in the fall because of the prevailing North American weather pattern of late spring and summer rains. Although these seasonal rains do aid in grass recovery, their intensity promotes erosion on exposed soil after the fire (Baker 1990). Summer tends to be the period when grass fires are most common. Most lighting-caused grass fires in North America occur in July and August (Howe 1995). The effects of high-intensity grass fires can last for long periods, and large areas of prairie remain bare years after summer burns (Cox et al. 1990; Howe 1995).

Although the direct effects of fire usually only extend at most 3 cm below the ground surface (Risser 1990), fire (particularly high-intensity fire) has been shown to form water-repellent layers within this portion of the soil. Grass fires create water nonwettability by volatilizing organic material in the soils' surface litter. The resulting substances migrate downward and condense to form a water-repellent layer (Wright and Bailey 1982; Brock and DeBano 1990). This resulting nonwettability prevents absorption and increases surface water runoff and subsequent water erosion (Baker 1990; Brock and DeBano 1990; Cox et al. 1990). The degree of soil nonwettability that can occur increases with increased fire intensity. Thicker water-repellent layers form in dry soils, such as those in the Southwest, than in wet soils. Coarse-textured soils are more likely to become water repellent after a fire than fine-textured soils (Wright and Bailey 1982).

Runoff increases after a grass fire, although the increased water yield is variable depending on vegetation type, presence of a water-repellent layer, and degree of slope. Runoff generally decreases as vegetation increases. Generally, grasses decrease runoff to a greater degree than shrubs. Runoff increases after a fire if a water-repellent layer is present, creating water overflow as increased runoff. The steeper the slope, the greater the turbidity and hardness of runoff water after a grass fire. The length of time required for water quality to improve is largely dependent on degree of slope in the burn area (Wright and Bailey 1982). Burned areas also show greater variability in surface evaporation and soil moisture than unburned areas (Biggs and Knapp 1995). This makes the exposed soil more vulnerable to wind erosion as well as alluvial erosion (Baker 1990).

Historically, grass fire has been an important tool of Native Americans both as a hunting aid and to modify habitat. Grass fires were utilized to control the movements of large grazing animals (bison, deer, etc) by driving or surrounding them with fire, or by attracting them to postfire areas of new plant growth (Collins 1990). Small animals were also attracted by the newly sprouting grass and successfully hunted (Pyne 1986).

Knowledge of plant resources was an important element in Native American subsistence. Many plants only bear seed or fruit on new growth. In most grasses burning stimulates new growth, and thus both flowering and seed yield. Crops of grass seed are denser after a grass fire, the fire serving to rejuvenate the plants. The seed yields for warm-weather grasses (C4 grasses) are from 7 to 12 times greater the year after a grass fire, compared to yields in old growth unburned areas (Hulbert 1986). Historically, the seasonal burning of areas known to contain specific types of grasses specifically to enhance their seed yield was a common Native American practice (Collins 1990; Pyne 1986).

LA 120945 is within the desert grassland ecotone. From the prehistoric botanical record it is obvious that it was clearly within this ecotone when the prehistoric grass fire (or burning episode) took place. Recovered charcoal from this fire shows that both mesquite and greasewood/saltbush were present in the general area at that time. The extent of their presence is not known. However, the current preponderance of mesquite is a recent development associated with overgrazing and fire control (Hulbert 1986; Van Devender and Spaulding 1979).

Although it is not possible for us to determine the cause of the prehistoric grass fire at LA 120945, human action cannot be completely ruled out. Fire played an important part, both directly and indirectly, in historic Native American subsistence strategies. While this grass fire could have easily been the result of natural forces, it also could have been connected with activities related to hunting or gathering. Whatever its cause, it took place in this locale sometime around the period of the last use of LA 120945, approximately A.D. 650-700.

Not only did fire serve to invigorate this grassland, it also may have served to set up a reciprocal interaction between humans and the environment (Hassen1985). The Eastern Jornada Mogollon at LA 120945 probably took advantage of the increased grass-seed yields after fires. They may even have set the fires themselves, knowing that fire would improve yields of grass seed and that the new growth would attract game.

The prehistoric prairie or grass fire at LA 120945 was far larger than the site itself. Whether this episode of burning was the result of natural forces, or human acts, is impossible to say.

Site Dating

LA 120945 was dated by a combination of precise (C-14 and archaeomagnetic) and relative (ceramic and lithic) dating methods, which helps correct for shortcomings inherent in these dating techniques. Radiocarbon (C-14) dates are often older than the sites dated because of the added age of the wood itself, while ceramic sequences tend to “float” in time unless anchored to more absolute dates.

Radiocarbon dating is based on measurements of the amounts of specific types of radioactive carbon isotopes within organic material. Samples were subjected to radiocarbon dating by Beta Analytic, Inc. (see Appendix 9).

Three radiocarbon samples were collected: one charcoal sample from the burnt stratum associated with artifacts (Stratum 3); and two from exposed portions of the same stratum in areas away from the site. The dating of all three of these samples was successful. The sample from LA 120945 yielded a date of 1290 plus or minus 50 B.P. This has a 2 Sigma calibrated date of CAL AD 660 to 795 (Cal B.P. 1290-1155). The two samples of charcoal taken from other areas of Stratum 3 had similar dates: 1329 plus or minus 60 B.P., with a 2 Sigma calibrated date of CAL AD 630-815 (Cal B.P. 1320 to 1135); and 1240 plus or minus 50 B.P., with a 2 Sigma calibrated date of CAL AD 670-895 (Cal B.P. 1280-1055). These dates give us a date range for the burning episode at LA 120945 of A.D. 670-790 (for more information see Appendix 9).

Variation in these dates is at least partially the result of differences in the actual age of the wood at the time it was burned. Generally, an “old wood” problem will result in a date that is as much as 50 to 100 years earlier than the feature being dated. However, it is also possible that a number of separate burning episodes are represented by these date ranges.

Archaeomagnetic dating is based on the presence of iron in the soil. Released by heat, these particles line up on magnetic north and remained fixed in that alignment once they cool down. By measuring the angle present, and comparing it to the mapped route of the wandering north pole, a precise date can be obtained for any area of burned earth (such as a hearth). In the case of LA 120945, archaeomagnetic dating was applied to the burned soil of the prairie fire present on the buried prehistoric soil surfaces.

Dates derived from archaeomagnetic testing at LA 120945 are surprising similar to the C-14 results (see Appendix 10). Although not as precise as had been hoped, they show a date of between A.D. 550 and A.D. 700.

It has also been possible to determine a relative date for the site within the Jornada Mogollon cultural period based on the presence of diagnostic artifacts. This allows gross age differences to be determined within the Eastern Jornada Mogollon. The ceramic assemblage from LA 120945, when compared with those from other sites, can be used to assign these sites to a specific culture and reveal their relative dates within that culture.

Ceramics from LA 120945 suggest that the site is early for the Jornada Mogollon. Although the ceramic artifact assemblage for this site is small (six artifacts), the lack of El Paso painted wares suggests that the site dates to the Transitional Late Archaic-early Jornada Mogollon. This is supported by both the small number of sherds, as well as the number of vessels represented by the assemblage.

It has been demonstrated that the number of sherds recovered from Jornada Mogollon sites increases in a progression through time: smaller numbers of ceramics are recovered from early sites, and larger numbers from later sites (Carmichael 1986; Whalen 1994). What is especially important is the number of vessels these sherds represent. The small numbers of sherds found on earlier Jornada Mogollon sites are not the result of single pot drops, but often represent as many vessels as there are sherds. In the case of LA 120945, the six sherds recovered represent three vessels and thus support an early transitional date for the site.

Sites dating to the transitional Late Archaic-Jornada Mogollon period appear in large numbers across areas of both southern and eastern New Mexico at roughly A.D. 700. These sites represent the movement of people onto the plains as part of a newly modified subsistence adaptation that takes place at this time. Whether this is a new population or the cultural shift of a local indigenous population is not known. Similarities in landscape use between this cultural stage and the preceding Late Archaic suggest existing knowledge of the area. In contrast, the presence of brown ware sherds originating in the Sierra Blanca region as a cultural constant at sites from this period argues for regional population movements.

Relative dates can also be obtained for sites with other types of diagnostic artifacts such as projectile points. Three projectile points were recovered at LA 120945. One whole projectile point is a Marcos type, while the other two are small base fragments of San Pedro points. All three of these projectile points date to the transitional Late Archaic-Early Jornada Mogollon period (Carmichael 1986).

LA 120945

A number of features were originally recorded at LA 120945 on the basis of the presence of burnt and oxidized soil. Charcoal-stained soil exposed in the side of a cut dune was especially intriguing. It appeared to be the cultural fill of a pit structure (Zamora and Oakes 1999). All of these presumed cultural features were found during excavation to actually be exposed portions of a single buried prehistoric ground surface that had experienced a prairie (or grass) fire prior to being buried. Although a prehistoric site was present and artifacts were recovered from this buried ground surface, the actual site area of LA 120945 was found to be considerably smaller within the project area than originally believed and contained no cultural features.

LA 120945 is an artifact scatter located on a buried prehistoric ground surface. Artifacts both within and outside of the right-of-way included animal bone and shell, as well as ceramic, lithic and ground stone artifacts. Soon after site use, the site area was burned as part of a regional prairie (or grass) fire. Later it was buried under heavy eolian deposition.

Dating

LA 120945 has been assigned to the transitional Late Archaic-Jornada Mogollon, based on the presence of diagnostic artifacts and corroborated dates. The C-14 dates of charcoal associated with the burnt soil layer at the site are A.D. 670-790. The archaeomagnetic dates are A.D. 550-700 . Diagnostic brown ware sherds and projectile points confirm these dating results.

LA 120945 was originally believed to be a large structural site. Upon excavation, this proved not to be the case. Instead, this site was found to be a single-component, short-term use area forming part of a larger site area. Since this larger site area is outside of the project area, we can only surmise its complete form. However, based on the portion of the site excavated, we believe that LA 120945 represents repeated, possibly seasonally based, short-term use.

The transitional Late Archaic-Early Jornada Mogollon affiliation of LA 120945 is confirmed by the radiocarbon date from the site (Appendix 9), A.D. 670-790. This is the date of the prairie (or grass) fire, not the site occupation itself. However, the closeness of these dates with the cultural period represented by the artifact assemblage essentially dates the site. These dates are still within the range of the transitional Late Archaic-Jornada Mogollon period. The closeness of the three dates suggests there is little in the way of an old wood problem at this site, but the slight differences in the dates may be a by-product of the ages of the wood that was burned.

Based on the ceramic assemblage, Wilson (Appendix 2) dates the site to before A. D. 1300, due to the lack of painted ceramics. However, the small num-

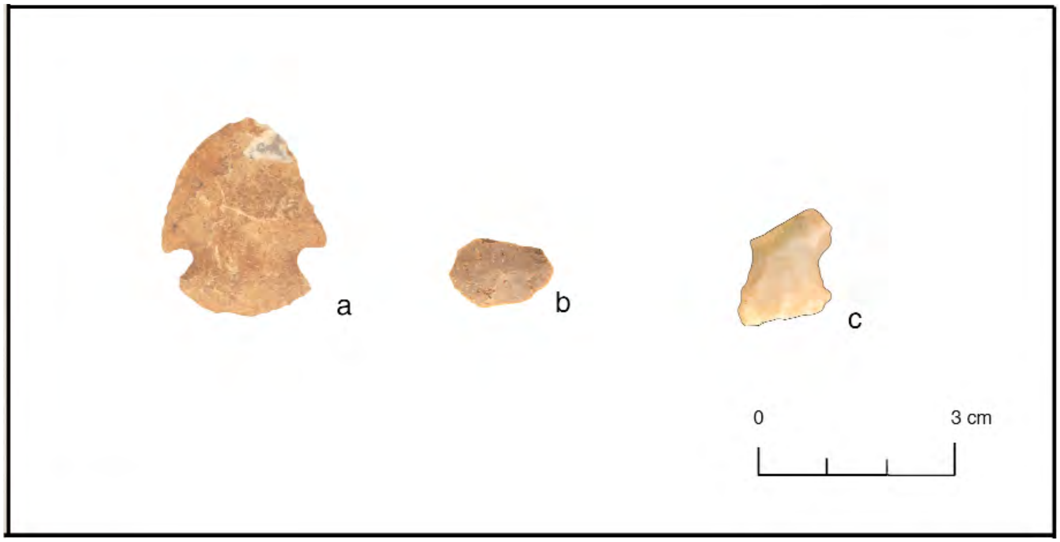

Figure 6. Projectile points.

ber of sherds (six) versus the number of vessels represented (three) suggests an early transitional Late Archaic-Jornada Mogollon date of A.D. 700 for the site. The recovered ceramic artifacts exhibit the expected lack of range in ceramic types for the period. Based on these dates, LA 120945 can be assigned to the early Huerco phase (Sebastian 1989). This period (dating prior to A. D. 900) corresponds to the 18 Mile phase in Jelinek's (1967) Middle Pecos sequence.

The projectile points recovered from LA 120945 are typical of the transitional Late Archaic-Early Jornada Mogollon period (Fig. 6). This form of relative dating, along with the other dating methods used, allows us to assign this site to the early Jornada Mogollon, or more specifically, the transitional Late Archaic-Early Jornada Mogollon period.

Site Structure

Site structure can be determined for a site based on the range and types of activities that may have been conducted at that locale. On-site activities can be deduced from the locations and functions of site features. Descriptive information on features, combined with analysis of the associated artifacts and other cultural material, can assist in determining feature type. In the case of sites such as LA 120945, where no features are present, site structure can be deduced from the form of the artifact assemblage and from faunal and floral remains.

The small size of the site (within the project area) suggests it served as a short-term resource procurement area. However, the large artifact assemblage coupled with the range of artifacts present argues for repeated long-tern (or seasonal) intensive use of the area (Adams 1978). This is further supported by the large total overall size of LA 120945. The revelation that LA 120945 was a seasonal short-term procurement site and not a pit structure village changed the thrust of investigations but not its overall focus, which was to determine the site's structure and the activities represented.

While the lack of sheet trash suggests that the site was used for only a short period of time, the large overall size of the site outside of the right-of-way suggests repeated use of the area over a period of time. Since repeated use is often indicative of seasonal use, this suggests the repeated use of the area by the same or related groups for resource procurement. It is very likely that these activities centered on plant resources and were supplemented by hunting. The occurrence of discarded ground stone artifacts indicates repeated site use (Schlanger 1991).

Pollen samples were collected from the surfaces of the single piece of ground stone recovered during the excavation, a basin metate fragment. Pollen recovered from the metate's use-surface could indicate the type of plant processed. Ambient pollen from the other surfaces of the metate could indicate environmental aspects of the period of site use. In addition, macrobotanical samples were collected from a number of areas of the site as flotation samples. These studies focused on the identification of plant remains and their significance with regard to economic and subsistence practices. This form of analysis is not limited to plants utilized for food. Weaving baskets and matting or making twine may also be indicated by this type of analysis.

No pollen was present in any of the samples analyzed (see Appendix 8), but the macrobotanical analysis yielded substantial information. Macrobotanical remains show that vegetation in the area during the period of its occupation and at the time of the burning episode was similar to that currently present (see Appendix 7). This is not to say that the ratios of these plant types were also similar during this earlier period. Although mesquite and snakeweed were present when the burning episode took place, the area was probably primarily prairie grassland. Only the presence of intact grassland sod would explain the ability of the vegetation to produce the intense heat indicated in the stratigraphic record of the area.

Analysis of the charcoal collected from LA 120945 shows it to be primarily mesquite, with some saltbush/greasewood. This is true of charcoal samples collected from three different areas of the burnt soil layer, which show that the vegetation of the site area at the time of the prairie fire was similar to what occurs there today, with differences in the degree of occurrence (Van Devender and Spaulding 1979).

The transitional Late Archaic-Early Eastern Jornada Mogollon occupation of the site is the sole component within the project area, although both earlier and later components may be present outside of the project area. This suggests that some aspects of Jornada Mogollon culture may have remained constant, despite regional adaption to different general environments. LA 120945 is on the southern edge of Laguna Gatuna, suggesting that the site location is the direct result of the proximity of Laguna Gatuna, a permanent water source. There is some evidence that Laguna Gatuna may have contained fresh water at the time of the site's occupation (see Appendix 6).

Because LA 120945 was a seasonal short-term procurement site, evidence of fewer activities should be present at than at a habitation site, with a longer period of use. This is not to suggest that all activities represented had equal importance for the population. Two activities stand out in importance: hunting and hunting-related activities, and the processing of wild-plant seed.

Site activities can be investigated by analyzing the artifacts present (Phagan 1986). Faunal remains are indicative of the range of faunal resources utilized by the population of a site. Evidence of hunting, to at least a limited degree, is present in both the faunal remains and artifacts from LA 120945. The condition of the projectile points recovered from the site is characteristic of hunting. The recovered point bases indicate that the rehafting of darts took place at the site.

The hunting of a variety of animal species can also be extrapolated from the presence of bone and even shell. Although the recovered faunal remains from LA 120945 contain a variety of animal species, the majority of the faunal remains recovered are rabbit (including jackrabbit and cottontail). These two species comprise 59.5 percent of the total assemblage, if probable rabbit bone is included (see Appendix 6). This indicates that these two species played an important role in the diet of the site inhabitants. Coupled with the large number of processing-related tools, particularly scrapers, this suggests that the processing of this game was taking place at LA 120945.

Additional data related to game processing includes the range of cutting and scraping tools within the lithic artifact assemblage (Phagan 1986). The large number of scrapers and the presence of gravers suggest a skinning and butchering tool kit. While it is possible that any processing may have involved other materials such as plant products, the faunal evidence indicates that hunting a range of large and small animals could have a focus of activity at this locale.

The presence and types of faunal remains, especially in light of the high utilization present on the site lithic artifacts, indicates the types and forms of faunal consumption. The faunal remains recovered from LA 120945 are overwhelmingly rabbit. There is evidence of processing on some of the better-preserved bone. It is likely that small animals such as these were returned to the site whole and processed there.

The other species in the assemblage, such as deer and badger, may represent opportunistic kills. However, the variety of species in the faunal assemblage is characteristic of other sites in the area, particularly those dating to the Archaic period (see Appendix 6).

Freshwater mussel shell is also present at LA 120945. Freshwater mussels are a common food source in the site area, commonly occurring at sites in the region. Historically, the Pecos River has been considered the closest source for these mussels (Wiseman 1985). Their presence at LA 120945 indicates that wild foods could have been gathered as far away from the site as the Pecos River, 48 km to the west.

While the Pecos River could be the primary source of the mussels found at LA 120945, it may not be the only source. Two of the three species of freshwater mussel common to southeastern New Mexico also inhabit the still water of lakes and ponds (see Appendix 6). Thus, it is possible that mussel shell at LA 120945 came from nearby Laguna Gatuna during the site's occupation, and that the lake contained fresh water at that time.

The second major activity pursued at LA 120945 was seed processing. This is indicated by the presence of a basin metate, which has been shown to relate to the processing of wild seeds (Lancaster 1984). Macrobotanical analysis shows that mesquite was present during the site occupation, making mesquite beans one possible foodstuff. The area also appears to have been primarily grassland, suggesting that grass seed may have been one focus of wild-plant collection.

Although wild-grass seed is usually considered the main item gathered in this area, acorns and mesquite beans are also possibilities. With a permanent water source at Laguna Gatuna, other plant seeds, fruits, and vegetal resources may also have been available in the immediate area (Castetter 1935). This is particularly true if Laguna Gatuna contained fresh water, as suggested by the presence of lake-dwelling freshwater mussel shell at LA 120945 (see Appendix 6). The opportunistic collecting and processing of insects, which historically utilized basin metates (Sutton 1988), also cannot be ruled out.

An added determinant of site structure has been the variety of vessel forms occurring in a site's ceramic assemblage. Unfortunately, the sherds are of such a small size that although the number of vessels (3) could be determined, the forms of those vessels could not (see Appendix 2).

Lithic artifacts are another method of identifying activities that may have been pursued at LA 120945. Specific forms of flakes are produced by different lithic material reduction strategies. Core flakes are produced on Jornada Mogollon sites as expedient and disposable tools. Biface flakes are produced during biface reduction, commonly in the production of specialized formal tools. Formal tools are produced for specific functions, although their use may not be limited to a single action. Lithic tools wear down during use. Although attempts to show that forms of wear are task-specific have proved inconclusive (Brose 1975; Moore 1996), general interpretations of the range of activities represented by the lithic assemblage are possible.

The overall pattern during the transitional Late Archaic-Jornada Mogollon period is toward greater technological diversity within the lithic artifact assemblage. This is characterized by a wider range of formal and expedient tools made in a number of ways, including bifacial and unifacial reduction manufacturing strategies. Bifacial reduction, usually restricted on Jornada Mogollon sites to the making of formal tools, has an extremely limited presence at LA 120945, given the number of formal tools present within the artifact assemblage. Greater production of formal tools would be indicated by a larger than expected number of biface flakes within the lithic artifact assemblage. This is not the case at LA 120945, where there is little evidence that tool production was taking place at the site. Of a total of 41 tools, 23 are expedient tools comprised of utilized flakes, and 18 are formal tools.

We would expect a larger number of expedient tools on a Puebloan site, of whatever cultural affiliation. This unusually heavy emphasis on formal tools suggests that the site is early (or transitional) for the Jornada Mogollon, indicating a corresponding emphasis on hunting-based specialized activities. These included not only hunting, but also game butchering and processing. While gravers are known to be used for wood as well as bone, the presence of gravers associated with scrapers at LA 120945 suggests that they were used in processing game. Gravers are used to cut a groove in a bone, allowing it to be split. This action was done both to obtain the marrow and as part of the utilization process of the bone itself, particularly for making tools.

The low utilization rate of both core and biface flakes as expedient tools at LA 120945 represents the pursuit of specialized activities, rather than the broad-based subsistence patterns commonly associated with Puebloan sites (whether Jornada Mogollon or Anasazi). Both cutting and scraping are represented in the lithic artifact assemblage. Animal processing is likely, based on the existence of scrapers and knives. This includes the processing of bone (as indicated by the gravers) and possibly the processing of leather.

Limited knapping of lithic materials took place at LA 120945, at least in the portion of the site that was excavated. What stone knapping that did occur was most likely connected with the maintenance of, not the production of, tools. Tool production was probably centered at a different locales, possibly the winter village location. If tool production did occur at LA 120945, it was not within the project limits.

The processing of available plant material (based on the site location near an area of permanent water and including the use of reeds, willow, etc.) may have also taken place, although no evidence of any riparian plant species was found in the collected macrobotanical samples. Macrobotanical data derived from flotation samples collected from the site suggest a range of vegetation similar to what is currently present within the site area.

The combination of artifacts present at LA 120945 is indicative of a transitional Late Archaic-Early Jornada Mogollon seasonal resource procurement site dating to the early Hueco phase. Analysis of the artifact assemblages suggests that subsistence was probably based on a combination of hunting animals and gathering wild plants. Additional activities involved in the maintenance of a small community can probably be assumed to have taken place at LA 120945, including the making and repair of clothing and equipment. This range of activities and the divisions of labor they represent suggest a population of both men and women. This, in turn, indicates that a family-based social group used the site.

The lack of trash indicates that at least the portion of the site within the right-of-way was used for only a relatively short period of time. However, the large overall size of the total site area (if we include the site area outside of the project area) suggests long-term repeated use of the area.

Resource Procurement

There has been a tendency to model Eastern Jornada Mogollon subsistence on hunter-gather use of the region. The Mescalero Apaches in particular had a form of subsistence analogous to that postulated for the Jornada Mogollon (Gallagher 1979; Wiseman 1996). This hunter-gather analogy is problematic given the variety of ceramic-era sites in the region. In the case of early transitional Late Archaic- Jornada Mogollon sites like LA 120945, however, it does seem to be an applicable model. At a transitional site from the hunter-gatherer subsistence base of the Late Archaic, there should be a greater emphasis on these activities than we would expect from the later Jornada Mogollon.

Another tendency has been to downplay the importance of agriculture when dealing with the ceramic cultural period in this area of New Mexico (Sebastian 1989). For transitional Late Archaic-Early Jornada Mogollon sites such as LA 120945, this may not be problematic. Although the early stages of domesticated plant utilization do occur during this period, their effect may have been minimal, serving more as a supplemental food source than as a main aspect of subsistence. This would be especially true in the case of a short-term resource-procurement site such as LA 120945.

Short-term procurement areas are a common occurrence among the Eastern Jornada Mogollon (Leslie 1979; Oakes 1985). These sites are usually associated with the task-specific gathering of plant foodstuffs (Oakes 1985). This type of site occurs in the area at a much greater frequency than habitation sites (Leslie 1979; Whalen 1979; Wiseman 1996).

Usually considered more characteristic of the Archaic periods, small, short-term resource-procurement areas associated with the gathering of wild plants are also a common feature in Puebloan culture. Historically, wild foodstuffs were utilized to supplement diets despite the cultivation of domesticated crops (Adams 1978; Ellis 1988). This is true of wild foodstuffs and plant material collected for other purposes, such as grass or reeds for basketry, medicinal plants, and plant material used for dyes or pigments (White 1962).

For the historic Pueblo Indians, in most cases, the collecting of wild plants took place as a day trip or at most a trip of several days from the village (White 1962). The location of LA 120945 on the eastern plains suggests that these people were operating out of a seasonal base camp in the area. This is also indicated by the small size of the site compared to the more common large gathering locales (Oakes 1985). The exact location of any settlement related to LA 120945 remains unknown. The presence of ceramics from the Sierra Blanca region to the northwest suggests that these people had a direct connection to, or at the very least, contacts with that area.

If the focus at LA 120945 was the gathering of wild plants (such as grass seed), it is likely that when members of the community (most likely women) were not occupied with their usual duties in camp (like the possible processing of game), they pursued other gathering activities.

The lithic artifacts may be a further indication of the gender of the site's inhabitants. Projectile points indicate hunting, an activity generally associated with males. The lithic tools that were recovered at LA 120945 are all tools associated with the killing and processing of game. Typically among the Pueblos, the hunting of large game is a male activity, while the processing of game is associated with women (except when the processing takes place away from the camp or habitation). In contrast, the gathering and processing of plant material are activities usually associated with women (White 1962). The combination of lithic tools used in hunting and animal processing with ground stone associated with seed (and maybe insect) processing suggests that the inhabitants of LA 120945 were a mixed group of men and women.

LA 120945 may have served as a short-term camp site associated with hunting and gathering. The processing of wild seed and small game could be actively pursued at the same site. It is therefore logical that bands would travel out from the seasonal village to gather wild seed and hunt, perhaps staying away for up to several days or a week at a time. LA 120945 could represent the short-term procurement area, or camp site, of just such a group.

Subsistence is rarely an either/or proposition. Rather it is the utilization of a range of resources, differing only in the direction of its emphasis. In a transitional period such as that represented by this site, an even wider range of resource use may be present as a culture redefines its procurement priorities.

The artifact assemblage at LA 120945 could reflect just such a form of resource procurement. While the site is identifiable as Eastern Jornada Mogollon, the combination of elements within the artifact assemblage suggests a subsistence strategy with an emphasis on specialized hunting and gathering rather than an agriculturally dominated subsistence base. As an early transitional manifestation of the Jornada Mogollon, this emphasis on hunting is also likely to be broad-based rather than restricted to a single species.

Although there is no evidence that maize was cultivated at LA 120945, this is a possibility given the site's position near what may have been a permanent water source (Carmichael 1986; Hard 1983; Leslie 1979). However, the lack of trough metates and two-handed manos argues against the processing of maize at the site, suggesting that any maize consumed was already present in a processed form and had probably been brought to the locale (Lancaster 1984). Groups on the northern plains historically transported maize, whole kernel and ground meal, to supplement their summer diets (Ludwickson 1975; Matthews 1877; Will and Spinden 1906). This could have also been the habit in this area, although the early date of LA 120945 argues against maize having a significant role in subsistence.

An alternative view would be to consider LA 120945 a seasonal camp primarily connected with nongame resource procurement. In this scenario, the faunal bone at LA 120945 simply represents the opportunistic killing of game to supplement the diet of the group involved in the collecting of locally available vegetal material or foodstuffs (Harrington 1967).

While the hunting of game may have served as one focus of activity at LA 120945, a second focus seems to have been the gathering and processing of locally available wild seed. The one broken, worn ground stone artifact indicates that this is one possibility. Grass seed and mesquite beans are two possible local flora resources (Harrington 1967). Oakes (1985) found similar evidence for the specialized large-scale gathering of a specific wild foodstuff (in this case acorns) in her work at Hackberry Lake.

Insects and other available foodstuffs may have further supplemented the diet of the site's population, although there is no direct evidence of this. None of the usual evidence for broad-based hunting and gathering that would be present at a permanent habitation site is present at LA 120945. This is especially apparent given the site's location adjacent to the potentially enriched, oasis-type environment of a permanent or even semi-permanent water source.

Jornada Mogollon sites containing pit structures and small surface room blocks are known in the southeastern plains region of New Mexico (Bullock 1999; Leslie 1979; Zamora 2001). LA 120945 differs from these sites by representing repeated use in a nonstructural setting, and in its lack of features. The repeated use of a site by Puebloan people familiar with the area suggests seasonal use, as does the short time frame for reuse represented by the portion of the site excavated. Seasonality at LA 120945 is also apparent in the site's artifact assemblage. The presence of ground stone artifacts commonly associated with the harvesting of wild seed suggests possibly a mid-to-late summer occupation.

Based on the type of temper present within the recovered ceramics, the ceramic assemblage at LA 120945 suggests that the site was occupied by a population with established contacts in the Sierra Blanca region. While this may simply be an indication of regional trade, given the seasonal nature of the site, it could also indicate a permanent winter residence near the Sacramento Mountains, Sierra Blanca (Farwell et al. 1991; Kelley 1984), or even near Roswell at a site such as Bloom Mound, the Henderson Site, or Rocky Arroyo (Wiseman 1993). Such seasonal variation in habitation is well known for the northern plains, particularly with groups such as the Pawnee and Arikara. These groups lived in permanent villages of earth lodges except during the summer months, when the population traveled onto the plains for communal bison hunts.

The excavated portion of LA 120945 formed an extremely small percentage of the total site area, making any interpretation little more than conjecture. However, based on the assembled data sets and related regional information, this may be an accurate picture of seasonal population movement and site function.

Alternatives to the usual manner of dealing with Eastern Jornada Mogollon sites reveal a broader, more complicated range of cultural behavior than is generally assumed for a prehistoric Puebloan culture. Rather than a pattern of either hunter-gatherer or sedentary subsistence, intricate combinations of the two are a more realistic approach in dealing with these sites. The result is a wide range of site types, with specific types tailored to the utilization of specific resources or to specific situations. LA 120945 could represent such a response to a specific need.

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APPENDIX 1: PALEOSOLS

Glen S. Greene

During excavation at LA 120945, a dark stratum was observed in the stratigraphic section. Questions arose concerning the origins of the stratum and its place in the local geochronology.

The National Resources Conservation Service office in Lovington, New Mexico, was visited on July 27 for information about the soils in the area of LA 120945. A report concerning the geomorphology of the area was obtained from the Bureau of Land Management in Carlsbad, New Mexico, on July 28, 1999. I was assisted in the field by J. David Ing.

Pedology and Geochronology

The soil survey for Lea County describes the broad generalities of soils associations in the area (Soil Survey Staff 1974). Soils in the vicinity of LA 120945 are assigned to the Largo-Pajarito complex (0-3 percent slopes). These soils are formed on alluvial fans and plains and on foot slopes having outcrops of Triassic red-bed material. At LA 120945, stabilized sand dunes have formed on plains areas and comprise the surficial soils.

Largo soil series are fine-silty, mixed (calcareous), thermic Typic Turriorthents. They are of the order entisols, having little or no horizon development, loamy and clayey with a regular decrease in organic matter content with depth, and bearing a toric (hot and dry) moisture regime (Soil Survey Staff 1974:23).

Pajarito soil series are coarse-loamy, mixed, thermic Typic Camborthids. They are of the order aridisols (arid and semiarid desert soils) that have no arfilic horizon present and possess a cambic horizon (fine sand or loamy fine sand) (Soil Survey Staff 1974:23).

Field Investigations

A reconnaissance was made to determine if the dark stratum in the dune at the site is present and at the same elevation in other dunes in the stabilized dune field. Shovel testing throughout nearby dunes proved that the dark stratum was within 30 cm of the same elevation. With that information at hand, the main excavation profile was cleared of sandy colluvium to expose a clean profile.

A stratigraphic section was drawn (Fig. 1), accompanied by pedogenic descriptions and measurements. All measurements are made upward from the bench surface left from the excavation, so that Unit 1 is the lowest in the profile.

Unit 1 3A Horizon

0-34 cm, common medium to large distinct mottled brown (7.5YR4/3d) to light brown (7.5YR6/4d) sandy loam; weak medium to very coarse subangular blocky; slightly hard, slightly sticky, nonplastic; few medium to coarse vesicular roots; very few thin colloidal stains on mineral grains; moderately alkaline; abrupt smooth to wavy boundary. Numerous krotovinas (animal burrows) are present in this horizon.

Unit 2 2E Horizon

34-48 cm strong brown (7.5YR5/4d) sandy loam; weak coarse to very coarse subangular blocky; slightly hard, slightly sticky, nonplastic; very few fine to medium tubular roots; very few thin colloidal stains on mineral grains; moderately alkaline; very abrupt smooth boundary.

Unit 3 C Horizon

48-120 cm, few laminar distinct pink (7.5YR7/4d) to reddish yellow (7.5YR6/8d) mottled fine to medium sand; structureless; loose, nonsticky, nonplastic, many very fine to coarse tubular roots; moderately alkaline.

Previous Research in the Area

Reference information for the regional geology was obtained from Dane and Bachman (1956). This was supported by Thompson (1980), in which a detailed geomorphological description of the region is presented by Fred Nials (Thompson 1980:9-23, 164-166). Nials presented the geological sequence as follows:

Holocene: Modern sand, "Puebloan" soil, "Altithermal" soil
Pleistocene: Pleistocene soil, indurated caliche
Pilocene-Pleistocene: Ogallala Formation
Upper Triassic: Dockum Group
Permian: Dewy Lake-Pierce Canyon Formation, Rustler Formation

Only the Holocene part of the geologic sequence is of concern to this report. Nials describes three deposits as follows: "The 'Atithermal' soil-forming interval was followed by a period of intense eolian erosion and deposition, during which much of the 'Altithermal' soil and sediments appear to have eroded away and redeposited elsewhere as dune sands. Subsequent to the erosion, a period of relative stability occurred, during which organic material began to accumulate as the initial stages of soil development, forming a weak A horizon. Minor amounts of local eolian erosion continued during soil formation, during which organically stained sediments were redeposited locally. This is indicated by multiple or unusually thick organic horizons in some localities.

"This weak, incipient soil has been informally called the 'Puebloan' soil because of the common association of ceramic sites with the soil. This name is strictly informal and does not imply that the soil formed during the Puebloan occupation(s). No formal name has been applied to this soil at present" (Thompson 1980:20-21).

Nials further describes the "Puebloan" soil as follows: "0-87 cm. Modern eolian cross-bedded laminated, fine, medium and occasionally coarse sand. This depositional unit has not been subdivided, although numerous distinct beds characterized by slight color and/or texture changes were observed. These beds are discontinuous and irregular in shape and thickness. Color of the upper 2-18 cm is strong brown (7.5YR5/6d). Below this the sediments appear to be slightly browner, although no consistent distinction could be made on the color chart. No pedogenic structure was observed. Dry consistence soft, moist very friable, non-sticky, non-plastic. Occasional krotovinas are filled with materials from underlying horizon. No acid reaction. Boundary very abrupt to abrupt, irregular.

87-133 cm. Reddish brown to yellowish red (5R4/5m) brown (7.5YR4.5/4d) fine-medium sand of eolian origin. Consistent soil when dry, very friable moist, non-sticky, non-plastic. No acid reaction. Boundary very abrupt, irregular. This horizon represents organic accumulation in eolian sand deposited on the underlying caliche.

The upper 87 cm are the result of modern coppice accumulation in nearby mesquite bushes. The lower boundary of this deposit is erosional and the underlying horizon is variable in thickness as a result.

The lower sand (87-153 cm) has been modified by pedogenic accumulation and represents a short period of stability and non-erosion" (Thompson 1980:165-166).

Observations and Conclusions

The dune exposure examined at site LA 120945 is comparable to the Holocene sequence described by Nials (Thompson 1980). I interpret the profile as shown in Fig. 1 as follows:

Unit 1 represents a relief pedogenic A horizon of stable conditions that existed long enough for organics to accumulate to a depth of 34 cm. Krotovinas formed within, but no root casts were observed. This may be a relict mollie epipedon.

Later and above Unit 1, a second pedogenic sequence, Unit 2, formed. This was followed by eolian erosion that removed the A horizon. Visible now is only the remaining relict albic horizon, the eluvial E. A faint, extremely thin, discontinuous dark stain was observed in the upper portions if this stratum. This is an organic stain that moved downward from the A horizon, which is now gone.

Unit 3 is the modern stabilized dune field with grasses (Gramineae) and mesquite (Prosopis) as modern floristic cover of the coppice zone.

Units 1 and 2 are a bisequum of two paleosols. No evidence of combustible materials was observed in either of the paleosol remnants. Although Nials did not identify any of his deposits as paleosols, there are close similarities in his descriptions of "Puebloan" soil in color, texture, consistence, structure, thickness, soil chemistry, and the presence of krotovinas. I suspect, then, that the "Puebloan" soil is the remnant of these two paleosols. Unit 3 is comparable to Nials's description of Modern Sand. Finally, it is concluded that there was no incident of burning exposed in the profile examined at LA 120945.

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APPENDIX 2: CERAMIC ANALYSIS

C. Dean Wilson

Excavations from LA 120945 resulted in the recovery of only six sherds from three vessels. All of these sherds exhibit plain and undecorated surfaces, brown to gray pastes, and granitic temper. Pottery with similar characteristics dominates most sites in the Carlsbad area (Hill 1996a, 1996b; Katz and Katz 1985, 1992; Leslie 1979; Wilson 2001).

Previous studies have employed various conventions to assign types to plain ware pottery from sites in the Carlsbad area. Some have used variation in paste and surface manipulations in brown ware pottery to identify previously defined regional types of the Jornada Mogollon area, including Jornada Brown and El Paso Brown (Katz and Katz 1985; Kelley 1984; Mera 1943; Runyon and Hendrick 1987; Wilson 2001). Others have simply placed all brown wares into a single plain brown ware category (Hill 1996a, 1996b; Whalen 1994). During such studies, variation within Plain Jornada Brown Ware forms was documented through the examination of a variety of descriptive attributes recorded independently of type. Finally, the assumption of local pottery production in the easternmost extension of the Jornada Mogollon, has resulted in the definition of type varieties for this region (Leslie 1979). Varieties of Jornada Brown defined for the Eastern extension are assumed to reflect spatial variation in available local materials, especially clays and sandstones that were used for temper (Leslie 1979). An example of a variety defined include southern area brown as a local variant of El Paso Brown found primarily in the Maroon Cliffs-Nash Draw area. This variety is characterized by local red clay and sandstone temper from the Permian formation, which results in a friable paste and easily weathered surface (Hill 1996a, 1996b; Leslie 1979).

Using criteria utilized during other recent OAS studies (Wilson 2001; Wiseman 1996), brown sherds from LA 120945 were assigned to previously identified types of the Jornada region based on temper and surface manipulation. This resulted in the assignment of one sherd to El Paso Brown (16.7 percent) and the five other sherds to Jornada Brown (83.3 percent). Other information documented during this study includes temper type, interior and exterior surface manipulation, and vessel form. In addition, three sherds were submitted for petrographic analysis (see Hill, this volume).

The one sherd assigned to El Paso Brown is a body sherd, which is unpolished on both sides and 4.5 mm thick. Paste is dark throughout to cross section, and temper was defined as a leucocratic igneous rock. Petrographic analysis indicates fine-grained granite or alpite.

The remaining five sherds were classified as Jornada Brown. These sherds may be derived from two vessels. All five sherds represent body sherds that had been polished on both sides. They all exhibited dark gray to gray-brown pastes and brown to yellow-red surfaces. The size of temper noted in these sherds varies, resulting in three sherds having leucocratic igneous temper and two with fine crystalline igneous. Two sherds assigned to this type were subjected to petrographic analysis. Both of these sherds were tempered with materials derived from granite (Hill, this volume). The vessel thickness recorded for these sherds ranges from 4.3 to 6.9 mm and averaged 5.4 mm.

The small sample size of sherds from this site drastically limits possible interpretations. While a large assemblage containing brown wares without decorated types would indicate an occupation sometime between A.D. 200 and 1050, the absence of later decorated types may simply reflect the small size of the sample, and the absence of Chupadero or other decorated types postdating A.D. 1050 may be coincidental. Thus, these sherds could reflect occupation dating to any of the span associated with the very long Jornada Mogollon occupation of this area. While it is possible that pottery could have been produced in areas near Carlsbad, the basic technology and temper characteristics may indicate the presence of intrusive igneous rocks from the Lincoln County porphyry belt (Hill, this volume), and thus may reflect trade ware from areas in the Sierra Blanca region to the northwest.

Such conjecture is supported by the very small number of sherds relative to a much larger sample of lithic artifacts. Thus, these few sherds may reflect the occasional utilization of generalized plain utility ware vessel forms obtained from Jornada groups to the west or northwest. Thus, a very mobile lifestyle, not strongly dependent on agriculture where pottery was occasionally utilized but not extremely important, is represented. Similar distributions are commonly found in the earliest pottery sites throughout the Southwest, where very low frequencies of similar plain brown ware are present. Thus, trends noted during the present study may reflect either an occupation fairly early in the Jornada Mogollon sequence or the long persistence of generalized mobile adaptions, which only occasionally employed pottery vessels.

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APPENDIX 3: PETROGRAPHIC ANALYSIS OF THREE BROWN WARE SHERDS

David V. Hill

Three brown ware sherds were submitted from LA 120945 for petrographic analysis. Examination of the ceramics was oriented toward variability in the ceramic fabric composition and microstructure of the sherds.

Methodology

The ceramics were analyzed with a Nikon Optiphot-2 petrographic microscope. The sizes of natural inclusions and tempering agents were described in terms of the Wentworth Scale, a standard method for characterizing particle sizes in sedimentology. These sizes were derived from measuring a series of grains using a graduated reticle built into one of the microscopes optics. The percentages of inclusions in untempered ceramics were estimated using comparative charts (Matthew et al. 1991; Terry and Chilingar 1955). Studies have been conducted regarding the reproducibility of determinations using these charts. Given the limited amount of inclusions that may be present or identifiable in ceramics and the variable size of the sherds in the sample, the comparative method for assessing the amount and size of materials found in ceramics has been found as useful for archaeological ceramic petrography as point counting.

Analysis was conducted by first examining the ceramic collection and generating a brief description of each of the sherds. A second phase was the creation of classification groups based on the similarity of the paste and temper between sherds. This process also allowed for the examination of the variability within each paste grouping. Additional comments about the composition of individual sherds were made at this time.

Descriptions

FS 54, Brown Ware

The paste of this sherd is a medium reddish brown color. The paste contains 15 percent very fine to fine, sized intrusive rock fragments. A few medium-sized grains are also present. The igneous rock is fine-textured and compositionally classifiable as a fine-grained granite or aplite. Isolated mineral grains within the ceramic body were derived from the syenite. The syenite consists of equigranular subhedral laths of potassium feldspar with quartz and sparse plagioclase. Some of the potassium feldspar laths are contained subophilitically within the quartz grains. Two medium-sized fragments of potassium feldspar are also present as isolated grains. The feldspars appear fresh, with only a few grains displaying slight weathering. A few fragments of brown biotite are also present in the paste.

FS 54a, Brown Ware

The paste of this sherd is a medium yellowish brown color and contains angular fragments of potassium feldspar, including one grain of microcline, and quartz. One of the potassium feldspar grains displays micrographic intergrowths with quartz. The sample is quite small and may not be representative of the paste of the parent vessel. As observed, the paste contains about 10 percent fine to coarse-sized isolated mineral grains and several fine to coarse-sized granite grains. The granite consists of equigranular subhedral laths of potassium feldspar with sparse plagioclase, quartz and brown biotite. The biotite has partially altered to clay minerals and hematite, staining the rock fragment a reddish color. Some of the plagioclase within the potassium feldspar laths are contained subophilitically within the quartz grains. The paste contains medium to coarse-sized rounded brownish red inclusions, which represent biotite that has altered to hematite and clay minerals.

FS 57, Brown Ware

Like the previous sample, the size of this sherd is only about 4 mm across and so may not be characteristic of the parent vessel. The paste of this sherd is a medium brown color and contains predominately isolated grains of quartz and potassium feldspar that range from fine to coarse in size and make up about 10 percent of the paste. Potassium feldspar and quartz are present in about equal amounts. The potassium feldspar grains appear fresh. Two potassium feldspar grains display slight alteration through sericitization. Judging from the amount of quartz present in the paste of this sherd, the grains were derived from a granite.

Discussion

The three sherds were derived from three separate ceramic vessels. FS 54 contained igneous rock fragments derived from a fine to medium-grained granite or aplite. FS 54A and FS 57 were tempered using a medium to coarse-grained intrusive igneous rock, also classifiable as granite. The differences in the texture and color of the paste indicated that FS 54A and FS 57 were derived from different vessels. Coarse, isolated grains of quartz, potassium feldspar, and plagioclase suggests a granitic source for these inclusions. Also, the reddish inclusions observed in FS 54A were not present in FS 57.

The presence of granite in brown ware ceramics from LA 120945, like brown wares from other sites in southeastern New Mexico and west Texas, indicates contact with or movement of peoples from the mountainous country to the northwest. Intrusive igneous rocks from the Lincoln County porphyry belt fall into the compositions observed within the current specimens (Kelly and Thompson 1964). Previous petrographic study of ceramics from Laguna Plata has also reported granite in some of the brown wares. The ceramics examined during the current project would fall within the classification of Temper Type I (Haskell 1977:220).

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APPENDIX 4: LITHIC ARTIFACT ANALYSIS

Peter Y. Bullock

Analysis of the 434 lithic artifacts from LA 120945 was accomplished with two basic goals in mind: to provide a descriptive summary of the lithic artifacts from the site, and to provide information that could be used to address the general research problems outlined in the data recovery plan for LA 120945.

The descriptive lithic artifact analysis attempted to identify patterns in prehistoric artifact production and use. Interpretation of this Jornada Mogollon site is based on the assumption that Puebloan (whether Jornada Mogollon or Anasazi) lithic assemblages reflect an effort to satisfy two needs: the production of flakes that can be utilized without further modification as expedient tools, and material that can be further modified into formal specialized tools. This is in contrast to the Archaic tradition, which commonly follows a biface-based lithic technology. With the Archaic, the goal is the production of specific tools with explicit distinctions made between tools and waste, and modified tools are common.

It has been argued that expedient tools, flakes utilized with little or no modification, are the result of material abundance on residential sites. However, they may also represent a convenient, flake-based, domestic lithic technology (Abbott et al. 1996).

The existence of formal tools such as projectile points, drills, etc. within an assemblage implies design directed toward specific tasks or activities. Early stages of both formal tool manufacture and expedient flake production produce flakes that are indistinguishable from each other. The waste flakes produced in the later stages of formal tool production, however, are distinctive biface thinning flakes. Distinctive resharpening, or rejuvenation, flakes are a common by-product of tool maintenance and reuse. Their presence is an indication of actions related to these activities occurring on a site.

The presence of nonlocal, or exotic, materials can be used to postulate spheres of social and economic interaction. Conversely, an absence of nonlocal lithic material may reflect the relative isolation of a population or community.

The research design developed for this site focused on the identification of site activities as a way of inferring site function. This lithic artifact assemblage indicates a range of activities that may have taken place at this site location. Different activities can be inferred from different artifact types and their frequencies of occurrence. Since LA 120945 appears to be a short-term procurement area or camp, a narrower range of activities can be expected than would be found at a residential site or long-term camp.

The guidelines and format of *Standardized Lithic Artifact Analysis: Attributes and Variable Code List* (OAS 1994) were followed in the analysis of lithic artifacts from LA 120945. Definitions used in lithic analysis are can be found in that volume.

Materials

The range of lithic materials used at LA 120945 is remarkably small. The lithic artifact assemblage is comprised of only four material types (Table 1), all of which are available locally (Banks 1990). Chert is by far the most common material (88.2 percent of the assemblage), followed by quartzite (9.0 percent). Silicified wood and metamorphic sandstone are present in smaller quantities.

Material use serves as an indication of human decision making processes with regard to the suitability of materials (Young and Bonnichsen 1985:128). The presence within a site area of tested material or substantial numbers of core flakes exhibiting dorsal cortex can thus illustrate the manner in which this material suitability is determined.

The large number of chert flakes exhibiting dorsal cortex indicates that the reduction of chert took place at this site (Table 2). Chert is present as flakes exhibiting varying amounts of dorsal cortex, suggesting that this material was being utilized for manufacturing tools. Although there is some evidence of the flaking of other materials, this is limited to the small-scale flaking of quartzite. Of the lithic artifact total, 70.9 percent lack any dorsal cortex. This suggests that lithic material suitability testing was conducted, except in the case of chert and perhaps quartzite, at another unknown location prior to its use at LA 120945.

Morphology

Core flakes make up the largest category of artifacts at LA 120945, 97.2 percent of the total assemblage (Table 1). Biface thinning flakes make up 1.4 percent. All other morphological categories constitute 0.7 percent or less.

The high percentage of core flakes can represent core reduction or the manufacturing of flakes for use as expedient tools. Core flakes are present in all material types. This range of occurrence suggests that the creation of core flakes expedient tools was taking place. This form of convenient disposable lithic technology is characteristic of Puebloan sites (Akins and Bullock 1992; Neusius 1988). Only among chert artifacts is there the range of cortex occurrence that might indicate core reduction.

Flake Portion

Numbers of distal and proximal flake portions within an assemblage can be an indication of core reduction or tramping by livestock. An extremely high percentage of distal fragments suggests breakage took place during core reduction. Numbers of distal and proximal fragments that are roughly equal are believed to represent breakage caused by livestock (Moore 1996), as are high percentages of proximal fragments.

The flake assemblage from LA 120945 contains slightly more distal to proximal portions among core flakes (Table 3). While this would normally indicate trampling by livestock, in this case the percentages may have been affected by the burial of the associated ground surface and the episode of widespread burning.

Flake Platform Type

Flake platforms are the remnants of the core or tool from which the flake was struck. Platform types provide information on the level of core reduction technology pursued at a particular site. Cortical platforms are those that contain cortex material, thus representing early stage reduction. Single-facet platforms can occur at any stage of reduction. Multiple-facet platforms represent late-stage core or biface reduction (Moore 1996).

Single-facet platforms are by far the largest category present (60.0 percent; Table 4). Flakes with cortical platforms comprise 28.5 percent of the total. Flakes where the platform is absent totaled 6.1 percent of the assemblage. Multiple-facet platforms were present on 1.4 percent of the assemblage. Crushed platforms made up the remaining 3.9 percent.

Tools

Of the 434 lithic artifacts, debitage used as expedient tools makes up the largest category (56.1 percent). Forty-one artifacts (9.4 percent) are formal tools (Table 5). Of the recovered tools, six scrapers (both end scrapers and side scrapers) make up the largest category (14.6 percent of the total tool assemblage). Other formal tools include gravers (12.2 percent), projectile points (7.7 percent), and drills (4.9 percent). The tool assemblage also contains one knife and one hammerstone.

Three projectile points were recovered at LA 120945. All dart points, they were assigned to temporal categories based on shape and size. One projectile point is a whole Marcos point. The other two projectile points are the bases of San Pedro points. These points are commonly associated in south-central New Mexico with the transitional period of the Late Archaic-Early Formative Jornada Mogollon (Carmichael 1986).

Material Texture

While material selection may depend on local availability, studies have shown different material textural preferences for prehistoric Puebloan and Archaic groups. Paleoindian and Archaic groups usually prefer finer-grained material, while Puebloan groups tend to utilize a wider range and quality of materials (Elyea and Eschman 1985:246).

While utilized debitage occurs in the widest variety of materials, the tendency is for projectile points and bifaces to be made of finer-textured material than most of the other artifacts. This suggests that formal tools are made of material that will enhance their specialized functions (Bleed 1985). An ability to have a sharp edge is valued in materials such as obsidian and chert, for projectile points and bifaces. Materials such as metamorphic sandstone, quartzitic sandstone, and chert are utilized where durability is valued, such as scrapers and choppers. A greater variety of materials are acceptable as utilized debitage, where the main value of the artifacts may be availability and convenience (Lancaster 1986).

At LA 120945 the majority of tools (95.1 percent) are made of chert. While the preference for sharper edges is obvious, coarser material also occurs in the assemblage in the form of quartzite. Utilized debitage is present in both materials at LA 120945.

Material selection for formal tools is also toward sharper edges over durability, although one side scraper is made of quartzite. As we've seen, scrapers dominate the formal tool assemblage at LA 120945. The need for large numbers of scrapers caused by the possibly specialized nature of the site may have resulted in some relaxation of material standards. All of the projectile points at LA 120945 are made of chert.

Discussion

The presence of bifaces, and their percentage within an assemblage, has been used by Kelly (1988:721-723) to differentiate between types of sites. Biface production should take place at residential sites, indicated by the presence of large numbers of bifaces and biface thinning flakes. In contrast, logistical camps and resource procurement areas should have few biface thinning flakes, but large percentages of resharpening flakes and biface fragments.

The frequency of biface thinning flakes is low in this assemblage, as expected for a logistic or resource-procurement site. The small percent of formal tools is typical for a Puebloan site, but we would expect a larger number of expedient tools, which could well represent the Early Formative period Jornada Mogollon. This suggests a nonspecialized range of activities for LA 120945 (Akins and Bullock 1992).

Prehistoric Puebloan sites (both Jornada Mogollon and Anasazi) tend to have fewer lithic artifacts for their size than earlier prehistoric sites. The large number of lithic artifacts from LA 120945 suggests an early or transitional date for this site. However, it is possible that artifact numbers reflect an artifact concentration in the excavated portion of the site.

Gross interpretations can be made of possible activities represented by a site's tool kit of utilized artifacts (Perry and Christenson 1987). Bidirectional wear is traditionally considered an indication of cutting and slicing, while unidirectional wear is thought to indicate scraping. Experiments conducted by Brose (1975) and Vaughan (1985) show that wear patterns are unreliable indicators of use (Moore 1996). However, it should be possible to determine, however roughly, the types of activities pursued at this site (Christenson 1987:77).

Projectile points indicate that hunting took place at LA 120945. Point bases suggest that the rehafting of arrows took place at this locale. The presence of scrapers suggests that animal butchering, and possibly leather processing, were all carried out at this site. The hammerstone may be related to the striking of flakes to use as expedient tools, although it could have also been used to sharpen (pit) the surfaces of ground stone tools.

Gravers are used in the splitting of wood and bone. They are used to score and cut a groove down the side of a bone or piece of wood. Once the cut is deep enough, the material is split in two. Wood may have been worked at LA 120945, since rehafting may have taken place, and split bone was not recovered.

Many of the expedient flake tools utilized in this assemblage could also have functioned like the formal tools. They may, however, represent different unknown activities, such as the processing of vegetal foodstuffs. These expedient tools could be the result of unplanned actions, such as the repairing of clothing or equipment.

One of the three projectile points found at LA 120945 is a Marcos point. Although many typologies assign Marcos points to the Late Archaic, accepted dates for the Late Archaic vary to such an extent that Marcos points could easily extend into the Early Formative period of the Jornada Mogollon (Carmichael 1986). Of course it is also possible that this was made earlier and reused at this site.

The other two are the bases of San Pedro points, a projectile point type associated in south central New Mexico with the Early Formative Jornada Mogollon period (Carmichael 1986). Both of these bases are broken at the notches, a commonly occurring break in hunting activities. The presence of bases is indicative of reshafting at a site. This type of point fragment is prevalent where point replacement has taken place. All of these points were tied into the occupation of LA 120945 and were recovered from the buried ground surface. Both of the fragmentary points presumably had been broken during the period the site was occupied.

Analysis of the lithic artifacts from LA 116503 shows that an expedient core-flake technology was utilized by the site's inhabitants. This served to supplement the tool use that was taking place. Any initial core reduction is limited to locally occurring materials. Little tool manufacturing was carried out, as indicated by the small number of biface thinning flakes. There is little evidence that the biface-reduction technology related to the manufacture of tools took place at this locale.

Assemblages from excavated Puebloan sites tend to reflect an expedient lithic technology, with flakes produced for use as short-term, disposable tools (Vierra et al. 1993). Formal tools, other than projectile points, are rare (Larralde 1994; Vierra et al. 1993). LA 120945 reflects this type of assemblage. Bifacial reduction is generally associated with Archaic and Basketmaker II or other early Puebloan sites (Moore 1996) and seems to have been replaced as part of the general cultural shift to a sedentary agricultural lifestyle. This shift seems to have taken place at a later period among the Jornada Mogollon, especially the Eastern Jornada Mogollon, than among groups such as the Mogollon and Anasazi.

This assemblage suggests that LA 120945 had a population with a transitional lithic tradition utilizing an expedient core reduction technology. Bifacial reduction seems to have been maintained exclusively for the extensive production of formal tools.

Nonlocal material is nonexistent at LA 120945 (Banks 1990). The lack of nonlocal material indicates little long-distance procurement associated with this site, suggesting that it functioned to some extent in isolation. However, this may be a skewed view of site structure, since only a small portion of the site was excavated.

Table 1. Lithic artifact by material

Type	Metamorphic Sandstone		Chert		Quartzite		Silicified Wood		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Core flake	5	100.0	372	97.1	39	100.0	7	100.0	423	97.4
Biface thinning flake			6	1.6					6	1.4
Biface (third) stage			3	0.8					3	0.7
Multipurpose core			1	0.3					1	0.2
Hammerstone			1	0.3					1	0.2
Total	5	100.0	383	100.0	39	100.0	7	100.0	434	100.0

Table 2. Percent of cortex by material type

%	Metamorphic Sandstone		Chert		Quartzite		Silicified Wood		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
0			229	59.8	18	46.2	4	57.1	251	57.8
10	1	20.0	27	7.1	4	10.3			32	7.2
20	1	20.0	22	5.7	1	2.6			23	5.5
30	1	20.0	18	4.7	4	10.3	2	28.6	25	5.8
40			16	4.2	1	2.6			17	3.9
50	1	20.0	5	1.3	1	2.6	1	14.3	8	1.8
60			11	2.9	1	2.6			12	2.8
70			15	3.9	4	10.3			19	4.4
80			18	4.7	3	7.7			21	4.8
90			11	2.9	1	2.6			12	2.8
100	1	20.0	11	2.9	1	2.6			13	3.0
Total	5	100.0	383	100.0	39	100.0	7	100.0	434	100.0

Table 3. Flake type by portion

Type	Whole		Proximal		Medial		Distal		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Core flake	379	98.7	18	94.7	1	100.0	25	100.0	423	96.4
Biface thinning flake	5	1.3	1	5.3					6	3.7
Total	384	100.0	19	100.0	1	100.0	25	100.0	429	100.0

Table 4. Flake type by platform type

Type	Absent		Cortical		Single		Multiple		Crushed		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Core flake	26	100.0	122	100.0	257	100.0			18	100.0	423	98.6
Biface thinning flake							6	100.0			6	1.4
Total	26	100.0	122	100.0	257	100.0	6	100.0	18	100.0	429	100.0

Table 5. Artifact function by material type

Function	Chert		Quartzite		Total	
	No.	%	No.	%	No.	%
Hammerstone	1	2.4			1	2.4
Utilized debitage	22	56.4	1	50.0	23	56.1
Drill	2	5.1			2	4.9
Graver	5	12.8			5	12.2
Scraper (end)	1	2.4			1	2.4
Scraper (side)	4	10.3	1	50.0	5	12.2
Knife	1	2.6			1	2.4
Projectile point	3	7.7			3	7.3
Total	39	100.0	2	100.0	41	100.0

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APPENDIX 5: GROUND STONE ANALYSIS

Peter Y. Bullock

One ground stone artifact was collected at LA 120945. Analysis followed *Standardized Ground Stone Artifact Analysis: A Manual for the Office of Archaeological Studies* (OAS 1994).

The artifact, a metate fragment, was found at the top of Stratum 4 at the level of the buried ground surface, within the excavated portion of the cut dune. It was made from a fine-grained sandstone from the Delaware Basin formation, available locally in exposed portions of Rattlesnake Ridge area to the east, and the San Simon Scape and Antelope Ridge areas to the south and east (Nicholson and Clebisch 1961).

The metate fragment is a side piece of a deep basin metate. Made of fine-grained sandstone, the stone was shaped by pecking prior to use. There are two use-surfaces on this fragment. The primary use-surface is a deeply worn basin. The extreme depth of this surface (4.8 cm) may have led to breakage. The secondary use-surface is on the side, opposite the original use-surface. This surface is flat and was used after the metate was broken. It may have been used for a more specialized task such as smoothing leather, wood, or bone, or perhaps as a palate for pigment.

The one ground stone artifact from LA 120945 provides important information on subsistence and other possible activities pursued at this locale. Basin metates are common artifacts at Jornada Mogollon sites. Mano form is used to distinguish metates used to grind cultivated maize from those used to grind gathered wild seed (Bartlett 1933). Two-handed manos are generally connected with the efficient grinding of maize, while one-handed manos are generally assumed to reflect the processing of wild seed (Lancaster 1986; Whalen 1994). Unfortunately, no manos were recovered at LA 120945.

Two-handed manos and basin metates are the major elements of an Jornada Mogollon grinding technology oriented toward efficient domesticated maize processing (Bartlett 1933; Lancaster 1986). These artifacts are usually portable and are found in archaeological contexts that show they were carried to short-term use areas and used inside of structures or in sheltered areas (Schlanger 1991). Basin metates, unlike trough metates, are rarely found as built-in features. They are usually found out in the open, sitting on the floors, or stored leaning against the walls of structures.

The co-occurrence of basin metates and two-handed manos, designed for the efficient grinding of domesticated maize (Bartlett 1933; Wright 1990), appears on Jornada Mogollon sites in the early Mesilla phase (Whalen 1994). This development is a logical outgrowth of the use of basin metates with one-handed manos to process gathered wild seed (Bartlett 1933; Shelly 1994; Wright 1990). The lack of manos or mano fragments from this site limits our ability to determine the type of seed (wild or cultivated) ground at this locale. However, without any evidence of maize processing at LA 120945, it is more likely that this metate was used to process wild seeds.

Manos (particularly two-handed manos) and metates had to be resharpened frequently. Bartlett (1933) suggests this had to be done every five days when the tools were in constant use. This resharpening was done by pecking the grinding surface with a hammer stone to rejuvenate the grinding surface. While there is some evidence of pecking on this artifact, it is not related to surface rejuvenation.

The metate fragment from LA 120945 is the result of transverse breaks. A common form of breakage, transverse breaks usually occur when these types of artifacts are being resharpened and the worker fails to provide enough support for the artifact (Shelley 1983). However, in this case the metate was used until the base of the basin became so thin that the metate broke. When these artifacts are broken they may be discarded immediately, stored for future use, or utilized in some other manner (Schlanger 1991).

Ground stone artifacts can have additional uses after their lives as grinding implements end. This artifact has evidence of secondary grinding wear, indicating it was used later for another purpose, perhaps to grind clays or paints, to smooth the surface of leather, or possibly to shape bone or wood.

Schlanger (1991) has found that there is a correlation between the locations of mano and metate fragments on a site and the length of that site's occupation. Broken mano and metate fragments only occur in fill and trash deposits when the site occupations or structures last longer than the use-life of these tools. The broken artifacts are first relegated to a floor surface. Through time these artifacts accumulate, waiting for a future use, and are then removed from the structure to designated trash locations (midden areas, fill, sheet trash, etc). In the case of LA 120945, the broken ground stone artifact remained on the site area after its occupation ended. At a short-term use-area such as LA 120945, this fragmentary artifact probably made the transition to trash status.

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APPENDIX 6: FAUNA

Nancy J. Akins

Of the 121 bone artifacts recovered from LA 120945, almost a quarter (N=30) was found in four flotation samples. Specimens from the flotation samples represent a variety of taxa, with the majority in the small mammal group. Unknown small mammal and probable lizard are the only new taxa introduced by the flotation samples.

Once returned to the lab, bone was cleaned by dry brushing and identified using comparative collections at the Office of Archaeological Studies. Each piece of bone or specimen was computer coded using an established format. Variables recorded include the field specimen (FS) number; a lot number assigned to each line within an FS; the count or number of specimens that fit the description recorded on that data line; whether an identification is certain or less than certain; whether bones were articulated, from the same individual, or pieces of the same bone; the taxon; the element or body part; the side; the part of the element represented; how complete the element is; the age of the animal; the criteria for assigning age; the presence and degree of environmental alteration; the presence and location of animal alteration; the color and location of thermal alteration; the type and location of processing; and whether the specimen is also a tool, an ornament, manufacturing debris, or pigment stained.

Taxonomic identifications were made as specifically as possible. Specimens that could not be identified to the species or family level were placed in an indeterminate category based on the size of the animal and whether it is mammal, bird, or undetermined. Specimens were counted only once, even when broken into a number of pieces during or after discovery.

Taxa Recovered

At least eight species are represented in this small assemblage (Table 1). Most of the sample is comprised of fragments identifiable only to the size of the animal (N=78, 64.5 percent). Small forms are in the majority, with substantially fewer in the medium and large range. A single piece of eggshell and nine freshwater mussel shells complete the assemblage.

Unidentified

A range of body sizes is represented in the highly fragmented bone (Table 1). Most fall in the small mammal range and are from large rodents or rabbits. When broken down by body part, fragments of the denser and more readily preserved long tubular bones are more common than flat bones (crania, vertebrae, carpals, tarsals, etc.). All of the unidentifiable specimens are small fragments representing less than a quarter of the element (Table 2). Burning is most common with the small mammal and medium to large mammal taxa. For both, there is a range of burning, some of which could have occurred after the bone was discarded and buried and some from extended burning, probably through human intervention (Table 3).

Medium to Large Rodent

Only one bone is definitely from a rodent. It is a tarsal, probably an astragalus fragment from a large rodent between woodrat and prairie dog in size. It is burned black.

Rabbits

Although only small numbers of cottontail and jackrabbit bones were found, these constitute the bulk of the identified assemblage. Both are also represented in the flotation samples.

The desert cottontail (*Sylvilagus audubonii*) is the only species of cottontail found in Lea County (Findley et al. 1975:87-89). In desertic areas, cottontails are found where brush is heaviest. Draws or valleys where mesquite and grass grow are favored. They forage on the ground, in shrubs, and in tree branches. Cottontails often take over burrows abandoned by other mammals and seek shade when temperatures are high and are most active at dawn and dusk. Young are born starting in late March through October and disperse from the nest at three weeks of age. They mature in 80 days and live about 1.5 years (New Mexico Fish and Game Species Account 16, 18, 19, 21).

Black-tailed jackrabbits (*Lepus californicus*) are found throughout the state below the ponderosa zone, with the greatest densities in grasslands and deserts. In southern Arizona their principal diet is grass, mesquite, and cacti. Young are produced from mid-February through mid-September and mature at eight months for males and a year for females. Full size is reached in about 28 weeks (New Mexico Fish and Game Species Account 10, 13, 17, 21).

Juveniles, or animals from two-thirds to adult size with unfused epiphyses, were found for both rabbit species (Table 4). For cottontails, epiphyses close in the first winter (Chapman et al. 1982:111), while in jackrabbits the proximal humerus, one of the later closing epiphyses, closes between 10 and 12 months (Dunn et al. 1982:137).

None of the jackrabbit bones are burned, and one cottontail bone is calcined (Table 3). Completeness varies from complete to fragmentary for both (Table 2). With only one burned rabbit bone, it is possible that some of the rabbits postdate the prehistoric use of this site.

Badger

Badgers (*Taxidea taxus*) are common in grasslands, where they excavate into burrows for ground squirrels, kangaroo rats, and other fossorial prey (Findley et al. 1975:308). Badgers are solitary and mainly nocturnal, spending days underground (Lindzey 1982:656-657).

The badger element recovered from LA 120495 is most of a tibia that is unburned and was found on the surface. It is quite possible this is a recent addition to the site, possibly all that remains of a road kill.

Artiodactyls

Very few artiodactyl bones were found. Two from medium-sized artiodactyls are small pieces of a tooth and a femur shaft fragment. A proximal metatarsal fragment was from the surface, and it could be from a modern road kill.

Both the mule deer (*Odocoileus hemionus*) and the white-tailed deer (*Odocoileus virginianus*) inhabit parts of Lea County, as does pronghorn (*Antilocapra americana*). The historic distribution of deer suggests the white-tailed deer ranged closer to the site area than mule deer (Findley et al. 1975:329, 331, 333).

Turtle

The ornate box turtle (*Terrapene ornata*) occupies a wide range of habitats and are most abundant in grasslands, where they can burrow. Hibernating between April and October, they often occupy the burrows of rodents (Degenhardt et al. 1996:105-106).

The piece of carapace recovered from this site was unburned and from the surface strip. The texture of the bone suggests it is from a juvenile rather than a full-grown turtle.

Lizard

A first phalanx, probably from a large lizard, was found in a flotation sample from the burned layer. The identification was not confirmed, but lizard was the best alternative after mammals, birds, and toads were ruled out. It is complete and unburned. Several large lizards inhabit Lea County. The leopard lizard (*Gambelia wislizenii*), the Texas horned lizard (*Phrynosoma cornutum*), and the great plains skink (*Eumeces obsoletus*) are the largest of the lizards found in southern Lea County (Degenhardt et al. 1996:137, 151, 239).

Nonvenomous Snake

Two vertebrae from a snake were found on the surface and are probably recent additions to the site area. Colubridae species found in Lea County include the glossy snake (*Arizona elegans*), the western hooknose snake (*Gyalopion canum*), the common kingsnake (*Lampropeltis getula*), the milk snake (*Lampropeltis triangulum*), coachwhip (*Masticophis flagellum*), gopher or bullsnake (*Pituophis melanoleucus*), the longnose snake (*Rhinocheilus lecontei*), the plains black-headed snake (*Tantilla nigriceps*), and the checkered garter snake (*Thamnophis marcianus*) (Degenhardt et al. 1996:262ff.).

Freshwater Mussels

Three species of freshwater mussel have been recovered from archaeological sites in southeastern New Mexico. These include the Texas hornshell (*Popenaias popei*), the Pecos pearly mussel (*Cyrtonaisas tampicoensis*), and *Lamsilis terres*. Information on the distribution of these three species in New Mexico is very sparse. In Texas, the hornshell has a fairly limited distribution, probably because the fish that hosts the larva of this species also has a limited distribution. It has been reported from mud-sand habitats and has not been reported north of Brantley Reservoir. The Pecos pearly mussel occurs in a wide variety of stream bottoms ranging from soft mud to large pebbles and in both fast-running and quiet water of lakes, rivers, and small streams. The third species also has a limited habitat preferring mud-sand or firm sand (Murray 1985:A24-A25). Only small nondiagnostic pieces of shell were recovered from this site. One or more of these mussels could have inhabited the nearby freshwater lake and been readily available to both human and animal predators. Otherwise, these may have been transported from the Pecos River.

Taphonomy

Vertical Distribution

To evaluate the assemblage and assess how much is related to the prehistoric remains, taxa and taphonomic variables are divided into three groups. Those collected from the surface comprise the first group, and those found during surface-scraping activities, the second. The third group is from the fill below the surface strip (subsurface). This last group includes the 30 specimens recovered in the flotation samples.

A third of the large mammal bone was from the surface (Table 5), as was some of the cottontail, and the only badger, deer, and snake. The single incidence of carnivore gnawing is also from the surface. All surface bone exhibits some form of weathering. Most are sun bleached or checked (small cracks that occur on bone that is exposed). Only one has pitting or corrosion, which results from properties of the soil (Table 6). None are burned, and a proportionately large amount are complete or nearly complete elements (Table 7).

Surface-strip materials are more like the subsurface group. The eggshell and most of the freshwater mussel are from the surface strip (Table 5). Bone exhibits a range of environmental alteration (Table 6). Almost a third are unaltered, while pitting or corrosion is the most common alteration. The only carnivore tooth puncture and rodent gnawing are from the surface strip. Burning is nearly absent; the one exception is a calcined cottontail bone (Table 7). Like the subsurface group, most are fragmentary.

Almost half of the subsurface group (Table 5), 30 of the 63 specimens, came from the flotation samples. Pitting or corrosion is again the most common environmental alteration, with more checked and polished bone than the surface strip (Table 6). Polish or rounding can occur when there is movement of material in the soil or from wind or water abrasion. It is also caused by digestive processes that blunt the edges of bone. The two can be difficult to distinguish. Much of the burning from the subsurface assemblage is in the flotation bone (Table 7). Heavy or sooted is the most common burn, followed by a light scorch, then dry burn.

Environmental Alteration

Alteration of bone by environmental factors can occur between the time the animal dies and its bones are buried, or after burial. Left exposed, bone cracks or splits parallel to the fiber structure (checking). This is followed by flaking (exfoliation) of the outer surface and more extensive splitting before splinters of bone begin to loosen and fall off. Finally, only large splinters of fragile bone remain. In experiments, this process can take from 6 to 15 years for large mammals and 4 to 5+ years for small mammals, if burial does not arrest the process (Lyman 1994:355).

Natural abrasion, producing a smoothness and polish, results from trampling of bone on sandy sediments, and polish and rounding from fluvial transport and boiling (Lyman 1994:381-383). None of the descriptions of these kinds of abrasions adequately describe the polished bone found in this assemblage. Surfaces are highly polished and edges rounded but without indications of digestion or boiling such as color change or leaching of collagen.

Once buried, the pH, aeration, water, and bacterial action affect bone preservation. Acidic soil causes breakdown and leaching of exposed surfaces of bone (Lyman 1994:421).

Conditions that result from exposure of bone on the surface and after burial are both found in the LA 120945 faunal assemblage (Table 6). Sun bleaching is primarily found in the surface collection bone (N=5), with a single piece from the surface strip. Checked bone is found in all, indicating some exposure before burial. Corrosion or pitting is most common for the buried bone but does appear on one surface bone, which could have recently been brought to the surface. Polish is found in the surface strip and subsurface bone assemblages.

Animal Alteration

Carnivore and rodent activity (Table 6) are rare. Only one specimen exhibits rodent gnawing, one carnivore gnawing, and one a tooth puncture. Another specimen is sufficiently rounded and discolored to suggest it may be scatological. The vertical location of the carnivore and rodent altered bone suggests these may result from relatively recent activities. Road kills (possibly the badger and the deer) attract carnivores, while vegetation and soft soil along roads and fences encourage rodent burrowing.

Burning

Burning ranges from light scorches to calcined. Heavy or black burned bone is the most common type. Scorched burns are light superficial burns, while charring, smoking, or blackening takes place when the collagen is carbonized. Bone becomes white, or calcined, when all of the organic material is gone. Burning can occur before or after deposition. Bone can burn after it is buried if the soil is dry and contains sufficient organic material. Color changes are the result of excessive heat modifying or damaging the bone through high temperatures or long exposure. It is generally not the result of cooking (Lyman 1994:384-385).

While burned bone is often considered an indication that an animal was eaten (e.g., Nicholson 1993:411), the equation of burning with food items is simplistic and sometimes unwarranted. Intentional burning of bone can be from cooking, disposal of food waste, fuel for fires, or cremation. Bone can burn naturally when it is near a grass, brush, or forest fire, or can burn in situ when there is sufficient organic material in the soil (Lyman 1994:388). Accidental burning and burning that takes place after burial are alternative explanations for burned bone recovered from archaeological contexts.

Experiments utilizing prehistoric-like campfires and bone buried at varying depths in sand and clay substrates find that bone buried 15 cm or more below the fire do not display characteristics of bone exposed to heat. Modern bone with some collagen buried less than 10 cm deep changes color dramatically, while the change in Archaic archaeological bone at the same depth is minimal. Some modern bone buried only 2 to 5 cm deep became calcined. High-intensity, short duration exposure to heat results in multiple surface colors, while long-duration, low-intensity heat leads to uniformity in color. Surface color in Archaic bone was uniform but muted (Bennett 1999:4-5).

Other studies have produced slightly different results. For example, one that put fresh goat bones directly into a fire and buried bone 1 to 15 cm below the coals found burning only in the first 5 cm below the coals, and none were burned beyond carbonization. Calcination was achieved only through direct exposure to fire (Stiner et al. 1995:227, 230, 231).

In an effort to document the differences between bone burned when fresh and when dry, Buikstra and Swegle heated fleshed, green, and dry human and animal bone in a kiln and an open fire. They found that fleshed bone could not become uniformly blackened, that burning flesh always produced some calcination before the remainder of the bone could blacken. Defleshed or green bone became uniformly blackened, and the dry bone coloration could blacken, but this was not as deep or uniform as in the green specimens. Dry bones could retain unburned areas, while other areas became calcined. When heated to a calcined state, there was little color difference between fleshed and green bone. All burned to a white, gray, or blue, while dry bone became light brown or tan with a black, gray, or white core (Buikstra and Swegle 1989:250-252).

These studies suggest that virtually every type of burning found at LA 120945 (Table 3)
can occur without human intervention. They also suggest that natural burning, such as in a grass fire, would not be of sufficient duration to cause all of the burning found or the variety of burn types. Some of the lightly burned or scorched bone and the dry bone burns could have occurred during a brush fire. However, the relatively short duration of such an event would not result in the large amount (relatively speaking) of blackened bone or the heavy to calcined burn. The inevitable conclusion is that some of the bone recovered subsurface, and possibly some of that from the surface strip, is prehistoric debris left with the ceramic and lithic artifacts.

Fragmentation

The majority of the bone recovered is highly fragmented, the proportion increasing with depth (Table 7). A variety of mechanisms probably caused this amount of breakage. Burned bone is more brittle or fragile (Lyman 1994:389; Stiner et al. 1995:235), but this assemblage does not have enough burning to account for all of the breakage. Trampling, weathering, sediment weight, and perhaps processing probably contributed. Unequivocal evidence of processing by humans was absent. A single spiral fracture was noted on a small mammal long bone shaft fragment. Since any number of taphonomic processes can create spiral fractures (Lyman 1994:324), this one remains equivocal.

Discussion

Accepting that at least some of the bone from LA 120945 is archaeological, it can be compared with other faunal assemblages from southeastern New Mexico. Counts are small but do suggest that at least one species of rodent, cottontails, jackrabbits, artiodactyls, turtles, and freshwater mussels were utilized. This, and the overall paucity of bone, fit well with findings for the area.

Examining 17 sites at Brantley Reservoir, mostly Archaic and Late Prehistoric period, Katz and Katz (1985:422-424) found indications of a well-established riverine subsistence orientation. By the Middle Archaic, intensive processing of freshwater mussels in rock-lined pits was evident. Bone was scarce and limited to cottontail and jackrabbit, a few rodents--some undoubtedly postoccupational burrowers--one deer specimen, two fish, and many small fragments, mostly from small mammals (Robertson 1985:A-19-A-23).

One site dating slightly later than LA 120945 and excavated as part of the WIPP project, recovered minimal amounts of bone (N=31) and a considerably larger number of mussels (N=187). Possible deer, possible bison, cottontail, and jackrabbit were identified (Lord and Clary 1985:183-187).

A few sites in the Carlsbad area produced small but varied faunal assemblages. The Champion site, consisting of a ring midden, hearths, and scattered artifacts had an abundance of freshwater mussels along with small numbers of cottontail, jackrabbit, squirrel, prairie dog, woodrat, turtle, and carnivore bones (Gallagher and Bearden 1980:119-120). A highway-related project at LA 29363 found a similar array of taxa, adding bison and bird to the above list (Moga 2001).

In general, most of the survey and excavations to date identify ceramic-period sites as nonstructural open sites that were probably short-term camp sites or locations used for gathering or plant-processing activities (Sebastian 1989:90-92). Unless these sites were used repeatedly, quantities of cultural material did not accumulate. A low-intensity occupation could easily result in the kind of faunal assemblage found at LA 120945.

Table 1. Taxa recovered

Taxon	Common Name or Size	Count (no. from flotation)	Total Percent (% without flotation)
Unknown small	small herp or mammal	1(1)	.8
Small mammal-medium bird	jackrabbit or raven or smaller	1	.8 (1.1)
Small mammal	jackrabbit or smaller	47(20)	38.8 (29.7)
Small to medium mammal	coyote or smaller	3(1)	2.5 (2.2)
Medium mammal	porcupine to coyote	1	1.5 (1.1)
Medium to large mammal	coyote or larger	8(3)	6.6 (5.5)
Large mammal	pronghorn or larger	17	14.0 (18.7)
Medium to large rodent	woodrat to prairie dog	1	.8 (1.1)
Sylvilagus audubonii	desert cottontail rabbit	14(2)	11.6 (13.2)
Lepus californicus	black-tailed jackrabbit	10(2)	8.3 (8.8)
Taxidea taxus	badger	1	.8 (1.1)
Medium artiodactyl	pronghorn, deer, mountain sheep	2	1.7 (2.2)
Odocoileus hemionus	mule deer	1	.8 (1.1)
cf. *Terrapene ornata*	ornate box turtle	1	.8 (1.1)
Sauria?	lizard	1(1)	.8
Colubridae	nonvenomous snakes	2	1.7 (2.2)
Egg shell		1	.8 (1.1)
Peleycopoda	mussel	9	7.4 (9.9)
Total		121(30)	100.0 100.0

Table 2. Taxon by completeness

Taxon	Complete	50-75% complete	25-50% complete	<25% complete
Unknown small				1 100.0%
Small mammal-large bird				1 100.0%
Small mammal				47 100.0%
Small to medium mammal				3 100.0%
Medium mammal				1 100.0%
Medium to large mammal				8 100.0%
Large mammal				17 100.0%
Medium to large rodent			1 100.0%	
Cottontail	4 28.6%	3 21.4%	1 7.1%	6 42.9%
Jackrabbit	3 30.0%			7 70.0%
Badger		1 100.0%		
Medium artiodactyl				2 100.0%
Deer				1 100.0%
Box turtle				1 100.0%
Lizard (?)	1 100.0%			
Snake	2 100.0%			
Egg shell				1 100.0%
Mussel				9 100.0%
Total	10 8.3%	4 3.3%	2 1.7%	105 86.8%

Table 3. Taxon by burning

Taxon	Unburned	Light/ Scorch	Light to Heavy	Dry Burn	Heavy/ Sooted	Heavy to Calcined	Calcined
Unknown small	1 100.0%						
Small mammal-large bird	1 100.0%						
Small mammal	33 70.2%	5 10.6%	1 2.1%		8 17.0%		
Small to medium mammal	3 100.0%						
Medium mammal	1 100.0%						
Medium to large mammal	4 50.0%			2 25.0%	1 12.5%	1 12.5%	
Large mammal	16 94.1%				1 5.9%		
Medium to large rodent					1 100.0%		
Cottontail	13 92.9%						1 7.1%
Jackrabbit	10 100.0%						
Badger	1 100.0%						
Medium artiodactyl	2 100.0%						
Deer	1 100.0%						
Box turtle	1 100.0%						
Lizard (?)	1 100.0%						
Snake	2 100.0%						
Egg shell	1 100.0%						
Mussel	9 100.0%						
Total	100 82.6%	5 4.1%	1 .8%	2 1.7%	11 9.1%	1 .8%	1 .8%

Table 4. Taxa (those with less than mature specimens) by age distribution and strata

Taxon/Strata	No. Juvenile	Percent Juvenile	No. Mature	Percent Mature
Small mammal	2	4.3	45	95.7
Medium to large rodent	1	100.0		
Cottontail	3	21.4	11	78.6
Jackrabbit	1	10.0	9	90.0
Box turtle	1	100.0		
Surface			9	100.0
Surface strip	3	6.8	33	75.0
Subsurface	5	7.4	61	89.7

Table 5. Taxon by stratigraphic unit

Taxon	Surface	Surface Strip	Subsurface	Total
Unknown small			1 1.5%	1 .8%
Small mammal-large bird			1 1.5%	1 .8%
Small mammal		8 18.2%	39 57.4%	47 38.8%
Small to medium mammal		1 2.3%	2 2.9%	3 2.5%
Medium mammal			1 1.5%	1 .8%
Medium to large mammal		2 4.5%	6 8.8%	8 6.6%
Large mammal	3 33.3%	11 25.0%	3 4.4%	17 14.0%
Medium to large rodent			1 1.5%	1 .8%
Cottontail	2 22.2%	7 15.9%	5 7.4%	14 11.6%
Jackrabbit		4 9.1%	6 8.8%	10 8.3%
Badger	1 11.1%			1 .8%
Medium artiodactyl		2 4.5%		2 1.7%
Deer	1 11.1%			1 .8%
Box turtle		1 2.3%		1 .8%
Lizard (?)			1 1.5%	1 .8%
Snake	2 22.2%			2 1.7%
Egg shell		1 2.3%		1 .8%
Mussel		7 15.9%	2 2.9%	9 7.4%
Total	9 7.4%	44 36.4%	68 56.2%	121 100.0%

Table 6. Animal and environmental alteration by strata

Alteration	Surface	Surface Strip	Subsurface	Total
Environmental:				
None		13 29.5%	22 32.4%	35 28.9%
Pitting/corrosion	1 11.1%	26 59.1%	33 48.5%	60 49.6%
Sun bleached	5 55.6%	1 2.3%		6 5.0%
Checked	3 33.3%	2 4.5%	7 10.3%	12 9.9%
Polished/rounded		2 4.5%	6 8.8%	8 6.6%
Animal:				
None	8 88.9%	42 95.5%	67 98.5%	117 96.7%
Carnivore gnawing	1 11.1%			1 .8%
Carnivore tooth puncture		1 2.3%		1 .8%
Scat (?)			1 1.5%	1 .8%
Rodent gnawing		1 2.3%		1 .8%

Table 7. Burning and completeness by strata

Burning/Completeness	Surface	Surface Strip	Subsurface	Total
Burn:				
Unburned	9 100.0%	43 97.7%	48 70.6%	100 82.6%
Light/scorch			5 7.4%	5 4.1%
Light to heavy			1 1.5%	1 .8%
Dry burn			2 2.9%	2 1.7%
Heavy/sooted			11 16.2%	11 9.1%
Heavy to calcined			1 1.5%	1 .8%
Calcined		1 2.3%		1 .8%
Completeness:				
Complete	3 33.3%	3 6.8%	4 5.9%	10 8.3%
50-75% complete	2 22.2%	2 4.5%		4 3.3%
25-50% complete		1 2.3%	1 1.5%	2 1.7%
<25% complete	4 44.4%	38 86.4%	63 92.6%	105 86.8%

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APPENDIX 7: FLOTATION AND RADIOCARBON SAMPLE ANALYSIS

Pamela J. McBride and Mollie S. Toll

LA 120945 is a small artifact scatter that dates to approximately the late A.D. 670s to A.D. 790 and fits into the transitional Late Archaic-Jornada Mogollon period. The area may have been the site of a seasonal camp from which foraging and hunting activities took place. A spring-fed lake is across Highway 180 from LA 120945 and may have been a water source for humans and wildlife prehistorically. Animals coming to drink at the lake could have been easily targeted by prehistoric hunters. Stillwater clamshell found at the site attests to the collection of freshwater shellfish from the lake. Potash mine waste and the lowering of the water table has greatly increased its salinity in this century.

Prehistoric plant resources would have included lacustrine species as well as plants common to the semidesert grassland and Chihuahuan desert scrub described by Brown (1994). A vegetation survey was conducted by Toll in June 1999. The area is composed of dune fields formed by blowing sand and populated primarily by mesquite (*Prosopis*; Table 1). Greasewood (*Sarcobatus*) was the most common shrub in the right-of-way, while threadleaf sage (*Artemisia filifolia*) and snakeweed (*Gutierrezia*) were rare. Muhly (*Muhlenbergia*) and grama (*Bouteloua*) grasses were observed growing within the right-of-way, and dropseed and muhly were growing in washes, along with globemallow (*Sphaeralcea*) and possible seepweed (*Suaeda*). Desert willow (*Chilopsis*) was restricted to the roadside, and narrow-leaf yucca was scattered throughout the area.

No features were associated with the artifact scatter. A burned layer that extends across a wide area is evidence of a brush fire that occurred at about the time of prehistoric use of the site. Flotation and radiocarbon samples were collected and analyzed from the burned layer at several elevations both outside and within the right-of-way.

Charred plant remains include goosefoot, pigweed, purslane, unidentifiable seeds, and a few unknown plant parts. Goosefoot and purslane were identified in three of the five samples with charred remains (Table 2). Noncharred plant parts included goosefoot and purslane seeds, but grass seeds and nonreproductive parts were the dominant unburned remains recovered, along with mesquite leaves. Wood from flotation and C-14 samples was predominately mesquite with small quantities of saltbush/greasewood (Tables 3 and 4). Results of flotation wood and C-14 analysis suggest that the plant environment has not changed considerably since the time of the fire. The recovery of mesquite and saltbush/greasewood charcoal is a fairly accurate reflection of modern shrub distribution. Greasewood is probably more in evidence on the landscape today because of increased salinity and the drop in the water table (Nicholson et al. 1961).

The nonwood remains from flotation samples may reflect slight changes in local conditions. Although pigweed, goosefoot, and purslane plants were not noted in the vegetation survey, these plants are widespread endemics in the region. What is surprising is the lack of charred grass remains from flotation samples when grass parts are such a large percentage of the modern contaminants present in samples. The absence of prehistoric grass remains is probably not a reflection of environmental change. According to Brown (1994:127-129) and Dick-Peddie (1993:19-20), alterations in the floral structure of semidesert grassland are a relatively recent phenomenon as a result of factors such as overgrazing and fire suppression in the last century. Chihuahuan desert shrubs like mesquite and snakeweed have widely replaced native grasses. One theory is that there never was a fire, and that the dark soil layer observed at LA 120945 is an organic stain that moved downward from the now absent A horizon (Greene 1999). The organic stain could have been formed partially by fire, which would explain the presence of charred seeds in the stratum. The presence of charred seepweed seeds suggests wetter conditions in the past (perhaps a reflection of a higher water table at the time of the fire). Seepweed is usually found growing along the banks of washes or streams in saline or alkaline soils (Martin and Hutchins 1980:593-595), as was the case with the seepweed observed during the vegetation survey.

Table 1. Plant collection list

Ethnobotany Lab No.	Parts Collected/Description	Identification
20	Immature pods, mature catkins, roots, wood. This is nearly the only woody species growing outside the right-of-way. Grows on hummocks.	*Prosopis glandulosa* var. *torreyana* Mesquite
21	Branch and flower. Largest tree around (about 12 ft in diameter and height). Just at roadside. A couple of blooms, many buds.	*Chilopsis linearis* Desert willow
22	The most common shrub in the right-of-way (a few little ones outside right-of-way)	*Sarcobatus vermiculatus* Greasewood
23	Rare in right-of-way	*Artemisia filifolia* Threadleaf sage
24	Rare in right-of-way	*Gutierrezia sarothrae* Snakeweed
25	Woody flower stalk, leaf, last year's flower stalk with some seeds	*Yucca* Narrow-leaf yucca
26	Grass growing mainly in washes outside right-of-way	*Muhlenbergia* Muhly
27	Grows mainly in washes outside right-of-way. Spikey hairs at ligules.	*Sporobolus cryptandrus?* Dropseed
28	This grass seems like about the only other plant growing along with mesquite on the hummocks.	*Muhlenbergia* (a different muhly from No. 26?)
29	Tiny sprouts all less than 4" high, perhaps just now emerging. Found only in areas of washes where water is slowest moving or forming pools. Found with high-density *Sporobolus* and new sprouts of *Gutierrezia* and *Prosopis*.	*Sphaeralcea?* Globemallow
30	Growing along the margin of a big wash	*Suaeda* (?) Seepweed
31	Growing in recently disturbed fiber optic pathway in right-of-way	*Atriplex* (?) Annual saltbush
32	Purple-flowered annual (growing in recently disturbed fiber optic pathway in right-of-way)	?
33	"Nasty Russian weed" (presumed introduced, invasive)	?
34	Found in right-of-way	*Muhlenbergia* (another muhly?)
35	Found in right-of-way	*Bouteloua* Grama grass

Other weedy species found in right-of-way: *Verbesina* (not collected).
Other introduced species found in right-of-way: *Salsola, Tamarix*.

Table 2. Flotation results, burn layer

FS No.	FS 17 outside R-O-W, 40 cm below present ground surface	FS 18 outside R-O-W, 20 cm below present ground surface	FS 19 outside R-O-W, 40 cm below present ground surface	FS 20 north of excavated area in R-O-W, 100 cm below present ground surface	FS 52 in excavated area, 151-162 cm below present ground surface	FS 54 in excavated area, 167 cm below present ground surface		Frequency (number of samples)	Percentage of all seeds
Sample volume	4950 ml	6000 ml	4650 ml	3500 ml	2250 ml	1500 ml	4850 ml		
Charred Remains:									
Amaranthus pigweed		0.8						1	10
Chenopodium goosefoot		1.0				2.0	0.2	3	30
Portulaca purslane	1.2	1.8					0.2	3	30
Suaeda seepweed						1.3		1	10
Unidentifiable		0.2 pp					0.2	2	20
Unknown				0.6 pp			0.8 pp	-	
Total Charred Seeds:	1.2	3.6	0	0	0	3.3	0.6	10	100
Uncharred Remains:									
Chenopodium goosefoot				12.6			0.2	2	
Compositae composite family		0.2							
Gramineae grass family			0.4					-	
Oryzopsis ricegrass				0.3				1	
Paniceae panic grass		0.5		1.7				2	
Portulaca purslane			0.6					1	
Prosopis mesquite	leaf+	leaf+	leaf+	leaf+				-	
Total Uncharred Seeds:	0	0.7	1.0	14.6	0	0	0.2	7	

Plant parts are seeds unless noted otherwise.
+ 1-10/liter
pp = plant part

Table 3. Species composition of flotation wood charcoal

FS No.	FS 17 outside R-O-W, 40 cm below present ground surface	FS 18 outside R-O-W, 20 cm below present ground surface	FS 54 in excavated area,167 cm below present ground surface	Total
Atriplex/ Sarcobatus saltbush/greasewood	<0.1g	<0.1g	-	<0.1g
Prosopis mesquite	0.1g	0.1g	<0.1g	0.2g
Total	0.1g	0.1g	<0.1g	0.2g

Table 4. Species composition of charcoal submitted for C-14 analysis

FS No.	FS 17 outside R-O-W, 40 cm below present ground surface	FS 18 outside R-O-W, 20 cm below present ground surface	FS 20 north of excavated area in R-O-W, 100 cm below present ground surface	FS 54 in excavated area,167 cm below present ground surface	Total
Atriplex/ Sarcobatus saltbush/greasewood	0.1g	<0.1g	<0.1g	-	0.1g
Prosopis mesquite	5.2g	7.0g	5.0g	2.6g	19.8g
Total	5.3g	7.0g	5.0g	2.6g	19.9g

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APPENDIX 8: POLLEN ANALYSIS

Richard G. Holloway

Two pollen wash samples were submitted from the single piece of ground stone recovered during excavation of LA 120945. The samples were taken from two use-surfaces on a fragment of a deep basin metate. The artifact was recovered from a depth of 60 cm below the present ground surface.

Methods

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

The area of the artifact sampled was washed with distilled water. This was followed by a wash with a dilute (<10) HCL, followed by a third wash using distilled water. The liquid from all three washes was combined into a plastic bottle and sent to Texas A&M University for extraction. Prior to chemical extraction, two tablets of concentrated *Lycopodium* spores (batch 307862, Department of Quaternary Geology, Lund, Sweden; 13,500 ± 500 marker grains per tablet) were added to each sample. 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 liquid samples were treated with 35 percent hydrochloric acid (HCl) overnight to remove carbonates and release the *Lycopodium* spores from their matrix. After neutralizing the acid with distilled water, the samples were allowed to settle for a period of at least three hours before the supernatant liquid was removed. Additional distilled water was added to the supernatant, and the mixture was swirled and then allowed to settle for 5 seconds. The suspended fine fraction was decanted through 150F 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.

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

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

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

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

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

Abbreviated microscopy was performed on each sample. In this case the entire slide was scanned at 200x magnification. Total pollen concentration values were computed for all taxa. In addition, the percentage of indeterminate pollen was also computed. Statistically, pollen concentration values provide a more reliable estimate of species composition within the assemblage. Traditionally, results have been presented by relative frequencies (percentages), where the abundance of each taxon is expressed in relation to the total pollen sum

(200+ grains) per sample. With this method, rare pollen types tend to constitute less than 1 percent of the total assemblage. Pollen concentration values provide a more precise measurement of the abundance of even rare types. The pollen data are reported here as pollen concentration values using the following formula:

$$PC = \frac{K*E_p}{E_L*S}$$

Where PC = pollen concentration; K = *Lycopodium* spores added; E_p = fossil pollen counted; E_L = *Lycopodium* spores counted; and S = sediment weight.

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

The resulting concentration value for these pollen samples is thus expressed as estimated grains per centimeter squared. The use of pollen concentration values from these particular samples are preferred, as explained above, in order to accentuate the variability between pollen wash samples. The use of the area washed also provides a mechanism for the comparison of calculated pollen concentration values between artifacts.

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

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

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

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

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

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

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

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

Results

The samples contained virtually no pollen. The only types present were background pollen types, which were likely adhering to the artifact.

Based on the largely negative evidence, no interpretation of these artifacts is possible. The rounded side of the metate fragment appeared to contain ten times the amount of pollen as the flat side. I believe that this was a statistical error based on a smaller amount of material examined on the slide. Alternatively, this may reflect a real situation, but based on only the background pollen types, it offers little in the way of interpretation.

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APPENDIX 9: C-14 DATING REPORT

BETA ANALYTIC INC.

DR. M.A. TAMERS and MR. D.G. HOOD

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REPORT OF RADIOCARBON DATING ANALYSES

Mr. Timothy D. Maxwell — Report Date: 5/18/00

Museum of New Mexico — Material Received: 4/6/00

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 142263	1330 +/- 60 BP	-25.4 o/oo	1320 +/- 60 BP

SAMPLE : 120945-17
ANALYSIS : Radiometric-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 630 to 815 (Cal BP 1320 to 1135) AND Cal AD 840 to 855 (Cal BP 1110 to 1095)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 142264	1230 +/- 50 BP	-24.7 o/oo	1240 +/- 50 BP

SAMPLE : 120945-18
ANALYSIS : Radiometric-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 670 to 895 (Cal BP 1280 to 1055)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 142265	1280 +/- 40 BP	-24.6 o/oo	1290 +/- 40 BP

SAMPLE : 120945-54
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 660 to 795 (Cal BP 1290 to 1155)

Dates are reported as RCYBP (radiocarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

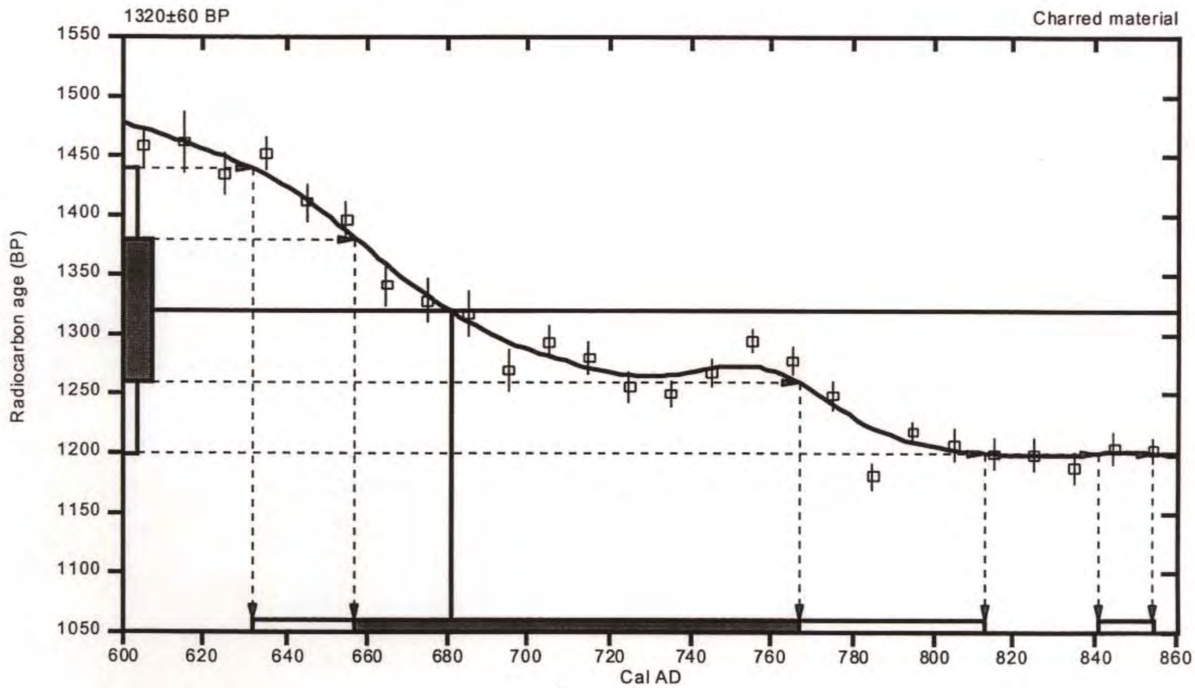
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.4:lab. mult=1)

Laboratory number:	**Beta-142263**
Conventional radiocarbon age:	**1320±60 BP**
2 Sigma calibrated results: (95% probability)	**Cal AD 630 to 815 (Cal BP 1320 to 1135) and Cal AD 840 to 855 (Cal BP 1110 to 1095)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 680 (Cal BP 1270)
1 Sigma calibrated result: (68% probability)	Cal AD 655 to 765 (Cal BP 1295 to 1185)



References:

Database used
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APPENDIX 10: ARCHAEOMAGNETIC DATING

Jeffrey Cox

In March of 1999, two archaeomagnetic sets containing eight individual specimens were collected from LA 120945. This site and a rather large portion of the surrounding area of over a square mile had a reddish layer of soil, several centimeters thick, coursing throughout the existing sand dunes. Above and below this layer, the soil was a “natural” neutral color, unlike the sand collecting in dune formations. At the time of collection of the archaeomagnetic material, it was not known whether this was just a unique soil type localized to this area or evidence of a rather larger burning event such as a wild fire. For the most part, the layer was uniform, but occasionally deeper reddish areas were encountered.

The two sets from LA 120945 were extremely weak because the soil was sandy with very little clay content. The two sets have a rather high delineation of 5.9 for sample LG1162 and 5.6 for sample LG1163. Because of this, it is not possible to give a definite age determination. However, because of the area in which the two sets lie on the archaeomagnetic curve, some dating information is possible. First, the question as to whether this is just a soil level or a burning event was addressed. The similarity of the two sets, even though quite large, indicates that a burning event of some sort occurred in the two areas in which specimens were collected. Because the material was collected from two completely different areas, I assume that the whole area burned, rather than just a localized soil type. Without further investigation, it is not possible to determine whether this layer represents a single burning event or multiple events. Because no other layers of this type are visible in the stratigraphy of the site, it may represent an ecosystem that existed previously and supported a large-scale firing of the soil. The present-day, sparse brush and high-desert vegetation would not produce the same type of phenomenon.

Second is the question of when this event occurred. Although a specific date range cannot be given, the area in which samples LG1162 and LG1163 are located on the archaeomagnetic dating curve does allow a more generalized dating scheme. In conjunction with the radiocarbon dates, the two archaeomagnetic sets point to a pre-A.D. 700 time frame. Archaeomagnetic dating results in the forth quadrant, where these two sets fall, represent a time frame of 300 years, from A.D. 400 to 700. Centerpoints that are to the right and below, such as lG1162 and LG1163, represent a date closer to the mid A.D. 500s. Thus, this layer represents an occurrence that took place between A.D. 500 and A.D. 650-700.

APPENDIX 11: CURATION

Raw data associated with the excavations at LA 120945, such as field notes, maps, photographs, and artifact categories, will be curated with the Archeological Records Management Section of the New Mexico State Historic Preservation Division, at the Laboratory of Anthropology in Santa Fe. Artifacts recovered from LA 120945 are curated in the Museum of New Mexico's Archaeological Research Collection. Included here is a listing of artifacts and their permanent accession numbers.

Faunal Material

FS 1. 11 NH bone
FS 2. 9 NH bone
FS 3. 1 NH bone, 1 shell
FS 4. 2 NH bone, 4 shell
FS 6. 2 NH bone
FS 9. 10 NH bone
FS 14. 5 NH bone
FS 15. 10 NH bone
FS 18. 12 NH Bone
FS 19. 10 NH bone
FS 20. 2 NH bone
FS 21. 1 NH bone, 1 egg shell
FS 23. 2 NH bone, 1 shell
FS 24. 1 NH bone
FS 26. 2 NH bone
FS 30. 3 NH bone
FS 31. 1 NH bone
FS 51. 3 NH bone
FS 52. 6 NH bone
FS 53. 2 NH bone
FS 54. 10 NH bone
FS 58. 12 NH bone

Lithic Artifacts

FS 1. 14 lithics
FS 2. 13 lithics
FS 3. 10 lithics
FS 5. 61 lithic
FS 6. 4 lithics
FS 7. 9 lithics
FS 9. 4 lithics
FS 10. 6 lithics
FS 11. 3 lithics
FS 13. 1 lithic
FS 14. 2 lithics
FS 15. 6 lithics
FS 20. 1 lithic
FS 21 4 lithics
FS 22. 3 lithics, 1 projectile point
FS 23. 6 lithics
FS 25. 1 lithic
FS 27. 2 lithics
FS 28. 1 lithic
FS 29. 2 lithics
FS 30. 27 lithics
FS 31. 10 lithics
FS 32. 7 lithics
FS 50. 8 lithics, 1 projectile point
FS 51. 26 lithics
FS 52. 84 lithics
FS 53. 8 lithics
FS 54. 87 lithics, 1 projectile point
FS 55. 20 lithics
FS 57. 32 lithics
FS 58. 92 lithics

Ground Stone

FS 54. 1 ground stone