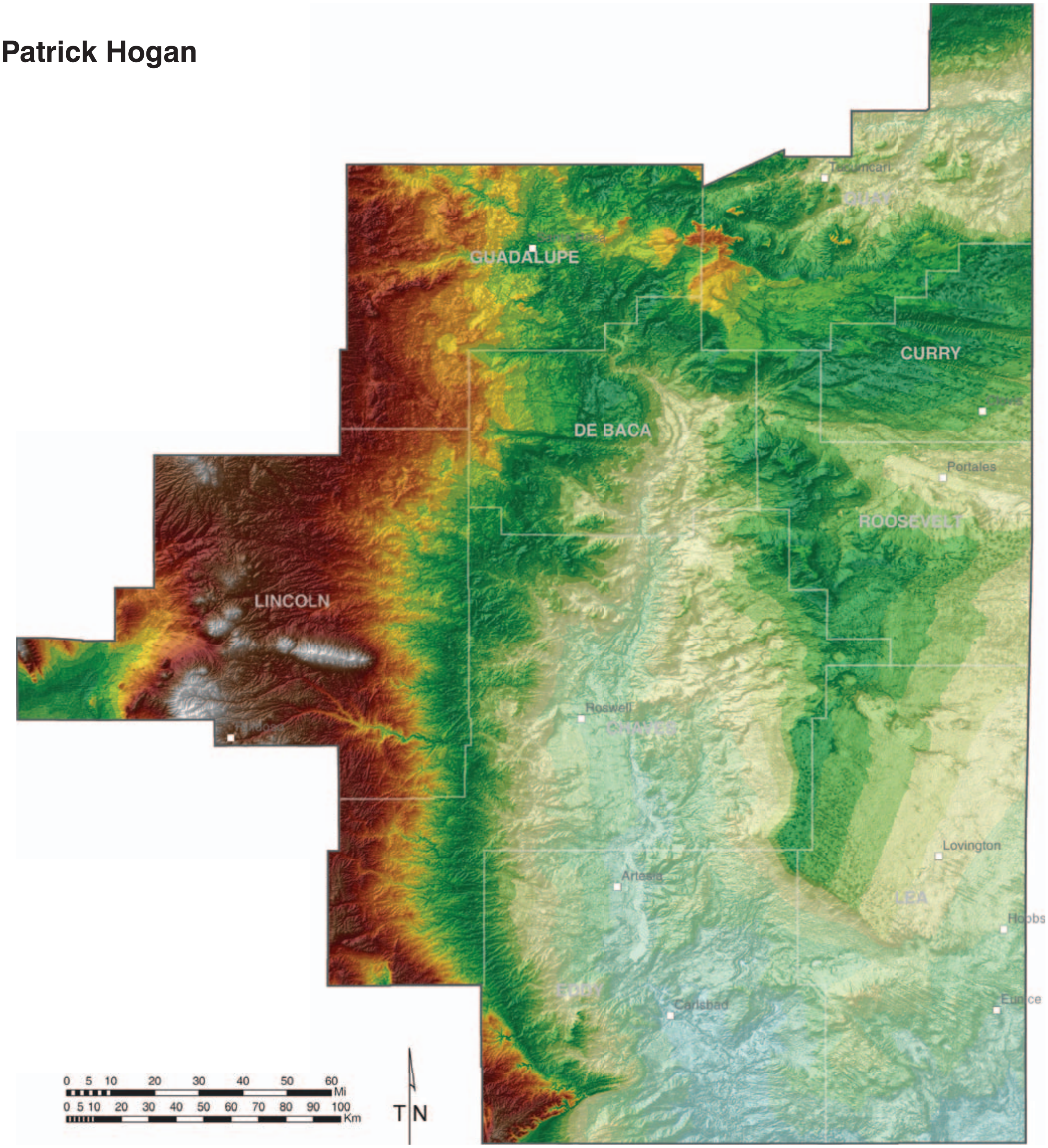
Southeastern New Mexico Regional Research Design and Cultural Resource Management Strategy

Patrick Hogan



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Development of Southeastern New Mexico Regional Research Design and Cultural Resource Management Strategy

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CHAPTER 1

INTRODUCTION

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The regional research design for southeastern New Mexico was prepared by the Office of Contract Archaeology, University of New Mexico under a contract with the New Mexico State Office, Bureau of Land Management (Task Order No. NAD04NM25; UNM Proposal 185-849). The overall objective of the research design is to develop a cost-effective research strategy that maximizes the information obtained from data recovery at pre-contact sites in the region. One approach to this problem is to develop a sampling strategy that focuses data recovery on the sites or site areas that are most likely to yield the required information, and that minimizes the collection of unnecessarily redundant information. The major challenges in implementing such a program are 1) to identify the relevant research issues and the kinds of data needed to address those problems; 2) to identify the kinds of sites that are most likely to yield those data; 3) to develop efficient and effective excavation and analysis strategies for data recovery; and 4) to develop some means of determining when a particular set of data requirements have been satisfied.

The report is structured to address six questions posed by the BLM. Chapters 2 and 3 address the question "What is the nature of the archaeological resources?" In Chapter 2, the region is divided into nine regional sampling units (RSUs) using a combination of physiographic units and drainage basins. These RSUs reflect gross environmental variability within the region that may have conditioned prehistoric settlement patterns and subsistence activities. The region was also divided into geoarchaeologic units that have implications for the integrity and relative visibility of archaeological sites. In Chapter 3, the NMCRIS database is used to provide a summary of the known archaeological resources in the region and to assess the extent of survey coverage. A site typology is developed to characterize the morphological and presumably the functional variability in those sites. A sample of recently excavated sites was then examined to determine how closely the behavioral implications of our site types matched the excavators' interpretations of the sites; to assess the kinds of data recovered from the different types of sites; and to assess the field methods being employed. Finally, the distribution of sites is examined for each of the five temporal periods – Paleoindian, Archaic, Ceramic, Protohistoric, and Unknown.

Chapter 4 addresses three questions: "What are the most important research questions that can be answered by the study of southeastern New Mexico archaeology;" "what data are needed to address those questions;" and "what should future research priorities be?" Four general problem domains – chronology and culture history, subsistence strategies, settlement system/mobility strategies, and environment – are identified as foci of research. Basic questions applicable to all temporal periods and questions specific to particular temporal periods are posed for each problem domain. The data needed to address the research questions are identified, and an integrated research strategy for collecting and interpreting those data is developed. As part of that strategy, explanatory concepts are introduced that provide a framework for understanding cultural developments in the region. Priority was given to research questions at the site/component and area levels that have to be answered before major regional research issues can be addressed.

Chapter 5 presents management recommendations for implementing the regional research design and addresses the question: "When have particular research questions have been adequately addressed?" Finally, Chapter 6 addresses the question: "What field and analytical methods are required to capture the critical data?" This chapter suggests field methods to maximize the information recovery from sites in the region and analytical methods to meet the data requirements of the research design.

CHAPTER 2

PHYSIOGRAPHY, GEOARCHAEOLOGY, AND DRAINAGE

The analysis reported in this chapter is directed toward two objectives: 1) to divide the region into sampling units, and 2) to categorize its geomorphological variability. As defined here, southeastern New Mexico comprises Chaves, Curry, De Baca, Eddy, Guadalupe, Lea, Lincoln, Quay, and Roosevelt counties. It encompasses 31,590 sq mi, an area about the size of South Carolina. The region has considerable environmental variability and, if we accept the premise that environment exerts some influence on human behavior, then some means of sampling that variability would facilitate both archaeological research and cultural resources management. The region was divided into eight physiographic units as an initial step in the environmental stratification. Drainage basins were then used as an alternative means of dividing the lands west of the Pecos River. Ultimately, a combination of four drainage basins and five physiographic units were selected as regional sampling units.

A geoarchaeologic map of southeastern New Mexico was also developed to categorize the coarse-grained geomorphological variability. This map divides the region into five geoarchaeologic units based on the nature and age of the surficial sediments. It provides general information on site visibility and the potential for buried cultural deposits, and is intended for use primarily as a planning and management tool.

PHYSIOGRAPHIC UNITS

Patrick Hogan

In their overview, Katz and Katz (2001:1) contend that the adaptive strategies employed by prehistoric peoples in southeastern New Mexico were closely tied to the characteristics of its three physiographic sections – the Sacramento Section of the Basin and Range Province, and the Pecos Valley and Llano Estacado Sections of the Great Plains Province. If they are correct, then dividing the region into physiographic units should help to isolate different components of the prehistoric settlement-subsistence systems. As such, the units can be used as sampling units for survey and excavation, and as provisional management areas.

The physiographic sections divide the region roughly into thirds along a north-south axis (areas of the Mexican Highlands Section in western Lincoln County, southwestern Chaves County, and southwestern Eddy County were excluded from this study since the sites in that section are most likely related to settlement systems centered in the Tularosa Basin). To the west (Figure 2.1), the Sacramento Section is characterized by the west-facing escarpments, summit plains, and broad eastern dipslopes of the cuesta-form Sacramento and Guadalupe Mountains, and by the igneous-intrusive masses of the Sierra Blanca, Capitan, Carrizo, Jicarilla, and Gallinas Mountains (Hawley 1986:26). The Estancia Basin and high tablelands of Chupadero Mesa in the northwestern part of the section lie outside of the region as defined here.

The Pecos Valley Section in the central part of the region is characterized by a stepped sequence of valley-border surfaces flanking the inner valleys of the Pecos and Canadian Rivers. Thick alluvial fills of Tertiary and Quaternary age are present in the broader areas of the Pecos valley south of Santa Rosa, and large areas of the older valley-border surfaces east of the river are mantled by Quaternary eolian deposits. Dissolution of the underlying evaporite and carbonate bedrock is an ongoing process in the Pecos Valley Section, and solution-subsidence depressions of varying size are common landscape features (Hawley 1986:27).

Physiography of the Southeast New Mexico Research Design Study Area

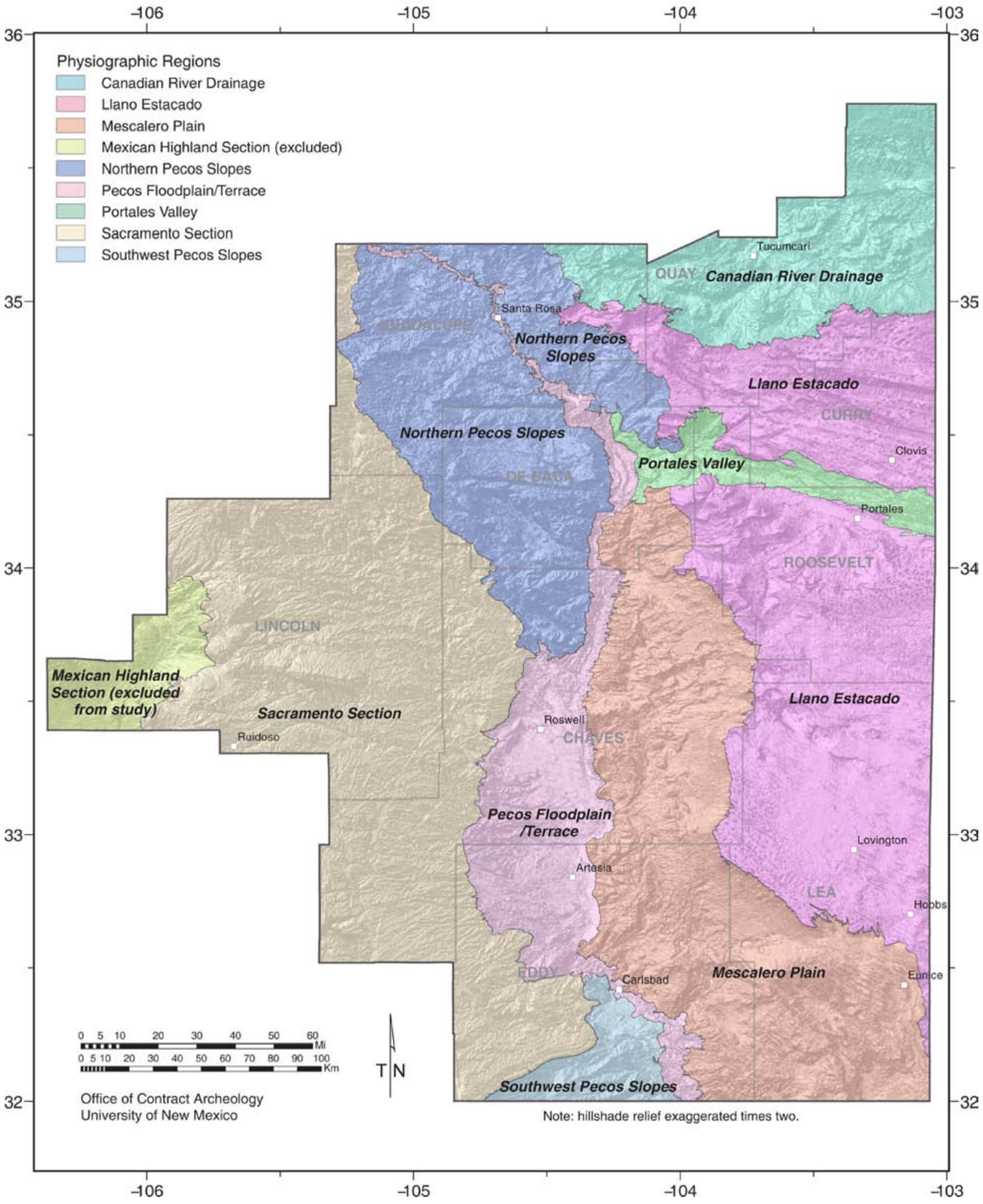

Figure 2.1

The Llano Estacado Section or Southern High Plains is a high, isolated pediment surface covering much of the Texas Panhandle and the eastern third of southeastern New Mexico (Reeves 1972:112–113). It is bounded on the north by the Canadian River escarpment and on the west by Mescalero Ridge, which ranges from sand-drifted hillsides to high cliffs of sandstone and caliche caprock. The terrain on the Llano Estacado is flat with a very slight southeastern gradient. South of the Portales Valley, the caliche caprock of the Ogallala Formation is generally near the surface; elsewhere, it is buried by sandy and clayey deposits. Surface drainage in the area is provided by widely-spaced ephemeral tributaries of the Red, Brazos, and Colorado Rivers – the nearly buried remnants of Pleistocene stream channels (Holliday 1997:50-51). The broad uplands between these shallow valleys are dotted with thousands of shallow depressions, many containing playas with lunate dunes on their leeward margins (Hawley 1986:27).

The Pecos Valley Section was further divided into six subsections (Figure 2.1). The Pecos River Valley subsection includes the modern inner valleys and canyons of the Pecos River and the inset Quaternary age terraces. For the most part, this subsection is a narrow band conforming to the course of the Pecos River but, in the Roswell-Artesia area, it includes a broad exposure of the Blackdom Terrace on the west side of the river (Fiedler and Nye 1933).

In defining this subsection, we were left with two other residual subsections west of the river. In the south, the Guadalupe Ridge and Reef Escarpment is the boundary separating the Sacramento and Pecos Valley Sections. Between this boundary and the Pecos River is a triangular area of gentle slopes referred to here as the Southwest Pecos Slope. To the north, the western boundary of the Pecos Valley Section corresponds roughly to the route of US 285 between Roswell and Vaughn. It encompasses remnants of Pliocene and lower Pleistocene alluvial deposits and higher piedmont erosion surfaces transitional to surfaces in the highlands of the Sacramento Section. Apart from these remnants, the terrain in the area is a nearly level plain dipping eastward toward the Pecos River. Comparable terrain extends eastward from the Pecos River to the boundaries defined for the Portales Valley and Llano Estacado subsections. Together, these two areas are referred to here as the Northern Pecos Slopes.

The Mescalero Plain is a pediment surface sloping westward from the base of the Mescalero Ridge to the Pecos River. As defined here, it extends southward from the Portales Valley to the New Mexico-Texas border. About 80% of the Mescalero Plain is mantled by the Mescalero Dunes. Regionally, the terrain is level but dunes, drainages, sinks, and resistant rock outcrops provide local relief (Reeves 1972).

The Canadian River Drainage and Portales Valley are the easternmost extensions of the Pecos Valley Section (Hawley 1986:27). The Canadian River flows north of the Llano Estacado. The drainage basin is bounded by two prominent escarpments. The southern escarpment marks the northern boundary of the Llano Estacado Section, while the northern escarpment is the boundary between the Pecos Valley and Raton Sections. Only a small part of this subsection falls within the study region.

The Portales Valley, at the northern end of the Mescalero Plain, splits the western edge of the Llano Estacado into northern and southern lobes. The valley appears to have been formed by the ancestral Brazos (Portales) River, which flowed southeastward across the Llano Estacado before being captured by headcutting of the ancestral Pecos River (Hawley 1993:262; Reeves 1972:113–114). Except for the upper reaches of Blackwater Draw, an ephemeral tributary of the modern Brazos River incised during the late Pleistocene, surface and subsurface flow in the Portales Valley is to the west toward the Pecos River. Terrain in the Portales valley is generally level except for the Sandhills or Muleshoe Dunes, an extensive accumulation of eolian deposits along the northern edge of the valley floor.

In mapping the physiographic units, the major boundaries illustrated by Hawley (1993:262, Figure 1) were transferred to the provisional southeastern quadrant of the *Surficial Geologic Map of New Mexico* (NMBGMR, 2005) by keying on the upper Cenozoic deposits common to both maps. The boundaries of the Pecos River Valley subsection were then drawn to encompass the late Pleistocene and Quaternary river alluvium (AR, ARy, ARo2). Next, the western boundary of the Canadian River Drainage was mapped based on the topography and drainages shown on the Santa Rosa and Tucumcari USGS 1:100,000 scale metric topographic maps. Finally, on the advice of the BLM's coordinating committee, the western boundary of the Portales Valley was redrawn to conform more closely to local usage.

GEOARCHAEOLOGIC MAP OF SOUTHEASTERN NEW MEXICO

Stephen A. Hall

The geoarchaeologic map is a new category of maps based on surface deposits and landforms that are associated with archaeological sites. Neither landforms nor archaeological sites are randomly distributed across the Earth's surface, and the relationship between the two may form patterns that can be recognized and charted on maps. The resulting maps can be used to predict whether sites of different ages will be at the ground surface or deeply buried. Consequently, the map serves as a guide in cultural resource planning and management.

Regional Geology and Geomorphology

The eight physiographic units defined previously are each characterized by unique bedrock and topographic expression and geologic history. These units also incorporate differences in surface hydrology, vegetation, fauna, climate, and lithic resources. Because of the differences in the physical and biotic landscape that are related to geologic history, the occurrence, preservation, and burial of archaeological sites may have geographic patterns that in turn reflect that geologic history. In the following discussions of these patterns, symbols in parentheses below are map units from the *Geologic Map of New Mexico* (NMBGMR 2003). Selected references that pertain to the geoarchaeology of each physiographic region are listed in Table 2.1.

Sacramento Section

The bedrock geology of the Sacramento Section is dominated by limestone of the San Andreas formation (Psa, Permian) with some outcrops of older Yeso formation (Py, Permian) along stream valleys where the San Andreas limestone is down cut. Undifferentiated Pennsylvanian rocks form the bulk of the Sacramento Mountains, and Tertiary igneous rocks form the Sierra Blanca and Capitan mountains. Recent alluvial deposits along the numerous streams in the area are too narrow to be shown on the 1:500,000 scale geologic and surficial geology maps of the state.

Large area of the Sacramento Section are predominantly denuded limestone bedrock with only a thin (<0.5 m) mantle of colluvium. In those areas, archaeological sites of all ages occur at the eroded surface. Recent alluvial deposits along the numerous small streams in the region may also contain archaeological sites. The potential extent of the archaeological record in buried recent alluvium in the region is not presently known.

Table 2.1 Selected Geologic References That may be Applied to the Geoarchaeology of the Physiographic Regions of Southeastern New Mexico

Physiographic Regions	Selected References
1. Llano Estacado	Hall, 2001; Holliday, 1995, 1997; Hunt, 1977a, 1977b; BEG, 1974, 1976, 1978a, 1983
2. Portales Valley	Hester, 1972; Holliday, 1997, 2001; Hunt, 1977a; BEG, 1978a
3. Mescalero Plain	Altschul et al., 2003; Ingbar et al., 2005; Hall, 2002; Hall and Goble, 2006; Henderson and Jones, 1952; Hunt, 1977b; BEG, 1976
4. Southwest Pecos Slope	Henderson and Jones, 1952; Hill, 1996; Horberg, 1949; Kelley, 1971
5. Sacramento Section	Altschul et al., 2004; Ingbar et al., 2005; Henderson and Jones, 1952; Kelley, 1971
6. Northern Pecos Slopes	Hunt, 1977a; Kelley, 1972
7. Canadian River Drainage	Hunt, 1977a; BEG, 1978b
8. Pecos River Valley	Fiedler and Nye, 1933; Jelinek, A. J., 1967
All Regions of SE New Mexico	NMBGMR, 2003, 2005

Northern Pecos Slopes

The North Pecos Slopes is a region of low relief and low escarpments formed predominantly by Permian and Triassic redbeds with some Cretaceous sandstone bedrock and with large areas of Holocene-Pleistocene piedmont alluvium (Qp). Narrow outcrops of Pleistocene terrace gravels occur along the Pecos River, the only large stream in the area. The bedrock of the region is largely denuded and mantled by thin colluvial sediments.

The eroded condition of the surface indicates that archaeological sites over most of the region are at the surface. The archaeological potential of the piedmont alluvium is not known. The alluvial deposits of a few small streams in the area, generally too narrow to be mapped, may contain buried archaeological sites.

Southwest Pecos Slope

The Southwest Pecos Slope encompasses the Holocene floodplain and Pleistocene terraces along the west side of the Pecos River, a broad area south of Roswell mapped as piedmont alluvial deposits (Qp, Holocene to Pleistocene and some Pliocene) and, in the vicinity of and south of Carlsbad (called Southwest Pecos Valley), large areas of outcropping limestone and gypsum (Pc, Castile Fm.; Ps, Salado Fm.; Pr, Rustler Fm.; Upper Permian).

The piedmont and floodplain alluvium may incorporate buried archaeological sites. Elsewhere on terraces and bedrock surfaces, sites of all ages are at the surface. The extensive piedmont deposits on the west side of the Pecos River valley have not been studied, and the age of these sediments and their archaeological potential is incompletely known.

Pecos River Valley

The Pecos River Valley is that part of the Pecos Valley Section mapped as alluvium (Qa, Holocene to Upper Pleistocene, the youngest unit on the state geologic map) and piedmont alluvial deposits (Qp, Holocene to Upper Pleistocene), especially in the Eddy, Chaves, and De Baca counties. The Pecos Valley region narrows in Guadalupe County where Permian and Triassic rocks are exposed in the river valley and Quaternary deposits are absent (NMBGMR, 2003).

The young alluvium and piedmont deposits may contain buried archaeology, while Pleistocene terraces at higher elevation predate the archaeological record and will incorporate prehistoric sites of all ages at the ground surface. Sites on Permian and Triassic bedrock in Guadalupe County are at the surface, although in some areas a thin mantle of colluvium that may mask some sites covers the bedrock.

Mescalero Plain

The Mescalero Plain is a broad area of low relief between the Pecos River valley on the west and the Llano Estacado on the east. An eolian sand sheet called the Mescalero sands characterizes the surficial geology of the region. The sand sheet is partly stabilized by shinnery oak cover that promotes the formation of parabolic dunes where the sand is thick. At the thin margins of the sand sheet, mesquite coppice dunes have formed. The areas with coppice dunes tend to be eroded. Surficial deposits in this area also include patches of Holocene to Pleistocene eolian sand (Qe), isolated outcrops of recent alluvium (Qa, Holocene), older alluvium (Qoa, Pleistocene), and red beds of the Chinle (TRcu, Triassic) and Artesia (Pat, Permian) Groups.

The Mescalero sands are composed of two sand layers; the older layer is late Pleistocene and the younger is early Holocene in age as determined by luminescence dating. As is the case with all eolian sand sheets, artifacts are often seen in blowouts while in adjacent places the sand may cover and mask the presence of archaeological sites. The early Holocene age of the younger sand layer indicates that sites younger than about 5000 years old will be at or near the surface while sites older than 5000 years will be buried. Sites of all ages are exposed by erosion. Also, sites of all ages occur at the surface of the older deposits and on bedrock.

Canadian River Drainage

The Canadian River Drainage lies north of the Llano Estacado escarpment, called The Caprock, and east of the Pecos River watershed. Low mesas and wide valleys characterize the topography. The region is dominated by Triassic redbeds and, in the western area of the region, Cretaceous sandstones and shales. Valleys and escarpment slopes are mantled by, in order of dominance, Holocene-Pleistocene alluvium (Qa), piedmont alluvium (Qp), and eolian sand (Qe). Alluvial deposits also occur along the Canadian River.

Sites of all ages occur at the surface of the denuded redbeds and associated bedrock. The potential for buried sites in the Qa alluvium and Qp piedmont alluvium is unknown. A few small streams in the area, tributaries to the Canadian, may also have narrow deposits that could contain archaeological sites.

Portales Valley

The Portales Valley is marked by a west-east trending linear band of eolian sand and low sand hills that extend from east-central New Mexico into the Texas Panhandle where it is called the Muleshoe Dunes. The Portales Valley sand hills are Holocene in age and mantle older eolian sand that is probably late Pleistocene in age although a thorough study has not been conducted. The sand hills occur on the Ogallala formation (To), thus separating the Llano Estacado into north and south subregions in New Mexico (*Geologic Map of New Mexico,* 2003).

The eolian sands of the Portales Valley contain archaeological sites at the surface and buried in the sand. Artifacts can be observed in blowouts although sites may be completely buried and not exposed at the surface.

Llano Estacado

The Llano Estacado surface is underlain by the Ogallala Formation (To, late Tertiary), which is composed of fluvial gravels exposed at the base with thicker eolian fine sand above. It is capped by “The Caprock,” a 3 m thick calcrete that is the resistant layer upon which the Llano Estacado is formed.

The surface geology is dominated by erosion that has exposed the upper weathered surface of the Caprock. Archaeological sites of all ages occur at the surface and are not buried. Bioturbation of site sediments by rodents and insects may be severe. In some places, young deposits that could contain archaeological materials are present. These young deposits include slope-wash sediments around the margins of playas and eolian sand deposits on the leeward (east) side of playas. Thin eolian deposits that contain archaeological sites also occur along the northern edge of the southern lobe of the Llano, the sand derived from the Mescalero Plain. The draws across some areas of the Llano are old drainages filled with Holocene-age sediment and may incorporate archaeological sites. Two large draws with Holocene fill occur north of Clovis and are shown on the *Geoarchaeologic Map of Southeastern New Mexico*. Other draws on the Llano Estacado are too small to show up on the map.

Geoarchaeologic Map Units

The geoarchaeologic map is divided into five units based on an unpublished draft of the *Surficial Geologic Map of New Mexico* (NMBGMR, 2005). The southeastern quadrant of this map identifies a total of 66 map units that are organized into seven categories: (1) alluvial deposits, (2) colluvium, (3) volcanic deposits, (4) lacustrine deposits, (5) eolian deposits, (6) calcretes, and (7) depression deposits. The various deposits range in age from Pliocene to late Holocene.

The geoarchaeologic map units (Figure 2.2) are defined by (a) the age of the deposits and, if the age of the deposits overlaps the archaeological record, then (b) the thickness of the archaeological-age deposits. The age of the archaeological record is defined as the past 14,000 calendar years (since about 12,000 BC) or 12,000 radiocarbon years. Deposits older than 12,000 BC are therefore unlikely to contain buried sites, although sites may be present on their upper surface.

Geoarcheological Map Units of the Southeast New Mexico Research Design Study Area

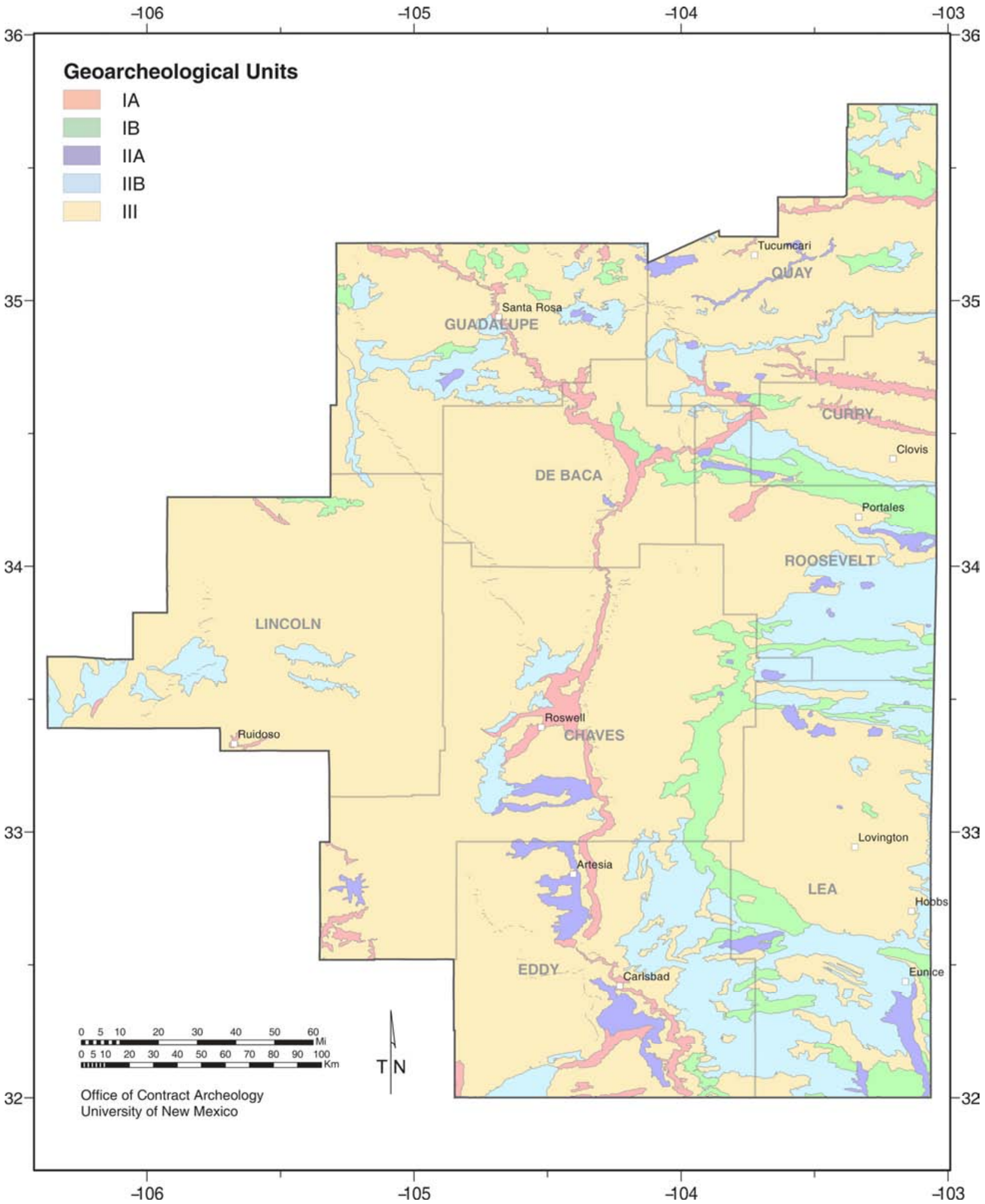

Figure 2.2

The thickness of surficial deposits is also important in assessing the potential for buried sites. When archaeological-age deposits containing archaeology are less than 0.5 m thick, the processes of bioturbation, gullying, and sheet erosion will probably expose artifacts, thus revealing the presence of the site. In defining map units for the geoarchaeologic map, if deposits are less than 0.5 m thick, then it is concluded that sites are visible at the surface. If deposits are more than about 0.5 m in thickness, then a site may not be visible at the surface and may be buried at depth. The combination of factors resulted in the identification of five geoarchaeologic units reflecting the relative probabilities that buried sites will be present in the mapped areas (Table 2.2).

Table 2.2 Geoarchaeologic Map Units, Southeastern New Mexico.

Unit	Area (sq. mi.)	Age of Surface	Geologic Origin	Buried Sites	Total No. Sites
IA	1,109	Holocene	Alluvium	Yes	676
IB	2,284	Holocene	Eolian sand	Yes	1,237
IIA	966	Holo.-Pleist.	Alluv.-colluv.-eolian	Maybe	189
IIB	5,051	Pleist.-Holo.	Colluvial-eolian	Probably Not	2,344
III	21,441	Pleist. & older	Multiple origins, denuded surfaces	No	4,810
Total*	30,851				9,256

*Area excludes Mexican Highland Section (738.8 square miles) in the far west-central portion of the southeastern New Mexico study area; total area surveyed for archaeological sites = 915.61 square miles or 3.0% of the study area.

Unit IA

This unit is thick recent (Holocene) alluvium that may contain buried archaeological sites. Sites may also be buried by young deposits and not visible on the surface. Thick deposits of recent alluvium are characterized by floodplain or low terrace surfaces that are generally level, low relief plains along river valleys. Surface deposits may be only a few centuries old and will mask older sediments and their contained sites. Gullies eroded into the low Holocene terrace may expose buried sites. These sites, especially if buried rapidly, potentially have intact living surfaces and intact features. They may be the best-preserved sites in the region. Unit IA is distributed along the Pecos River Valley through the central portion of the map area, along the Canadian River valley in northern Quay County, and in a few other drainages and High Plains draws. The largest single area of unit IA is the alluvial valley of the Pecos River amounting to 50.5 % of the total mapped area of unit IA.

Floodplain. Floodplains occur adjacent to modern channels of the Pecos River and other large streams. While dry most of the year, the floodplain is inundated briefly during large flood events, and the surface can be buried by fresh alluvium.

Alluvium Along Channels. Recent alluvium along the Pecos and other streams was being deposited until channel cutting in the late 1800s, forming a low terrace above the present-day channel. Sites may be buried by recent alluvium with no surface indications that they are present, although some sites may be exposed in cut banks.

Unit IB

This unit is thick young deposits of eolian sand that may contain buried archaeological sites or that may overlie surfaces with archaeological sites. Major areas of Unit IB include the Mescalero Sands just west of the High Plains surface, several areas on the High Plains such as near Portales, and the large area of eolian sand in southern Lea County in the vicinity of Jal. Patches of recent eolian sand occur throughout the southeastern New Mexico, generally east of the Pecos River.

While sites may be buried in the sand sheets of southeastern New Mexico, luminescence ages of the Mescalero Sands indicate that that sand sheet has been stable since about 5000 years ago. Thus, archaeological sites younger than 5000 years will be visible at the surface of the sand sheet. Older sites are buried in the sand.

Loose eolian sand is a magnet for burrowing animals. They quickly disturb the sediment of a site, disrupting all but the largest features. Concentrations of charcoal from small hearths become dispersed borderless masses commonly referred to as a “dark stains.” Eolian sand is also easily eroded (or deflated), quickly reducing a site to a lag deposit of artifacts and stones on the eroded surface. Small piles of stones indicate where a feature used to be. Artifacts are present, but any stratigraphy is lost.

Coppice Dunes. Recent mesquite coppice dunes dominate many areas of eolian sand in the region. The dunes formed within the last 100 years and can contain historic artifacts such as glass and metal. The dunes are everywhere in some areas, thus they occur on sites. The dunes may protect sites from erosion, but in cases where dunes have been excavated, pre-dune surfaces as well as its archaeology are often eroded. Coppice dunes generally occur in areas of thin sand and recent erosion exposes archaeological sites. Artifacts from deflated sites are strewn about the eroded surfaces and piles of stones indicate where a feature was once present. Intact sites associated with coppice dunes can be elusive.

Parabolic Dunes. Where sand is thicker, parabolic dunes formed within the past 100 years. Unlike coppice dunes where archaeology can be exposed between them, parabolic dunes mask underlying sand layers and sites. The only way to assess the presence of sites is to seek blow outs where underlying prehistoric sand are exposed.

Sand Sheets. Sand sheets may be of different ages on a subcontinent scale, but in southeastern New Mexico, the major eolian sand sheets probably accumulated at the same time (although no one knows for sure at this time). In the Mescalero Sands, eolian sand accumulated from about 9000 to 5000 years ago. During the past 5000 years, the surface of the sand sheet has been quasi-stable and archaeological sites younger than 5000 years occur at the surface (Hall, 2002; Hall and Goble, 2006). Sites older than 5000 are buried in the sand sheet. Surface and buried sites alike are strongly bioturbated.

Red Sand. An older layer of sand occurs beneath the sand discussed above. It is Pleistocene in age and pre-dates the archaeological record. Luminescence (OSL) dates from the Mescalero Sands investigation indicate that it accumulated 70,000 to 90,000 years ago. Sites occur on the old red sand surface and archaeological features can intrude into it.

Unit IIA

Complexes of mixed young and old deposits occur throughout southeastern New Mexico and are mapped as Unit II. Unit IIA areas are deposits that are predominantly young and that have a 50% chance or higher of harboring buried archaeological sites. The deposits themselves are mixtures of alluvial, colluvial, and eolian origins.

Alluvial Flats. Denudation of bedrock at the end of the Pleistocene resulted in the deposition of silts on low gradient surfaces adjacent stream valleys, especially along the west side of the Pecos River valley. While unstudied, these deposits can contain buried sites. Cut banks along gulleys in the alluvial flats can reveal buried sites although sites also tend to be located on higher ground on alluvial terraces above the alluvial flats. Bioturbation can be severe in this setting.

Colluvial Slopes. Many low-gradient hillsides and slopes contain a few decimeters of silt and fine sand that mantles older deposits and bedrock. Sites may be partly buried and partly masked by the thin colluvium. Artifacts from the site can also be bioturbated into younger colluvial sediments.

Unit IIB

Complexes of young and old deposits that are predominantly older than the archaeological record are mapped as Unit IIB. These deposits are mostly colluvial and eolian in origin and include large areas of Pleistocene eolian sand deposits. Pleistocene sediments with calcic paleosols that pre-date the archaeological record dominate many areas of mixed deposits. Sites of all ages occur at the surface, and they are strongly bioturbated. Within this area are small patches of younger Holocene deposits that may contain sites.

Pleistocene Terraces. Terraces occur topographically above the Pecos River and Canadian River and can have sites situated on them. The terrace alluvium pre-dates the sites. Terrace gravels also contain cherts and other lithologies suitable for stone tools.

Pleistocene Deposits with Calcic Soils. A variety of old alluvial-eolian-colluvial deposits occur in patches in the project area. These deposits are remnants of sediments that once covered larger areas. They are generally characterized by the presence of well-developed petrocalcic soils or paleosols, including the Mescalero paleosol that occurs beneath the Mescalero Sands. These deposits pre-date the archaeological record. Sites of all ages occur on them and while features may be intrusive, there are no buried sites. Sites here are strongly bioturbated.

Unit III

The largest mapped area in the project is comprised of surfaces that are Pleistocene or older in age and pre-date the archaeological record. These surfaces are mapped as Unit III. Seventy percent of southeastern New Mexico is Paleozoic-Mesozoic-Tertiary bedrock, and these rock surfaces are today strongly eroded. Archaeological sites of all ages occur at the landscape surface. These sites have been at the surface since they were occupied and, as a result, they are strongly impacted by animal burrowing and erosion.

Denuded Bedrock Surfaces. The vast areas of Paleozoic limestone west of the Pecos, the small areas of Cretaceous limestone and Triassic sandstone and shale, the igneous rocks of the Capitan and adjacent mountains, the Caprock of the Ogallala formation that forms the High Plains, and large areas of various Pleistocene deposits together make up about 70% of the study area. All of these surfaces are eroded. Sites of all ages occur on the eroded surfaces. Sites here are strongly bioturbated. While a thin mantle of colluvium can be present, site visibility is nearly absolute.

Geoarchaeologic Map Resolution

The surficial materials base map has a scale of 1:250,000, and the smallest feature shown on the base map is approximately 0.5 miles in diameter. Landscape features such as playa lakes on the Southern High Plains and stream valleys that are less than 0.5 miles across are not mapped. Consequently, many archaeologically significant localities are not shown on the geoarchaeologic map. Also, most of the areas of mapped surficial materials cross many drainage divides and incorporate numerous small stream valleys. The alluvium in these small valleys could contain buried archaeological sites. A good example is the Garnsey bison kill site east of Roswell (Speth, 1983) that is buried in recent alluvium in the axis of a stream valley that is only about 150 feet across. This narrow alluvial valley deposit and its buried site are not resolved on the 1:250,000 scale geoarchaeologic map. Thus, the geoarchaeologic map of southeastern New Mexico serves as a general guide to areas of buried and unburied sites. Broad geographic areas with a higher potential for buried sites may require different management and planning strategies than would areas with a low potential for buried sites.

It is possible to produce geoarchaeologic maps with high resolution that would capture the potential presence of the buried Garnsey site. A geoarchaeologic map at a scale of 1:24,000, such as the standard USGS 7.5 minute topographic map, would provide geomorphic resolution that would be directly applicable to archaeology in the field. Two recent mapping projects produced high-resolution geoarchaeologic maps of southeastern New Mexico: the Loco Hills area and Azotea Mesa (Altschul et al., 2003, 2004). The geoarchaeology of the two areas was mapped using 7.5-minute topographic maps and high-resolution color infrared and black and white aerial photographs and the results field checked. Maps at this scale can be applied directly in the field to cultural resource issues of land-use management

Site Visibility and Condition

The distribution of geoarchaeologic map units among the physiographic units is not uniform (Table 2.3) which, as the preceding discussion suggests, has implications for both site visibility and integrity. Only two circumstances occur in the field: archaeological sites are either visible at the ground surface or they are not visible at the surface. Both situations present a challenge to the archaeologist and earth scientist to assess the information potential of the sites and the degree to which that information potential may have been compromised by various post-depositional processes.

Visibility

Buried Sites. Geoarchaeologic map units IA and IB represent geologic settings where sites may be buried by young deposits of alluvium and eolian sand, respectively. Consequently, they mark the areas where standard surface survey methods will most likely miss sites, and where subsurface survey and testing methods should be employed. Of the physiographic units, the Pecos River Valley and the Southwest Pecos Slopes stand out as having the highest percentages of Unit IA alluvium, while the Portales Valley and Mescalero Plain have the highest percentages of Unit IB eolian deposits (Table 2.3).

Table 2.3 Physiographic Regions and Geoarchaeologic Map Units, Southeastern New Mexico; percentages.

		Geoarchaeologic Map Units Area Percentages				
Physiographic Regions	Area (Square Miles)	IA	IB	IIA	IIB	III
Canadian River Drainage	2464	2.6	8.6	2.9	5.7	80.2
Llano Estacado	7093	3.7	5.4	2.3	25.7	63.0
Portales Valley	672	5.2	68.8	4.7	0	21.3
Mescalero Plain	5770	0	8.9	3.1	31.1	46.9
Southwestern Pecos Slopes	610	12.1	0	21.1	15.0	51.9
Pecos River Valley	2475	22.6	0	9.7	8.5	59.2
Sacramento Section	7616	1.1	0.7	0.5	2.2	95.5
Northern Pecos Slopes	4151	0.7	2.0	2.8	19.8	74.6
All of Southeastern NM	30,851	3.5	7.2	3.1	16.6	69.6

Geoarchaeologic map Units IIA and IIB represent deposits that are identified in the unpulished surficial geology map of New Mexico as Holocene-Pleistocene (IIA) and Pleistocene-Holocene (IIB) in age. The mixed distribution and ages of these deposits introduces uncertainty about whether or not sites will be at the surface or buried in these areas. As Unit IIB consists mostly of Pleistocene deposits, sites in this map unit are probably all at the surface. The highest percentages of Unit IIB occur on the Mescalero Plains, Llano Estacado, and Northern Pecos Slopes, while the highest percentages of Unit IIA are mapped in the Southwest Pecos Slopes and Pecos River Valley physiographic units (Table 2.3).

Surface Sites. Geoarchaeologic map Unit III consists predominantly of old deposits and ancient denuded surfaces where sites of all ages are expected to occur at the surface. Nearly 70% of southeastern New Mexico is covered by Unit III deposits, with the highest percentages occurring in the Sacramento Section, Upper Canadian River, and Northern Pecos Slope physiographic units (Table 2.3). If the area covered by Unit IIB is added, then as much as 86.2% of the region is mapped as old surfaces. Except for the Portales Valley, two-thirds or more of all of the physiographic units are mapped as Unit IIB or Unit III. Even allowing for the limitations of the map resolution, these figures suggest that the great majority of sites in southeastern New Mexico will be visible at the surface.

Condition

Sites at the surface are subjected to all physical, biotic, and chemical processes that alter the earth’s surface, collectively referred to by earth scientists as surficial processes. In southeastern New Mexico, bioturbation and erosion are the primary surficial processes affecting site condition. Bioturbation tends to mix cultural deposits. With such disturbance, the artifacts are no longer in their original lateral and vertical position, and the sediment matrix of the site has been moved from the initial depositional state corresponding to the time of site occupation or immediately after site abandonment. In extreme cases, living surfaces are obliterated and walls of features are lost. The sedimentary particles that make up the matrix of the site, including charcoal, plant seeds, pollen, small bones, snail shells, clay-absorbed minerals and isotopes, are all moved and dispersed from their original location within the site. While still present at the site, these small particles may be dispersed 5 to 10 cm or more from where they were first deposited, removing them from their primary context.

On the other hand, it is important not to dismiss a site because of bioturbation. Fine-scale turbation will move artifacts a few centimeters, but the artifacts and associated prehistoric remains are still present and still in moderate association. While some features may be faint, they too are still present and can be distinguished upon excavation. Coarse-scale turbation, such as by rodents and badgers, severely disturbs site stratigraphy, and the results of these burrowers are clearly visible in the field and can be taken into account during site excavations. Multiple component sites are special cases where bioturbation may require extra caution in the field.

Erosion is the ultimate site destroyer. In extreme cases, the sedimentary matrix of the site is completely removed and artifacts are either carried away or strewn about on the eroded surface as a lag. On occasion, the base of features that intrude into older pre-site deposits may be left behind intact while the remainder of the site is gone. Site erosion is especially clear in areas of eolian sand where deflation removes the sand matrix from a site leaving behind a pavement of artifacts. Although scattered, artifacts in the lag deposits may retain some behaviorally-meaningful patterning. Datable materials and archeobotanical and faunal remains are unlikely to be preserved unless there are features that extend below the erosion surface.

The longer a site has been subjected to surficial processes, the greater the likelihood that it is no longer intact. For sites on old surfaces, the length of exposure is directly related to the age of the site; that is, older sites will be more affected by disturbance processes than younger sites. If the surface is relatively stable, a condition evidenced by ongoing soil development, then bioturbation will probably be the predominant surficial process affecting site condition. Although some disturbance will result, the site may still yield significant archaeological data. Under the current climatic regime, however, erosion is the predominant surficial process in the region. Consequently, most of the sites on old surfaces are expected to be lag deposits with a low probability of yielding subsistence remains or organic material for radiocarbon dating.

In other geomorphological contexts, the degree of disturbance will depend on how long the site was exposed before being buried. Rapid burial is most likely to occur in alluvial contexts mapped as Unit IA, but even in these contexts, the majority of buried sites are likely to have been affected to varying degrees by bioturbation and erosion. Rapid burial is possible but less probable in eolian environments (Unit IB), and sites in these environments are more likely to have been erosion and turbation processes either before being buried or after subsequent re-exposure. The data potential of sites in eolian contexts is therefore expected to be lower than that of sites in alluvial settings but higher than that of sites exposed on old surfaces.

Given the scale at which the regional geoarchaeologic units are mapped at present, they cannot be used to judge the condition of individual sites. As the above discussion indicates, however, they can be used to make probabilistic estimates of average site condition (Table 2.4).

Site Distribution

The distribution of known sites among the physiographic units and geoarchaeologic map units is shown in Table 2.5. Although there are apparent differences in the site associations, most of the variability appears to be the result of uneven survey coverage. A linear regression analysis of the area surveyed in each of the eight physiographic areas (Figure 2.3) indicates that there is a significant positive correlation ($r^2 = 0.977$) between the area surveyed and the number of known sites.

Table 2.4 Expected Average Condition of Sites in Geoarchaeologic Map Units.

Geoarchaeological Map Units	Archaeological Site Condition
IA	Best potential for well-preserved buried sites; high probability of buried sites in alluvium but affected to varying degrees by bioturbation and erosion
IB	Best potential for well-preserved buried sites; high probability of buried sites in dune sand but likely affected by erosion and turbation processes
IIA	Some potential for sites buried in recent deposits; eroded-bioturbated sites may occur on old surfaces
IIB	Limited potential for buried sites; predominance of eroded sites on old surfaces
III	Sites all at surface on denuded old surfaces; sites may be eroded and bioturbated

Table 2.5 Physiographic Regions and Archaeological Sites in Each Geoarchaeologic Map Unit, Southeastern New Mexico; percentages.

	Total Sites		Geoarchaeologic Map Units Site Percentages				
Physiographic Regions	Number	%	IA	IB	IIA	IIB	III
Canadian River Drainage	232	2.5	40.5	2.6	2.6	1.7	52.6
Llano Estacado	276	3.0	8.9	7.2	2.2	21.0	60.9
Portales Valley	65	0.7	1.5	58.5	33.8	0	6.2
Mescalero Plain	4661	50.4	0	25.1	2.2	45.2	27.4
Southwestern Pecos Slopes	267	2.9	13.9	0	5.2	8.6	72.3
Pecos River Valley	1249	13.5	38.4	0	2.0	7.0	52.7
Sacramento Section	2044	22.1	1.7	0	0.5	2.2	95.7
Northern Pecos Slopes	462	5.0	1.5	0.6	0.2	4.3	93.3

Owing to the cluster of five physiographic areas with low values for area surveyed, the data were converted to log values and reanalyzed. The log-log regression analysis again showed a strong direct correlation ($r^2 = 0.962$). Linear regression analysis of the geoarchaeologic map unit (Figure 2.4) also shows a strong positive correlation between the area surveyed and the number of known sites ($r^2 = 0.983$).

In short, these analyses indicate that the number of known sites in any physiographic or geoarchaeologic map unit is directly proportional to the area surveyed in that unit, which suggests that doubling the area surveyed will produce a doubling of the number of sites regardless of how the region is divided. The formula describing this relationship is:

Number of sites=39.8 + (9.76 x Areas Surveyed)

As with other linear regression relationships, small values of *Area Surveyed* in this formula will yield values for *Number of Sites* that are outside the normal distribution.

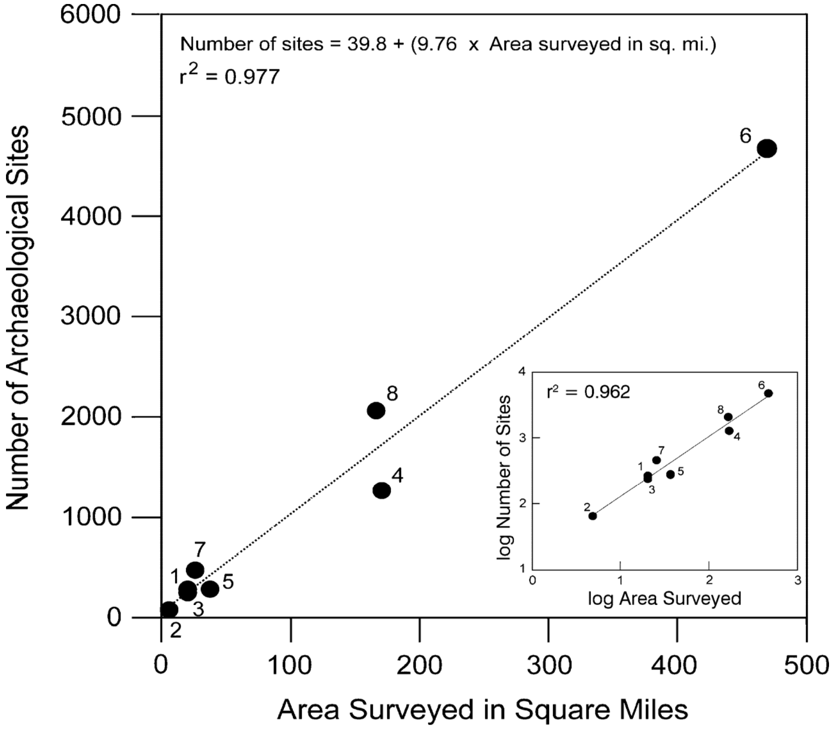

Figure 2.3 Prehistoric archaeological sites vs. Area surveyed in square miles for each physiographic region in southeastern New Mexico; physiographic regions are numbered according to area in SE New Mexico from smallest to largest: 1 = Southwest Pecos Slopes, 2 = Portales Valley, 3 = Canadian River Drainage, 4 = Pecos River Valley, 5 = Northern Pecos Slopes, 6 = Mescalero Plain, 7 = Llano Estacado, 8 = Sacramento Section; total 9,256 archaeological sites; total surveyed area is 915.61 square miles; dashed regression line; **Inset Diagram** is same data converted to log values; regression line and correlation coefficient show strong positive correspondence; a doubling of survey area results in a doubling of the number of sites.

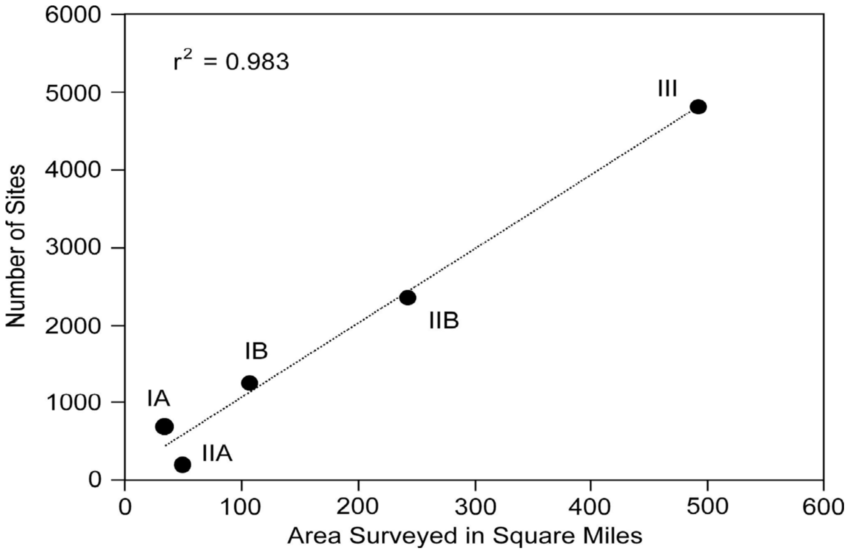

Figure 2.4 Number of sites vs. Area surveyed in square miles for each of the geoarchaeologic map units in southeastern New Mexico; regression line and correlation coefficient show strong positive correspondence regardless of geoarchaeological status; at coarse-scales, a doubling of survey area results in a doubling of the number of sites.

Site densities were calculated for each physiographic and geoarchaeologic unit using surveyed area to compensate for this correlation (Table 2.6). About 3% of southeastern New Mexico has been surveyed and 9256 prehistoric sites have been documented, giving an average site density for the region of 10.11 sites/square mile. The site density data points for the different physiographic (Figure 2.5) and geoarchaeologic (Figure 2.6) map units describe a normal curve about this mean. Based on the visual inspection, it appears that the map units with surveyed areas smaller than about 200 square miles exhibit greater variability from the regional mean. Whether this pattern is real or a function of small sample size (i.e., the small proportion of the region that has been surveyed) remains to be seen through future site analysis. If site density is unit specific, then the challenge is to discover what environmental factors in the landscape encouraged or discouraged prehistoric occupation, resulting in large numbers of sites in some regions and fewer numbers in others.

The highest site densities among the geoarchaeologic map units occur in Units IA and IB. These two units have the highest probability of containing buried sites, and their high site densities suggest that they also have a high probability of containing surface sites as well. Site densities for these Unit IA and IB within each physiographic unit (Figure 2.7) were plotted to further examine this pattern. This plot shows that the Pecos River Valley, the Northern Pecos Slopes, the Canadian River Drainage, and the Llano Estacado have significantly higher site densities in alluvium (IA) than overall southeastern New Mexico. Also, the Mescalero Plain and the Llano Estacado have significantly higher site densities in eolian sand (IB). Interestingly, the Llano Estacado is the only physiographic region with a significantly higher site density in both alluvial and eolian environments. Again, whether this is a function of small sample size or reflects real site location preference is not yet certain, although the strong statistical correlation of sites versus surveyed area suggests that there is a predominant regional pattern that is valid on a coarse-scale.

Field Application of the Geoarchaeologic Map

To apply the geoarchaeologic map in the field, the basic geology of the landscape including the general geologic age of landforms must be recognized. The practitioner must distinguish Holocene, Pleistocene, and pre-Quaternary sediments and rocks, and the origin of local deposits and landforms must be correctly appraised. In the field, the experienced practitioner must link together the physical landscape with archaeology. One difficulty of assessing the geoarchaeology of a large area such as southeastern New Mexico is that the broad physical landscape is highly variable. Changes occur in the local topography and geomorphology within a few hundred feet that are significant to the presence and preservation of archaeological sites. While the coarse-scale geoarchaeologic map is a useful guide for planning purposes, it is not a substitute for fieldwork by an experienced practitioner.

Geoarchaeologic Maps and Literature

Maps and publications that provide specific information on the relationship between geomorphology and archaeological sites are rare. The literature has always included “after-the-fact” studies where a geomorphic assessment of a known site, generally conducted at the time of site excavations, is published along with the archaeological report. These site-specific studies are seldom if ever extrapolated to a bigger picture. Investigations that produce geomorphic, stratigraphic, and spatial information (maps) that predict the potential three-dimensional location of prehistoric remains in the physical landscape are almost non-existent. In southeastern New Mexico, only the Pump III models (Altschul et al. 2003, 2004), Hall’s (2002) geoarchaeological study of the Mescalero Sands (2002), and the models developed by Eastern New Mexico University for the Melrose Air Force Range (Fallis 2002; Moffitt 2005; Shelley 1995; Shelley et al. 1998) fill these general criteria. Cultural resource managers, as well as the field archaeologist, are left to their own devices to interpret and adapt the archaeological aspects of the geomorphic literature and published geologic maps to their needs and questions concerning the archaeological record. And, of course, geologic maps are produced by geologists for use by other geologists and never take into account archaeological aspects of the landscape. The present *Geoarchaeologic Map of Southeastern New Mexico* provides a bridge between geology and archaeology.

Table 2.6 Number and Density of Known Sites by Physiographic and Geoarchaeological Map Unit. Site densities are calculated using area surveyed.

	Area Surveyed		**Known Sites**		**Site Density**
	square miles	percent	number	percent	(sites/sq mi)
Physiographic Regions					
Sacramento Section	166.42	18.1	2044	22.1	12.28
Northern Pecos Slopes	25.58	2.8	462	5.0	18.06
Southwest Pecos Slope	20.29	2.4	267	2.9	13.16
Pecos River Valley	170.68	18.6	1249	13.5	7.32
Mescalero Plain	470.23	51.3	4661	50.4	9.91
Canadian River Drainage	20.29	2.2	232	2.5	11.43
Portales Valley	4.92	0.5	65	0.7	13.21
Llano Estacado	37.20	4.1	276	4.1	7.42
Total	915.61		9256		10.11
Geoarchaeological Units					
IA	34.04	3.7	676	7.3	19.86
IB	107.34	11.6	1237	13.4	11.52
IIA	49.81	5.4	189	2.0	3.79
IIB	243.16	26.2	2344	25.3	9.64
III	492.35	53.1	4810	52.0	9.77
Total	926.70		9256		9.99

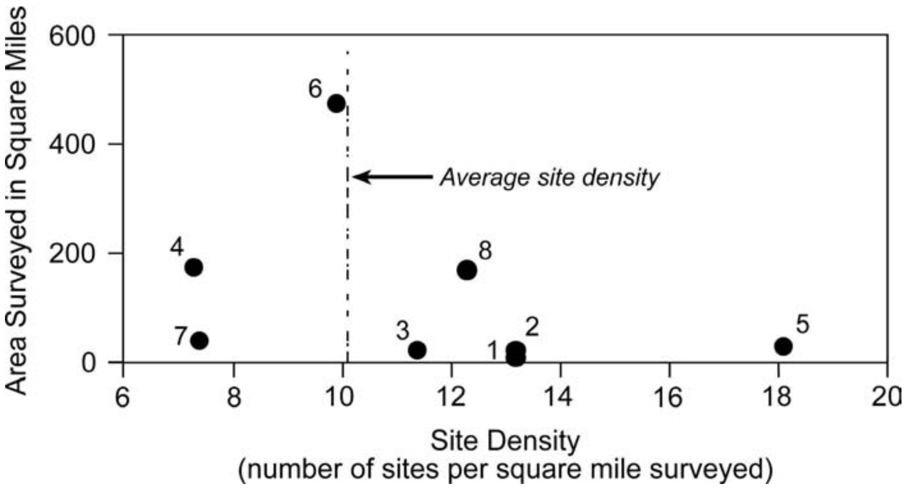

Figure 2.5. Area surveyed vs. Site density for each physiographic region, SE New Mexico; physiographic regions: 1 = Portales Valley, 2 = Southwest Pecos Slopes, 3 = Canadian River Drainage, 4 = Pecos River Valley, 5 = Northern Pecos Slopes, 6 = Mescalero Plains, 7 = Llano Estacado, 8 = Sacramento Section; total 9256 sites; total area surveyed 915.61 square miles

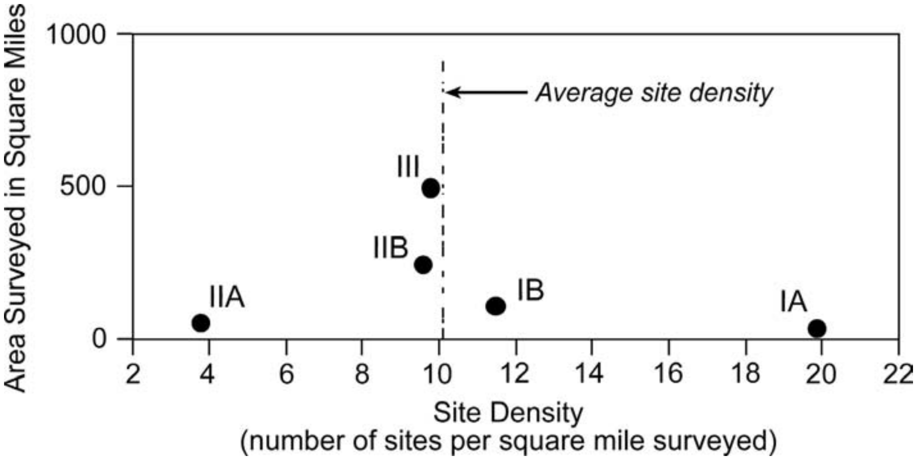

Figure 2.6. Area surveyed in square miles vs. Site density as number of sites per square mile surveyed for each of the 5 geoarchaeologic map units; the data points describe a normal curve and show that the average site density for all of SE New Mexico (10.11 sites per square mile) is achieved when the area surveyed exceeds 200 square miles; data from Table 2.6

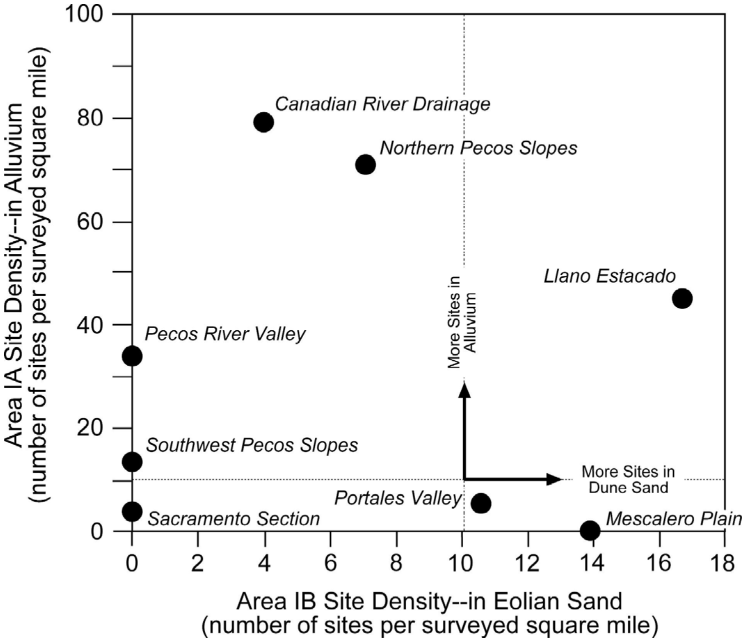

Figure 2.7 Area IA site density vs. Area IB site density for the surveyed areas of each physiographic region, southeastern New Mexico; the dotted lines are the average site density value for the entire study area

Summary and Conclusions

1. The *Geoarchaeologic Map of Southeastern New Mexico* is a new category of maps utilizing ages of deposits and surfaces to identify areas of potentially buried sites and areas where sites are all at the surface.

2. The project area is categorized by five geoarchaeologic map units: IA, Holocene alluvium; IB, Holocene eolian sand; IIA, sediments of mixed origin and Holocene to Pleistocene ages; IIB sediments of mixed origin and predominantly Pleistocene age; III, old sediments and rocks and ancient surfaces that pre-date the archaeological record.

3. Southeastern New Mexico is subdivided into eight physiographic regions for coarse-scale spatial analysis within the project area. The physiographic regions are 30,851 square miles with 9,256 prehistoric and protohistoric archaeological sites (this excludes the Mexican Highlands Section).

4. Only 915.6 square miles of southeastern New Mexico have been surveyed for archaeological resources, about 3.0% of the entire region.

5. Average site density in southeastern New Mexico is 10.11 sites per square mile of surveyed area.

6. At least 70% (map unit III) and perhaps as much as 86% (map units IIB and III) of the terrain of southeastern New Mexico is Pleistocene and older bedrock surfaces where sites of all ages occur at the surface. No less than 77% of all known prehistoric sites occur on these IIB and III surfaces. Small drainage valleys within these units are not visible at the scale mapped, however, and the alluvium within those valleys could contain buried archaeological sites. It is therefore recommended that priority be given to high-resolution (1:24,000) geoarchaeologic mapping within units IIB and III.

7. Potentially buried sites in alluvium (IA) are most common along the Pecos and Canadian rivers, and potentially buried sites in eolian sand (IB) are most common in the Portales Valley and Mescalero Plain regions. Together these map units are 10.6% of the project area and have 18.8% of all of the prehistoric sites. Site densities in these two map units are the highest in southeastern New Mexico.

8. If the current sample of surveyed area is representative of the region, then based on the regional average site density, 302,620 additional sites may remain to be documented.

9. The number of prehistoric archaeological sites corresponds strongly to the surveyed area for both physiographic regions ($r^2 = 0.977$) and geoarchaeologic map units ($r^2 = 0.983$). A doubling of the survey area results in a doubling of the number of sites.

10. The highest site densities occur in the Northern Pecos Slopes physiographic area (18.06 sites/sq mi) and in geoarchaeologic map Unit IA (19.86 sites/sq mi).

11. Site densities may be related to the area surveyed. As the area surveyed exceeds 200 sq mi, site density trends toward the average for the region.

12. Site density in alluvial environments (IA) is greatest in the Canadian River Drainage, Northern Pecos Slopes, Llano Estacado, and Pecos River valley areas.

13. Site density in eolian sand environments (IB) is greatest in the Llano Estacado and Mescalero Plain areas.

14. Only the Llano Estacado has higher than average site densities for both alluvial and eolian environments.

15. Based on the strong direct relationship between numbers of sites and the area surveyed in the eight physiographic regions and five geoarchaeologic map units it appears that, although each map unit has unique intrinsic properties potentially relevant to prehistoric human occupation, no one unit stands out as having a greater or lesser proportion of sites than another. This relationship is of course based on a 3 % survey of the region that may have incorporated unknown geographical biases. On the other hand, these are all of the existing data for southeastern New Mexico and, regionally, the results are statistically strong.

DRAINAGE BASINS

Patrick Hogan

In examining the site distributions relative to the physiographic units (Chapter 3), we became concerned that the units defined on the west of the river might provide an adequate reflection of the north-south environmental variability evident in that part of the region. In part, that concern was related to how those units had been defined. While the sections and subsections located east of the Pecos River are internally consistent with well-defined boundaries, the boundaries separating units west of the river seemed vague and arbitrary. As already noted, the boundary between the Sacramento and Pecos Valley Sections is defined largely by mapping remnants of ancient valley and basin fills. Consequently, the Northern Pecos Slopes and Southwest Pecos Slope subsections are differentiated from the Sacramento Section solely by the presence of those remnant deposits. Most archaeologists would have difficulty distinguishing these three physiographic units in the field, and it is doubtful that they had much meaning for prehistoric groups. It therefore seemed advisable to develop some alternative means of subdividing the lands west of the Pecos River that would better facilitate archaeological research. Drainage seemed the best alternative for this purpose, and the drainage units seemed to produce more meaningful clustering of sites west of the river than did the physiographic units.

Drainage basin boundaries were obtained mapped from the 1:100,000 Surface Water Basins layer of the New Mexico Office of State Engineer Statewide Geodatabase. To avoid having numerous small divisions, individual drainages were grouped into four larger drainage basins (Figure 2.8). In the south, the Seven Rivers-Dark Canyon drainage basin encompasses streams draining the eastern flanks of the Guadalupe Mountains, while the Rio Peñasco-Rio Felix drainage basin encompasses streams originating in the southern Sacramento Mountains. The Rio Hondo-Arroyo del Macho drainage basin comprises streams draining the northern Sacramento, Capitan, Carrizo, Jicarilla, and Gallina Mountains – the heart of Kelley’s Sierra Blanca region. In the north, the Pintada Arroyo-Yeso Creek drainage basin encompasses drainages in the Vaughn Plains, some of which have been disrupted by subsidence and karst development.

Acknowledgement

We thank D. J. McCraw of the New Mexico Bureau of Geology and Mineral Resources, Socorro, NM, who generously provided an advance copy of the southeastern portion of the *Surficial Geologic Map of New Mexico*.

Drainage Basins and Physiography of the Southeast New Mexico Research Design Study Area

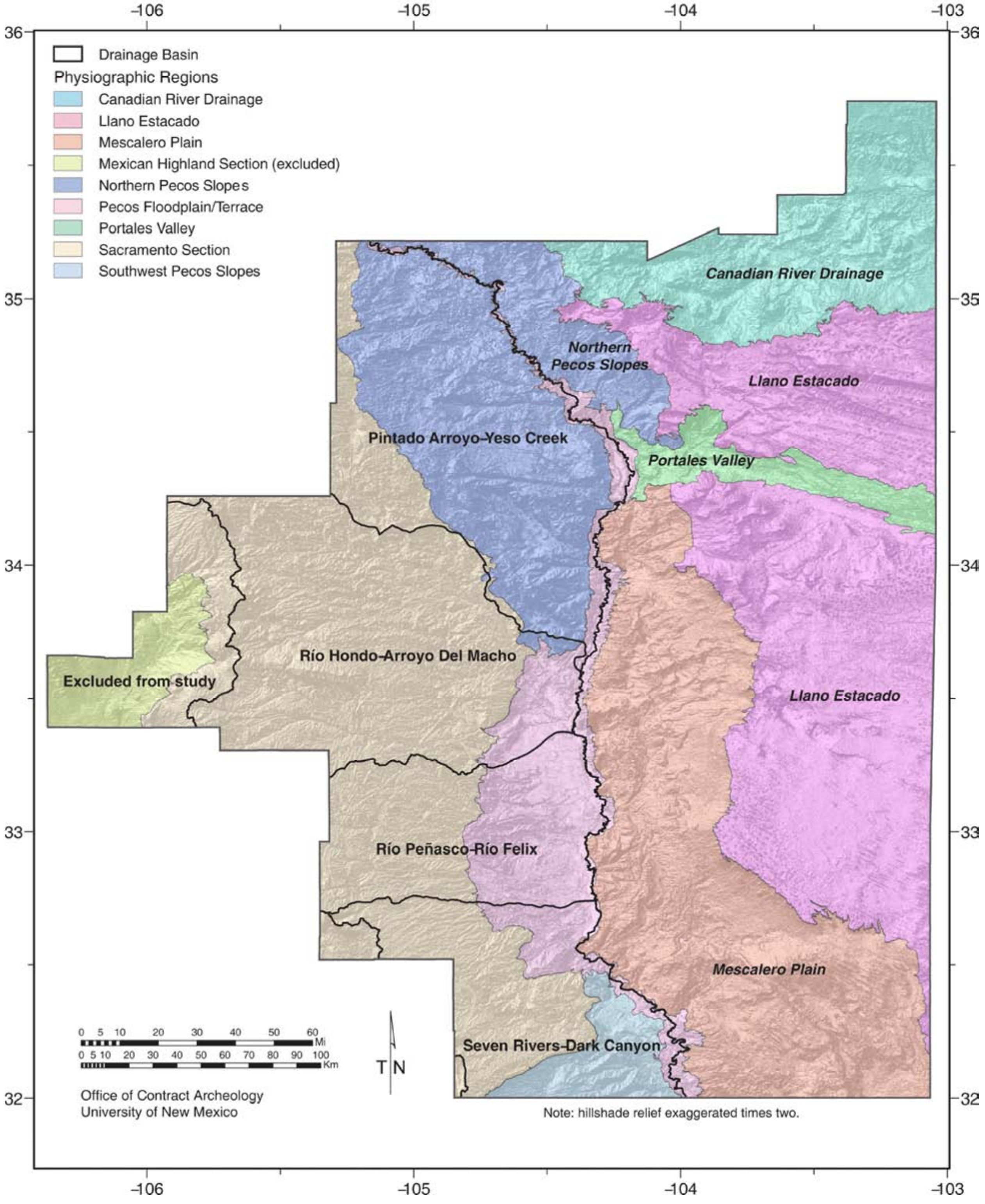

Figure 2.8

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CHAPTER 3

SITE TYPOLOGY

Patrick Hogan and Ronald L. Stauber

Our primary objective in this chapter is to formulate a preliminary classification of sites in southeastern New Mexico. The classification has two major uses. Its first use is in examining how the different kinds of sites are distributed among the physiographic divisions and drainage basin units defined for southeastern New Mexico in the previous chapter. In effect, this amounts to a very rudimentary and coarse-grained analysis of settlement patterns in the region. The second use is in stratifying the sample of sites selected for data recovery. Stratification can be used to ensure that the sample reflects the variability of sites found in an area or, alternatively, it can be used to select the sample of sites most likely to yield data relevant to particular research problems. Both uses require that the sites be classified along two dimensions, first by temporal period and then by functional or morphological attributes intended to group sites reflecting a similar range of human behaviors.

Both uses place some limitations on the classification process. Because the classification will be used to select samples of sites for data recovery, both the temporal periods and site types must be defined with attributes that can be identified during survey, since the survey records will be the basis for deciding which sites will be excavated. Its use for examining the distribution of known sites in the region imposes further restrictions as the site types and temporal periods must be defined on the basis of attributes coded in the extant New Mexico Cultural Resources Information System (NMCRIS) database. For both uses, the site types are necessarily morphological categories, although they may have functional implications that can be used for a broad assessment of prehistoric settlement patterns. Similarly, the temporal periods must be broad enough to include the largest possible proportion of sites. Given these restrictions, the classification developed here should be considered a preliminary first-cut and, as outlined in the next chapter, future research should be directed in part toward refining both the temporal scheme and the site typology.

The chapter begins with a brief review of some of the site typologies developed by previous researchers working in the region. The NMCRIS data for sites in southeastern New Mexico are then examined, first to define provisional temporal periods and then to develop a classification of component types. For the latter task, we focused on an analysis of variability in the types of features associated with the components classified in NMCRIS as “artifact scatters with features” and “simple features.” Based on that analysis, eight new component types are defined. The final site typology consists of these new component types and four of the original NMCRIS component types – artifact scatters, single residence, multiple residence, and residential complex/community.

The next section of the chapter provides a review of some of the sites excavated in the region over the past 15 years. The objectives of this review were to compare our classification with the excavator’s interpretations, to evaluate the geoarchaeologic units defined in Chapter 2 as predictors of site condition, and to determine whether particular site types are more likely to yield subsistence and chronological data. In the final section, the distribution of known sites in southeastern New Mexico is examined for each temporal period to determine if there is any obvious patterning in the mix of component types associated with the different physiographic and drainage basin units and to assess the likelihood that sample of known sites are representative of the full range of prehistoric and protohistoric sites actually in those areas.

PREVIOUS TYPOLOGIES

A number of typologies have been developed for prehistoric sites in southeastern New Mexico, and some of those studies were reviewed to identify the attributes that have proven most useful in distinguishing site types. Based on sample survey data from the Abo Oil and Gas Field, Kemrer and Kearns (1984:70–73) defined four major site types – multiple use, temporary camps, lithic procurement/workshop, and limited activity. These types can largely be distinguished using two criteria.

Their first criterion, the presence/absence of ceramics or milling stones or hearth/fire-cracked rock (FCR) features, separates multiple use locales and temporary camps from lithic procurement/workshop locales and limited activity sites. The second criterion is the presence/absence of lithic source materials, which separates lithic procurement/workshop locales from limited activity sites, and separates a subset of the multiple use locales from temporary camps. The criteria used to distinguish large temporary camps from multiple use sites that do not have lithic source materials are less clear. From their discussion of the classification of particular sites (Kemrer and Kearns 1984:86–100), however, the primary distinction seems to be whether the discrete loci encompassed by the site are all temporary camps, or a combination of temporary camps and limited activity sites. This distinction suggests that multiple use locales are not a separate site type but a combination of temporary camps and either lithic procurement/workshop or limited activity sites.

Kemrer and Kearns also divide their major site types into a series of subtypes using varying criteria. For multiple use sites and temporary camps, the subtypes are defined by the various present/absent combinations of ceramics, milling stones, and hearth/FCR features (e.g., ceramics absent, milling stones and hearth/FCR present; ceramics and milling stones present, hearth/FCR absent, etc.). Size is used to define the subtypes for lithic procurement/workshop locales, whereas the subtypes for limited activity sites are defined by differences in the composition of their lithic assemblages.

Lord and Reynolds (1985:17, 192) postulate that the WIPP area was seasonally utilized by groups who established temporary base camps near semi-permanent water sources. Task groups would range into the surrounding area to hunt and gather. After preliminary processing, the collected resources would be returned to the base camp for temporary storage. At the end of the seasonal occupation, the stored resources would be transported to permanent villages, probably located near the Pecos River. Inherent in this model are three basic site types, only two of which were expected to occur in the WIPP area, the temporary base camps and procurement/processing sites. Two of the three sites investigated by Lord and Reynolds were interpreted as plant processing sites based on the presence of ground stone, a paucity of formal flaked lithic tools other than projectile points, and debitage assemblages indicative of limited tool maintenance or manufacture (Lord and Reynolds 1985:191–192, 198). Lord and Reynolds interpreted the third site as a limited base camp based the large number of projectile points, hearth features, shell and bone accumulations, and its location near a potential water source (1985:218–220, 223). They acknowledge that the low density of lithics, ceramics, and ground stone at the site seems inconsistent with this interpretation, however.

Gallagher and Bearden (1980:35) developed a similar but much more explicit site typology in their evaluation of prehistoric sites at Brantley Reservoir. Initially, four site types were defined using total site area, and the presence or absence of burned rock – large artifact and burned rock scatters, small artifact and burned rock scatters, large artifact scatters, and small artifact scatters. Two other site types were defined based on the presence of specialized features – burned rock structures (i.e., ring middens and burned rock middens) and mortarholes (i.e., bedrock mortars). Functions analogous to Mescalero Apache sites were assigned to these morphological categories. Large artifact and burned rock scatters were hypothesized to be semi-permanent, lowland/riverine base camps; small artifact and burned rock scatters, temporary support camps; large artifact scatters, hunting staging loci; and the small artifact scatters, plant procurement loci. The primary function of the burned rock structure sites was presumed to have been the preparation of mescal or sotol, while mortarhole sites were suspected to be related to the exploitation of some riverine resources, possibly walnuts (Gallaher and Bearden 1980:37–39).

Analysis of the Brantley Reservoir sites was directed in part to testing the functional hypotheses. Based on those analyses, the interpretation of the burned rock structures was supported. The interpretation of large artifact and burned rock scatters as base camps was not supported, however. Those sites were reinterpreted as centers for collecting and processing wild plant foods, the same function attributed to the small artifact and burned rock scatters. It therefore appeared that the large and small artifact and burned rock scatters were not separate types but part of a size continuum for a single site type (Gallagher and Bearden 1980:273). The postulated function of small artifact scatters was also changed from plant procurement loci to quarry/workshops. The large artifact scatters and mortarhole sites could not be evaluated because the site sample included too few sites of those types.

In reporting their work at Brantley Reservoir, Katz and Katz (1985:115) pointedly reject the typology developed by Gallagher and Bearden. They argue first that there was no evidence for functional variability among small and large sites, and second that a typology based on the presence or absence of burned rock obscured considerable functional and perhaps temporal variability. In formulating a new typology, Katz and Katz (1985:39–55) first devised a classification of feature types. Three feature classes were defined, each of which was subdivided into three feature types. Burned rock accumulations, their first class, was divided into burned rock rings, burned rock concentrations, and burned rock scatters. Burned rock rings are interpreted as specialized facilities for processing succulents, while burned rock concentrations are generally interpreted as hearths. The Katzs' assert that burned rock scatters are a unique feature type and not simply the eroded remnants of hearths or burned rock rings (1985:48), but they offer no positive evidence to support this contention. The second feature class, stone circles, consists of tipi rings, stone enclosures, and cairns. Tipi rings are assumed to be stones used to weigh down the edges of skin tents or tipis; stone enclosures are suspected to be the foundations of domestic structures, at least at SM 108 (LA38326); and cairns are suspected to be some kind of markers, although it is unclear whether they are prehistoric or historical. The third feature class, miscellaneous features, comprises isolated charcoal stains, chipping stations (i.e., concentrations of flaked lithic detritus), and mortar holes.

The site classification used by Katz and Katz makes an initial distinction between sites lacking features and those where features are present. Classification of the latter sites then consists of listing the kinds of features that are present. In interpreting the sites described in the report, however, the Katzs' also employ a variety of functional terms that correspond in part to their morphological categories. Sites with burned rock rings are consistently interpreted as succulent processing areas and, if burned rock hearths are also present, then hunting is presumed to have been a secondary activity. Sites with burned rock hearths or tipi rings are interpreted as either temporary camps or limited activity sites depending on the size and composition of their artifact assemblages. Sites with chipping stations or lacking features are most often interpreted as limited activity sites or as having some more specific function such as lithic procurement or tool manufacture.

The site typology developed for the Melrose Air Force Range (Fallis 2002; Moffitt 2005; Shelley 1995; Shelley et al. 1998) emphasized variation in lithic assemblages. In contrast to previous studies, frequencies of eleven categories of flaked stone debitage, tool, and core types were used as primary data in defining the site types (Shelley and Durand 1995; Shelley et al. 1998:20-31). Frequencies of ground stone and presence/absence of ceramics and fire-cracked rock were also taken into consideration in positing base camp, quarry, tool production and maintenance, and plant processing site types. Initial classification was explicitly inspectional and judgmental (Shelley et al. 1998:20), but quantitative analyses of sample diversity and richness were applied to evaluate expectations that assemblages classified as base camps should reflect high diversity and richness among the artifact types, and that plant processing assemblages should be characterized by low diversity and low richness among the types.

Expectation for quarry sites and tool production and maintenance sites were not specifically addressed in their study.

With the exception of the Melrose Air Force Range studies, the most common division in all of these typologies is either between sites with features and without features, or between sites with and without fire-cracked rock, which often amounts to the same thing. Subsequent divisions were then made on the basis of site area, the occurrence of more specialized features, or differences in the artifact assemblages. Site area is the least useful of those criteria since there appears to be no functional differences between large and small sites. Assemblage attributes are also of limited utility in this instance because the only artifact data routinely coded in NMCRIS are estimates of the number of lithic and ceramic artifacts at the site. A site typology based on features is therefore the most practical alternative for this project.

COMPONENT CLASSIFICATION

Site data for the nine counties encompassed by the BLM Carlsbad and Roswell Districts (Guadalupe, Quay, DeBaca, Curry, Lincoln, Chaves, Roosevelt, Eddy, and Lea) were downloaded from the NMCRIS database, and the historical components were deleted. Some sites in western Lincoln County were also removed when the study area boundary was redrawn along the crest of the Guadalupe and Sacramento Mountains. Our reasoning here was that sites on the steep western slopes of those ranges were more likely associated with settlement systems centered in the Tularosa Basin than with systems centered in the Pecos River valley. Finally, 1718 sites with recently reserved LA numbers were excluded from the analysis because their records had little information beyond location. The final database consists of 9256 sites and 9797 components (5% of the sites are multi-component).

Temporal Periods

Following the NMCRIS categories, a breakdown of the components by culture and period is provided in Table 3.1. Cultural affiliation and age are unknown for slightly more than half of the components, and 43–67% of the components within identified culture categories have date ranges that are either unspecific or cross-cut two or more periods. Consequently, no temporal divisions were made below the level of culture.

Following Katz and Katz (2001:22), the components were grouped into four broad temporal periods – Paleoindian, Archaic, Ceramic, and Protohistoric. NMCRIS - defined Anasazi, Jornada Mogollon, and Plains Village components are grouped in the Ceramic period. NMCRIS - defined Apache and Plains Nomad components, and a few Unknown components with tipi rings are grouped in the Protohistoric period. This last period is somewhat problematic in that most of the Protohistoric components have date ranges that extend into the historical period, and it is unclear if any were actually occupied before AD 1600, the cutoff date for sites treated under this research design.

Morpho-Functional Types

Classification of the components into morphological/functional categories was a two-step process. The first step was to code NMCRIS component type for the 4337 components missing this variable. This classification was based on the kinds of features found at the sites. Features at multi-component sites were assumed to be common to all components unless the associations between features and components were specified.

Table 3.1 Dating of Southeastern New Mexico Components (NMCRIS earliest and latest periods).

PERIODS	**NUMBER**	**PERCENT**	**PERIODS**	**NUMBER**	**PERCENT**
Pre-Clovis	1		Early Pithouse	17	
Clovis	7		Early-Late Pithouse	77	
Clovis-Late Paleoindian	2		Early Pithouse-Early Pueblo	14	
Clovis-Terminal Paleoindian	2		Early Pithouse-Late Pueblo	274	
Folsom/Midland	27		Late Pithouse	217	
Folsom/Midland-L. Paleoindian	1		Late Pithouse-Early Pueblo	394	
Late Paleoindian	13		Late Pithouse-Late Pueblo	734	
Late-Terminal Paleoindian	4		Early Pueblo	86	
Terminal Paleoindian	6		Early-Late Pueblo	749	
Unspecific Paleoindian	102		Late Pueblo	228	
			Unspecific Jornada Mogollon	526	
Total Paleoindian	**165**	**1.7%**			
			Total Jornada Mogollon	**3316**	**33.8%**
Early Archaic	26				
Early-Middle Archaic	9		Plains Woodland	1	
Early-Late Archaic	27		Plains Woodland-Panhandle	2	
Middle Archaic	36		Panhandle	10	
Middle-Late Archaic	72		Unspecific Plains Village	22	
Late Archaic	322				
Unspecific Archaic	368		**Total Plains Village**	**35**	**0.4%**
Total Archaic	**860**	**8.8%**	Unspecific Plains Nomad	25	
			Apache	56	
Basketmaker II	3		Unknown	18	
Basketmaker III	2				
Basketmaker III-Pueblo I	4		**Total Protohistoric**	**99**	**1.0%**
Pueblo I-II	1				
Pueblo I-III	2		**Total Unknown**	**5161**	**52.7%**
Pueblo I-IV	1				
Pueblo II	26				
Pueblo II-III	26		**Total Components**	**9797**	**100%**
Pueblo III	17				
Pueblo III-IV	16				
Pueblo IV	10				
Unspecific Anasazi	53				
Total Anasazi	**161**	**1.6%**			

NMCRIS Component Types (sitetype1)

Components with roomblocks, pithouses, tipi rings, wickiups, or isolated structures were classified as single residences, multiple residences, or residential complexes depending on the number of features present. Single residences have one dwelling; multiple residences, between 2 and 10–15 dwellings (the precise number of rooms or residential structures was not always evident); and residential complexes, more than 10–15 dwellings. Because roomblocks were coded for anywhere between two and several hundred rooms, the original documentation of all sites with roomblocks was checked before the classification was finalized. In the few cases where the size of the roomblock was not indicated, the components were designated as multiple residences. Components with other types of features were classified as artifact scatters with features unless the absence of artifacts was explicitly noted (i.e., total artifacts = 0). Those components were classified as simple features. Lastly, components with no associated features were classified as artifact scatters.

As shown in Table 3.2, artifact scatters and artifact scatters with features are the co-dominant types. Together, they constitute 93% of the components. About 2% of the components are classified as residences. Archaic components contribute little to that total, which is somewhat surprising since shallow house pits are relatively common at Archaic sites in the Tularosa Basin. One possible explanation is that structures have not been recognized because relatively few Archaic sites have been excavated in southeastern New Mexico. The high proportion (42%) of Protohistoric residential components, on the other hand, likely results from the fact that tipi rings, which are classified here as residential structures, are one of the few temporal diagnostics for the Protohistoric period that is widely recognized by survey crews.

Table 3.2 Distribution of NMCRIS Component Types (sitetype1) by Temporal Period.

Component Type	**Paleoindian**	**Archaic**	**Ceramic**	**Protohistoric**	**Unknown**	**Total**
simple features	9	24	36	3	414	486
*artifact scatters**	112	415	1521	29	2704	4781
artifact scatters with features	44	420	1801	25	2020	4310
*single residence**	0	1	71	26	19	117
*multiple residence**	0	0	57	16	4	77
*residential complex**	0	0	26	0	0	26
*Retained in final typology						
Total	**165**	**860**	**3512**	**99**	**5161**	**9797**

The second step in the classification process focused on the artifact scatters and artifact scatters with features. It was quickly apparent that no further breakdown of the artifact scatters was possible, however. The artifact data coded in NMCRIS is limited to ordinal categories indicating the approximate number of lithic, ceramic, historical, and total artifacts (i.e., 1s, 10s, 100s, etc.). All other information is entered as text in the assemblage notes. There are assemblage notes for less than one-quarter of the sites and artifact counts for 60% of the artifact scatters are either missing or coded as "unknown." Consequently, there was no basis for expanding the classification of these components here, but it should be a priority for future research. If the 1981 components for which we have data are representative, then about three quarters of the artifact scatters are lithic scatters and one-quarter are sherd-and-lithic scatters. The majority of assemblages number in the tens (57%) or hundreds (29%) of artifacts. About 6% of the sites have thousands of artifacts; 1%, have tens of thousands of artifacts; and 7% have fewer than 10 artifacts.

Expanded Classification of "Artifact Scatters with Features" and "Simple Features" (sitetype2)

In the absence of artifact data, the feature data coded for components in NMCRIS provided the only information upon which to base an expanded site typology. Using this information, an expanded typology was developed for the components from southeastern New Mexico classified in NMCRIS as simple features or artifact scatters with features. We began by looking at some general characteristics of the feature assemblage – the feature types present, their relative frequencies, and the number and diversity of features associated with the individual components. For this analysis, the features at multi-component sites were listed only once, so the total number of components is 4553. Although feature types are listed for all of those components, counts are missing for one or more feature types in about 10% of the records. The total number of components therefore varied depending on the characteristic being examined.

Feature Assemblage Characteristics. The total feature assemblage consists of 29 feature types and 16,270 features. Relative frequencies of these feature types were calculated on the basis of *abundance*, the number (N) of features in each type, and *ubiquity*, the number of components at which each type occurs (O). The rankings of feature types for abundance and ubiquity are shown in Table 3.3. The two measures have the same types in the top 12 rankings, although the rank orders differ. Those 12 feature types include 96% of all features in the sample and 94% of all components with features. The four highest ranked types alone include 80% of the features and 74% of the components in the sample. This patterning suggests that a classification based on a small number of feature types should be adequate to characterize nearly all of the components.

Feature diversity among the components was examined using separate indices for richness and evenness. *Richness* is simply the number of different feature types associated with a component. Roughly 82% (3725) of the components have only one feature type, 15% (684) have two types, and 2% (112) have three types. The remaining 1% consists of 32 components with four feature types, two components with five types, and one component with six types. Even this most diverse component includes only one-fifth of the 29 feature types present in the total feature assemblage, so it is clear that the richness values for all of the components are low.

An even distribution is one in which the proportions of the different feature types are roughly equal. The *evenness* of components with two or more feature types and feature counts (*n* = 785) was measured using Simpson's Measure of Diversity (Pielou 1969:223), which has values ranging from 0.0 to 1.0. As shown in Figure 3-1, about one-third (37%) of the components have relatively high diversity values (D = 0.68-1.0) indicating that their features are evenly distributed, but the high frequency of 1.0 values results primarily from components that have only two features of different types. The largest proportion of components (47%) have moderate diversity values (D = 0.35-0.67), which can be considered "somewhat even." The remaining 16% of components have low diversity values (D = 0.00-0.34) indicating an uneven distribution of features. In this case, however, these evenness measures are of little value in characterizing feature diversity because most components have so few feature types.

The number of features associated with the individual components ranges from 1 to 111 exclusive of two extreme outliers. The distribution has a strong positive skew (Figure 3.2) with a mode of 1, a median of 2, and an interquartile range between 1 and 4. In other words, 45% of the 4073 components have only one feature; 78%, have fewer than four features; and 95%, have fewer than 11 features. Only 1% of the components, including the two outliers, have more than 32 features. The outliers are both large hearth fields. LA 54363 has 200 hearths and charcoal stains, and two isolated structures, while LA 105775 has one charcoal stain and 400 fire-cracked rock concentrations.

The 40 components with more than 32 features were examined for any patterning in the occurrence of feature types. Sixteen feature types are associated with those components, nine of which are either single occurrences or have a feature/component average of 1.0 (Table 3.4). Two-sample difference of proportions tests (Blalock 1972:228) of the remaining seven feature types indicate that proportions for fire-cracked rock concentrations (*z* = 7.39), bedrock mortars (*z* = 4.53), and roasting pits (*z* = 2.45) are significantly higher among the components with more than 32 features than for the total assemblage, and the proportion for hearths (*z* = -7.05) is again significantly lower. The proportions for charcoal/ash stains (*z* = -0.41), ring midden/mescal pits (*z* = -1.00), and burned rock middens (*z* = 1.77) do not differ significantly from their proportions in the total feature assemblage. Overall, these statistics suggest that components with lots of features generally have the same common feature types as components with few features. That is, excepting bedrock mortars and possibly roasting pits, the difference are quantitative rather than qualitative.

Table 3.3 Rank ordering of feature types.

Feature Type	Number of Features (Abundance)	Proportion (N)	Rank (N)	Frequency of Occurrence among Components (Ubiquity)	Proportion (O)	Rank (O)
Hearth	5506	.3384	1	2090	.3751	1
Fire-Cracked Rock Concentration	5061	.3111	2	1066	.1913	2
Ring Midden/ Mescal Pit	1463	.0899	3	554	.0994	3
Charcoal/Ash Stain	1046	.0643	4	545	.0978	4
Bedrock Mortar	672	.0413	5	92	.0165	11
Petroglyph/ Pictograph	420	.0258	6	80	.0144	12
Roasting Pit	373	.0229	7	151	.0271	6
Burned Rock Midden	367	.0226	8	99	.0178	10
Rockshelter	213	.0131	9	201	.0361	5
Midden	184	.0113	10	125	.0224	8
Rock Alignments	177	.0109	11	103	.0185	9
Lithic Quarry	146	.0090	12	134	.0240	7
Unspecified Other Feature	95	.0058	13	14	.0025	20/21
Pit, Undefined	68	.0042	14	14	.0025	20/21
Burial/Grave	60	.0037	15	36	.0065	16
Mound	58	.0036	16	44	.0079	14/15
Depression	55	.0034	17	44	.0079	14/15
Cave	48	.0030	18/19	48	.0086	13
Cairn	48	.0030	18/19	30	.0054	17
Bin/Cist	47	.0029	20	12	.0022	22
Stone Circle	46	.0028	21	29	.0052	18/19
Wall	34	.0021	22	29	.0052	18/19
Thermal Feature, undefined	32	.0020	23	9	.0016	23
Well	17	.0010	24	2	.0004	28
Grinding Slick	9	.0006	25	5	.0009	25/26
Cache	8	.0005	26	7	.0013	24
Ramada/Shelter	7	.0004	27	3	.0005	27
Bone Bed	5	.0003	28	5	.0009	25/26
Activity Area	2	.0001	29	1	.0002	29
Total	**16,270**	**1.0000**		**5572**	**1.0001**	

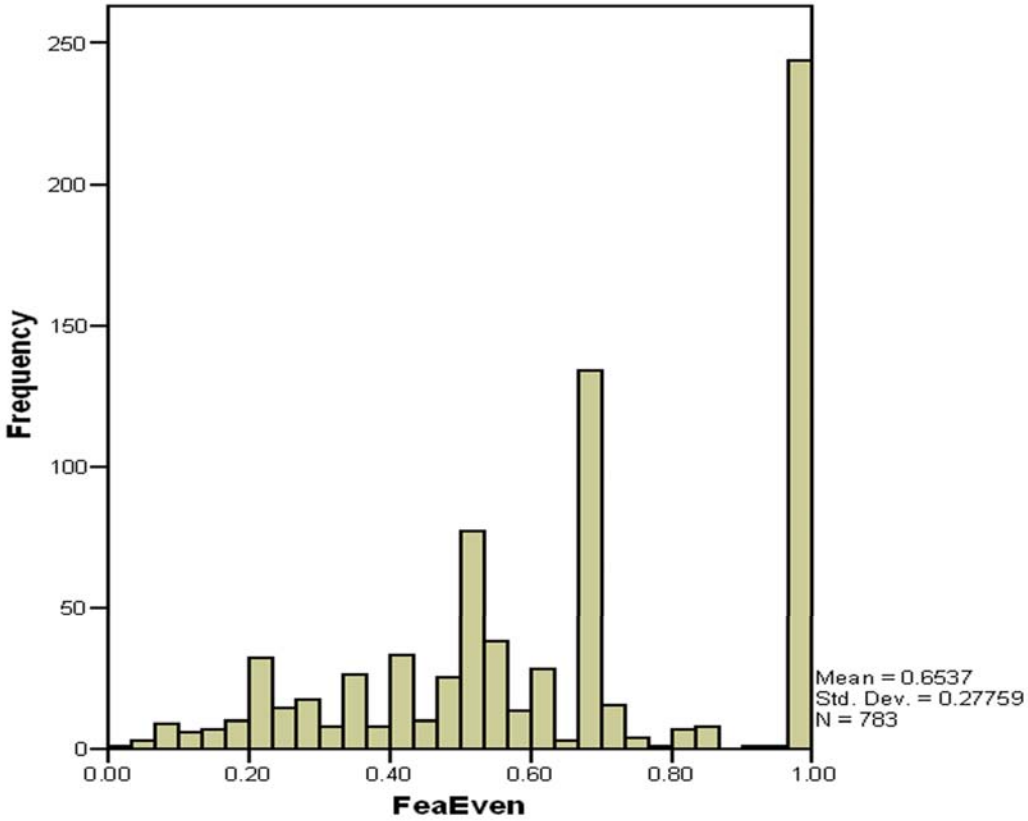

Figure 3.1 Histogram showing evenness values (Simpson's Measure of Diversity for non-residential components with features.

Table 3.4 Features Associated with Components that ave more than 32 features.

Feature Type	**Number of Features**	**Number of Components**	**Average Fea/Comps**
Fire-Cracked Rock Concentration	1166	22	53.00
Hearth	510	18	28.34
Bedrock Mortar	323	7	46.14
Ring Midden/Mescal Pit	187	9	20.78
Roasting Pit	178	6	29.67
Charcoal/Ash Stain	153	10	15.30
Burned Rock Midden	145	6	24.17
Petroglyph/Pictograph	44	1	44.00
Pit, Undefined	20	1	20.00
Bin/Cist	12	1	12.00
Rockshelter	3	1	3.00
Midden	2	2	1.00
Stone Circle	1	1	1.00
Rock Alignment	1	1	1.00
Cache	1	1	1.00
Burial/Grave	1	1	1.00
Total	**2747**	**88**	

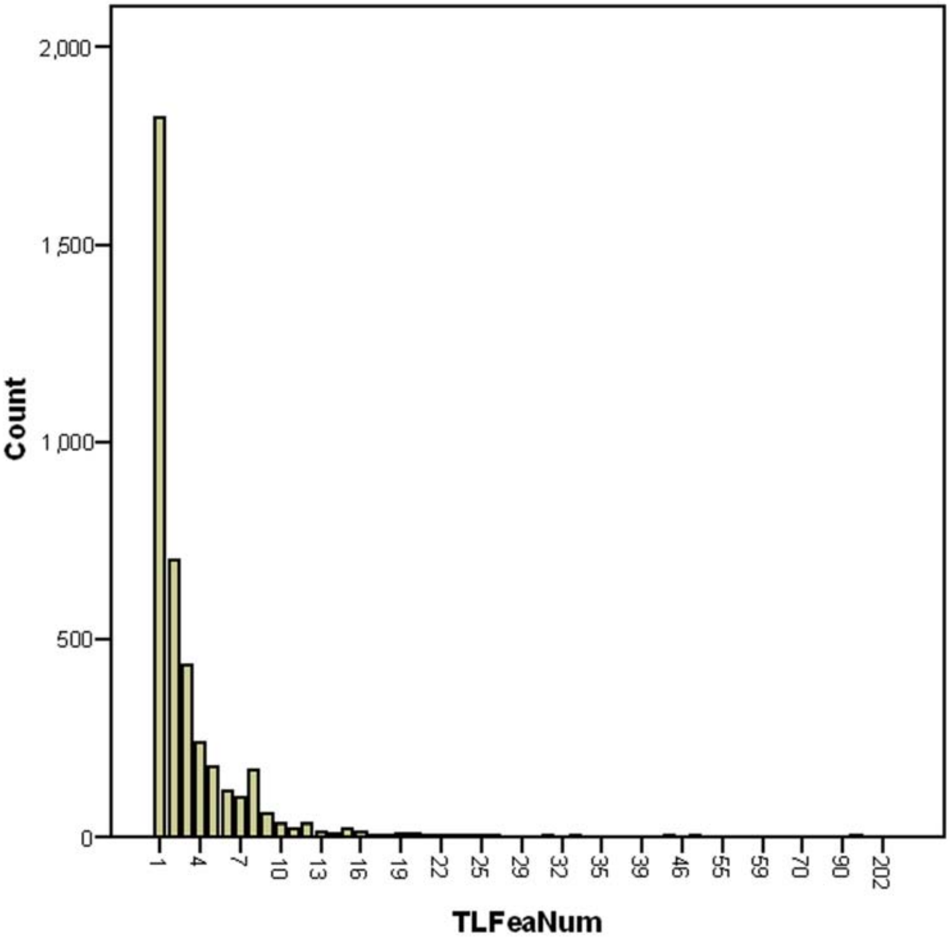

Figure 3.2 Histogram showing the total number of features at non-residential components with features.

In summary, our analyses found one overriding pattern that will hardly be a revelation to any archaeologist working in the region. The great majority of these components are very simple and they are all pretty much the same. In general, the components classified as simple features or artifact scatters with features can be characterized as having 1–4 features (79%) and one (82%) or two (15%) feature types. Most of these features (76% of occurrences) will be one of four feature types – hearths, fire-cracked rock concentrations, ring midden/mescal pit, or charcoal/ash stains. The most common feature types are, in order of frequency of occurrence: hearths, fire-cracked rock concentrations, ring midden/mescal pits, charcoal/ash stains, rockshelters, roasting pits, lithic quarries, middens, rock alignments, burned rock middens, bedrock mortars, and petroglyph/pictographs.

Component Reclassification. Given these general characteristics, it is clear that a classification based on single feature types can accurately reflect the character of nearly all of the components. Further, the number of feature types required for the classification is relatively limited. The typology would be most useful for archaeological research if the resulting morphological categories had functional implications, however, and the behavioral correlates of the some of the common feature types are ambiguous. The functional interpretation of the petroglyphs and pictographs, for example, is problematic.

Charcoal/ash stains and middens also pose an interpretive problem. As coded in NMCRIS, charcoal/ash stains may be the remnants of small thermal features, burned structures, refuse deposits or occupation surfaces. Similarly, the term "midden" is applied not only to secondary refuse but to almost any cultural deposit where artifacts are associated with ash or charcoal stained sediments. Although these features were not used in developing the site typology, their presence is an important indicator that a site might yield datable materials and/or subsistence remains. Consequently, in selecting sites for excavation within any temporal period/site type category, preference should be given to sites with midden deposits and/or charcoal/ash stains.

In contrast, there is ample indirect evidence suggesting that ring middens and burned rock middens are associated with the processing of mescal and other succulents. Bedrock mortars also appear to be specialized processing facilities, although there is no definitive evidence indicating what they were used to process. The few bedrock metates, coded as grinding slicks, also fall into this general category. Following Kemrer and Kearns (1984), hearths and fire-cracked rock concentrations are tentatively interpreted as "domestic features;" that is, as features associated with food preparation and consumption at residential camps. Roasting pits and undefined thermal features are also included in this category because we could identify no criteria that consistently distinguish these four feature types.

A third general category consists of natural features. Included in this group are rockshelters and caves, which were used by prehistoric groups as shelters, caches, and burial chambers. Lithic quarries (i.e., lithic procurement and workshop areas) also fall into this category.

Features that could be the remnants of structures constitute a fourth general category. The four feature types in this grouping are rock alignments, walls, depressions, and mounds.

The final classification system for the simple features and artifact scatters with features (sitetype2) retained two of these general categories, domestic features and possible structures. Following Katz and Katz (1985), the specialized processing facilities were split into two types, one consisting of ring midden/mescal pits and burned rock middens; and the second, of bedrock mortars and grinding slicks. Rockshelters, caves, and quarries were also kept as separate categories, the quarries because they are functionally distinct, and the rockshelters and caves because their cultural deposits differ from those normally found at open sites.

The results of the classification are shown in Table 3.5. As expected, most of the components (63%) were classified as domestic features. Ring middens (14%) and miscellaneous features (10%) are the next most common types. The proportions of component types for the Archaic and Ceramic periods are broadly similar to those of the total assemblage. For the Protohistoric period, the proportion of possible structures (28%) is higher and the proportion of domestic scatters (36%) lower than for the total assemblage. Given the small sample size, however, the differences may not be meaningful. The proportions of rockshelters and caves are also somewhat higher for the Paleoindian period than for the overall assemblage.

Eleven feature types are associated with the miscellaneous features component type category (Table 3.6) that are either rare occurrences or have no clear behavioral correlates. Most (69%) are charcoal/ash stains, but there are also moderate numbers of isolated midden deposits (9%), petroglyph/pictographs (8%), burials (4%), and cairns (3%). The rare occurrences include some components with significant research potential, such as Paleoindian bone beds and Archaic wells, but no patterning can be inferred from so few cases.

Table 3.5 Expanded Component Types (sitetype2) for Simple Features and Artifact Scatters with Features by Temporal Period (excludes 34 components that had no feature types coded).

Expanded Component Type	Paleoindian	Archaic	Ceramic	Protohistoric	Unknown	Total
possible structures	2	14	87	7	111	221
domestic features	34	288	1153	10	1507	2992
ring middens	0	64	253	5	352	674
bedrock mortars	0	11	28	0	30	69
miscellaneous features	7	36	250	4	188	485
caves	1	4	16	0	12	33
rockshelters	6	16	28	2	101	153
quarries	3	11	6	0	115	135
Total	**53**	**444**	**1821**	**28**	**2416**	**4762**

Table 3.6 Feature Types Associated with the Miscellaneous Feature Component Type. Note that 11 of the components have two feature types.

Feature Type	Paleoindian	Archaic	Ceramic	Protohistoric	Unknown	Total	Proportion
Charcoal/Ash Stain	2	22	204	1	115	344	.6936
Midden	0	3	24	0	19	46	.0927
Petroglyph/Pictograph	0	3	10	3	22	38	.0766
Cairn	0	2	3	0	14	19	.0383
Burial/Grave	0	2	8	0	8	18	.0363
Unspec. Other Feature	2	1	1	0	9	13	.0262
Bin/Cist	0	1	4	0	0	5	.0101
Bone Bed	3	0	0	0	1	4	.0081
Cache	0	1	0	0	3	4	.0081
Pit, Undefined	0	0	2	0	1	3	.0060
Well	0	2	0	0	0	2	.0040
Total	**7**	**37**	**256**	**4**	**192**	**496**	**1.0000**

Final Site Typology

The final typology proposed here for prehistoric and protohistoric sites in southeastern New Mexico consists of the eight types formulated in the previous section (sitetype2) plus four of the original NMCRIS component types. Those 12 types are:

1. **artifact scatter** – lithic and/or ceramic scatter with no other features (NMCRIS 1993:4-25). This morphological type undoubtedly includes a variety of functional categories. Some sites may be residential or task group camps with features that are either buried or have been eroded. Others probably reflect a more limited range of activities associated directly or indirectly with the resource procurement. An expanded classification of artifact scatters, based on the type and diversity of artifacts, is therefore needed to refine the site typology.

2. **single residence** – a single residential structure or unit, commonly occurring with an artifact scatter and/or other facilities or features (NMCRIS 1993:4-25).

3. **multiple residence** – two to fifteen residential structures or units, with an artifact scatter and/or other features.

4. **residential complex/community** – more than fifteen residential structure or units; may also have public structures/areas such as plazas and/or kivas.

The second, third, and fourth site types are primarily useful in distinguishing the permanent or semi-permanent settlements associated with the Ceramic period occupation of southeastern New Mexico, but they are also applicable to hunter-gatherer sites with recognizable structures or shelters. In the latter instances, it is hypothesized that the labor invested in the construction of structures reflects the intended duration of the occupation; consequently, sites in these categories might represent seasonal camps or residential basecamps.

5. **quarry/lithic procurement areas** – locations where lithic raw materials are present that have been collected for use by prehistoric and/or protohistoric groups. Sources can be either outcrops or gravels. The artifact scatters associated with these sites are expected to evidence testing and initial reduction of lithic raw materials and more intensive workshop areas may be present. Other kinds of features may also be present but the lithic procurement activities have priority in defining this site type.

6. **possible structures** – sites with features that may indicate the presence of some type of structure or shelter (e.g., depression, mound, wall, rock alignment). Some of these sites are expected to be residences, others may be more ephemeral shelters associated with agricultural fields or with camps.

7. **ring middens/burned rock middens** – sites with features classified as ring middens, burned rock middens, or mescal pits that have no evidence of structures and that are not associated with lithic procurement areas. Other features may be present, most commonly suggesting the presence of an associated camp. Ring middens and burned rock middens are hypothesized to be specialized plant processing facilities.

8. **bedrock mortars/metates** – sites with bedrock mortars and/or grinding slicks that have no evidence of structures, that have no ring middens or burned rock middens, and that are not associated with lithic procurement areas. Other feature types may be present. Bedrock mortar/metates are hypothesized to be specialized plant processing facilities, but there is no good evidence indicating what resources are being processed. Further, it is not clear whether they occur as isolated facilities or in association with residential camps.

9. **domestic features** – sites with hearths, fire-cracked rock/burned caliche concentrations, roasting pits, and/or undefined thermal features that lack evidence of structures and that are not associated with lithic procurement areas or specialized facilities (i.e., ring midden/burned rock middens or bedrock mortar/metates). The features defining this site type are hypothesized to be generalized facilities associated with food processing and consumption. As such, domestic feature sites are most likely residential camps.

10. **rockshelter** – an overhang, indentation, or alcove formed naturally by rockfall or in the rock face, generally not of great depth, with evidence of human use (NMCRIS 1993:A7-6).

11. **cave** – a natural hollow or opening beneath the earth's surface with an aperture to the surface, with evidence of human use. A cave differs from a rockshelter in terms of the depth of penetration and the constriction of the opening (NMCRIS 1993:A7-2).

In this typology, caves and rockshelters are residual categories identifying natural shelters evidencing human use but with no associated features that would cause it to be classified into one of the previous site types. A cave or rockshelter site with masonry walls or rock alignments would be classified as a possible structure; one with associated bedrock mortars, as a bedrock mortar/metate site; or one with hearths, as a domestic feature site.

Most cave and rockshelter sites in the region expected to be short-term or seasonal camps occupied by residential or specialized task groups. Some may have served primarily as locations for caching food, tools, or raw materials, and others may have been used primarily for ritualistic purposes.

12. **miscellaneous features** – sites with feature types other than those that would lead it to be classified into one of the previous categories. This residual category includes about 5% of the components in our sample and almost certainly represents a variety of different human activities. As discussed in the previous section, however, miscellaneous feature sites most commonly have charcoal/ash stains (69%) or middens (9%), suggesting that most are probably camps or residential sites.

Final Site Type Classification Guidelines

After reviewing the draft of this research design, the BLM requested that a key be added to clarify the site type definitions and to facilitate the classification of newly recorded sites. The key is based on the NMCRIS feature types, definitions for which are provided in the *Users Guide: New Mexico Cultural Resources Information System Guidelines for Submitting Archaeological Records* (NMCRIS 1993). For convenience, relevant NMCRIS feature definitions are included in the italicized portions of the key. The key is intended to mimic the classification process described in this chapter and does not provide for all possible combinations of features.

1. Is the component a scatter of lithic and/or ceramic artifacts with no other features?
   1a. Yes, component type is **artifact scatter**.
   1b. No, see 2.

2. Does the component have one or more residential structures (i.e. isolated room, pithouse, ramada/shelter, roomblock, tipi ring, or wickiup)?
   2a. Yes, see 3.
   2b. No, see 6.

Isolated Room – the remains of a small surface structure constructed of adobe, jacal, or masonry. Structure should be spatially detached from any larger structure.

Pithouse – a habitation structure built entirely or partially underground.

Ramada/Shelter – all temporary shelters, including lean-tos, windbreaks, brush enclosures, and sun shades.

Roomblock – the remains of a contiguous, multi-room habitation structure constructed of adobe, jacal, or masonry. Usually manifests a surface mound with construction debris exposed, and some wall alignments visible. Includes all pueblos and Navajo pueblitos.

Tipi Ring – the circular pattern left when a tipi is dismantled.

Wickiup – a short-term habitation constructed of matting, grass, or bark overlaying a frame.

3. Is there only one residential structure/unit?
   3a. Yes, component type is **single residence**.
   3b. No, see 4.

4. Is there more than one but fewer than 15 residential structures/units?
   4a. Yes, component type is **multiple residence**.
   4b. No, see 5.

5. Are there more than 16 residential structures/units?
   5a. Yes, component type is **residential complex/community**.

6. Do the features coded for the component include a lithic quarry or quarry?
   6a. Yes, component type is **quarry/lithic procurement area**.
   6b. No, see 7.

Lithic quarry – use only for actual outcrops of lithic material that have been mined or otherwise exploited for the purpose of stone tool manufacture.

Quarry – an area where geological materials are available for removal and use off-site.

7. Do the features coded for the component include depressions, mounds, undefined rock alignments, or walls?
   7a. Yes, component type is **possible structure**.
   7b. No, see 8.

Depression – an area that is sunk below the immediate surrounding terrain. Use to indicate depressions that are a direct result of some human activity but the nature of which is unclear.

Mound – a pile of materials which may represent the remains of a structure. Use for structural mounds which cannot be further differentiated (e.g., rubble mounds).

Undefined Rock Alignments – a group of rocks which appear to have some cultural association. Use for possible walls, wall-like phenomena, human produces architectural oddities, rock piles, etc.

Wall – an upright structure which divides, encloses, or protects an area, constructed of various materials.

8. Do the features coded for the component include ring middens, mescal pits, or burned rock middens?
   8a. Yes, component type is **ring midden/burned rock midden**.
   8b. No, see 9.

Burned Rock Midden – large dense concentrations, often mounded, of fire-cracked rock, usually associated with large scale plant processing. Although other cultural materials are usually present in the midden, fire-cracked rock is predominant.

Mescal Pit – a pit dug for the processing of succulent plants. Often leaves behind masses of fire-cracked rock and charcoal stained sediments.

Ring Midden – a general donut-shaped or concentric burned rock midden.

9. Do the features coded for the component include bedrock mortars or grinding slicks (bedrock metates)?
   9a. Yes, component type is **bedrock mortars/metates**.
   9b. No, see 10.

Bedrock Mortar – a pecked or ground concavity in a large boulder or outcrop used for the processing of food or other items.

Grinding Slick – a ground surface or surfaces appearing on a fixed or otherwise immoveable rock or rock outcrop.

10. Do the features coded for the component include hearths, fire-cracked rock/caliche concentrations, roasting pits, or undefined thermal features?
    10a. Yes, component type is **domestic feature**.
    10b. No, see 11.

Fire-cracked Rock Concentration – a concentration of thermally altered rock or caliche that cannot be defined as to its function or use.

Hearth – an extramural, localized area of controlled intentional burning. Encompasses all surficial fire-related phenomena including fire pits, formal hearths, unstructured hearths, fire rings, burned rock rings, fire deflectors, and slab-lined hearths.

Roasting Pit – an excavated hole or pit for cooking without the direct application of fire, usually accompanied by concentrations of burned rock.

Undefined Thermal Feature – a feature identified by the presence of charcoal or ash staining, and/or fire-cracked rock that cannot be defined as to its function or use.

11. Do the features coded for the component include rockshelter?
    11a. Yes, component type is **rockshelter**.
    11b. No, see 12.

12. Do the features coded for the component include cave?
    12a. Yes, component type is **cave**.
    12b. No, component type is **miscellaneous features**.

EXCAVATED SITES

The morpho-functional classification of components developed in the previous section is based exclusively on surface evidence as documented in the NMCRIS database. Consequently, there is some question about how accurately the typology reflects the variability in any subsurface materials that might be present at the site. The question is an important one in deciding whether the typology is useful for preliminary settlement pattern studies, and it is even more critical if the component types are used in selecting a sample of sites for excavation. As a preliminary test of the typology, we therefore reviewed all of the excavation reports we could obtain that had been published after 1990 (see references at end of chapter). This cutoff date was chosen to reflect current excavation practices in the region. The reports describe investigations at 51 sites that had either been excavated during data recovery programs, or that had been tested with a resulting recommendation of no further work. Our feeling was that including the latter sites would provide a more realistic appraisal of the data potential of the different component types.

A breakdown of those sites by component type and geoarchaeologic unit is provided in Table 3.7 along with the excavator's interpretation of the site and the presence or absence of surface and subsurface artifacts, features, and cultural deposits. The sample does not include any examples of single residences, possible structures, or caves/rockshelters (the Sunset Shelters Site, LA 71167, was classified as a bedrock mortar site under our typology). Artifact scatters are also under-represented in the sample, which probably reflects survey recommendations that these sites have limited data potential and therefore are not eligible for the National Register.

Overall, the functional connotations of the component types correspond reasonable well with the excavator's interpretations. There is clearly considerable variability in the interpretation of *artifact scatters*, which indicates that this component category encompasses a variety of different activity loci, and reinforces our recommendation that priority needs to be given to developing an expanded classification for these sites. The interpretations of *miscellaneous features* also vary. In all four cases, the only features noted at the sites were charcoal/ash stains, which have no clear behavioral correlates. In contrast, the interpretations of *domestic features* appear consistent with our interpretation of the component type as indicating a residential occupation. The variability in the domestic feature components appears to be primarily in the duration and intensity of the occupations. Similarly, the interpretations of *quarry*, *ring midden*, and *bedrock mortar* sites coincides with the presence of the specialized features emphasized in our classification. The excavator's interpretations encompass the residential occupations associated with these components, a fact that we recognized but elected to de-emphasize in the typology. Finally, the interpretations of the *residential sites* also match our classification. For LA 3334, the Angus Site, the agreement is not surprising. The agreement for LA 68188, Fox Place, likely reflects a post-excavation recoding of the NMCRIS database, however. Based on the initial description provided in the report, this site would probably have been classified as a simple feature in NMCRIS and as a miscellaneous feature in our expanded classification (i.e., the only visible surface evidence at the site were charcoal and ash stains exposed in a channel cut).

We next looked at variability in the occurrence of subsurface materials among the excavated sites in different geoarchaeologic units. Subsurface artifacts were recovered from 42 of the 51 sites (82%) with little variation in the presence or absence of buried deposits among the geoarchaeologic units. Twenty seven of the sites (53%) have subsurface features and cultural deposits, but again there was no clear patterning in their presence or absence among the geoarchaeologic units. The proportion of sites with buried features or cultural deposit is 0.40 for Unit IA and 0.67 for Unit IB, the two geoarchaeological units judged most likely to have relatively well-preserved sites. The proportion is 0.75 for Unit IIA, 0.56 for Unit IIB, and 0.48 for Unit III. Assuming that the sample of excavated sites is representative, these results suggest the geoarchaeologic units, at the scale mapped, are a poor predictor of the presence or absence of subsurface features at individual sites.

In descending order, the proportions of sites with subsurface features or cultural deposits among the component type were 1.0 for residential sites and bedrock mortars, 0.75 for miscellaneous features (i.e., sites with charcoal/ash stains), 0.67 for ring middens, 0.52 for domestic features, 0.25 for artifact scatters, and 0.0 for the quarries (the domestic features associated with these lithic procurement areas were outside of the areas investigated during the data recovery program). Our definition of subsurface feature excludes ash stained sediments or pits associated with surface-visible features such as fire-cracked rock and burned caliche concentrations, so the actual proportion of sites with subsurface materials is actually somewhat higher. Although estimates based on such a small sample of sites are clearly tentative, these figures suggest that subsurface cultural sediments are not particularly rare at sites in southeastern New Mexico. The presence of buried cultural materials does not necessarily mean that the site is necessarily intact, however, as the deposits may have been eroded before being covered.

Table 3.7 Occurrences of Surface and Subsurface Materials at Excavated Sites.

SITE TYPE/GEOARCH	**LANO**	**EXCAVATION INTERPRETATION**	**SURFACE**		**SUBSURFACE**		
			Artifacts	**Features**	**Artifacts**	**Features**	**Deposits**
Artifact Scatter							
IA	103931	trading camp	Y	N	Y	N	N
	117250	limited use	Y	N	N	N	N
III	6826	game lookout/lithic procurement	Y	N	Y	Y	N
	51095	limited use, lithic reduction	Y	N	Y	N	N
	111747	scatter assoc w/ pithouse village	Y	N	Y	N	N
	117246	lithic procurment area	Y	N	N	N	N
	117248	temporary camp	Y	N	Y	N	N
	117257	short-term camp	Y	N	Y	Y	N
Misc. Features							
IIB	84982	limited use	Y	Y	N	Y	N
	144606	short-term camp	N	N	N	Y	N
III	117255	short-term camp, multiple use	Y	Y	Y	Y	N
	134275	plant processing facility	Y	Y	Y	N	N
Domestic Features							
IA	75163	seasonal basecamp	Y	Y	Y	Y	Y
	54347	short-term camp, repeated use	Y	Y	Y	N	N
IB	109927	multiple short-term camps	Y	Y	Y	Y	N
	35657	short-term or seasonal camp	Y	Y	Y	N	N
	106730	multiple short-term camps	Y	Y	Y	Y	N
IIA	109926	short-term camp	Y	Y	Y	Y	Y
	22107	multiple residential camps	Y	Y	Y	Y	N
	22111	probable temporary camp	Y	Y	N	N	N
	22112	multiple residential camps	Y	Y	Y	Y	Y
IIB	34150	Ar, temp camp/Cer, mult residence	Y	Y	Y	Y	Y
	109922	multiple short-term camps	Y	Y	Y	N	N
	109920	temporary camp	Y	Y	Y	N	Y
	109294	multiple short-term or seasonal camps	Y	Y	Y	Y	Y
	109292	multiple short-term camps	Y	Y	Y	Y	N
	109291	multiple short-term camps	Y	Y	Y	Y	N
	68183	short-term camp	Y	Y	Y	N	N
	104607	temporary camp	Y	Y	Y	N	N
	37464	short-term camp	Y	Y	Y	Y	N
	122047	short-term camp	Y	Y	N	N	N
	122048	short-term camp	Y	Y	Y	N	N

SITE TYPE/GEOARCH	LANO	EXCAVATION INTERPRETATION	SURFACE		SUBSURFACE		
			Artifacts	**Features**	**Artifacts**	**Features**	**Deposits**
	122050	short-term camp	Y	Y	N	N	N
	122045	short-term camp	N	Y	N	N	N
	98820	short-term camp, repeated occupupation	Y	Y	Y	Y	N
III	190930	temporary camp/lithic manufacturing	Y	Y	Y	N	N
	134274	seasonal camp/plant processing area	Y	Y	N	N	N
	6825	short-term camp	Y	Y	Y	Y	N
	58971	residential basecamp	Y	Y	Y	Y	Y
Quarry Sites							
III	21177	lithic procurement area/temp camp	Y	Y	N	N	N
	27676	lithic procurement area/temp camp	Y	Y	Y	N	N
Ring Midden							
III	45863	seasonal camp/plant processing area	Y	Y	Y	Y	N
	103523	multiple short-term camps	Y	Y	Y	Y	N
	134277	seasonal camp/plant processing area	Y	Y	Y	N	N
	131686	seasonal camp/plant processing area	Y	Y	Y	Y	N
	131687	seasonal camp/plant processing area	Y	Y	N	Y	N
	130417	none given	Y	Y	Y	N	N
Bedrock Mortar							
IIB	68182	mult-occ camp/food processing facility	Y	Y	Y	Y	Y
	71167	seasonal camp, reoccupied	N	N	Y	Y	Y
Multiple Residence							
III	3334	year-round residence	Y	Y	Y	Y	Y
Residential Complex							
IA	68188	long-term H-G basecamp	Y	Y	Y	Y	Y

Our next concern was therefore the kinds of data actually recovered from the sites. Specifically, we looked at three general data sets: subsistence remains, absolute dates, and major artifact classes (Table 3.8). The recovery rate for pollen was low for all site categories except the long-term residences and the bedrock mortar sites, both of which had buried refuse deposits. Given the expense of processing pollen samples, it appears that their collection is best restricted to contexts that are both protected and in clear cultural contexts (e.g., buried refuse deposits, the interiors of storage features, and pollen washes on ground stone and ceramic vessels). Faunal remains were recovered from slightly less than half of the sites (47%) and at five of those sites, the remains were limited to freshwater mussel shell. Again, the presence or absence of faunal materials appears more related to preservation conditions than to component type, although the low proportions of faunal materials at quarry and ring midden sites is consistent with the specialized functions proposed for those component categories. The excavation methods used may also be a factor, however. The common use of quarter rather than eighth inch screen means that significantly fewer small bones and bone fragments would have been recovered and, at many sites, the relatively small areas excavated by hand would militate against the recovery of faunal remains.

Macrobotanical remains were recovered from the two long-term residential sites, both bedrock mortar sites, and high proportions of the ring midden and miscellaneous feature components. The proportion of domestic scatters yielding macrobotanical remains was lower (0.41), and none were recovered from the artifact scatters or quarries. In many cases, those remains consisted only of charred fuel wood. Although poor organic preservation is undoubtedly part of the problem, improved field methods might enhance recovery rates. From our readings, it appears that a sample of 1 to 2 liters of soil is generally collected for flotation. Logically, if macrobotanical materials are expected to be scarce owing to the poor organic preservation at shallow open sites, then yields might be increased if larger volume of sediments were processed by flotation. Ideally, the entire fill from features should be processed or at least the minimum sample size should be increased to something on the order of 5 liters of sediments. It also appears that the collection of flotation samples has been limited to features even in cases where extensive refuse deposits (cultural soils) are present. Typically, materials cleaned from thermal features and other food scraps are major components of refuse deposits, so they should be heavily sampled for subsistence remains.

Even with improved sampling methods, there is no guarantee that the recovery of macrobotanical remains will significantly improve. At open sites, flotation is best suited to the recovery of woody materials, small hard seeds, or other plant parts that are preserved by charring (e.g., corn cupules). Fleshy plant parts used as food are much less likely to be recovered. Evidence of these resources is more likely to be preserved as microfossils. Phytoliths are more likely to be preserved than pollen in many contexts, and efforts to recover them at open sites might be productive once the background research is completed to determine which plant resources produce identifiable phytoliths. Lipid residues may also prove useful if the signatures of plant resources in southeastern New Mexico can be identified. One immediate application of these techniques would be to the analysis of microscopic plant materials embedded in the fissures of grinding stones, which may be preserved even at open sites.

In contrast to the variable recovery of subsistence remains, radiocarbon dates were obtained for half of the domestic feature and quarry components, and for all of the miscellaneous feature, ring midden, and bedrock mortar sites. No radiocarbon dates were obtained from artifact scatters, however. Except for the scatters, it therefore appears that absolute dates can be regularly obtained from open sites in southeastern New Mexico, particularly if more use is made of AMS dating at sites yielding only small quantities of charcoal.

Table 3.8 Artifacts and Subsistence Remains Recovered from Excavated Sites.

SITE TYPE/GEOARCH	**LANO**	**SUBSISTENCE REMAINS**			**C14**	**ARTIFACTS**			
		Fauna	**Macrobot**	**Pollen**	**Date**	**Debitage**	**Lith. Tools**	**Ceramics**	**Gr. Stone**
Artifact Scatter									
IA	103931	Y	N	N	N	Y	Y	Y	N
	117250	N	N	N	N	Y	N	Y	Y
III	6826	Y	N	N	N	Y	Y	Y	Y
	51095	N	N	N	N	Y	N	N	N
	111747	Y	N	N	N	Y	N	Y	N
	117246	N	N	N	N	Y	N	N	N
	117248	N	N	N	N	Y	N	N	N
	117257	N	N	N	N	Y	Y	N	N
Misc. Features									
IIB	84982	Y	Y	Y	Y	Y	N	Y	Y
	144606	N	Y	N	Y	N	N	N	N
III	117255	Y	Y	N	Y	Y	Y	N	N
	134275	N	N	N	Y	Y	Y	N	N
Domestic Features									
IA	75163	Y	N	N	N	Y	Y	Y	Y
	54347	N	N	N	N	Y	Y	N	Y
IB	109927	N	Y	not coll	Y	Y	Y	Y	Y
	35657	N	N	N	Y	Y	Y	Y	Y
	106730	N	Y	not coll	Y	Y	Y	Y	Y
IIA	109926	Y	N	N	N	Y	Y	Y	Y
	22107	Y	Y	Y	Y	Y	Y	Y	Y
	22111	N	N	N	N	Y	N	N	Y
	22112	Y	Y	N	Y	Y	Y	Y	Y
IIB	34150	Y	Y	N	N	Y	Y	Y	Y
	109922	Y	N	N	N	Y	N	Y	Y
	109920	N	Y	N	Y	Y	Y	Y	Y
	109294	Y	Y	not coll	Y	Y	Y	Y	Y
	109292	N	Y	not coll	Y	Y	Y	Y	Y
	109291	shell	N	not coll	Y	Y	Y	Y	Y
	68183	N	N	N	N	Y	Y	Y	N
	104607	N	Y	not coll	not coll	Y	Y	Y	Y
	37464	N	N	not coll	Y	Y	Y	Y	Y
	122047	shell	N	N	N	Y	?	N	Y
	122048	N	N	N	N	Y	Y	N	Y
	122050	N	N	N	N	Y	?	N	Y
	122045	N	N	N	N	N	N	N	N

SITE TYPE/GEOARCH	LANO	SUBSISTENCE REMAINS			C14	ARTIFACTS			
		Fauna	Macrobot	Pollen	Date	Debitage	Lith. Tools	Ceramics	Gr. Stone
	98820	shell	coll	N	coll	Y	Y	Y	Y
III	190930	N	N	N	Y	Y	Y	Y	Y
	134274	N	N	N	N	Y	Y	N	Y
	6825	Y	Y	Y	Y	Y	Y	Y	N
	58971	Y	Y	Y	Y	Y	Y	N	Y
Quarry Sites									
III	21177	N	N	N	N	Y	Y	N	N
	27676	N	N	N	Y	Y	Y	N	N
Ring Midden									
III	45863	N	Y	Y	Y	Y	Y	Y	N
	103523	Y	Y	not coll	Y	Y	Y	Y	Y
	134277	N	Y	N	Y	Y	Y	N	Y
	131686	shell	Y	not coll	Y	Y	Y	N	Y
	131687	shell	Y	not coll	Y	Y	Y	N	Y
	130417	N	N	N	N	Y	Y	N	N
Bedrock Mortar									
IIB	68182	Y	Y	not coll	not run	Y	Y	Y	Y
	71167	Y	Y	Y	Y	Y	Y	Y	N
Multiple Residence									
III	3334	Y	Y	Y	Y	Y	Y	Y	Y
Residential Complex									
IA	68188	Y	Y	Y	Y	Y	Y	Y	Y

There was little clear patterning in the artifact classes recovered from the sites. The presence or absence of ceramics is presumed to be largely a function of differences in the age of the occupations. Ground stone appears to be associated primarily with residential occupations, and was less often recovered from artifact scatters and quarry sites. Our primary observations again relate to the field methods employed in recovering these materials. As shown in Table 3.9, investigations at many of the sites have emphasized mechanical stripping and trenching over more labor-intensive manual excavations. This approach appears effective in locating buried features but it precludes the recovery of subsurface artifacts.

There are at least three reasons why the recovery of a large sample of subsurface artifacts may be important in understanding the prehistoric activities undertaken at these sites. First, it seems a reasonable assumption that most of the surface artifact scatters at sites in southeastern New Mexico have been picked over by collectors, so excavations provide the best chance of obtaining culturally and temporally diagnostic artifacts or indeed any formal tools. Second, even in shallow sediments, there is some size sorting of archaeological materials, so excavations are needed to provide a sample of the full range of materials present. The use of eighth inch rather than quarter inch screen is again recommended for the

Table 3.9 Areas Exposed at Excavated Sites.

SITE TYPE/GEOARCH	**LANO**	**EFFORT**	**AREA EXCAVATED (SQ M)**			
			Manual	**Mech. Strip**	**Mech. Trench**	**Other Tests**
Artifact Scatter						
IA	103931	D	128			
	117250	D	2	341		
III	6826	D	61			
	51095	D	10	~320		
	111747	D	45		20 m	
	117246	D	5	224		51 auger tests
	117248	D	19	1981	158 m	
	117257	D	18	393		
Misc. Features						
IIB	84982	D	>38	~1526	~23 m	
	144606	M	20		3 m	
III	117255	D	277	880		
	134275	D	15		~27 m	
Domestic Features						
IA	75163	D	400			
	54347	D	22			
IB	109927	T	~40		~30 m	49 STPs
	35657	T	~4		~35 m	87 STPs
	106730	T	~9		~50 m	33 STPs
IIA	109926	T	~20		~45 m	47 STPs
	22107	D	~70	?	~235 m	
	22111	T				23 STPs in ROW
	22112	D	~30		~200 m	50 STPs
IIB	34150	D	240	~2600	28 m	
	109922	T	~16		~30 m	36 STPs
	109920	D	~10	~100	~20 m	42 STPs
	109294	T	7	~50	~55 m	
	109292	T	~10	?	~40 m	111 STPs
	109291	T	12		~30 m	
	68183	D	22			
	104607	D	33			10 STPs
	37464	D	6	~300	~6 m	STPs in BC scatters
	122047	D	27.5			14 STPs on 10 m grid

SITE TYPE/GEOARCH	LANO	EFFORT	AREA EXCAVATED (SQ M)			
			Manual	Mech. Strip	Mech. Trench	Other Tests
	122048	T	7			36 STPs on 10 m grid
	122050	T				22 STPs on 10 m grid
	122045	D	10.5			15 STPs on 10 m grid
	98820	D	134	~12,000	~650 m	
III	190930	T	4			57 STPs
	134274	D	5		~28 m	
	6825	D	323			
	58971	D	~250	~30	~10 m	
Quarry Sites						
III	21177	T	~8			16 STPs
	27676	T	8			28 STPs
Ring Midden						
III	45863	D	83		~35 m	
	103523	D	>76			
	134277	D	34		~75m	
	131686	D	59		30m	
	131687	D	70		~95 m	
	130417	T				12 STPs
Bedrock Mortar						
IIB	68182	D	46.5			
	71167	D	37.75			
Multiple Residence						
III	3334	D	212	713	~70 m	
Residential Complex						
IA	68188	D	~430	~3800	~450 m	382 auger holes

same reason, since much of the small debitage produced during the later stages of tool manufacture and tool refurbishment will pass through a quarter inch screen. Third, an adequate sample of artifacts is needed to discern site structure patterns that may not be evident using only surface artifacts. At many of the sites, for example, excavations within fire-cracked rock concentrations were limited to a single 1 by 1 m square. Not only is the excavation of so small an area inadequate to determine if a subsurface pit is associated with the scatter, it is inadequate to recover any artifacts associated with that feature. Taking

Binford's (1978) drop and toss zones as a model, most of the larger debris associated with activities around a hearth would probably be found 2-3 m back from the features. At camps occupied for periods of weeks or longer or camps that are reoccupied regularly, similar accumulations of debris can be expected on the margins of the settlement (Binford 1983; Yellen 1977). Unless a suitable area is exposed through manual excavation, these patterns would not be visible.

Based on this review, there appears to be a reasonably close correspondence between the functional connotations of our component types and the excavator's interpretations. Thus there is some justification for use of the typology in preliminary settlement pattern studies and as a preliminary means of stratifying the sample of sites selected for excavation. It should be recognized, however, that the artifact scatter component type is purely a morphological category that, based on the excavator's interpretations, encompasses a diverse range of prehistoric activities.

We are much less confident in making any recommendations about the kinds of data likely to be recovered from the different component types. The sample includes most of the sites excavated in the region over the past 15 years. Yet not all of the component types are represented and, except for the domestic scatters, the sample includes only a few excavated examples of the component types that are represented. Consequently, by almost any measure, the sample is inadequate to characterize the diversity within any component type. We therefore recommend that future data recovery be directed in part toward obtaining a minimum representative sample of each component type.

In the short-term, though, priority must be given to the recovery of chronological and subsistence data, and based on the information available, it appears that sites consisting only of artifact scatters and quarry/lithic procurement areas that have no associated residential occupations are the site types that are least likely to yield those data. Consequently, an initial emphasis on data recovery at the component types most likely to yield the needed data would be justified during the initial stages of research. Full implementation of the research design will ultimately require investigations at the full range of sites in order to reconstruct regional settlement systems, however.

Our review also suggests that site condition is more important than component type in assessing a site's data potential. As site condition appears to be largely a function of geomorphological setting, this should be one of the major factors considered in selecting a sample of sites for data recovery. At the coarse-scale at which they are currently mapped, the geoarchaeologic units cannot provide this information, as shown by the poor correspondence between geoarchaeologic unit and site condition in the sample of excavated sites. The information is best obtained for each individual site either through a formal testing program or through more extensive testing as part of the survey documentation.

SPATIAL DISTRIBUTION

The emphases of the spatial analysis were 1) to examine the mix of component types in each physiographic unit, and 2) to assess the probability that the known components are representative of the full range of prehistoric sites within those units. Katz and Katz (2001:1) argue that the economic survival strategies of prehistoric populations in southeastern New Mexico were closely tied to the characteristics of its physiographic sections. If true, then the environmental variability among the physiographic units should be mirrored by variation in the mix of component types.

The corresponding negative hypothesis is that the environmental characteristics distinguishing the different physiographic units had no influence on prehistoric settlement-subsistence strategies. If they did not, then we would expect the distribution of sites to be random with respect to the physiographic units, in which case, the number of components associated with a physiographic unit should be roughly proportional to the area covered by that unit. This negative hypothesis cannot be evaluated, however, because we don't know how many sites there are in each physiographic unit. Consequently, the proportional area covered by archaeological survey rather than total proportional area was used to calculate the expected number of components for each physiographic unit. In most cases, there is a marked difference in those two values (Table 3.10).

About 3% of southeastern New Mexico has been surveyed by archaeologists. Most of this surveyed space (51%) is in the Mescalero Plain or, more specifically, in the southern part of the Mescalero Plain (Figure 3.3). West of the Pecos River, surveys in the Seven Rivers-Dark Canyon and Rio Penasco-Rio Felix basins constitute over 80% of the surveyed space (Table 3.10). Thus there is a clear bias in survey coverage toward the southern third of the region. This bias is also evident in the NMCRIS component data. Half of the components are located on the Mescalero Plain and another quarter are in the Seven Rivers-Dark Canyon basin. We therefore cannot assume that the survey data are representative of the entire region. Further, survey coverage within the physiographic units ranges from 8% for the Mescalero Plains to 0.5% for the Llano Estacado (Table 3.10), which is probably too low to ensure that the sample of components reflects the full range and mix of sites within any unit.

Two-sample difference of proportions tests were used to determine if there were statistically significant differences between the actual and expected number of components associated with the physiographic units. The resulting z-scores indicate the degree of difference between the actual and expected number of components and whether the actual number of components is higher (positive) or lower (negative) than the expected number. A *z*-score greater than 1.96 or less than -1.96 indicate that the difference is statistically significant at the 0.05 level.

Only two physiographic units have component proportions that deviate significantly from the expected proportions based on surveyed space (Table 3.10). The number of components is higher than expected for the Sacramento Slope and lower than expected for the Pecos River Valley. The drainage basins, which crosscut the Sacramento Slope and the northwest and southwest Pecos Slopes, provide a more detailed picture of site distribution west of the river. All of the values deviate significantly from expected values. The Rio Penasco-Rio Felix basin has a lower than expected number of components, while the other basins have higher than expected numbers of components. The differences are especially marked for the Rio Hondo-Arroyo del Macho and Seven Rivers-Dark Canyon basins.

The distribution of Paleoindian components (Figure 3.4, Table 3.11) is generally proportional to the surveyed space, although the Mescalero Plain has a significantly lower than expected number of components (z = -2.26). The Llano Estacado has a higher than expected number of components (z = 1.56), but the difference is not statistically significant. There is no obvious patterning in the distribution of component types relative the physiographic units or drainage basins. However, it should be noted that the two possible structures and 21 of the 34 domestic features, are multi-component sites. This raises the possibility that the projectile points defining the Paleoindian component are either not associated with the features or are heirlooms collected by later occupants of the site. The first alternative would mean that the component is misclassified; and the second, that there was in fact no Paleoindian occupation.

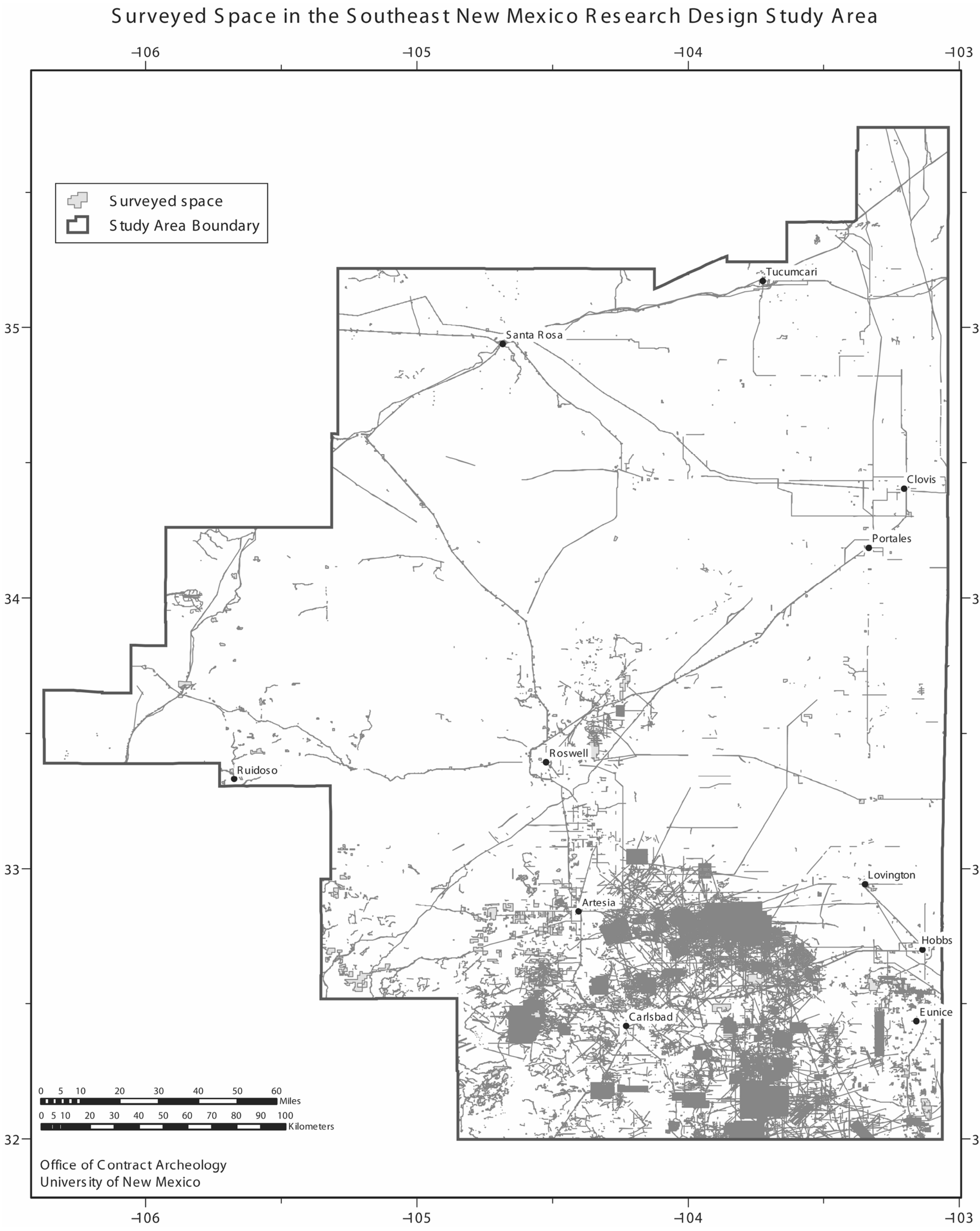
Surveyed Space in the Southeast New Mexico Research Design Study Area
-106
-105
-104
-103
35
34
33
32
Surveyed space
Study Area Boundary
Tucumcari
Santa Rosa
Clovis
Portales
Roswell
Ruidoso
Lovington
Artesia
Hobbs
Eunice
Carlsbad
0 5 10 20 30 40 50 60
Miles
0 5 10 20 30 40 50 60 70 80 90 100
Kilometers
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Figure 3.3

Table 3.10 Proportional Area, Survey Area, and Number of Components for Physiographic Units and Drainage Basins.

	Acres	Proportion Region	Survey Acres	Proportion Unit	Proportion Survey	Components	Proportion Components	*z*
PHYSIOGRAPHIC UNITS								
Sacramento Slope	4,874,340	.2469	106,509	.0219	.1815	2136	.2179	2.8306
Pecos Valley								
Pecos River Floodplain	1,584,239	.0802	109,236	.0411	.1862	1341	.1368	-3.6960
Northern Pecos Slopes	2,656,438	.1345	16,373	.0690	.0279	490	.0500	1.4579
Southwest Pecos Slope	390,283	.0198	14,109	.0362	.0240	276	.0282	0.2933
Portales Valley	429,767	.0218	2831	.0066	.0048	72	.0073	0.1711
Mescalero Plain	3,692,885	.1870	300,946	.0815	.5129	4926	.5026	-1.0275
Upper Canadian River	1,576,716	.0799	12,988	.0082	.0221	237	.0242	0.1471
Llano Estacado	4,539,747	.2299	23,806	.0052	.0406	323	.0330	-0.5395
Total	19,744,415	1.0000	586,798		1.0000	9801	1.0000	
DRAINAGE BASINS								
Pintada Arroyo-Yeso Creek	2,601,927	.3184	16,022	.0062	.0781	745	.0760	2.8102
Rio Hondo-Arroyo del Macho	2,687,872	.3289	19,704	.0073	.0961	1416	.1445	5.5073
Rio Penasco-Rio Felix	1,404,085	.1718	61,883	.0441	.3019	401	.0409	-3.8863
Seven Rivers-Dark Canyon	1,477,692	.1809	107,402	.0727	.5239	2553	.2605	5.9897
Total	8,171,576	1.0000	205,011		1.0000	5115		

Paleoindian Component Site Types in the Southeast New Mexico Research Design Study Area

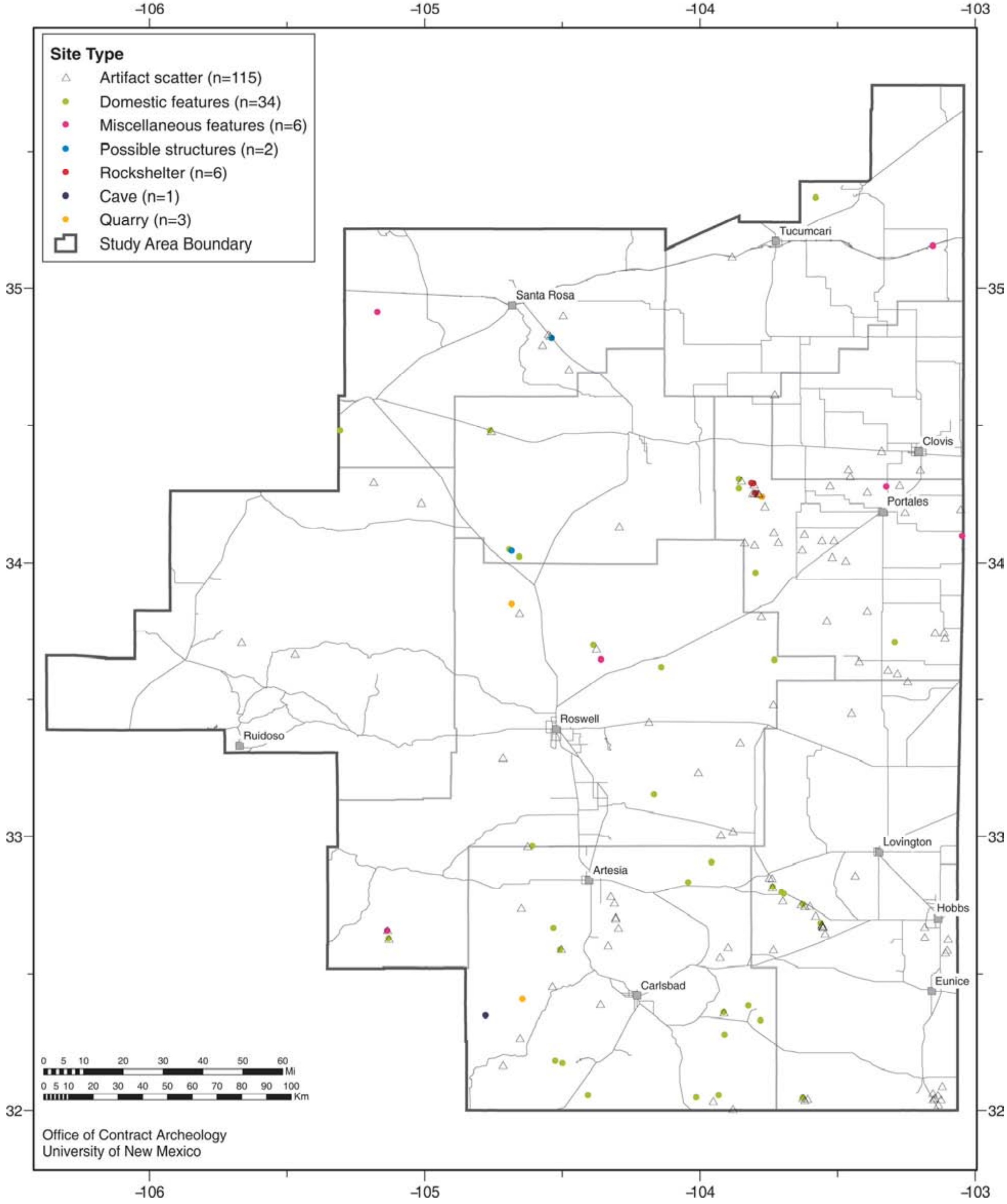

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Figure 3.4

Table 3.11 Distribution of Paleoindian Component Types by Physiographic Unit and Drainage Basin.

	Artifact Scatter	Possible Structure	Domestic Features	Ring Midden/ Burned Rock	Bedrock Mortar	Miscellaneous Features	Cave	Rockshelter	Quarry/Lithic Procurement	Single Residence	Multiple Residence	Residential Complex	Total	z-scores
PHYSIOGRAPHIC UNITS														
Sacramento Slope	9	0	4			1	1	0	2				17	-0.7177
Pecos Valley														
Pecos River Valley	9	0	5			1	0	0	0				14	-0.8361
Northern Pecos Slopes	7	2	4			1	0	0	0				14	0.4134
Southwest Pecos Slope	0	0	1			0	0	0	0				1	-0.1134
Portales Valley	7	0	0			1	0	0	0				8	0.1797
Mescalero Plain	37	0	15			0	0	0	0				52	-2.2622
Upper Canadian River	1	0	1			1	0	0	0				3	-0.0356
Llano Estacado	42	0	4			2	0	6	1				55	1.5587
Total	**112**	**2**	**34**			**7**	**1**	**6**	**3**				**165**	
DRAINAGE BASINS														
Pintada Arroyo-Yeso Creek	4	1	4			2	0	0	1				12	0.3453
Rio Hondo-Arroyo del Macho	4	0	1			0	0	0	0				5	-0.0304
Rio Penasco-Rio Felix	2	0	1			0	0	0	0				2	-0.4817
Seven Rivers-Dark Canyon	6	0	5			1	0	1	1				14	-0.8457
Total	**16**	**1**	**11**			**3**	**0**	**1**	**2**				**34**	

For the Archaic (Figure 3.5, Table 3.12), the number of components is somewhat higher than expected in the northwest part of the region, as indicated by the z-scores for the Northern Pecos Slopes (*z* = 1.02) and Pintada Arroyo-Yeso Creek drainage basin (*z* = 1.00), and somewhat lower than expected for the Mescalero Plain (*z* = -3.03) and the Rio Penasco-Rio Felix drainage basin (*z* = -1.16). Only the Mescalero Plain deviates significantly from the expected number of components, however. When broken down by component type, the Mescalero Plain has a significant lower than expected numbers of artifact scatters (*z* = -1.96), and ring middens occur at significantly higher than expected frequencies on the Sacramento Slope (*z* = 2.36) and more specifically within the Seven River-Dark Canyon drainage basin (*z* = 4.23). The latter association is consistent with the interpretation of ring middens as specialized succulent processing facilities, as mescal and sotol are most abundant in the Seven Rivers-Dark Canyon drainage. Eight of the 11 Archaic bedrock mortar components occur in the Pecos River Valley, which suggests that these features may also have had some specialized function. In this case, however, the sample size is too small to be definitive. In contrast, domestic features – the second most numerous site type – occur in close to the expected numbers in all of the physiographic units and drainage basins. Assuming that our behavioral interpretation of these sites as residential camps is correct, this patterning seems consistent with the movement of small hunter-gatherer groups through a variety of environmental zones.

The patterning of Ceramic components (Figure 3.6, Table 3.13) is the opposite of the Archaic components in exhibiting marked clustering. The number of Ceramic components is significantly higher than expected in the Mescalero Plain (*z* = 7.74) and Rio Hondo-Arroyo del Macho drainage basin (*z* = 2.80), and significantly lower than expected in the Pecos River Valley (*z* = -3.79), the Rio Penasco-Rio Felix drainage basin (*z* = -2.08), and the Seven Rivers-Dark Canyon drainage basin (*z* = -3.03). More instructive is how the different component types contribute to this overall pattern. The high value for the Rio Hondo-Arroyo del Macho drainage results from the significantly higher than expected numbers of single residences, multiple residences, and residential complexes (*z* = 2.48, combined score for all three categories) and artifact scatters (*z* = 2.23). The former association is not surprising since the upper part of the Rio Hondo-Arroyo del Macho drainage basin encompasses Kelley's (1984) Sierra Blanca region. In contrast, the Mescalero Plain has significantly higher than expected number of artifact scatters (*z* = 6.68), but the number of residential components is significantly lower than expected (*z* = -3.07). The significantly lower than expected numbers of artifact scatters (*z* = -2.74) also contributes to the low *z*-score for the Pecos River Valley, while the low *z*-score for the Rio Penasco-Rio Felix drainage basin results from lower than expected numbers of all component types, none of which is individually significant.

The distribution of possible structures generally mirrors that of the residential components. Possible structure occur in higher than expected numbers on the Sacramento Slope (*z* = 2.56) and in the Rio Hondo-Arroyo del Macho drainage (*z* = 1.32), and in significantly lower than expected numbers in the Mescalero Plain (*z* = -2.02). The numbers of domestic features, on the other hand, are significantly higher than expected for the Mescalero Plain (z = 11.86), and significantly lower than expected for the Sacramento Slope (*z* = -2.54), the Pecos River Valley (*z* = -2.03), and the Seven Rivers-Dark Canyon drainage (*z* = -2.47). The Seven Rivers-Dark Canyon drainage does have a significantly higher than expected number of ring middens (*z* = 9.92), however, and camps are associated with many of those specialized features.

The distribution of Protohistoric components (Figure 3.7, Table 3.14) is roughly proportional to the area surveyed in all physiographic units except the Mescalero Plain (*z* = -2.26), which has a significantly lower than expected number of components. The sample size is too small for any assessment of the spatial patterning of the individual site types, so no further analysis was attempted.

Archaic Component Site Types in the Southeast New Mexico Research Design Study Area

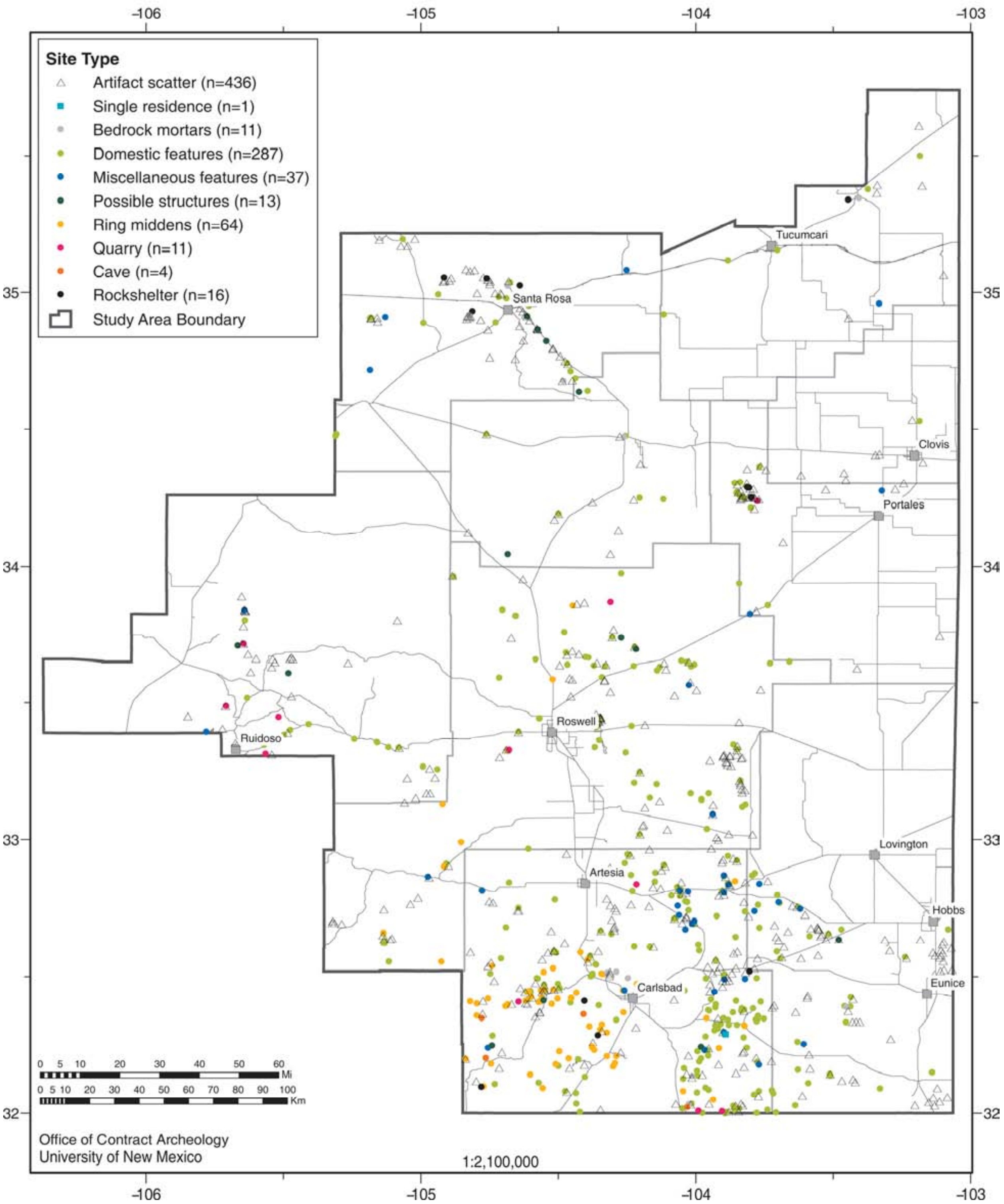

Figure 3.5

Table 3.12 Distribution of Archaic Component Types by Physiographic Unit and Drainage Basin.

	Artifact Scatter	**Possible Structure**	**Domestic Features**	**Ring Midden/ Burned Rock**	**Bedrock Mortar**	**Miscellaneous Features**	**Cave**	**Rockshelter**	**Quarry/Lithic Procurement**	**Single Residence**	**Multiple Residence**	**Residential Complex**	**Total**	***z*-scores**
PHYSIOGRAPHIC UNITS														
Sacramento Slope	72	5	46	37	0	3	3	3	5	0			174	0.4792
Pecos Valley														
Pecos River Valley	59	3	58	11	8	3	0	0	3	0			145	-0.4014
Northern Pecos Slopes	51	4	14	1	1	2	0	5	0	0			78	1.0156
Southwest Pecos Slope	6	0	8	9	0	0	1	0	0	0			24	0.0816
Portales Valley	9	0	1	0	0	1	0	0	0	0			11	0.1351
Mescalero Plain	171	2	138	6	1	25	0	1	2	1			347	-3.0269
Upper Canadian River	6	0	4	0	1	2	0	1	0	0			14	-0.1191
Llano Estacado	41	0	18	0	0	0	0	6	1	0			66	0.7045
Total	**415**	**14**	**287**	**64**	**11**	**36**	**4**	**16**	**11**	**1**			**859**	
DRAINAGE BASINS														
Pintada Arroyo-Yeso Creek	48	2	17	1	3	2	0	3	1	0			77	1.0023
Rio Hondo-Arroyo del Macho	34	3	25	1	0	1	0	0	5	0			69	0.8448
Rio Penasco-Rio Felix	19	0	10	3	0	2	0	0	0	0			34	-1.1609
Seven Rivers-Dark Canyon	51	2	41	52	2	1	4	3	2	0			158	0.0165
Total	**152**	**7**	**93**	**57**	**5**	**6**	**4**	**6**	**8**	**0**			**338**	

Ceramic Component Site Types in the Southeast New Mexico Research Design Study Area

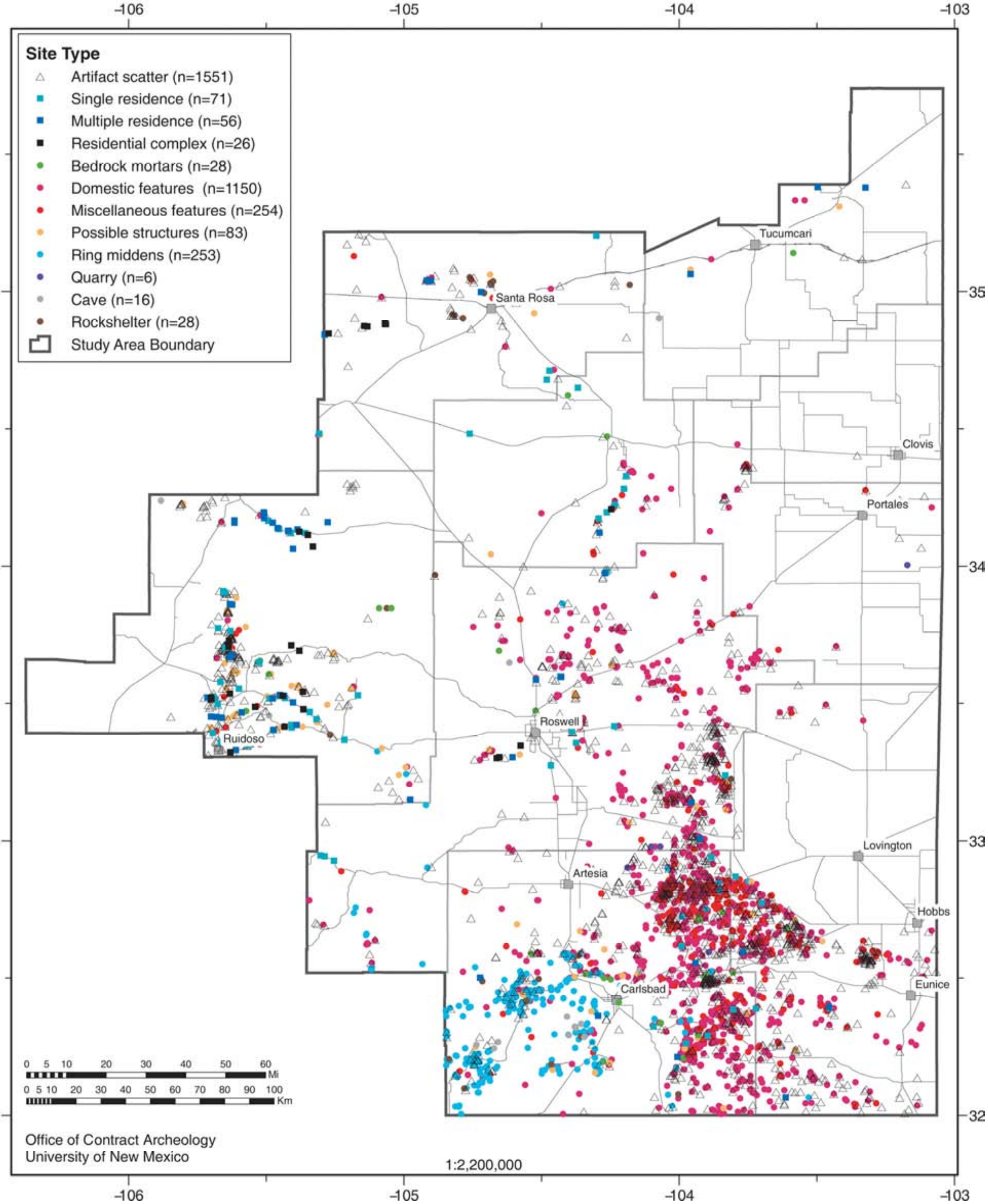

Figure 3.6

Table 3.13 Distribution of Ceramic Component Types by Physiographic Unit and Drainage Basin.

	Artifact Scatter	Possible Structure	Domestic Features	Ring Midden/ Burned Rock	Bedrock Mortar	Miscellaneous Features	Cave	Rockshelter	Quarry/Lithic Procurement	Single Residence	Multiple Residence	Residential Complex	Total	z-scores
PHYSIOGRAPHIC UNITS														
Sacramento Slope	276	48	56	175	7	20	14	14	1	43	36	16	706	0.9317
Pecos Valley														
Pecos River Valley	119	9	118	31	10	15	0	3	0	12	6	4	327	-3.7893
Northern Pecos Slopes	42	3	14	1	0	5	0	8	0	3	4	6	86	-0.1446
Southwest Pecos Slope	10	2	10	30	1	2	0	0	0	0	1	0	56	-0.3172
Portales Valley	12	0	5	0	0	2	0	0	0	0	0	0	19	0.0255
Mescalero Plain	1018	22	924	16	9	202	1	2	4	12	7	0	2217	7.7385
Upper Canadian River	5	2	3	0	1	0	0	1	0	1	3	0	17	-0.4722
Llano Estacado	40	1	23	0	0	4	1	0	1	0	0	0	69	-0.7765
Total	**1522**	**87**	**1153**	**253**	**28**	**250**	**16**	**28**	**6**	**71**	**57**	**26**	**3497**	
DRAINAGE BASINS														
Pintada Arroyo-Yeso Creek	60	4	18	1	2	4	0	6	0	5	5	6	111	0.1818
Rio Hondo-Arroyo del Macho	226	37	40	2	8	14	3	6	1	38	35	18	428	2.8016
Rio Penasco-Rio Felix	19	2	15	5	0	3	0	0	0	5	1	0	50	-2.0826
Seven Rivers-Dark Canyon	74	11	56	221	3	7	10	9	0	1	3	0	395	-3.0301
Total	**379**	**54**	**129**	**229**	**13**	**28**	**13**	**21**	**1**	**49**	**44**	**24**	**984**	

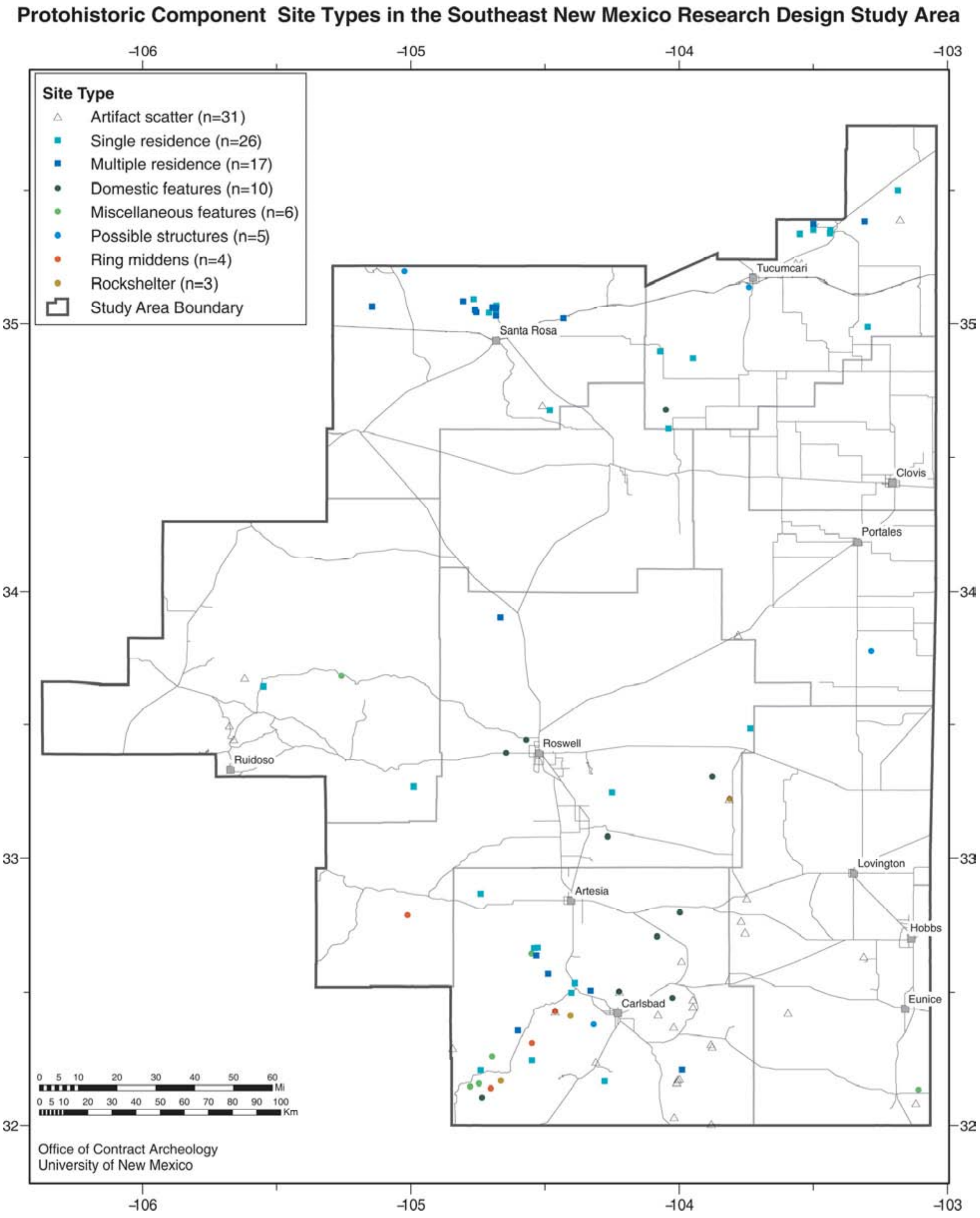
Protohistoric Component Site Types in the Southeast New Mexico Research Design Study Area
Site Type
△ Artifact scatter (n=31)
■ Single residence (n=26)
■ Multiple residence (n=17)
● Domestic features (n=10)
● Miscellaneous features (n=6)
● Possible structures (n=5)
● Ring middens (n=4)
● Rockshelter (n=3)
Study Area Boundary
Tucumcari
Santa Rosa
Clovis
Portales
Roswell
Ruidoso
Lovington
Artesia
Hobbs
Eunice
Carlsbad
-106
-105
-104
-103
35
34
33
32
0 5 10 20 30 40 50 60 Mi
0 5 10 20 30 40 50 60 70 80 90 100 Km
Office of Contract Archeology
University of New Mexico

Figure 3.7

Table 3.14 Distribution of Protohistoric Component Types by Physiographic Unit and Drainage Basin.

	Artifact Scatter	**Possible Structure**	**Domestic Features**	**Ring Midden/ Burned Rock**	**Bedrock Mortar**	**Miscellaneous Features**	**Cave**	**Rockshelter**	**Quarry/Lithic Procurement**	**Single Residence**	**Multiple Residence**	**Residential Complex**	**Total**	**z-scores**
PHYSIOGRAPHIC UNITS														
Sacramento Slope	4	2	1	5		3		1		4	1		21	0.0239
Pecos Valley														
Pecos River Valley	4	2	3	0		0		0		8	9		26	0.5956
Northern Pecos Slopes	1	1	1	0		0		0		3	4		10	0.3853
Southwest Pecos Slope	1	0	0	0		0		0		1	0		2	-0.0268
Portales Valley	0	0	0	0		0		0		0	0		0	0.0000
Mescalero Plain	14	0	5	0		1		1		2	0		23	-2.2579
Upper Canadian River	3	1	0	0		0		0		7	2		13	0.4675
Llano Estacado	2	1	0	0		0		0		1	0		4	-0.0014
Total	**29**	**7**	**10**	**5**		**4**		**2**		**26**	**16**		**99**	
DRAINAGE BASINS														
Pintada Arroyo-Yeso Creek	1	0	0	0		0		0		3	5		9	0.3456
Rio Hondo-Arroyo del Macho	3	1	2	0		0		0		1	0		7	0.2369
Rio Penasco-Rio Felix	0	0	0	1		0		0		2	0		3	-0.4037
Seven Rivers-Dark Canyon	3	2	1	4		3		1		7	4		25	0.5411
Total	**7**	**3**	**3**	**5**		**3**		**1**		**13**	**9**		**44**	

Not surprisingly, the distribution of Unknown components (Figure 3.8, Table 3.15) most closely matches that of all components; that is, it is a mix of components from all periods. Like the Ceramic components, the Unknown components occur in somewhat lower than expected number in the Pecos River Valley (z = -1.45) and in significantly higher than expected number in Rio Hondo-Arroyo del Macho drainage basin (z = 2.33). Conversely, the Unknown components – like the Archaic components – occur in higher than expected number in the Pintada Arroyo-Yeso Creek drainage (z = 1.93) and in significantly lower than expected numbers on the Mescalero Plain (z = -5.05). The Unknown components also have a significantly higher than expected number of components in the Seven Rivers-Dark Canyon drainage (z = 1.99), which is not characteristic of either the Archaic or Ceramic components.

The distribution of Unknown sites shows the expected clustering of ring middens in the Seven Rivers-Dark Canyon drainage basin. The Unknown domestic scatters are roughly proportional to the surveyed area except on the Mescalero Plain where they occur in significantly higher than expected numbers (z = 4.06). The probable structures occur in significantly lower than expected numbers on the Mescalero Plain (z = -2.34) but there is no corresponding positive association with the Rio Hondo-Arroyo del Macho drainage as there is for the Ceramic components. In fact, the Unknown possible structures occur in somewhat greater than expected numbers on the Sacramento Slope as a whole (z = 1.08) and in the Pecos River Valley (z = 1.26). This last association could indicate that some of these Unknown components are actually historical in age.

Overall, the spatial analysis revealed few unexpected patterns in the distribution of prehistoric components in southeastern New Mexico. Nevertheless, we did achieve our primary objective. The associations of components of different ages with different sets of physiographic units indicate that those units reflect environmental variability in southeastern New Mexico that conditioned human settlement to some degree. Similarly, the site types defined appear adequate to characterize broad differences in site function. Although the system can be refined, it appears that a combination of physiography and drainage can be used to divide the region into units of analysis. Within those units, the component types can be used as a basis for sampling settlement variability within those units.

Unknown Time Period Component Site Types in the Southeast New Mexico Research Design Study Area

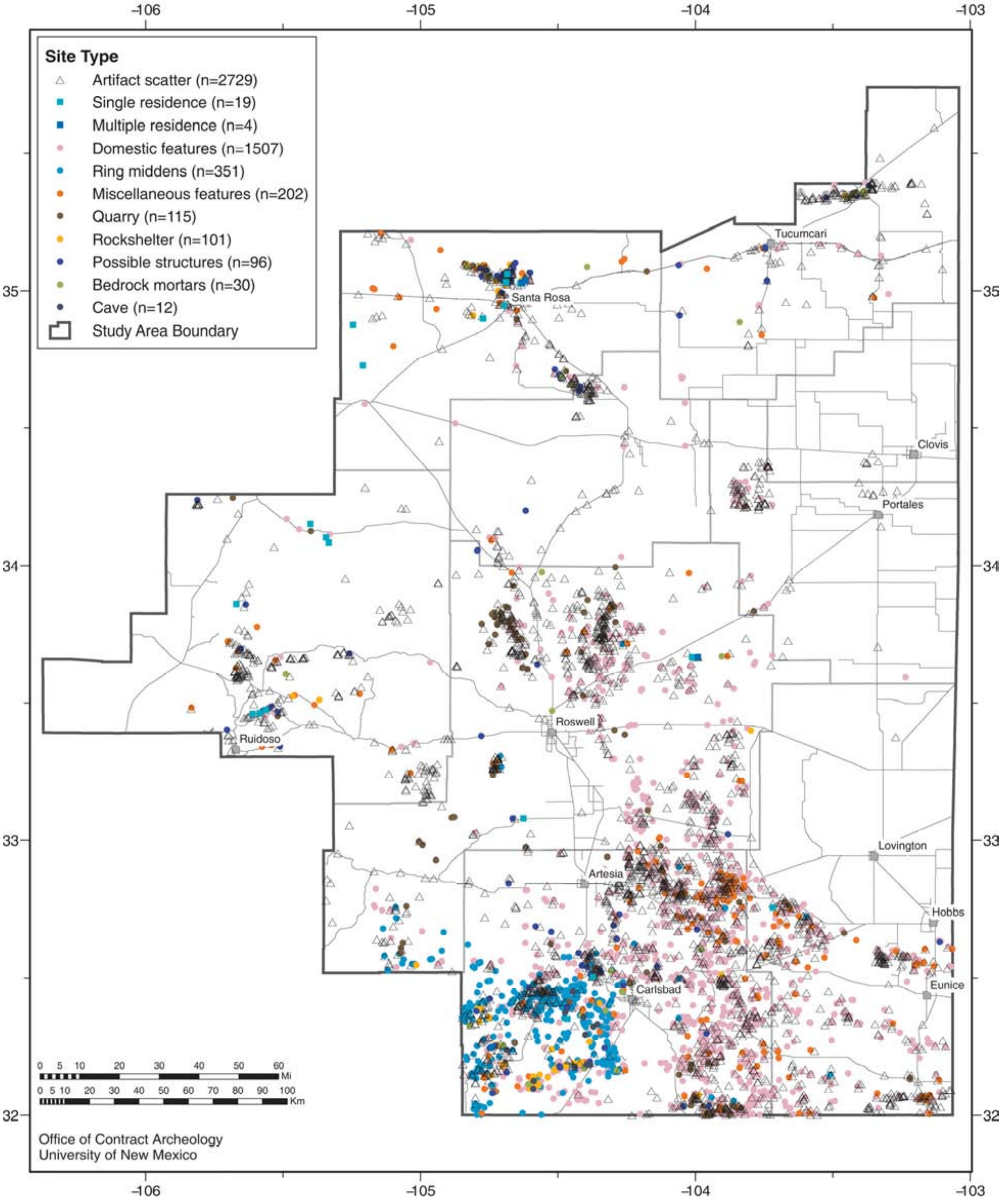

Figure 3.8

Table 3.15 Distribution of Unknown Component Types by Physiographic Unit and Drainage Basin.

	Artifact Scatter	Possible Structure	Domestic Features	Ring Midden/ Burned Rock	Bedrock Mortar	Miscellaneous Features	Cave	Rockshelter	Quarry/Lithic Procurement	Single Residence	Multiple Residence	Residential Complex	Total
PHYSIOGRAPHIC UNITS													
Sacramento Slope	573	35	200	252	5	31	12	45	49	9	1		1212
Pecos Valley													
Pecos River Valley	480	38	186	32	4	17	0	31	29	5	0		822
Northern Pecos Slopes	205	14	35	0	3	13	0	20	7	3	2		302
Southwest Pecos Slope	15	3	111	58	3	1	0	1	0	0	0		192
Portales Valley	33	0	1	0	0	0	0	0	0	0	0		34
Mescalero Plain	1177	8	921	10	2	119	0	1	26	2	1		2267
Upper Canadian River	136	12	21	0	13	4	0	2	2	0	0		190
Llano Estacado	88	1	32	0	0	2	0	1	2	0	0		126
Total	**2707**	**111**	**1507**	**352**	**30**	**187**	**12**	**101**	**115**	**19**	**4**		**5145**
DRAINAGE BASINS													
Pintada Arroyo-Yeso Creek	267	13	35	0	5	15	0	20	14	4	0		373
Rio Hondo-Arroyo del Macho	343	18	35	3	2	10	0	2	34	6	0		453
Rio Penasco-Rio Felix	92	2	12	1	0	1	0	0	10	1	0		119
Seven Rivers-Dark Canyon	305	30	353	328	7	25	12	44	15	2	1		1122
Total	**1007**	**63**	**435**	**332**	**14**	**51**	**12**	**66**	**73**	**13**	**1**		**2067**

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CHAPTER 4

PROBLEM DOMAINS FOR SOUTHEASTERN NEW MEXICO

Patrick Hogan

The primary objectives of this chapter are 1) to identify and prioritize research questions related to the prehistoric and protohistoric occupations in southeastern New Mexico; 2) to identify the kinds of data needed to address those questions; 3) to develop an integrated research strategy for interpreting those data; and 4) to introduce explanatory concepts that can be used to develop subsistence-settlement models and that provide a framework for understanding cultural developments in the region.

Relatively few excavation projects have been completed in southeastern New Mexico, and many sites that have been excavated have yielded minimal information. Consequently, adequate data concerning chronology, subsistence practices, and settlement patterns are lacking for all of the major cultural-temporal periods (Paleoindian, Archaic, Formative/Ceramic, and Protohistoric). This research design is therefore structured around general problem domains that address basic questions relating to the nature of the cultural adaptations and changes in those adaptations through time.

CHRONOLOGY AND CULTURE HISTORY

The overall objective of research under this problem domain is to determine the temporal ordering of archaeological sites in the region. The basic questions that must be answered for each temporal period in order to achieve this objective vary depending on the level of inquiry.

At the site/component level, the question is simply:

- ***when was the site occupied?***

At the intermediate, area/generalization level, the question is:

- ***which sites are contemporary?***

Theoretically, these questions could be answered with an adequate suite of absolute dates. In practice, however, many of the sites are unlikely to yield datable materials, and only a small proportion of the sites are likely to be excavated. Given this situation, relative dating will be the primary basis for determining the age and contemporaneity of most sites in the region. Consequently, refinement of the relative chronology is a research priority for all cultural-temporal periods.

At the regional/interpretive level, the questions become:

- ***when do observable changes in the cultural adaptations occur? and,***
- ***are those changes associated with environmental change, demographic pressure, and/or internal or external cultural developments?***

There are also some cultural-historical questions specific to each cultural-temporal period, most of which are only addressable at the regional/interpretive level. Those questions are discussed later in this chapter.

A number of relative and absolute dating methods are available to address these questions. For survey, relative dating based on temporally-diagnostic projectile points and ceramics is, and will probably remain, the primary dating method. The current limitations of this method are well known. First, detailed morphological descriptions of the temporal diagnostics are often lacking, particularly for projectile points, and similar point styles have different date ranges in different regional chronologies. Second, the ceramic and projectile point chronologies commonly used for cross-dating were developed in adjacent areas of the Southwest and Plains. The chronological data supporting those sequences is often inadequate even in the regions where they were developed, and may not be applicable to southeastern New Mexico. Third, the temporally-diagnostic artifacts found at a site may not indicate the full range of occupations and may even be incidental to the major occupation (e.g., curated Archaic projectile points at Ceramic period sites or pot drops at Archaic sites). Fourth, a significant proportion of sites in the region lack temporal diagnostics, either because they were never discarded at those locations or because the diagnostics have been removed by later groups or modern collectors.

Several absolute dating techniques can potentially be employed in southeastern New Mexico, and consideration should be given to the resolution and limitations of each method. Tree-ring dates have a potential resolution of one year to a few decades, so dendrochronology is clearly the most reliable method for determining whether sites or features within a site are contemporaneous. This method has very limited application, however. Chronologically-sensitive species are present only at higher elevations along the western edge of the region, and even in this area, the construction timbers used in Ceramic period structures tend to be from trees with complacent growth rings.

In the absence of tree-ring dates, archaeomagnetic dating can potentially provide high-resolution chronological data for the Ceramic and Protohistoric periods. High precision archaeomagnetic dates have 95% confidence intervals on the order of ±15 to 50 years, but the intervals for low precision dates are considerably larger. Several factors affect precision, but the most important are the iron content of the baked sediments and the expertise of the technician collecting the sample. Sediment texture plays a lesser role. Sediments with a higher clay content tend to provide more precise dates, but excellent results have sometimes been obtained from samples consisting of loams and sandy loams.

The actual archaeomagnetic date is derived by fitting the orientation of ferrous particles in the sample to a master curve showing the movement of the magnetic pole over time. Because past movements of the poles were irregular, these curves have overlapping loops. Archaeomagnetic samples with pole positions near those loops will therefore have two or more potential dates, typically about 200 years apart. In these cases, the archaeologist must employ other chronological indicators (e.g., radiocarbon dates, ceramic cross-dating, etc.) to determine which of the alternative dates is the more probable.

Radiocarbon dating will undoubtedly be the principle chronometric method used to date sites in southeastern New Mexico. Charcoal dates are generally more reliable than dates on bone or soil humates, and should be used whenever possible. Dates on shell are generally unreliable. Nominally, the resolution of radiocarbon dates is about 200 years; that is, a date with a standard error of 50 years is about the best that can be expected. The resolution can be somewhat improved if multiple samples can be processed from a single piece of wood or other organic matter. By averaging those dates, the standard error of the pooled mean can be reduced. There are, however, a number of significant sources of error that are not taken into consideration in calculating the standard error, which must be considered when interpreting radiocarbon dates. Chief among these are fluctuations in atmospheric carbon isotopes, isotope fractionation and, for dates using wood charcoal, built-in age and cross-section effect.

Calibration curves correct for fluctuations in atmospheric C14, so both the radiocarbon and calibrated calendar dates for a sample should be routinely reported. Isotope fractionation is a problem because some plants do not metabolize carbon isotopes in direct proportion to their availability in the atmosphere. Thus they can yield erroneous dates. Corn is probably the best known example of this problem, but many arid-adapted species also have C4 or CAM metabolic pathways. Isotope fractionation can be corrected readily if the ratio of stable isotopes is known, so isotope ratios should be requested routinely for all radiocarbon samples submitted for dating.

Built-in age is a problem because wood decays slowly in arid or semi-arid environments, so wood that is several centuries old might have been used as fuel or incorporated into a structure. A radiocarbon date from that old wood will overestimate the age of the targeted cultural event. This source of error is not significant in terms of cultural chronologies for the Archaic period, but it is an important consideration in assessing the contemporaneity of sites or of features within a site. It also is an obvious source of error for sites dating to the Ceramic and Protohistoric periods, because the cultural chronologies for these periods are more fine-grained. The radiocarbon date from a piece of wood also will be the average of the annual rings in that sample and not an estimate of the date when the tree died. Thus, if a timber containing 500 annual rings were dated, the resulting radiocarbon date would predate the age of the outer ring by about 250 years. This is cross-section effect. These potential sources of error can be avoid or minimized by dating annuals or short-lived perennials whenever possible. Small twigs or branches are better than larger fragments, since cross-section effect is less of a problem and they are less likely to have significant built-in age. If larger fragments must be used, the outer 10 or 20 rings can be stripped off and submitted for dating.

Thermoluminescence (TL) dating also has some potential applications in the region. The standard error for TL dates incorporates most of the major potential sources of error, which makes them more directly amenable to statistical analysis than radiocarbon dates. The other major advantage of this technique is that sherds can be dated directly, so there is little question that the date can be linked to the targeted cultural event. The resolution of what are termed survey TL dates is ±20% which, for the general age of occupations in the southeastern New Mexico, is generally lower than that of radiocarbon dates. The resolution can be improved to ±5-10%, though, if multiple samples of approximately the same age are dated and, if the soil dose rate can be measured by inserting TL probes at representative sites within the study area.

Paleoindian

The Paleoindian period in southeastern New Mexico is roughly dated between 11,500 and 8000 BP. Chronological divisions of this period are based on a series of complexes defined primarily by variations in projectile point form. The date ranges attributed to these complexes are supported to varying degrees by radiocarbon dates and stratigraphic associations, often from sites outside of the region. Because point styles are often the only basis for dating Paleoindian sites in southeastern New Mexico, issues of chronology and typology are inextricably linked.

In discussing the chronological problems associated with the Paleoindian period, Sebastian and Larralde (1989:23) echoed Cordell's (1979:15) concern that too few radiocarbon dates were available for Paleoindian sites in the Plains and Southwest to build a reliable chronology. Since that overview was published, the number of radiocarbon dates associated with Paleoindian occupations in the Plains and Southwest has almost tripled (Eighmy and LaBelle 1996;Table 1). These new dates have allowed some refinement of the projectile point chronology, particularly for the fluted series points.

There is currently no clear indication of a pre-Clovis occupation in southeastern New Mexico, so the Clovis complex remains the earliest, definitive evidence for human occupation of the region. Radiocarbon dates from Blackwater Locality No.1, Miami, and Lubbock Lake bracket the Clovis occupation on the Llano Estacado between 11,400 and 10,800 rcy BP (Holliday 1997:177). Based on the radiocarbon dates from Lehner and Murray Springs in southeastern Arizona, Haynes (1993:220) argues that the actual interval may be even shorter, possibly 11,200 to 10,900 rcy BP.

Folsom is also reasonably well dated on the Southern High Plains, with radiocarbon dates from Blackwater Locality No. 1 and Lubbock Lake indicating an age range between 10,800 and 10,200 rcy BP (Holliday 1997:182). For the Plains and Southwest as a whole, the range is slightly larger, ca. 10,950 to 10,250 rcy BP (Haynes 1993, Haynes et al. 1992) with the oldest Folsom dates overlapping the youngest Clovis dates.

Dating of the unfluted point styles is less secure, and Holliday (1997:185–186) identifies three significant chronological issues:

- ***the dating of Midland and its relationship to Folsom,***
- ***the age of Plainview and its relationship to Folsom, and***
- ***the age and typological relationships among Plainview and the other unfluted point series.***

Midland points are relatively small, thin lanceolate points with a concave base and straight to slightly convex lateral edges. Both faces exhibit flat, regular scars from lateral thinning parallel or sub-parallel to the fine marginal retouch, but remnants of the ventral surface of the flake perform are commonly evident. The basal concavity is generally less pronounced than Folsom, but some specimens exhibit the deep basal concavity and attenuated ears that are characteristic of the Folsom fluting process. A few examples also have a basal nubbin that on Folsom preforms serves as the striking platform for fluting. On average, the points are smaller and thinner than Plainview and, except for the absence of fluting, they resemble Folsom in size and overall form.

Midland points are not well dated. The solid carbon dates from the Midland (Scharbauer) type site appear unreliable (Wendorf and Krieger 1959), although a reanalysis of the site stratigraphy by Holliday and Meltzer (1996) suggests that the Midland points associated with the human remains may be younger than 10,000 rcy BP. Judge (n.d.:35) lists two radiocarbon dates, 10,000±200 rcy BP (A-499) and 10,600±500 rcy BP (A-504), as being associated with the Midland level at the Hell Gap site in southeastern Wyoming. These are two of four radiocarbon dates obtained from the lower portion of geological Unit E (Haynes 1993:Figure 8; Irwin-Williams et al. 1973:Figure 3), but their relationship to the Midland materials is uncertain. As described in the preliminary report of the excavations, a small Goshen camp and a Folsom camp were found at the base of geological Unit E in Locality 1. "Although vertical separation between the two occupations was slight, their horizontal distribution was distinct. … Very slightly above the Folsom remains were a few artifacts assignable to the Midland Complex" (Irwin-Williams et al. 1973:44). Given the minimal separation of the three components and the large standard errors for the radiocarbon dates, Haynes (1993:Table 1) rejects A-499 as unreliable and combines the other three dates to obtain an average age of 10,290±500 rcy BP for an undifferentiated Goshen-Folsom-Midland level. Based on the available evidence, then, Midland points can be tentatively dated between 10,300 and 10,000 rcy BP, but they may have appeared earlier and persisted later.

Despite the dearth of chronological evidence, there is general acceptance that the date range for Midland points overlaps that of Folsom points. Apart from the overall similarity of the two point styles, Midland and Folsom points have been found eroding from the same eolian unit at sites on the Llano Estacado, most notably at Midland and Shifting Sands (Amick 1995:2425; Holliday 1997:187). Further, although the Folsom archetype is fluted on both faces, the artifacts recovered from Folsom components at a number of sites also include points fluted only on one side, as well as "pseudo-fluted" and unfluted forms. It therefore seems likely that Midland is not a distinct point type but an unfluted variant of Folsom (Amick 1995; Frison 1991:51; Hofman 1992). Although Judge (1970) has demonstrated that the manufacturing trajectories of the two point styles are distinct, the primary difference is that the basal thinning of Folsom points is accomplished by fluting, whereas Midland point bases are thinned by lateral flaking. Since controlled lateral thinning is also characteristic of Folsom point performs, the Midland manufacturing trajectory can be viewed as an attenuated version of the Folsom trajectory. That some Midland points have characteristics associated with the Folsom fluting technique further suggests that the two trajectories may be part of a single technological tradition.

Plainview are lanceolate points with slightly convex lateral edges, a lenticular cross-section, and a concave base. Lateral flake scars are roughly parallel to collateral, and the proximal half to two-thirds of the lateral edges are moderately to strongly abraded (Knudson 1973:40–41). Final basal thinning is usually accomplished by the removal of multiple small vertical flakes (Turner and Hester 1993:175). Based on measurements of the Plainview and Ryan's Cache collections (Hartwell 1995:Table 3; Knudson 1973; Table D-1), Plainview points are generally larger than Midland points, although there is a slight overlap. Mean length is 57 mm with a standard deviation of 9 mm; mean width is 23.4 mm with a standard deviation of 2.6 mm; and mean thickness is 6 mm with a standard deviation of 1.5 mm.

Judge (n.d.:37) argues that two other named point types, Meserve and Milnesand, are variants of Plainview. Milnesand points have a straight or slightly convex base, but exhibit the same basal thinning attributes and extensive abrading of the lateral edges as Plainview. They have been found in good archaeological context only at the Milnesand and Williamson site, and both of those sites also yielded Plainview points (Holliday 1997:193). The only difference between Plainview and Meserve points is that the latter has a triangular blade with unifacially beveling (Turner and Hester 1993:154). Since beveling is a common technique used to sharpen projectile points, Meserve appear to be reworked Plainview points.

Goshen points in the northwestern Plains are also morphologically similar to Plainview, but the two types may date to different periods. Goshen was reportedly found stratigraphically below Folsom at Hell Gap (Irwin-Williams et al. 1973). The Clovis-age AMS dates for Goshen at the Mill Iron Site (Frison 1996:8) are consistent with that placement, although the possibility that the radiocarbon dates were contaminated by coal deposits cannot be totally discounted. In contrast, Plainview in the Southern High Plains occur stratigraphically above Folsom at Lubbock Lake, Lake Theo, and probably at Blackwater Locality No. 1. Radiocarbon dates associated with Plainview cluster at 10,000 rcy BP with a range of 10,300 rcy BP or older at Bonfire Shelter to 9200 rcy BP or younger at Ryan (Holliday 1997:189–190).

Two constricted base points, Agate Basin and later Hell Gap, follow Folsom in the northern Plains. Agate Basin points are long (average 7.5 cm), narrow points with a thick cross-section and slightly convex lateral edges that taper to a narrow base (Judge n.d.:41). Hell Gap points are similar but have slight shoulders and a wider blade. Both styles typically have collateral flaking. Hofman (1989:40–41) reports that Agate Basin and Hell Gap points are relatively common in the southern Plains. Only Agate Basin points have been found in a stratigraphic context, however. Agate Basin points appears contemporaneous with late Folsom in the spring conduit deposits at Blackwater Locality No. 1 (Haynes and Agogino 1966:819), and other Agate Basin material was recovered from lower Unit E, which probably dates to about 10,000 years BP (Hester 1972:59). Points morphologically similar to Agate Basin are also dated to about 10,000 BP at Lubbock Lake (Holliday 1997:192). Constricted base points therefore seem to have roughly the same date range in the Southern Plains as in the northwestern Plains; that is, 10,500–9500 rcy BP for Agate Basin and 10,000–9500 rcy BP for Hell Gap (Frison 1991:24–27). Thus there is considerable overlap with Plainview.

A variety of unfluted points were recovered from an extensive bison bone bed located stratigraphically above the Folsom and Agate Basin material at Blackwater Locality No. 1. Sellards (1952:72–74) called this assemblage the Portales Complex, and he described the projectile points as similar to Eden, Scottsbluff, San Jon, and Plainview. San Jon was defined by Roberts (1942) based on a single lanceolate point recovered from the San Jon site. The basal portion of the point has collateral flaking, a square base, and basal and lateral grinding. The tip is heavily reworked (Hill et al. 1995:382). Eden and Scottsbluff are diagnostic of the widespread Cody Complex. Cody Complex points are long, narrow points with straight lateral edges and short stem indented by lateral flaking (Judge n.d.:48). Thinning and shaping of the points is achieved through regular, usually comedial, pressure flaking that produces a prominent medial ridge and gives the points a characteristic diamond-shaped cross-section (Bradley 1993:260). Eden points are very narrow with barely perceptible shoulders. In some instances, the stem is formed entirely by abrading. Scottsbluff points have a wider blade and more pronounced shoulders.

The Portales Complex is no longer valid. Johnson and Holliday (1997) have demonstrated that the bone bed containing the type collection was churned and probably consisted of bison bone from at least two discrete events widely separated in time. The type collection itself is a mixed assemblage of heavily reworked points. Wheat (1972:153) incorporates most of the Portales into his Firstview Complex, which is seen as the central and southern Plains equivalent of the northern Plains Cody Complex. As originally defined, both Firstview and San Jon points were diagnostic of the complex, but subsequent research (Wheat 1976) indicated that the latter were reworked Firstview points. Based on his analysis of the points from Olson-Chubbuck, Wheat argues that there are subtle but consistent morphological differences between Eden-Scottsbluff and Firstview points. Judge (n.d.:44–45) emphasizes that the stems of Firstview points are fashioned by lateral abrasion in a direction perpendicular to the point axis rather than by pressure flaking. Bradley (1993:260), however, states emphatically that on technological grounds, the Firstview points from Olsen-Chubbuck are Cody points.

The Evans bone bed from which the Portales type collection was recovered is located in the upper part of Haynes' Unit E at Blackwater Locality No. 1 (Johnson and Holliday 1997). Firstview-Cody materials are reportedly present throughout Unit E, which is dated between 10,000 and 8500 rcy BP, and in lower Unit F dated 8500–8000 rcy BP. At Lubbock Lake, Firstview-Cody artifacts are found in stratum 2m, which dates 10,000 to 8500 rcy BP (Holliday 1997:195). The stratigraphic evidence therefore indicates that Firstview-Cody on the Southern High Plains may date between 10,000 and 8000 BP. The only direct dates for Firstview-Cody, however, are 8690 rcy BP and 8970 rcy BP from the Evans bone bed (Johnson and Holliday 1997:337), and 8500 rcy BP from the a Firstview feature at Lubbock Lake (Holliday 1997:195). Those dates are more in line with the 9400–8700 rcy BP date range for the Cody Complex on the northwestern Plains (Frison 1991:Table 2.2).

In the northwestern Plains, the Cody Complex is succeeded by the Allen-Frederick-Lusk Complex, marked by lanceolate parallel-oblique projectile points (Frison 1991). The complex is dated between 8500 and 8000 rcy BP and is the last of the classic Paleoindian complexes. Dating the end of the Paleoindian period in the Southern Plains is more problematic since there are no known sites in the Llano Estacado (Holliday 1997:197) or greater Southern Plains (Hofman 1989:44) that span the Paleoindian to Archaic transition. In the Central and Lower Pecos regions of Texas, however, Paleoindian style projectile points (Golondrina, Texas Angostura, and possibly Lerma) are associated with evidence for the kind of broad-spectrum hunting and gathering characteristic of the Archaic. Golondrina points date from about 9000 BP to perhaps as late as 8000 BP, and Angostura is dated between about 8800 and 8000 BP (Holliday 1997:154–157; Turner and Hester 1993). Although these point styles appear rare or absent in southeastern New Mexico, it is clear that the Paleoindian and Archaic periods, or more precisely the adaptations characteristic of those periods, overlap at a pan-regional scale.

From the above discussion, it is clear that the priority chronological issue relating to the Paleoindian period in southeastern New Mexico is determining the age and relationship among the unfluted point series. Absolute dates and stratagraphic evidence are needed to firmly establish the relative ages of the various point styles. Given the situation at Blackwater Locality No. 1 and Lubbock Lake, however, stratified sites are most likely to be rare, serendipitous discoveries associated with major land disturbing activities. Most of the chronological data is therefore expected to come from radiocarbon dates on bone associated with the projectile points. Typological and technological studies are equally important to this research. Although the immediate concern is to ensure consistent typology of the projectile points, the longer-term goal is to determine if the sequence of projectile point styles represents successive developments within a single technological tradition or multiple traditions. In other words, do the different point styles represent different cultural adaptations and/or different populations? The ultimate answer to this question will, of course, require more than chronological and technological data. The subsistence and settlement strategies associated with the different Paleoindian complexes must also be reconstructed.

Archaic

Chronological controls for the Archaic period are also based largely on changes in projectile point styles, but little effort has been devoted to developing a projectile point sequence for southeastern New Mexico. Local phase sequences (Corley 1965; Jelinek 1967; Kelly 1984; Lehmer 1948; Leslie 1979) have focused on the Ceramic period, leaving the Archaic undivided, so researchers have necessarily relied on projectile point chronologies developed outside of the region. Southeastern New Mexico lies at the intersection of several Archaic traditions – Oshara to the north, Cochise to the northwest, Chihuahuan to the west, and the Panhandle Plains and Trans-Pecos areas of Texas to the east and southeast. Projectile points of all of these traditions are found in southeastern New Mexico, which complicates cross-dating because morphologically similar point styles may have different date ranges in different chronologies (Sebastian and Larralde 1989:42). The central Texas chronology (Suhm and Jelks 1962) is the most commonly used, but Sebastian and Larralde (1989:46) argue that it may not be applicable to the northern half of the region. Many of the types also have broad temporal spans, either because of uncertainty about the age estimates or because the types themselves are not temporally sensitive.

The primary chronological issues related to the Archaic period are therefore:

- ***what are the ages and typological relationship among the various projectile point forms found in the region?***
- ***can projectile points be used to refine the chronology for the Archaic period?***
- ***does the variability and spatial distribution of point styles in southeastern New Mexico indicate the presence of populations affiliated with multiple Archaic traditions?***

Although projectile point form attributed to the three Southwestern Archaic traditions (Oshara, Cochise, Chihuahuan) are present, point styles most closely resembling Texas Archaic forms are predominant throughout southeastern New Mexico, including the Los Esteros/Santa Rosa Lake (Levine and Mobley 1976) and Ute Lake (Hammack 1965) areas at the northern boundary of the study area. Concerns that a projectile point chronology based primarily on Texas styles may not be applicable to the entire region therefore appear unwarranted. The problem posed by the broad temporal spans attributed to many of the central Texas styles has also been corrected to some extent by subsequent revisions of the Suhm and Jelks handbook (Turner and Hester 1993). There remains the possibility that the date ranges for some point styles in Texas are not applicable to southeastern New Mexico but any differences will have to be established through local dating of the individual point styles. Until those data are accumulated, projectile point cross-dating will remain the primary means of chronological control for the Archaic period.

Two tentative Archaic chronologies have been formulated that combine the available absolute dates and stratigraphic evidence from southeastern New Mexico, the Texas projectile point chronology, and Leslie's (1978) point typology for extreme southeastern New Mexico. The first was initially developed by Katz and Katz (1985) for the Brantley Reservoir area and subsequently offered as a regional phase sequence for the Archaic period (Katz and Katz 2001:34–36). The latter divides the Archaic into four sub-periods. The earliest sub-period, Archaic 1, is dated between 7200 and 5200 BP and the Jay point is the primary diagnostic. There is then a gap in the radiocarbon record separating Archaic 1 from Archaic 2, which is dated between 3700 and 3000 BP and has no diagnostic projectile points.

Archaic 3 is dated between 3000 and 2000 BP. The associated projectile points are medium-size stemmed dart points including Darl and Leslie's types 8C (Palmillas), 8D (Carlsbad), and 9. Darl are long, slender, carefully-flaked points with slight shoulders and an expanding or rectangular stem (Turner and Hester 1993:101). They are most common in central Texas where they are dated to the Transitional Archaic (ca. 2300–1300 BP). Palmillas are small leaf-shaped points with slight to well-barbed shoulders and an expanding stem with a knob-like convex base (Katz and Katz 1985:67; Turner and Hester 1993:167). Points identified as Palmillas are found from east Texas to the central coastal Plain and have been described by some authors in the lower Pecos. Turner and Hester note that the type does not appear common in any specific area, however, possibly because the type is poorly defined. This could also account for its broad temporal span, which is defined only as middle to late Archaic. Nevertheless, Mallouf (1985) considers Palmillas and to a lesser extent Darl to be characteristic of the early half of the late Archaic (ca. 2500–1850 BP) in the Trans-Pecos area, and points resembling Palmillas appear relatively common in the Guadalupe Mountain area (P. Katz 1978; Roney 1995). Carlsbad appears to be a local point style. It has a triangular blade and wide corner notches forming pronounced shoulders and a long widely expanding stem with a convex base that is typically about half of the overall length of the point (Katz and Katz 1985:67; Lord and Reynolds 1985:153). In the WIPP area, a Carlsbad point was found in indirect association with Feature 36 at ENMU 10418, which was radiocarbon dated (Tx-5023) to 2830±140 BP (Lord and Reynolds 1985:95,156).

The last sub-period, Archaic 4, is 2000–1500 BP. The projectile points listed as characteristic of this period are San Pedro; Leslie’s 6 C, 6D, and 8A; and three varieties of Pecos points (Katz and Katz 2001:36). Based on the illustration (Katz and Katz 1985:65), the identification of the San Pedro point seems questionable. San Pedro points are typically long slender points with deep lateral notches and a straight to slightly convex base that is the widest part of the point. The illustrated point has relatively shallow notches and the shoulders are wider than the base. Pecos is a provisional type defined by Katz and Katz (1985:68–69). It is described as a triangular point with small but prominent barbs and a slightly contracting stem. The stem is long, perhaps one-third of the total length and the base may be convex, rectangular, or indented. A date range of AD 1–750 is suggested for Pecos points but the evidence supporting that age estimate is not discussed.

As a local phase sequence, the Brantley Reservoir chronology contributes significantly to our understanding of the Archaic period in southeastern New Mexico, but its specificity makes it less useful as a regional chronology than the more general projectile point sequence developed by Shelley (1994) for the Llano Estacado. Shelley’s chronology relies heavily on the stratigraphic evidence from Lubbock Lake (Johnson and Holliday 1986). Johnson and Holliday divide the Archaic into Early (8500–6400 BP), Middle (6400–4500 BP), and Late (4500–2000 BP) periods. The Early Archaic period corresponds to the transition from the earliest Holocene warming trend to the onset of Middle Holocene xeric conditions. The Middle Archaic spans the Altithermal, which the stratigraphic evidence from Lubbock Lake indicates consisted of two long droughts at 6400–5500 BP and 5000–4500 BP separated by a more mesic interval between 5500 and 5000 BP. The Late Archaic period corresponds to a period of cooler, moister conditions that persisted until about 1000 BP. The 2000 BP end date for the Late Archaic is based on radiocarbon dates of 1740±40 BP (AD 210) and 1830±60 BP (AD 120) from Deadman’s Shelter, which are the earliest dates associated with pottery and arrowpoints on the Texas Panhandle (Johnson and Holliday 1986:42).

Although they are concerned primarily with shifts in Archaic subsistence strategies in response to these climatic changes, Johnson and Holliday briefly discuss the limited evidence for changes in projectile point styles. Trinity, Ellis, and Bulverde projectile points were recovered from Stratum 4B at Lubbock Lake, which was deposited between about 5000 and 4500 BP, the later drought of the Middle Archaic period. In addition, Williams, Travis, Pedernales, Pandale, and Darl points were recovered from the “jointed sands” at Blackwater Locality No. 1, which Holliday interprets as an eolian deposit also dating to about 5000–4500 BP. For the late Archaic, they note that points similar to Marcos and Ensor were recovered from the “lower midden zone” at Chalk Hollow, which dates to about 2500 BP, that Ellis and Palmillas point were recovered from Little Sunday, and that points similar to Marcos were recovered from Pete Creek – all sites located at the northeast margins of the Llano Estacado (Johnson and Holliday 1986:42). No projectile points are identified as being associated with the Early Archaic.

Shelley's projectile point chronology differs from Johnson and Hollidays' in two respects. First, he incorporates Leslie's morphological types into his chronology. Shelley (1994:390) identifies Leslie's 8A as Marcos; 8B, as Ensor; 8C, as Palmillas; and 9, as Palmillas or Ensor. Type 8D is identified as Carlsbad, and types 10B and 10C are identified as Maljamar – two local types. All of these types are attributed to the Late Archaic period.

The second difference is that Shelley believes that the jointed sands (Haynes' Unit F) at Blackwater Locality No. 1 may be older than 5000–4500 BP. Holliday's dating of Unit F is based on a radiocarbon date of 4855±90 BP on the organic residue fraction of a paleosol formed on Unit F. Haynes and others suspect that Holliday's sample may have been contaminated by recent humic acids and is therefore too young (Shelley 1994:386). Shelley argues that whether or not the soil date was contaminated, it obviously post-dates the deposition of Unit F and therefore any tools within those deposits. Based on this evidence and postulated early dates for Williams, Pedernales, and Travis points in central Texas (Suhm and Jelks 1962), Shelley tentatively identifies Pedernales and Travis points as diagnostic of the Early Archaic. He assigns Williams points to the Late Archaic, along with Marcos and Palmillas, based on the occurrence of similar projectile points in deposits at Chalk Hollow radiocarbon dated between 3600 and 2350 BP (Shelley 1994:387). Pandale and Darl points are assigned to the Middle Archaic period, as are Ellis, Bulverde, and Trinity points based on the dates for Stratum 4B at Lubbock Lake.

The updated Texas projectile point chronology (Turner and Hester 1993) indicates that some of Shelley's assignments may be in error. Pandale, a lanceolate point with a distinctive corkscrew twist, is dated between 6000 and 4500 BP, and is probably the oldest Archaic point style at Blackwater Locality No. 1. Bulverde points have a triangular blade, pronounced shoulders or barbs, and a thin rectangular base that is wedge-shaped in cross-section. They are dated between 5000 and 4500 BP in central Texas, which is fully consistent with the date range for Stratum 4B at Lubbock Lake. Travis, a triangular point with rounded shoulders and a rectangular stem, is dated at about 4650–4050 BP. Ellis are crudely-flaked corner-notched points with a triangular stem and an expanding stem with a straight base. They are dated between about 4000 and 1300 BP in Texas, which is later than the 5000–4500 BP dates for Ellis at Lubbock Lake. Pedernales is dated between 4000 and 3200 BP, which is consistent with the 3600 ± 100 BP date for this point style at San Jon (Hill et al. 1995). Pedernales points vary from triangular corner-notched points with pronounced barbs to lanceolate points with rounded shoulders. Their distinctive feature is a parallel-sided indented stem. Often, the indented stem is formed by a flute-like flake struck from one or both faces (Turner and Hester 1993:171). Marcos are broad triangular, barbed points with deep corner-notches and an expanding stem. They are dated between 2600 and 1800 BP, which is slightly later than their suggested date at Chalk Hollow (i.e., 3600–2350 BP). Ensor, a broad-based triangular point with shallow side-notched and a straight base, is dated to about 2200–1400 BP. Darl, as already noted, dates between about 2300 and 1300 BP. Finally, Trinity, Williams, and Palmillas points are dated only as "Middle to Late Archaic," which would be roughly 4500–2300 BP. Trinity are relatively small roughly triangular points with expanding stems, straight to slightly convex bases, and shallow ground side-notches, while Williams are broad triangular, corner-notched points with an expanding stem and convex base. Palmillas has already been described.

Overall, these date ranges are consistent with the limited chronological information available for southeastern New Mexico and the Llano Estacado, which suggests that they can be used to revise Shelley's projectile point chronology. There are only three inconsistencies, two of them minor. Based on the evidence from Lubbock Lake and Chalk Hollow, respectively, the initial dates for Ellis and Marcos points appear to be earlier than those suggested by Turner and Hester. The difference is not significant, however. Even with the earlier dates, these point styles still fall within the late Archaic period as defined by Johnson and Holliday. The third inconsistency is the suggested date range for Darl points is at least 2000 years later than the probable age of Unit F at Blackwater Locality No. 1. The most probable explanation for this discrepancy is either that the point was misidentified or that it was incorporated into Unit F by bioturbation.

Based on the available evidence, then, Pandale is tentatively dated to the Middle Archaic period and is the only one of these point styles that may be associated with the early Altithermal drought. Bulverde is tentatively dated to the latter half of the Middle Archaic (the later Altithermal drought) and Travis to the end of the Middle Archaic and beginning of the Late Archaic. Ellis, Williams, Travis, and Palmillas all appear to have date ranges spanning the whole of the Late Archaic, while Marcos, Ensor, Darl, and possibly Carlsbad appear near the end of the period. Maljamar is also dated to the late Archaic.

This revision of Shelley's chronology leaves no diagnostic point types for the Early Archaic. The Texas points that fall into this time period – Golondrina and the Early Barbed styles – are noticeably absent, although some Angostura points have been identified. Jay points would also fall within this period. The date range for Bajada points, ca. 7000–5000 BP (Chapin 2005:125), spans the latter half of the Early Archaic and the early drought and mesic interval of the Middle Archaic. Both of these point styles are relatively common in the Estancia Basin but are rare in southeastern New Mexico. At San Jon, two side-notched projectile points were recovered from stratum 2s, which is bracketed by radiocarbon dates of 8360+210/-205 and 7570+115/-110 (Hill et al. 1995). The authors describe these points as similar in morphology to a variety of points from the eastern and central United States considered to be very late Paleoindian or early Archaic (e.g., Kirk, Keithville, Palmer, or the Logan Creek Complex), but no type description has been published.

Like Shelley's original formulation, this revised chronology needs to be tested and refined. Absolute dates in direct association with projectile points are needed to refine the local date ranges for individual point styles. Concurrently, typological studies are needed to refine the definition of the various point styles to ensure consistent typological identifications and to resolve any confusion in typing projectile points of different Archaic traditions. Nevertheless, the provisional sequence does provide a regional chronological framework that will facilitate research to address a number of cultural historical issues relating to the Archaic period.

In particular, Sebastian and Larralde (1989:43–47) identify two such issues, the first being:

- ***What is the nature of the transition from Paleoindian to Archaic?***

Irwin-Williams (1979) argues that Paleoindian hunters withdrew from the Southwest as climatic conditions deteriorated and were replaced by Archaic populations moving into the region from the west. The alternative view is that the Paleoindians became Archaic hunter-gatherers as they broadened their subsistence base to include a wider variety of plants and animals in response to environmental changes during the early Holocene. The question then is: does the early Archaic occupation represent an adjustment of the Paleoindian population to changing environmental conditions or population replacement as more generalized hunter-gatherers moved into areas abandoned by the Paleoindian hunters?

In order to answer this question, a number of lower level problems must first be addressed, a situation that is common to most culture historical problems. First, the local chronology must be refined to the point where sites spanning the transition can be identified and dated. Second, we need to have an adequate understanding of the adaptive strategies employed by late Paleoindian and early Archaic groups, which means that sufficient data must be obtained to reconstruct the subsistence and settlement patterns. Third, we need to understand how environmental conditions changed during the transition period, and how those changes affected the critical subsistence resources utilized by the late Paleoindian and early Archaic groups. Fourth, changes in tool forms and lithic technologies must be examined and compared with contemporary assemblages from adjacent regions to identify evidence of population movement and cultural continuity or discontinuity.

Sebastian and Larralde (1989:43) also note that only 18 of the 53 radiocarbon dates then available from southeastern New Mexico are older than 2000 rcy BP, and only 6 are older than 3000 rcy BP. This same pattern is evident in the much larger sample of dates assembled by Katz and Katz (2001, Appendix 1). Of the 235 radiocarbon dates in that sample, only 45 (19%) are older than AD 1. Two of the dates fall within the early Archaic period as defined here; eight dates fall within the middle Archaic; and 35 dates fall within the late Archaic. The questions raised by these data are:

- ***Was the region sparsely settled or sporadically utilized during the early and middle Archaic periods?***
- ***Does the apparent population increase beginning during the late Archaic reflect intrinsic growth or an influx of groups from adjacent regions?***

In addressing those questions, initial consideration needs to be given to whether the patterning in the radiocarbon record is a reflection of demographic trends during the Archaic period or a function of differential preservation and site visibility. That assessment will depend in part on research to more specifically identify the geomorphological processes likely to have affected early and middle Archaic sites in the different regional sampling units (RSUs). If it appears that a large proportion of early and/or middle Archaic sites may be buried, then the most effective strategy may be to develop site location models to identify likely site locations. Those locations can then be tested to determine if buried sites of the relevant age are actually present.

In addition to the geoarchaeological research, other independent measures of demographic trends should be formulated. Relative numbers of the different projectile point styles is one measure that could be rapidly developed as a relative measure of population growth. Ultimately, the number of residential sites and living space area are likely to be the more reliable measures of population, but developing those measures will require excavation of a representative sample of sites from each period. Further, a basic understanding of the settlement system during each temporal period is needed in order to estimate the average number of residential sites occupied by the hunter-gatherers during an annual cycle.

Assuming that the patterns in the radiocarbon dates are indicative of demographic trends, then the next step in the analysis is to explain those patterns. A logical approach to this problem is to examine the evidence for environmental change during the Archaic period and to assess the effects of those changes on the water sources and critical plant and animal resources utilized by hunter-gatherers in southeastern New Mexico. Besides securing the necessary paleoenvironmental data, this approach clearly requires the basic information about the subsistence strategies employed during the early, middle, and late Archaic periods needed to identify the critical food resources. Information about changes in tool forms and lithic technologies is also needed as evidence for cultural continuity or discontinuity across the subperiods. As part of this last inquiry, one other question that needs to be investigated is: to what extent do the projectile point styles represent different technological traditions, and are those traditions associated with different adaptive strategies? Because point styles attributed to several Archaic traditions occur in the region, preliminary data relevant to this question can be obtained through an analysis of the spatial distribution of the different point styles. This analysis should indicate whether the projectile points associated with different traditions are clustered in different parts of the region and/or are restricted to particular time periods. If there is clustering, then it may be that particular groups were targeting a specific resource area on a seasonal basis. If the sites are distributed over multiple areas, however, then it is more likely that the annual round was centered in southeastern New Mexico. In either case, the preliminary data would have to be followed up by research to identify the subsistence and settlement patterns associated with each Archaic tradition to provide a definitive answer to the question.

Ceramic

In contrast to the Archaic, a number of phase sequences have been proposed for the Ceramic period occupation in southeastern New Mexico. The western margins of southeastern New Mexico – essentially the Guadalupe, Sacramento, Sierra Blanca and Capitan Mountains and their foothills – fall within the Jornada Branch Mogollon as originally defined by Lehmer (1948). Two series of related phases were defined for the northern and southern variants of the Jornada, which are distinguished largely by differences in their ceramic assemblages. Those of the southern variant consist predominantly of El Paso Brownware, and the phases for that variant – Mesilla, Doña Ana, and El Paso – were defined on the basis of limited excavations in the Rio Grande Valley and Tularosa Basin. The ceramic assemblages of the northern variant are characterized by a predominance of Jornada Brown and later by the common occurrence of Chupadero Black-on-white and Three Rivers Red-on-terracotta. The northern phase sequence is therefore more applicable to southeastern New Mexico. The Capitan Phase (ca. AD 900–1100) includes the earliest pottery sites in the northern district, and like the Mesilla phase, pithouses are the primary domestic structures. The definition of this phase is based primarily on excavation data from Site 2000 in the Rio Peñasco valley (Jennings 1940). The succeeding Three Rivers Phase (ca. AD 1100–1200) is seen as a transitional phase to surface structures, although Lehmer (1948:85–86) acknowledges that pithouses persist into this period. The San Andres Phase (ca. AD 1200–1400) is equivalent to the El Paso Phase, and marked by the appearance of adobe-walled pueblos with rooms grouped around plazas. In contrast to the southern variant phases, the northern variant phases were not widely adopted, and their use of the later two phases has been superseded by Kelley's Sierra Blanca sequence.

Kelley (1984) divides the Ceramic period occupation of the Sierra Blanca region into three phases, two of which – Corona and Lincoln – relate to the northern portion of her study area. The third phase, Glencoe, occurs in the southern part of the region, and is largely contemporaneous with both the Corona and Lincoln phases.

Glencoe Phase (ca. AD 1100–1400/1425) sites are situated on the eastern flanks of the Sierra Blanca and Sacramento ranges, within an area bounded on the south by the Rio Peñasco and extending northward to the Bonito and Ruidoso valleys of the Rio Hondo drainage and Nogal Mesa (Kelley 1984; Wiseman 1985). They consist of a scattered arrangement of pithouses near drainages within the piñon-juniper zone. The major pottery type of this phase is Jornada Brown, with small quantities of Chupadero Black-on-white, Mimbres Boldface Black-on-white, and Three Rivers Red-on-terracotta occurring at early Glencoe sites in the Peñasco Valley. At late Glencoe sites in the Ruidoso Valley, Chupadero Black-on-white, El Paso Polychrome, Lincoln Black-on-red, and Three Rivers Red-on-terracotta occur regularly. On the basis of these ceramic assemblages, Kelley suggests that the Glencoe Phase had its beginnings early in Pueblo III. During late Pueblo III, the Peñasco Valley seems to have been abandoned, while the Glencoe Phase occupation in much of the northern area gave way to a Lincoln Phase occupation. In the Ruidoso Valley, however, the Glencoe Phase seems to have persisted into the early Pueblo IV period.

In the north, sites of the Corona Phase (ca. AD 1100–1200) occur in the upper Gallo and Macho drainages along the north and southeast slopes of the Capitan Mountains. Villages comprise a few to 50 scattered house units with no recognizable formal arrangement. House units consist of one-to-nine rooms with upright stone slab foundations and jacal superstructures. Floors are dug slightly below ground surface. Some rooms have hearths and appear to be domiciles; others have flagstone floor and were probably used for storage. At least two sites have roughly circular slab outlines that may be ceremonial structures. The two major ceramic types at Corona sites are Jornada Brown and Chupadero Black-on-white.

Lincoln Phase (ca. AD 1200–1400/1425) sites are found in the same area as the Corona sites but also extend into the Rio Hondo drainage. Bloom Mound, located near the junction of the Rio Hondo and the Pecos, is also identified as a Lincoln Phase site. Villages are masonry or coursed adobe pueblos arrayed either as a linear roomblock fronting east on a plaza or in a square surrounding a plaza. The size of the pueblos varies from 10 to more than 100 rooms. Corona Corrugated is the predominant utility ware at these sites and Jornada Brown declines in importance. Chupadero Black-on-white, Lincoln Black-on-red, Three Rivers Red-on-terracotta, and El Paso Polychrome were the major painted wares.

As a result of work by the Lea County Archaeological Society, Corley (1965) argued that extreme southeastern New Mexico was occupied by groups closely related to the Jornada Mogollon. A sequence of four phases was formulated for the Eastern Jornada area (Corley 1965; Leslie 1979), which encompasses the southern portions of the Mescalero Plain and Llano Estacado. Components of the Eastern Jornada have also been reported from the Andrews Lake site in Texas (Collins 1971) and "are recognizable in excavation and survey reports at many other sites in the Texas part of the Southern Plains" (Hughes 1989:27).

As described by Leslie (1979), the Querecho Phase, (AD 950–1150) is marked by the initial occurrence of ceramics and corner-notched arrow points. Only nonstructural sites are known for the early part of this phase, but small rectangular pit rooms and possible surface room floors have been found at a few late Querecho sites. The major ceramic types from this period are variants of Jornada Brown with some Cebolleta and Mimbres black-on-white tradewares. Although Querecho sites are found throughout the Eastern Jornada area, gathering sites of this period are more common in the shinnery-covered dunes than those of the later phases.

A more sedentary lifeway is suggested by sites dating to the succeeding Maljamar Phase (AD 1150–1300). Maljamar phase sites include both gathering camps and pithouse villages, some containing 20–30 small rectangular structures. Local variants of Jornada Brown continue as the dominant ceramic type, with some corrugated utility wares occurring near the end of the phase.

Chupadero Black-on-white is the major decorated type, accompanied by small amounts of El Paso Polychrome and Three Rivers Red-on-terracotta. Corner-notched arrowpoint styles are replaced by side-notched forms after about AD 1200. At the end of this phase, Leslie argues that the Eastern Jornada area was some dislocation of the regional population and that the Eastern Jornada are may have been temporarily abandoned. The few sites or components dating to this transitional phase have yielded a distinctive ceramic assemblage containing Glaze A red and yellow types; Gila, Ramos, and El Paso polychromes; and Lincoln Black-on-red.

The latest Eastern Jornada phase, the Ochoa Phase, includes village sites with 15–30 surface rooms arrayed as units or small roomblocks, and large, shallow pithouses. The ceramic assemblage consists largely of a single locally made type, Ochoa Indented, and some Chupadero Black-on-white. Arrowpoints are triangular forms with notched or indented bases, and small "thumb-nail" end-scrapers and four-edge beveled knives are common. This phase is tentatively dated between AD 1350 and 1450–1500.

A local phase sequence was developed on the basis of survey and excavation data from the Brantley Reservoir Area near Carlsbad (Katz and Katz 1985). The sequence includes two ceramic period phases. The Globe Phase (AD 750–1150) is marked by the introduction of brownware ceramics (primarily El Paso Brown) and "true" arrowpoints, including variants of Scallorn and Livermore. The phase is further characterized by a shift in settlement location from riverine to upland locations. Sites are temporary or seasonal camps with the same features found at earlier pre-ceramic sites – burned rock rings, fire-cracked rock concentrations/hearths, and fire-cracked rock scatters. A new feature type that probably appears during this phase are stone circles, which are tentatively identified as domestic structures. Two forms of this feature type were observed. One is a simple surface arrangement of large stones; the second is a semi-subterranean structure with stone slabs set into the ground at an angle.

The succeeding Oriental Phase (AD 1150–1450) is marked by the appearance of painted ceramics, and by diminishing use of the Brantley area. El Paso Polychrome, Chupadero Black-on-white, and Three Rivers Red-on-Terracotta appear at the beginning of the phase, and it ends with the disappearance of Chupadero Black-on-white and Lincoln Black-on-red. Fresno, Harrell, and Washita arrowpoints are also diagnostic of this phase. Sites are artifact scatters with associated burned rock rings and fire-cracked rock concentrations. One site, BR 47, also had four stone circles identified as tipi rings but the dating of these features to the Oriental Phase is uncertain.

Seven ceramic period phases were defined for the Middle Pecos Valley between Fort Sumner and Roswell (Jelinek 1967). Sites dating to the Early 18 Mile Phase (ca. AD 750–900) appear to be the earliest relatively permanent settlements established in areas suitable for agriculture. These sites are marked by ceramic assemblages consisting of Jornada Brown and a few sherds of Lino Gray. By the Late 18 Mile Phase (AD 900–1000), small sedentary communities are well established in the valley. Architectural forms include slab-lined pithouses, small rectangular blocks of semi-subterranean rooms with vertical sandstone slab foundations, and slab-lined storage cysts. Middle Pecos Micaceous Brown (a local variant of Jornada Brown) becomes predominant during this phase, with lesser amounts of South Pecos Brown and Roswell Brown. Red Mesa Black-on-white is relatively common although it rarely constitutes more than 10% of the ceramic assemblage.

The widest utilization of the valley and probably peak population is dated to the Early Mesita Negra (AD 1000–1100) and Late Mesita Negra (AD 1100–1200) phases. Little evidence of architecture is available for these phases, but continued use of pithouses and small surface structures seems likely. The phases are distinguished primarily on the basis of ceramics. Middle Pecos Micaceous Brown remains predominant in the Early Mesita Negra assemblages, and Red Mesa Black-on-white continues to be present in small quantities. Two locally produced reduction-fired painted types – Crosby Black-on-gray and Middle Pecos Black-on-white – also appear for the first time. Late Mesita Negra assemblages are characterized by a decline in Micaceous Brown, and increase in the amount of Roswell Brown, increasing quantities of local painted graywares, and the first appearance of Chupadero Black-on-white in significant quantities.

The number of sites declines during the Early McKenzie (ca. AD 1200–1250) and Late McKenzie (ca. AD 1250–1350) phases, but they are generally larger than during the preceding phases. Early McKenzie ceramic assemblages are similar to Late Mesita Negra assemblages but with higher proportions of McKenzie Brown and Middle Pecos Black-on-white, and a near absence of intrusive ceramics. In late McKenzie assemblages, Middle Pecos Black-on-white is predominant with lesser amounts of McKenzie Brown are predominant. The proportion of Chupadero Black-on-white also increases and significant quantities of corrugated utility wares occur for the first time. Architectural forms are not well known but include rectangular, slab-based surface rooms. Post-McKenzie phase (after AD 1350) sites appear to be temporary camps and the only structures are possible tipi rings. Ceramics are largely glazewares and other Pueblo intrusives, although one site yielded sherds of a corrugated McKenzie Brown vessel. Jelinek interprets the Post-McKenzie sites as marking a transition from sedentary farming to nomadic bison hunting that began during the Late McKenzie phase.

Jelinek focused his investigation on the Pecos Valley south of Fort Sumner, and his phase sequence is primarily applicable to that area. Two additional phases were proposed for the Roswell area, but they are poorly defined. As summarized by Wiseman (2002:5–6), the Crosby phase (ca. AD 1000–1200) is equivalent to the Mesita Negra phases in the north. Ceramically, it is distinguished by the predominance of Roswell Brown (rather than Middle Pecos Micaceous Brown) and Crosby Black-on-gray. The type site, P9, is classified by Jelinek (1967:43–44) as site type B, a "concentration of several hundred flakes and/or sherds and occasional indications of permanent architecture." The Roswell Phase (ca. AD 1200–

1300) is equivalent to the McKenzie phases in the north. The ceramic assemblage is dominated by Roswell Brown, Jornada Brown, and Chupadero Black-on-white. The two sites listed for this phase, P7 and P8, are classified as concentrations of several thousand sherds and/or flakes with little or no indication of permanent architecture. The possibility of a pre-Crosby phase is also suggested by the ceramic collections from P56 and P63, both of which appear to be temporary camps. The assemblages from these sites include large quantities of South Pecos and Roswell Brown (Jelinek 1967:67).

In discussing the relationship among these phase sequences, Wiseman (1997) argues that three or four different ethnic groups may be represented. Following Kelley (1984:153−154), Wiseman draws an initial distinction between the southern Glencoe and northern Corona-Lincoln Phase occupations in the Sierra Blanca area. He suggests that the Glencoe farmer-hunter-gatherers were indigenous to the area, while the Corona-Lincoln farmer-hunters intruded into the northern part of the area from the Chupadero Mesa (Gran Quivira) area. The occupants of the Middle Pecos Valley are potentially a third ethnic group. Jelinek (1967:160−163) speculates that agriculture was adopted by an indigenous, possibly Tanoan population in the Middle Pecos under the influence of Anasazi populations in the middle and northern Rio Grande valley. Wiseman (1992:137; 2004:86), on the other hand, argues that the similarities of ceramic assemblages and architecture of the Corona phase, pre-McKenzie phase Middle Pecos, and early Chupadero Mesa sites are so great that they probably represent a single cultural manifestation. Nevertheless, the differences in the Lincoln and McKenzie phase occupation suggest that the Middle Pecos may have been ethnically distinct after AD 1300, particularly if Jelinek is correct in his assertion that agriculture was abandoned in favor of bison hunting. Wiseman suggests that a fourth ethnically distinct group may have occupied the Eastern Jornada area. Although the ceramic assemblages and architecture at sites in this area are similar to the Jornada Mogollon, no evidence of agriculture has been found in the Eastern Jornada area, suggesting that the population were hunter-gatherers. Wiseman (1997:138) also raises the possibility that the Eastern Jornada may have been a Southern Plains rather than Southwestern people.

Recent research in the Roswell area has fueled further speculation about the ethnic identity of Ceramic period populations in southeastern New Mexico. Excavations by the Office of Archaeological Studies at Fox Place, King Ranch, and Townsend have uncovered remnants of small, oval to round pithouses and wickiup floors. Wiseman (2002:168−174) argues that similar structures may be associated with Late McKenzie sites in the Middle Pecos and Ochoa sites in the Eastern Jornada, but that they are distinct from the deep pithouses at contemporary Glencoe sites. He speculates that these less durable structures may be characteristic of indigenous, Southern Plains hunter-gatherers who maintained exchange relations with the more sedentary Jornada Mogollon farmers and adopted some aspects of their material culture. Akins (2003:310−312), on the other hand, contends that the structures and site layout at the Fox Place and Townsend are virtually identical to those of Mesilla phase sites in the Rio Grande valley and Tularosa Basin. She further questions Wiseman’s portrayal of the Jornada Mogollon as sedentary farmers, arguing that early Jornada groups were primarily dependent on hunting and gathering supplemented by agriculture. She acknowledges that the Jornada were primarily dependent on agriculture after about AD 1100, but emphasizes that they still maintained secondary residences where hunting and gathering activities were conducted on a seasonal basis. In short, Akins believes that Wiseman has created a false dichotomy in equating the Jornada Mogollon with sedentary farmers and Plains groups with hunting and gathering. In her opinion, sites like Fox Place and Townsend fit readily into the range of Jornada Mogollon settlements. Cranial measurements from burials at the Henderson Site bear directly on this problem, but the results of comparisons with Pueblo and Plains burials are not conclusive. The results of the analysis tentatively suggest that the Henderson material “morphologically fits its intermediate geographical position – exhibiting a form distinct from, but with some similarities to, both the Pueblo and the Texas groups” (Rocek and Speth 1986:161).

Except for Brantley Reservoir, all of the sequences discussed above rely heavily on ceramic cross-dating in assigning temporal spans to specific phases. As those sequences were formulated 20–40 years ago, there is a clear need for a systematic review of the current date ranges assigned to the ceramic types, and for revision of the dates assigned to the various phases. Additional absolute dates from local sites are also needed to further refine the ceramic chronology.

Radiocarbon and thermoluminescence dates can be used to refine the dates of some long-lived types, but higher-resolution dendrochronological and archaeomagnetic dates will be necessary for the later painted wares. Radiocarbon dates typically have 95% confidence limits of 200 years or more. Radiocarbon dates on wood charcoal are also potentially affected by the "old wood" problem and cross-section effect. The best that can be done to improve resolution is first to date annuals or small shrubs whenever possible, and second to run two or more dates from the same fragment of material and average the dates to reduce the standard error. Thermoluminescence dating has a similar error range but there is no "old wood" problem, and it can be used to date sherds directly. On the other hand, collecting the samples is not as straightforward as radiocarbon dating nor is its reliability fully proven. Dendrochronology has rarely been successful at sites in the region owing to the predominant aboriginal use of complacent species for construction timbers. Archaeomagnetic dating can also yield relatively precise dates, but its applicability may be limited primarily to structural sites.

The dating of Jornada Brown is particularly critical, as it relates directly to the question of when ceramics were introduced into southeastern New Mexico. As the phase sequences indicate, dates for the initial appearance of ceramics in the region has been estimated at anywhere from AD 750 to 950. Based the radiocarbon dates from Deadman's Shelter (Hughes and Willey 1978), however, Jornada Brown pottery was being produced by AD 200. Conversely, the absence of ceramics at Sunset Archaic sites, which appears to have been repeatedly occupied between about AD 1 and AD 400, suggests that pottery was not in widespread use in the Sierra Blanca area until AD 400–500 (Wiseman 1996:187–188). Additional absolute dates are obviously needed from sites with plain brownwares to determine when pottery first appeared in southeastern New Mexico and whether it was introduced at different times in different parts of the region. Nevertheless, the evidence currently available indicates that the ceramic period began several centuries earlier than originally assumed, and the Ceramic Period chronologies should be modified accordingly.

There is a similar problem in dating the end of the Ceramic period in southeastern New Mexico. Whereas ceramic dating of the initial occupation of a site is based on the ceramic types present, dating the end of the occupation is based in part on what ceramic types are absent. In southeastern New Mexico, the end dates for latest Ceramic period sites are typically based largely on the presence of Glaze A and absence of later glazewares, suggesting that the sites were abandoned in the mid-to-late fourteenth century. In the southern Rio Grande valley, however, Marshall and Walt (1984:138) note that Glaze A appears to persist into the fifteenth century. More recently, it has been suggested that Glaze A may date as late as the early sixteenth century (Eckert 2006; Snow 1997).

Another chronological issue is reconciling the local phase sequences to facilitate regional comparisons. In their overview for southeastern New Mexico, Katz and Katz (2001:37–40) address this problem by dividing the Ceramic period into seven regional phases: Formative 1(AD 500–750), Formative 2 (AD 750–950), Formative 3 (AD 950–1075), Formative 4 (AD 1075–1125), Formative 5 (AD 1125–1200), Formative 6 (AD 1200–1300), and Formative 7 (AD 1300–1375). To the extent that the date ranges for the regional phases are common to multiple local phases, it provides a provisional framework for regional comparisons.

There are two problems with this approach, however. One is that the local phases are developmental as well as temporal sequences. That is, the phases describe changes in artifact types, architectural forms, settlement locations, and/or subsistence patterns that are by definition specific to a particular area. While there is some value to generalizing those definitions as Katz and Katz have done, it is premature given our rudimentary understanding of cultural developments at the local level.

A better approach at this stage of research is to develop a temporal framework based strictly on changes in ceramic and projectile point styles that crosscuts the local phases and that is devoid of any developmental implications. Because the units are arbitrary slices of time, sites can readily be slotted into the sequence on the basis of relative or absolute dates. This would avoid problems like those encountered in the Roswell area where sites like Fox Place and King Ranch could not be assigned to an existing culture chronology because their structures are unlike those described for the Sierra Blanca and Middle Pecos phases (Wiseman 2002:6). The temporal framework can also be used as one axis of a regional sampling matrix to ensure that a representative sample of sites are selected for excavation. Finally, this approach does not preclude the continued use of local phase sequences in examining local cultural developments and regional cultural differences.

The second problem with the approach adopted by Katz and Katz is that it will be impossible to assign most ceramic sites to their phases on the basis of temporally diagnostic artifacts, and it may be difficult even with absolute dating. The majority of ceramic sites in the region are sherd and lithic scatters with relatively small ceramic assemblages, which may mean that the absence of some of the less common wares most useful for dating may not be significant. In rough order of appearance, some of the more common ceramic types in the region are: Jornada Brown (ca. AD 200–1350), El Paso Brown (ca. AD 400–1300), Red Mesa Black-on-white (ca. AD 850–1050), Mimbres Black-on-white (Style II, ca. 850–1050; Style III, ca. AD 1000–1150), Chupadero Black-on-white (ca. AD 1100–1500), El Paso Polychrome (ca. AD 1100–1400), Three Rivers Red-on-terracotta (ca. AD 1100–1300), Playas Ware (ca. AD 1150–1519), Ramos Polychrome (ca. AD 1150–1519), St. Johns Polychrome (AD 1175–1300), McKenzie Brown (ca. AD 1100–1300, most common after AD 1200), Corona Corrugated (ca. AD 1225–1460), Gila Polychrome (ca. AD 1250/1300–1400), Lincoln Black-on-Red (ca. AD 1300–1400), and Glaze A Polychrome (ca. AD 1300–1425 or later). Given these date ranges, the basic distinction is between sites dating before and after AD 1100. For many of the non-structural sites in the Mescalero Sands, this may be the only distinction that can be made. If some early whitewares are present, then a second cut can be made between AD 850/900 and 1100, but those types are not particularly common. For the later ceramic period, additional distinctions can potentially be made between sites dating later than AD 1175–1200 and after AD 1300.

Because archaeological research in southeastern New Mexico has focused primarily on the Ceramic period, numerous culture historical questions have arisen relating to this interval.

- ***When were cultigens introduced into southeastern New Mexico?***
- ***Was agriculture adopted by some segments of the local population or did Anasazi and/or Jornada farmers expand into the region?***
- ***Was there a single cultural adaptation based partly on agriculture and partly on the exploitation of wild plant and animal resources, or was the region concurrently occupied by populations of farmers and hunter-gatherers?***
- ***To what extent are the differences in the material culture and settlement and subsistence patterns noted in different areas of southeastern New Mexico a reflection of ethnic differences?***
- ***What are the relative influences of cultures in adjacent areas of the Southwest, Southern Plain, and Trans-Pecos? How do those patterns change over time?***
- ***Is the local population Puebloan, Plains, or a mixture of both?***

- ***Did agricultural groups eventually withdraw from southeastern New Mexico, or did they abandon farming and revert to a hunting and gathering adaptation focused on bison hunting?***
- ***If so, was the transition fostered by the development of Pueblo-Plains trade centered on the exchange of bison meat for cultigens?***

Like most culture history questions, these questions must be addressed at the regional/integrative level, which means that a series of intermediate questions must first be answered. First, the subsistence strategies employed by various groups in the region must be reconstructed to assess the relative dependence on cultigens, wild plant foods, and small and large game. Second, we need to know the extent to which subsistence strategies varied in different parts of the region and across time, which means that we must have some means of distinguishing local groups as well as a reliable regional chronology. The latter problem has already been addressed. The former requires identification of local differences in the artifact inventories, architectural forms, and settlement/mobility strategies. With these data, questions relating to ethnic differences, the concurrent presence of agricultural and hunter-gatherer populations, and (with comparative data from other regions) the relative influence from adjacent culture areas can also be addressed. The same data can also be used to provisionally address the question of population identity, although analysis of a large burial population would be needed for any definitive answer to this problem. Finally, a detailed reconstruction of paleoenvironmental conditions in the region would be needed to assess the possible influence of environmental factors on the observed cultural changes. The basic information needed to address these questions therefore consists largely of chronological, subsistence, settlement, and environmental data.

Protohistoric

The date range for the Protohistoric period is defined somewhat arbitrarily. The beginning date is tentatively set at AD 1450, about the time that agriculture was apparently abandoned in southeastern New Mexico and the Plains Nomad adaptation emerged. An end date of AD 1600 was stipulated in the BLM task order for this project, which coincides with the beginning of the Spanish Colonial period in New Mexico. Euro-American settlement in the region dates from the late nineteenth century, however, and the Spanish records contain only scant references to Native American groups in southeastern New Mexico. An end date of AD 1750 or even AD 1850 may therefore be more appropriate.

Dating events within this period will be a major challenge. Given the nature of the occupations, it is doubtful that dendrochronological or archaeomagnetic dates can be obtained, and the span of the period scarcely exceeds the 95% confidence intervals for routine radiocarbon and thermoluminescence dates. Any chronology developed for the period is therefore likely to depend heavily on probabilistic interpretation of absolute dates and on cross-dating of Pueblo ceramics and Euro-American artifacts when present. On the other hand, the resolution of radiocarbon and TL dates is adequate for dating sites to the Protohistoric period, which is sufficient for investigations preliminary investigations of settlement-subsistence strategies.

A more fundamental issue is the development of criteria to identify Protohistoric sites, particularly during survey. Tipi rings are one obvious feature associated with Protohistoric occupations in southeastern New Mexico, but a wider range of diagnostic artifacts and features needs to be found to identify a wider range of site types. Research by Carmichael and Unsinn (2000) identifying four-pile (cruciform) fire-cracked rock features as probable Mescalero agave pits is an example of the kind of research that is needed. In addition, several protohistoric complexes have been defined in adjacent areas of the Texas Panhandle, the Trans-Pecos and Central Texas regions, and the southern Rio Grande Valley that may be applicable to southeastern New Mexico. Comparison of these complexes with assemblages from southeastern New Mexico might provide an additional set of Protohistoric diagnostics.

In the northern Llano Estacado, the Tierra Blanca Complex (Boyd 2001; Habicht-Mauche 1992; Hughes 1989) assemblages include small triangular notched (Washita, Harrell) and unnotched projectile points (Fresno), distinctive "snub-nosed" end-scapers, beveled knives, and a variety of side-scrapers, and drills. Small quantities of ceramics are also present, including thin, dark sherds of a locally made utility ware, and Rio Grande glazeware, most of which is Glaze C and D. Based on the ceramics and a few radiocarbon dates, the Tierra Blanca complex is tentatively dated between about AD 1450 and 1650 (Habicht-Mauche 1992:251–252). Two kinds of sites have been documented – large villages marked mainly by the stone foundations of jacal structures, and small hunting camps. The complex seems to represent "a semisedentary and semi-nomadic, bison-hunting and possible corn-growing people who were much involved in trade with the Anasazi pueblos . . ." (Hughes 1989:35).

The Garza Complex (Baugh 1986; Boyd 2000; Habicht-Mauche 1992; Hughes 1989; Johnson et al. 1977) appears to be centered in the lower Texas Panhandle along the tributaries and main branches of the upper Brazos River. The lithic assemblages include small triangular notched (Washita, Harrell, Garza, Lott) and unnotched projectile points (Fresno), "snub-nosed" end-scapers, and bifacial knives. The small ceramics assemblages consist of locally made, Southwestern-style utility ware, and relatively high percentages of Rio Grande glazeware, most of which is Glaze E and F. The ceramics and available radicarbon dates suggest a date range of roughly AD 1550–1700 for the complex, although a few sites have yielded earlier glazewares and sherds of Chupadero Black-on-white and Jornada Brown (Habicht-Mauche 1992:253; Hughes 1989:36), which may indicate both an earlier beginning date for the Garza phase and interaction with groups in southeastern New Mexico. Other tool forms include mano and metate fragments, bone awls and fleshing tools. Habicht-Mauche (1992:253) also indicates that a bison scapula hoe and bison tibia digging stick were apparently recovered from the Montgomery site but never reported. Most of the known Garza sites appear to be temporary camps, but the Bridwell Site includes the remains of a man-made circular enbankment 46–50 m in diameter, which may have surrounded a base camp or village (Habicht-Mauche 1992:254; Hughes 1989:36). The settlement-subsistence system of the Garza Complex may therefore be similar to that described for the Tierra Blanca phase.

The Toyah Complex or Toyah Phase (Johnson 1994; Prewitt 1981, 1985; Ricklis 1992) is widespread in north-central, central, and southern Texas, and may extend into northeastern Chihuahua (Mallouf 1999). The phase is dated between AD 1300 and 1700 in central Texas (Prewitt 1981:84). Although there is a progression of radiocarbon dates from north to south (Prewitt 1985:225–228), Toyah materials appear rather abruptly throughout its range (Ricklis 1992:262–263), and typically represent a sharp break in the local cultural sequences. This evidence suggests that the complex represents a migration of Plains hunters following the southward expanding bison herds, or alternatively, the rapid adoption by local groups of a specialized bison-hunting technology (Ricklis 1992:263). The distinctive Toyah assemblage includes Perdiz and Cliffton arrowpoints, thin bifacial knives that are often alternately beveled, an abundance of unifacial end-scrapers, flake drills or performators, a blade-core lithic technology, grinding stones, bone awls, various bison bone tools, and bone-tempered ceramics.

Seymour (2002, 2004) has recently defined two protohistoric complexes based largely on excavations at the Cerro Rojo Site in the Hueco Mountains. The Cerro Rojo Site is a basecamp with 275 features, mostly structures, that are spread over the tops, slopes, and saddles of a series of ridges. It appears to have been occupied primarily during the 18th century, although the initial Protohistoric occupation may date as early as AD 1400–1500. Seymour (2004) argues that differences in the artifact assemblages indicate that the site was occupied by both Apache and Manso groups. Four types of structures were distinguished at the site in addition to rockshelters: slab-ring huts formed of stacked cobbles and boulders, rock-ringed huts formed by one or more courses of cobbles and boulders, tipi rings of widely spaced rock, and structural clearings. All four structure types are associated with the Cerro Rojo (Apache) Complex, and rockshelters were occupied occasionally. Only rock-ringed huts and rockshelters are associated with the Canutillo (Manso) occupation. Ceramics at the site are plain brownwares and include Valle Bajo (Mission) Brownware, and four previously undescribed Protohistoric varieties. Much of this material is assumed to have been attained through trading and/or raiding.

The two complexes are distinguished primarily on the basis of their lithic assemblages. The Cerro Rojo assemblage consists largely of expedient shaped tools crudely shaped by percussion, but with finely retouched edges. Tools include end- and side-scrapers, drills, distinctive forms of perforators, agave knives, well-made bifacial knives, and well-made Washita and Harrell projectile points. The Canutillo lithic assemblage includes finely retouched, broad-based perforators; large, well-flaked triangular and lanceolate biface knives; snub-nosed end-scrapers; core and debitage indicative of core-blade and bipolar reduction; and varieties of triangular, basal-notched or basal indented projectile points (Soto, Chihuahua, and Bliss).

The culture history questions for this period derive as much from the work of ethnohistorians as from archaeological research.

- ***Can Protohistoric groups in the region be distinguished based on differences in artifacts, features, and site layout?***
- ***Are there differences in the settlement and subsistence strategies of those groups? Can those groups be tied to late prehistoric populations in the region?***
- ***Can they be tied to the historic groups mention in the Spanish records – Jumanos, Querechos, and Teyas?***
- ***When did Apachean groups arrive in southeastern New Mexico?***
- ***To what extent did Protohistoric groups in southeastern New Mexico participate in the Plains-Pueblo exchange network?***
- ***What impact did the introduction of the horse have on regional settlement-subsistence strategies?***
- ***How did Apache settlement-subsistence strategies change as a result of conflict with the Comanches?***

As for any temporal period, archaeological groups are initially distinguished based on differences in artifact assemblages, architectural forms, or settlement layout. The settlement/subsistence strategies of those groups are then investigated, in part to provide further evidence to determine whether the tentatively identified groups are in fact distinctive. A logical starting point for this research would be to determine if the protohistoric sites in southeastern New Mexico have affinities with one or more of the complexes already defined in adjacent areas. If the Protohistoric groups are linked to the prehistoric populations in the region, then it should be possible to demonstrate continuous occupation of the area and continuity in some aspects of material culture should be demonstrated. An occupational hiatus and marked change in material culture, on the other hand, is generally interpreted as evidence for population replacement.

As already noted, Jelinek (1967:156–159) sees a sharp increase in the use of bison during the Late McKenzie phase and a corresponding reduction in the evidence for agriculture. He speculates that prehistoric farmers in the Middle Pecos valley focused increasingly on bison hunting as the bison herds expanded in the Southern Plains and, between about AD 1250–1350, he argues that they abandoned their old sedentary lifeway to become nomadic hunters (Jelinek 1967:162–164). Evidence from the Henderson Site (Rocek and Speth 1986; Speth 2004) generally supports this hypothesis, but indicates that the transition may not have been as drastic as Jelinek infers.

Henderson is an E-shaped pueblo with 100–130 rooms built around two plazas, located near the mouth of the Rio Hondo. It was first occupied in AD 1250–1270 and was largely abandoned sometime in the early 1300s, although an ephemeral terminal occupation or re-occupation of the site is dated to about AD 1400. Although initially interpreted as a typical Lincoln phase site, subsistence remains from the site are more characteristic of a Plains Village pattern. Specifically, the evidence indicates that maize and bison were subsistence staples, which were supplemented by the seasonal procurement of a variety of wild plant resources, large and small game, fish, and freshwater mollusks. The bison bone at Henderson are largely of moderate to high utility, suggesting that bison were procured at some distance from the site and only selected portions of the carcass were transported back to the village. The predominance of male bison in the assemblage further suggests that most of the hunting was done in the spring and that the bison herds moved beyond the effective range of hunters during the fall and winter months. Based on this evidence and the seasonality of other major faunal resources, Speth (2004:421–422) contends that most of the able-bodied adults left the village after the agricultural crops were harvested, and spent most of the fall and winter pursuing bison and other resources in areas some distance from the settlement.

Comparison of the bison assemblage from Henderson with those from contemporary pueblos indicates that, after AD 1300, the residents at Henderson were increasingly involved in the exchange of dried bison meat with the Lincoln phase villages at higher elevations and perhaps with pueblos in the Gran Quivira area. An increasing emphasis on bison hunting to meet the demand for bison products would have aggravated the existing scheduling conflict between agricultural activities and bison hunting. Under those conditions, Speth (2004:426) speculates that the inhabitants of Henderson may have taken the short step from a semi-sedentary, farming-hunting economy to a semi-nomadic or fully nomadic lifeway focused on bison hunting and exchange. If Speth is correct, and if a semi-sedentary farming-hunting adaptation was generally characteristic of late Ceramic period groups in southeastern New Mexico, then evidence for cultural continuity with Protohistoric period groups is most likely to be found in the hunting tool kits of both groups. Similarities in structures and site layout may also be apparent between protohistoric sites and the fall-winter camps of late Ceramic period groups.

Efforts to tie archaeologically-defined protohistoric groups to the groups identified in the early Spanish records rely primarily on three lines of evidence: 1) that an archaeological complex dates to the appropriate time period; 2) that is in the same location as the historically described group; and 3) that the settlement and subsistence practices inferred from the archaeological materials match those of the historically described group. The difficulty is that the problems generally associated with defining archaeological groups are compounded by the limitations of the historical data. There are relatively few references to Native American groups in southeastern New Mexico in the Spanish records, and those references provide incomplete and conflicting data.

Two Southern Plains groups, the Querechos and the Teyas, are described in the chronicles of the Coronado expedition in 1541 (Hammond and Rey 1940). Both groups are described as semi-nomadic bison hunters who lived in tipis and used dogs for transport. The Teyas were said to be painted or tattooed, while the Querechos were not. The chronicles also indicate that the two groups were enemies. Although there is some disagreement over Coronado's route, the probable homeland of the Querechos was in the northern Texas Panhandle, in an area extending "from the Canadian River Breaks on the north through the upper drainages of the Red River to the southeast" (Habicht-Mauche 1992:249). The Teya *rancherias* were first encountered after about five days of travel to the south or southeast, suggesting that their homeland was probably located among the canyons of the upper Brazos drainage east of present-day Lubbock. Based on this evidence, Habicht-Mauche (1992) equates the Tierra Blanca complex with the Querechos; and the Garza complex, with the Teyas. She further argues that the Querechos were almost certainly Plains Apaches, while the Teyas were most likely Caddoan speakers.

The name "Jumano" appears in the Spanish records in reference to several Native American groups that tattooed or painted their bodies (Scholes and Mera 1940). The two references of relevance to southeastern New Mexico are to the Jumanos pueblos – Las Humanas (Gran Quivira), Tabira (Pueblo Blanco), and Genobey (Pueblo Pardo) – and to the "true Jumanos," a group of semi-nomadic bison hunters living in small rancherias along the Pecos River at the eastern edge of the buffalo plains (Kelley 1986; Kenmotsu 2001; Vivian 1979). The Jumanos pueblos are so-called because at least some segment of the population had painted nose stripes and because the Jumanos often visited the pueblos to trade (Kenmotsu 2001:25-26). The true Jumanos themselves were a distinct nation originally residing in west-central Texas between the Pecos and Conchos rivers on the margins of the Llano Estacado and Rolling Plains. They traveled widely and were closely associated with the Jumanos pueblos but in conflict with the Apaches. Based on their location and lifeway, Kenmotsu (2001:35–37) argues that the Jumanos are visible in the archaeological record as a regional variant of the Toyah Complex.

These hypothesized linkages between archaeological complexes and early historical groups require additional testing but, if they are correct, then at least three distinct groups of Plains bison hunters appear to have ranged into southeastern New Mexico during the protohistoric period. Although the major settlements of these groups may have been outside the region, seasonal camps and procurement sites should be present. Archaeological research in southeastern New Mexico therefore has the potential to contribute valuable information concerning at least a portion of the settlement-subsistence strategy, including exchange relations with the Pueblos.

The task of relating the protohistoric groups to modern linguistic groups has occupied ethnohistorians and linguists for more than a century, and no consensus has yet emerged. Archaeological research can contribute to this work, but our approach is subject to the inherent limitation that there is no necessary relationship between material culture and biological or linguistic groups. More importantly, the combined effects of European conquest, disease, and the rapid cultural change precipitated by such innovations as firearms and horses resulted in a near total disruption of native populations in the Southwest and Southern Plains. While some adjusted and survived, others were wiped out or assimilated. Although there might be some slender threads of material culture continuity in the resulting morass, they will be, at best, difficult to trace. A more productive approach that plays to the strengths of the discipline is to formulate and test hypotheses of group identity using archaeological data, and to investigate how those groups were impacted by the events of the protohistoric period and how they responded to them (Boyd 2001:15–17).

SUBSISTENCE STRATEGIES

The overall objectives of research under this problem domain are to understand the strategies used by aboriginal groups to meet their annual and long-term nutritional needs, and to examine how and why those strategies changed through time. Again, the basic questions that must be addressed for each cultural-temporal period vary depending on the level of inquiry. At the site/component level, the basic question relating to subsistence is:

- ***what plant and animal food resources were collected, processed, and/or consumed by the site's inhabitants?***

As that information is accumulated for sites in different areas, the subsistence patterns characteristic of each can be identified. At this area/generalization level, the questions are:

- ***what seasonal variation was there in the procurement of food resources?***
- ***what were the subsistence resource staples?***
- ***what areas were the foci of subsistence activities?***

At the regional/interpretive level, information from the lower level investigations can be combined to reconstruct the subsistence strategies employed during different time periods, and changes in those strategies through time can be examined. At this level, the basic questions are:

- ***what was the relative contribution of hunting, gathering, and cultivation?***
- ***what strategies were used to buffer against periods of low resource availability?***
- ***how were scheduling conflicts handled?***
- ***were there differences in the subsistence strategies employed by contemporary groups?***
- ***how did subsistence strategies change in response to changes in resource availability induced by environmental change and demographic pressure?***
- ***how did subsistence strategies change with the introduction of various technological innovations – cultigens, ceramics, the bow-and-arrow, horses, firearms?***

Direct evidence of subsistence resources is provided by faunal remains, macrobotanical materials, plant microfossils (i.e., pollen and phytoliths), and food residues, and indirect evidence of subsistence activities is provided by the kinds of artifacts and features found at the sites. Organic preservation is often poor at open sites, however, and the inferences based on artifacts and features are rarely specific to a particular food resource. A two-pronged approach using modeling to supplement the excavation data is therefore advocated. The modeling is viewed as an iterative process involving pattern recognition studies using existing data, the development of preliminary models, data collection to test the implications of those models, refinement of the preliminary models and/or formulation of new models, another round of data collection to test the implications of those models, and so on. Repeated testing and refinement of the models formalizes the process of integrating new and existing data and of reassessing the conclusions reached on the basis of those data. It also establishes benchmarks for tracking progress toward addressing the research problems.

The models most commonly developed for cultural resource management applications examine the associations between site locations and environmental parameters (Kohler 1988). These models are typically directed toward predicting site locations; that is, to defining areas with higher and lower probabilities of containing sites. However, the same pattern-recognition processes can be used to identify correlations between site locations and environmental variables reflecting the distribution of potential food resources (e.g., vegetation and wildlife habitat for wild plant and animal resources, and soils and moisture/temperature conditions for cultivated crops). The primary advantage of this approach is that it makes maximum use of sites with limited data potential. The most useful information will be obtained from sites that can be classified into temporal periods and morpho-functional categories, but even if all we know about the site is its location, it can still contribute to the overall pattern recognition study.

More advanced models utilize optimal foraging theory to predict the food resources most likely to be exploited (Bettinger 1991:83–111; Kelly 1995:73–108; Winterhalder and Smith 1981). Diet breadth models may be particularly useful in reconstructing subsistence strategies in New Mexico. In general terms, diet breadth models are based on a ranking of potential food resources in terms of net return rates for the energy and time invested. Return rates are calculated using three factors: 1) the energy (calories) per unit obtainable from the resource; 2) search time – the energy and time expended in locating the resource, which is largely a function of its abundance in the foraging area; and 3) handling time – the energy and time expended in procuring and/or processing the resource. In formulating the models, it is assumed that a forager is moving randomly through a resource patch, and that he or she will select the combination of resources that maximizes the net energy intake per unit of foraging time. Given these assumptions, the general model predicts the optimal mix of resources that will be exploited by the forager and, equally important, which resources will not be exploited.

The use of such models has three advantages. First, the development of diet breadth models does not require extensive archaeological data, yet the implications of the model can be tested using archaeological data. Thus the models are particularly useful in contexts like southeastern New Mexico where a relatively small number of sites have been excavated and where many sites are likely to yield only limited direct evidence of subsistence practices. Second, because search time and handling time are calculated separately, the models can be used to examine the circumstances in which use of a particular resource will be intensified, or in which food resources will be added or subtracted from the diet in response to changes in resource abundance and/or changes in subsistence technology. The underlying assumptions of the models can also be changed to more realistically mirror the apparent objectives of the prehistoric populations. Third, optimal foraging theory provides a battery of explanatory concepts derived from ecology that can be used to explain observed adaptive responses over time, as well as to identify cultural changes for which ecological explanations are inadequate.

Paleoindian

For the Paleoindian period, the primary subsistence issue raised by Sebastian and Larralde (1989) is whether Paleoindian groups were specialized big-game hunters or generalized hunter-gatherers.

The presumption that Paleoindians were specialized big-game hunters is based largely on three lines of evidence: 1) the consistent occurrence of Paleoindian artifacts with the remains of large game animals, particularly bison; 2) the predominance of projectile points and butchering and hide-processing tools in the lithic assemblages; and 3) the predominance of small sites with lithic raw materials from distant sources, which suggests high mobility over long distances, a pattern consistent with hunters following migrating herds. Sebastian and Larralde (1989:33–35) question this interpretation, arguing that Paleoindian groups may have been more generalized hunter-gatherers.

Their argument, following Cordell (1979) and Tainter and Gillio (1980), is based largely on general ethnographic analogy. Specifically, ethnographic studies of hunting and gathering groups worldwide indicate that few groups outside of the Arctic and Subarctic are primarily (>50%) dependent on hunting, and that groups in temperate climates tend to be primarily dependent on gathered plant resources. Given these general patterns, Sebastian and Larralde suggest that our perceptions of Paleoindian subsistence may be biased because the cultural-temporal diagnostics used to identify Paleoindian occupations are all tools associated with the procurement and processing of large game animals. In the absence of those diagnostics, they suggest that archaeologists may have failed to recognize sites related to plant gathering or the small-game procurement components of the Paleoindian subsistence system. Their argument therefore implies three specific questions, two relating directly to subsistence strategies and a third, more general question relevant to both the subsistence and settlement problem domains:

- **to what extent were Paleoindian subsistence strategies focused on hunting large game animals?**
- **what was the relative importance of small game and wild plant resources in the Paleoindian diet?**
- **how can Paleoindian sites lacking conventional diagnostic artifacts be identified?**

Sebastian and Larralde (1989) contend that Clovis, in particular, was probably a broadly-based hunter-gatherer adaptation, a view supported by recent evidence from the Gault Site in central Texas (Collins 2002). Although no plant remains are preserved, the Clovis faunal assemblage at Gault includes the burned bones of turtles, frogs, birds, and small mammals as well as those of mammoth, horse, and bison. The thickness and extent of the Clovis deposits also suggest repeated occupations of some duration, which Collins interprets as evidence of limited mobility within a relatively restricted range.

Judge (nd:61) notes that the mean number of bison at kill sites increases sharply between the Folsom and Late Paleoindian periods, which suggests and increasing specialization in bison hunting. He further speculates that the relatively small numbers of bison at Folsom kill sites evidence the exploitation of small, dispersed bison herds, whereas the much larger numbers of bison at Late Paleoindian kill sites indicate a hunting strategy adapted to large aggregated bison herds. Sebastian and Larralde (1989:38) extend this argument, suggesting that the Folsom hunting was based on a generalized encounter strategy involving high residential mobility, whereas the mass kills of the Late Paleoindian period must have involved considerable pre-planning and coordination. If the mass kills provided a storable resource critical for winter survival, as Greiser (1985) contends, then the Late Paleoindian adaptation may have been characterized by a collector strategy emphasizing logistical mobility and a reliance on stored food resources.

The available data from Folsom sites in the Southwest and Southern Plains appear consistent with this interpretation. Most kill sites are small reflecting the efforts of small groups or individual hunters (Amick 1994; Bamforth 1985) and, although bison are always present, there is usually some diversity of game (Bonnichsen et al. 1987). Todd (1991) also notes that bison kill sites in the Southern Plains exhibit a broader seasonality that of kill sites in the Northern Plains, which suggests year-round hunting.

The data are less clear for the late Paleoindian period, but taphonomic studies at large kill sites indicate that the bone beds contain only partially butchered carcass remnants, suggesting a gourmet selection of cuts and the use of only a small proportion of the potential meat products (Frison 1992; Frison and Todd 1987). Although some meat surpluses were stored as impromptu frozen caches, there is no evidence that the mass kills were intended to provide stored food reserves. This short-term strategy contrasts with the later Archaic communal kills where the meat surpluses were dried for storage (Frison 1992), but it is consistent with the "high-technology forager" model developed by Kelly and Todd (1988).

Kelly and Todd (1988:233–234) contend that Paleoindian groups were primarily dependent on terrestrial game animals, not only because hunting large game is more energy efficient than plant gathering, but because a general knowledge of prey behavior could be applied in an unknown territory whereas gathering would require detailed knowledge of the spatial and temporal distribution of plant resources. In an environment characterized by a regionally abundant but locally unpredictable distribution of game animals, this adaptation would require an emphasis on search-and-encounter hunting tactics; high residential mobility and logistical mobility over large territories; and a reliable, highly curated lithic technology (Kelly and Todd 1988:239). One implication of this model is that a reliance on stored food reserves would have been a high-risk strategy if the future availability of game could not be predicted. Rather than putting up long-terms stores after a kill, a more secure strategy in these circumstances would be to renew the search for additional food resources almost immediately. The residential group would remain in the area as long as game was encountered within a reasonable foraging distance of the camp, subsisting on the original kill and any additional kills made in the area. As logistical trips became longer, however, the low-risk option would be to relocate the residential camp to a distant kill, abandoning any unused food that could not be readily transported to the new location (Kelly and Todd 1988:238–239).

Although the apparent emphasis on bison procurement during the Folsom and Late Paleoindian periods does not preclude the possibility that plant resources and smaller game were important components of the Paleoindian diet, it does seem inconsistent with the general ethnographic model summarized by Sebastian and Larralde. Modern ethnographic data may not be directly applicable to conditions during the Paleoindian period, however. Binford (2001:190) found that his Terrestrial Model (which is based on associations between environmental variables and hunter-gatherer adaptive strategies worldwide) predicts a greater dependence on hunting, particularly in temperate environments, than was actually documented for the ethnographic groups in those areas. He argues that the greater than expected dependence on gathering documented for the ethnographic groups reflects a long-term trend of intensification of food production in response to increasing populations pressure during the Holocene, whereas the Terrestrial Model is behaviorally more germane to periods such as the end of the Pleistocene when population densities were lower (Binford 2001:191). For plains-savannah regions, the Terrestrial Model predicts a primary dependence on hunting largely because most of the primary production in such environments is tied up in secondary biomass, which is inedible for humans but can support large herbivore populations that can be preyed upon by human groups. Optimal foraging theory further suggests that larger body-size herbivores would be the favored prey.

For Sebastian and Larralde, the question of how to identify Paleoindian sites lacking conventional diagnostic artifacts was a critical operational issue because those sites were expected to provide the evidence for gathering that general ethnographic analogy predicted as the dominant component of Paleoindian subsistence system. Radiocarbon dates or a clear association with late Pleistocene-early Holocene deposits would provide direct evidence that such sites are of Paleoindian age, but there are also several lines of indirect evidence that can be used to identify potential Paleoindian sites. First, the lithic reduction strategy may be distinctive as Paleoindian lithic technology incorporates intensive reduction of large biface blanks and the production of blades from prepared cores. Second, expedient tools at known Paleoinidan sites tend to exhibit more extensive retouch and shaping than comparable tools from Archaic and Ceramic period sites. Third, a relatively high proportion of high-quality, non-local lithic raw materials may be indicative of a Paleoindian occupation.

It is also possible that the assumption that such sites will lack diagnostic projectile points is erroneous. Among modern hunter-gatherers, gathering typically occurs within the foraging radius of residential camps (Kelly 1995:111-141), and plant resources are generally brought back to the camp for processing. Consequently, if the Paleoindians were primarily dependent on gathering, then the evidence for plant resources is more likely to be found at residential camps than at specialized plant processing localities. As maintenance and refurbishment of the curated hunting tool kit also tends to occur at residential camps, projectile points and other diagnostics may be present. When combined with indications that a Paleoindian subsistence strategy based primarily on hunting is not at odds with the ethnographic data, there seems reason to doubt that there is a class of Paleoindian sites that remains unrecognized. This argument does not diminish the importance of developing additional criteria to identify Paleoindian sites, but it does suggest that any evidence for the use of plant resources and small game by Paleoindian groups will probably be found at the residential camps.

That little such evidence has so far emerged from excavations of Paleoindian camps can be attributed to two factors. First, organic preservation at sites of this age tends to be poor, and the remains of plant and small game animals are much less likely to be preserved than the bones of large mammals. Second, and this is the key point of the arguments made by Sebastian and Larralde, intensive efforts to recover such evidence are rare because archaeologists have focused their investigations primarily on kill sites and the big-game hunting component of the subsistence system.

Poor organic preservation poses a severe limitation on research, and a full understanding of the Paleoindian subsistence strategy may not be achievable barring the discovery of unusually well-preserved sites. Nevertheless, progress can be made toward that objective by giving a higher priority to the search for evidence of the use of plants and small game. More emphasis should be given to the investigation of residential camps and to Paleoindian components in upland settings and other locations outside of the plains-savannah habitat. The methods commonly used to recover small plant and animal remains from Archaic and later sites such as flotation should be routinely employed during these investigations, and other methods for recovering more resistant plant remains such as phytoliths should be explored. Analysis of the lithic assemblages should also give greater emphasis to wear pattern and residue analyses of the expedient tools to identify implements that were not part of the hunting tool kit. Finally, analyses of Paleoindian faunal assemblages should give more consideration to assemblage diversity and the relative importance of any minor elements in the overall subsistence system.

None of these research tactics are likely to yield positive results quickly, nor given the previous discussion, do I expect them to provide evidence that the Paleoindians were not primarily dependent on hunting large game. They do represent an attempt to test that hypothesis, however, and they could give us a more complete understanding of Paleoindian diet and of the backup strategies employed by Paleoindian groups.

Archaic

In contrast to the Paleoindian period, there is a presumption that hunter-gatherers during the Archaic period employed a broad-spectrum adaptation utilizing a variety of resources but focused primarily on wild plants and small game. Although this adaptation is assumed to apply to all Southwestern Archaic traditions, Sebastian and Larralde (1989:5256) identify four attributes that seem to be characteristic of Archaic subsistence strategies in southeastern New Mexico: a minimal reliance on storage; lack of evidence for the early use of cultigens; consistent evidence for the exploitation of riverine resources or at least freshwater mussels; and near absence of evidence for bison hunting. In discussing Ceramic period subsistence patterns, they also raise the issue of intensified resource exploitation in response to increasing population density (Sebastian and Larralde 1989:86), a concept that may be equally useful in explaining subsistence strategies during the Late Archaic period.

Speculation about Archaic subsistence strategies in southeastern New Mexico has been based largely on analogy with the Mescalero Apache, most explicitly in the work of Gallagher and Bearden (1980). There are at least two reasons for doubting the appropriateness of that analogy for reconstructing prehistoric subsistence strategies (Sebastian and Larralde 1989:53). The first is the use of horses by the Mescalero. Basehart's informants indicated that the average Mescalero family had two to four horses but emphasized that many families owned no horses at all (1974:95). In reviewing other evidence, however, Basehart (1974:96) concludes that ". . . the minimum number of horses per household would range from four to six. This estimate, while somewhat higher than those preferred by informants, appears reasonable. . ." Even admitting the likelihood that the number of horses in a particular group was subject to considerable fluctuation, these figures suggest that Mescalero bands had transport capabilities well beyond those groups limited to foot travel.

Bohrer's (1981) analysis of the plant remains from Fresnal Shelter provides a second reason for doubting the appropriateness of the Mescalero analogy. Fresnal Shelter is located in the pinyon-juniper transition zone on the western flanks of the Sacramento Mountains, just outside of the western boundary defined here for southeastern New Mexico. The major occupation is dated from about 2100–925 BC (Carmichael 1982). Based on ubiquity, Bohrer (1981:45) identifies 11 subsistence items regularly utilized at Fresnal Shelter. Five have long periods of availability once mature – the fruiting bracts of four-wing saltbush, seeds of buffalo gourd, stems of turk’s head cactus, juniper berries, and roots of four o’clock. Three others mature seasonally but reliably – prickly pear fruits, feathergrass seeds, and mesquite pods. Only three – amaranth seeds, dropseed grass seeds, and panic grass seeds – mature at different times depending on the weather. Among the less common plant resources recovered from Fresnal are chenopod seeds, pinyon nuts, yucca fruits, acorns, squawbush fruits and, after about 1500 BC, chapalote maize. The low ranking for acorns is attributed to its absence in the immediate vicinity of the shelter. Pinyon and yucca are common in the area surrounding the site, however, and Bohrer suggests that their low ranking may indicate that appropriate storage technologies had not been developed for those resources. In addition, the availability of pinyon nuts tends to be variable and relatively unpredictable. The low ranking for maize is not explained, but it clearly appears to have been only a minor dietary component

Bohrer sees the common dietary items at Fresnal Shelter as indicative of a risk-minimization strategy emphasizing food resources that are predictable in terms of their location and availability. While some seed resources may have been valued for their storage properties, she contends that "in the eyes of the occupants of Fresnal Shelter, allowing food to remain stored on the living plant (fleshy roots, stems, berries) may create as reliable a food supply as aggregating harvests of these or certain other plant products in caches" (1981:46). In contrast, the staple resources of the Mescalero Apache indicate that cached plant products were valued above all others, and that roots or long-lingering fruits had no place in their list of staples. For that reason, Bohrer suggests that the Southern Paiute (Kelly 1964) may provide a more appropriate analogy of the Archaic subsistence strategy in southeastern New Mexico.

Bohrer's interpretation of the Fresnal Shelter data is cited by Sebastian and Larralde as one reason for doubting that storage played a major role in the subsistence strategies employed by Archaic groups in southeastern New Mexico. The other reason is Binford's (1980) observations that among ethnographically documented hunter-gatherers in temperate environments, storage is practiced only by groups living in areas where the effective temperature 15° C or below. As southeastern New Mexico has an effective temperature of 14°-15° C, the climate is mild enough that hunter-gatherers could get through the winter with only a minimal reliance on stored food reserves (Sebastian and Larralde 1989:55).

The correlation of effective temperature with dependence on stored food reserves suggests that the use of storage by hunter-gatherers is primarily a tactic for dealing with temporal variations in resource availability. It is most commonly applied as a solution to the "overwintering problem." That is, food reserves are accumulated during the warmer part of the year to sustain the group during the colder months when few resources are available in the environment. Given this perspective, the argument made by Sebastian and Larralde can be reworded as a hypothesis that sufficient food reserves were available to allow Archaic hunter-gatherers in southeastern New Mexico to continue foraging through the winter months, which precluded any significant reliance on storage. Storage may also be applied in response to the limited seasonal availability of abundant resources, however, or to the spatial distribution of patches of concentrated resources (Binford 2001:256). If a particular food resource is periodically available in greater abundance than can be immediately consumed, then a group might invest a short-term labor effort in processing and storage to artificially extend the availability of that resource. This situation may apply to predictable resources, such as the seasonal presence of migrating bison herds, but it is more typical of unpredictable resources such as pinyon nuts and annuals whose availability vary with the weather conditions, and which Bohrer argues were only minor dietary components for the inhabitants of Fresnal Shelter precisely because of their unpredictability.

Bohrer's arguments introduce two additional factors into the diet breadth model discussed earlier. The first is temporal variability in resource abundance, which is the major determinant of search time. That variability occurs on at least three time scales: seasonal variation over an annual cycle; annual variation due to fluctuating weather conditions, which is probably perceived by hunter-gatherers at a time-scale of something like two-to-three human generations; and long-term variability in response to changing climatic conditions. Variability at the first two time scales will directly affect human foraging decisions, while long-term variability may be a factor in culture change. At any of these scales, resources vary along several dimensions – *intensity* or *amplitude*, how much a resource's abundance fluctuates over time; *frequency*, how often a resource's abundance fluctuates above or below a given level; *spatial extent*, how large an area is affected by fluctuations in a resource's abundance; and *predictability*, how much can be known in advance about a resource's future abundance (Kelly 1995:101).

The second factor introduced by Bohrer is the concept of *risk*, which is the chance that unpredictable variation in some ecological or economic variable will result in food shortages. In general, hunter-gatherers respond to risky conditions by altering their diet as the range of resources and conditions change (Kelly 1995:100). Many short-term responses to perceived risk will probably not be visible in the archaeological record but I would expect the overall subsistence strategy employed by a group to accommodate the risk engendered by seasonal variations in resource abundance as well as the average variations resulting from fluctuating weather conditions within the group memory. Responses to risk at these intermediate time scales should therefore be evident in the archaeological record.

The responses to risk most commonly discussed in theories of hunting and gathering are 1) diversifying the resource base to make it more stable and reliable, 2) sharing or exchange, and 3) storage. Optimal foraging theory indicates that diet diversification occurs in response to a perceived reduction in the availability of high-ranked resources and not through a conscious decision to reduce risk. Bohrer's contention that the Archaic inhabitants of Fresnal Shelter minimized risk by focusing on predictable plant resources, most of which are low-ranked, therefore seems inconsistent with the faunal assemblage at the shelter, which indicates that deer – a high-ranked resource – was the focus of subsistence activities (Wimberley and Eidenback 1981; Witter 1972).

Winterhalder (1986) compared the cost-benefits of sharing versus diet diversification under varying environmental conditions, which also has implications for the use of storage. His analysis suggests that diet diversification can provide a small reduction in the variation of the net rate of food intake but also reduces foraging efficiency. Sharing between two foragers with the same diet breath, in contrast, can significantly reduce the variation in the pooled net rate of food intake, with no reduction in the rate of foraging efficiency. However, Winterhalder also argues that the payoff for sharing will vary with environmental factors affecting *intraforager variance* (how much variation there is in the daily return rate of a single forager) and *interforager correlation* (whether the return rates for foragers in a groups tend to be the same or different on any given day). A cross-tabulation of these two dichotomized variables produces four possible conditions. As summarized by Kelly (1995:169–171), if intraforager variance and interforager correlation are both high, then there is little point in sharing since the foragers in the group all have either a little or a lot. In this situation, short-term storage would be the most effective risk-reduction options for the individual households. If intraforager variance is high and interforager correlation is low, however, then sharing would be the best option possibly supplemented with some household storage. If the intraforager variance is low and interforager correlation high, then assuming that the population is in balance with the resource base, then there would be little need for either sharing or storage as the subsistence risk would be minimal. Finally, if intraforager variance and interforager correlation is low, then some sharing or exchange of one class of items for another might occur if members of a group or different groups specialized in the procurement of different resources.

The basic issue of whether or not Archaic hunter-gatherers in southeastern New Mexico employed storage as part of their overall subsistence strategy implies a series of empirical questions that potentially can be answered through excavation:

- ***is there evidence of food storage facilities at Archaic sites?***
- ***what food resources were being stored?***
- ***is there evidence that the reliance on food storage changed over time?***

As the preceding discussion indicates, however, explaining why food storage was or was not practiced also requires an understanding of how the abundance of subsistence resources in southeastern New Mexico varied over time.

- ***what seasonal variation is there in the abundance of potential food resources?***
- ***is there a protracted period of low resource availability?***
- ***to what extent is the abundance of potential food resources affected by annual fluctuations in precipitation and temperature?***
- ***to what extent can the future availability of a potential food resource be predicted?***

Although archaeological data can potentially tell us what resources were actually being exploited and something about gross long-term changes in the resource structure, much of the data needed to address these questions will necessarily come from studies of the modern environment and retrodictions based on those analyses.

As Sebastian and Larralde recognized, the introduction of cultigens into southeastern New Mexico is linked to the concept of intensification. As defined by Binford (2001:188), *intensification* "refers to any tactical or strategic practices that increase the production of food per unit area. Production can be increased by investing more labor in food procurement activities or by shifting exploitation to species occurring in greater concentrations in space." His description of this process is generally consistent with the diet breadth model in that the subsistence strategy progressively focuses on lower ranked resources.

> In environments in which the resource mix permits intensification, the preferred strategy of human actors experiencing subsistence stress will be increased dependence upon terrestrial plants. Human dependence upon aquatic resources occurs either as a supplement to a plant-based strategy or as the primary strategy in environments that prohibit plant-based subsistence options (Binford 2001:210, Generalization 7.05).

Although environmental change might, in some instances, precipitate the subsistence stress triggering intensification, Binford argues that it is primarily a response to population packing, which reduces the mobility options of hunter-gatherers and limits them to a smaller annual range. Specifically, his research suggests that:

> Groups that are dependent on terrestrial animal resources appear to respond to packing pressures at a population density level of 1.57 persons per 100 square kilometers. When population levels of 9.098 persons per 100 square kilometers are reached, the shift away from primary dependence upon animal resources has already occurred and dependence upon either terrestrial plants or aquatic resources has increased correspondingly (Binford 2001:443).

For Binford, the adoption of agriculture is one of the intensification options open to hunter-gatherers with access to cultigens. Consequently, as Wills has argued, "foragers adopt domesticated plants not to become farmers but to remain effective foragers" (1988:36). In addressing the issue of the adoption of agriculture, we therefore need to answer several, more specific questions:

- ***were late Archaic hunter-gatherers in southeastern New Mexico intensifying resource procurement in response to subsistence stress and, if so, when?***

- ***when did groups in southeastern New Mexico have access to cultigens and when were they actually adopted?***

- ***what other intensification options were open to hunter-gatherers in New Mexico?***

- ***what, if any, selective advantages would have favored the adoption of agriculture over those other options?***

In discussing the introduction of cultigens into the Southwest, Minnis (1985:329) suggests that cultivation provided a reliable and efficient form of insurance against the failure of one or more wild resource staples. Similarly, Wills contends that "… the adoption of domesticated plants can be explained as natural selection for strategies that reduce environmental uncertainty and thus increase population fitness" (1988:31). Given these arguments, I have suggested that the reliability and predictability of cultigens would be particularly advantageous for hunter-gatherers for whom storage was a primary over-wintering strategy (Hogan 1994). However, this argument may not be applicable to southeastern New Mexico where winters are shorter and milder, and where there are probably fewer temporal incongruities in the availability of subsistence resources. In such environments, the advantages of cultigens might be related less to risk minimization and more to their potential to increase the production of food per unit area. If so, then the selective pressures favoring the adoption of cultigens would be the same as those favoring other forms of intensification.

The list of radiocarbon dates assembled by Katz and Katz (2001) provides the most readily available data for assessing regional demographic trends. Assuming that the number of radiocarbon dates is related to population levels, the small number of early dates suggests that population density probably remained below Binford's subsistence stress threshold for hunters until 1500–1000 BC. Although the number of radiocarbon dates increases after that period, regional population density probably did not approach the stress threshold for groups primarily dependent on terrestrial plants until AD 100–500 at the earliest and possibly not until AD 500–1000. If these guesses are anywhere close to accurate, then there should be some initial evidence for intensification, primarily an increase in diet breadth, between 1500 and 1000 BC but there would appear to be little selective pressure favoring the adoption of cultigens until AD 100-500 or later.

If the preliminary dates from Fresnal Shelter are accepted (Carmichael 1982), then it appears that hunting and gathering groups in southeastern New Mexico may have had access to primitive maize and beans as early as 1500 BC. The earliest evidence of cultivation in southeastern New Mexico, however, is from the Sunset Archaic Site (LA 58971). The seven radiocarbon dates from this site suggest that it was occupied intermittently during the first five centuries AD, with the earliest occupation occurring at about AD 1–50 (Wiseman 1996:52–55). These dates appear consistent with the demographic trends suggested above and provide tentative support for the hypothesis that population packing was a critical factor in the adoption of cultigens by hunter-gatherer populations in New Mexico. If this hypothesis is correct, then the explanation for why cultigens were not adopted by late Archaic hunter-gatherers in southeastern New Mexico may be simply that the density threshold at which cultigens would provide a selective advantage was not reached until near the end of that period.

The questions remaining are what other intensification options were open to hunting and gathering groups in southeastern New Mexico, and whether agriculture would have offered any selective advantages over those options. Neither of these questions is easily addressed given the limited subsistence data currently available for the Archaic period. The archaeological evidence for intensification includes settlement data indicating reduced residential mobility and a reduction in the size of food procurement areas, more labor invested in specialized facilities for food procurement and storage, and increased exploitation of species that require extensive processing (Binford 2001:189). The available evidence for intensification in southeastern New Mexico is limited largely to the third data category.

The Archaic subsistence data now available relates almost exclusively to the late Archaic period, as defined here (4500–1500 BP). Data for the early and middle Archaic periods is reported only from Lubbock Lake, which is located on the Llano Estacado, beyond the boundaries of the study region. For the early Archaic, Johnson and Holliday (1986:20,25) report remnants of a bison kill/butchering locale in Stratum 2e containing at least three bison that were incompletely butchered with the hump muscles removed. This evidence suggests a hunting strategy similar to that postulated for the Paleoindian period. For the Middle Archaic, there are a number of campsites and kill/butchering locales from Strata 3 and 4 that are stratigraphically dated between about 6400 and 5000 BP. The faunal assemblages consist largely of bison but also include pronghorn, coyote, jackrabbit, woodrat, pocket gopher, and turtle. Assuming that all of these taxa were used for food, this evidence could indicate a broader diet breadth, but similar variability is also evident in Paleoindian faunal assemblages. The primary evidence for plant utilization is a rock-covered baking oven with an associated metate from Stratum 4B that is radicarbon dated to 4900–4700 rcy BP (Johnson and Holliday 1986:22–23, 37). Based on the evidence from Lubbock Lake and other excavated sites on the Llano Estacado, Johnson and Holliday (1986:47–48) propose that Archaic subsistence patterns were characterized by more emphasis on bison hunting during periods of increased moisture (i.e., 8500–6400 BP, 5500–5000 BP, 4500–1000 BP) and more emphasis on plant gathering during periods of drought (i.e., 6400–5400 BP and 5000–4500 BP). Their model is simplistic in relating changes in subsistence strategies solely to climatic change (Shelley 1994:380) but if they are correct, then there appears to be little evidence for intensification during the Archaic period other than an increase in diet breadth during intervals of mid-Holocene drought. The model is specific to the Llano Estacado, however, and cannot be applied generally to the other areas of southeastern New Mexico.

In the Brantley Reservoir area of the Pecos River Valley, Katz and Katz (1985:396–402) divide the Archaic occupation into three phases: Avalon, McMillan, and Brantley. The Avalon Phase (4950–2950 BP) was defined on the basis of components at five sites and is supported by nine radiocarbon dates with midranges of 4637 to 3120 rcy BP. The settlement pattern is characterized by campsites located along major water courses such as the Pecos River and Rocky Arroyo. This pattern and the freshwater mussel processing feature at BR 6 suggest that the exploitation of riverine resources was a component of the subsistence system. An upland component of the settlement system is represented by IW 42 in Rocky Arroyo. Katz and Katz (1985:398) suggest that the burned rock concentrations at this site are probably the remnants of plant processing features. They further suspect but cannot document that faunal procurement was also a component of the upland subsistence pattern.

The McMillan Phase (2950–1950 BP) is represented by four components at Brantley and is supported by nine radiocarbon dates with midranges of 3030 to 2325 rcy BP. The settlement pattern is similar to that of the Avalon Phase with camps along or a short distance back from the Pecos River. Katz and Katz interpret this evidence as indicating a continued riverine-focused subsistence strategy. Based on the presence of projectile points at upland sites, however, they also infer that the subsistence system had an upland hunting component that has no counterpart in the Avalon Phase (Katz and Katz 1985:400).

The Brantley Phase (1950–1200 BP) is represented by eight components. The 12 radiocarbon dates from six of those components have midranges of 1896 to 1362 rcy BP. The number of sites increases during this phase, possibly indicating population growth, but the proportions of riverine to upland sites remains the same. Katz and Katz (1985:401–402) interpret this evidence as indicating continuity in the subsistence system. They note, however, that burned rock rings (the earliest example of which was dated to 2599 rcy BP) are associated with seven of the eight Brantley components. Katz and Katz interpret these features as succulent processing facilities, including two components in riverine settings. As agave and sotol are upland plants, they suggests that the anomalous presence of these features may be indicative of early experimentation with a new subsistence resource (Katz and Katz 1985:402).

Katz and Katz postulate a relationship between their McMillan Phase sites and late Archaic cave sites in the Guadalupe Mountains (1985:400). Little archeobotanical material has been recovered from the latter sites, but faunal assemblages are reported from two sites. Honest Injun Cave (Applegarth 1976:49–75) is located in Chihuahuan Desert Scrub at an elevation of 1097 m. The primary occupation level in the cave is dated to 2930 rcy BP. The faunal assemblage is dominated by small rodents, lizards, and toads that may have resided in the cave or been introduced by small predators. Applegarth (1976:66) suggests that the more common taxa that may have been used by humans are cottontail, jackrabbit, cotton rat, and pocket gophers. Based on her MNI counts (Applegarth 1976:73–75) and evidence from other sites in the region, I would add woodrats, ground squirrels, and prairie dogs to the list of potential subsistence resources. Significantly, the identifiable bone includes only one large mammal, a deer. No archeobotanical remains were recovered from the site, but a few ground stone fragments were found suggesting that plant resources were also a dietary component.

Hooper Canyon Cave (Roney 1995) is located within the upper pinyon-juniper zone at an elevation of about 1940 m. Based on two radiocarbon dates from the site, Roney dates the late Archaic occupation between about 1000 and 400 BC. Flotation sample from the site were not processed, but the quantity of ground stone recovered suggests that seed plant resources were being exploited. In contrast to Honest Injun Cave, the faunal assemblage from the late Archaic stratum at Hooper Canyon Cave is dominated by large mammals (84%), primarily deer. Other large mammals, bison and elk, are represented only by tooth fragments. Rabbits, primarily cottontail, were the most common small game, and woodrats may also have been a food source (Roney 1995:36–37).

In combination, the data from Brantley Reservoir and the Guadalupe Mountains provides evidence that the diet breadth of late Archaic hunter-gatherers had broadened to include a number of small-game species by about 3000 BP. There is also indirect evidence in the form of ground stone for an increasing dependence on plant resources. Insufficient data are available to demonstrate that the increased diet breath is a response to population packing, however. The exploitation of aquatic resources might also be indicative of intensification, possibly as early as 4600 BP. However, Binford notes that aquatic resources may also be tapped as part of a stabilizing increase in diet breadth prior to population packing, particularly in setting where rivers carry water through regions with little rainfall (2001:444). The best evidence for intensification may therefore be the appearance of ring middens which, on the basis of indirect evidence are presumed to be associated with the processing of succulents. Except for one very early assay, the radiocarbon dates for ring middens in southeastern New Mexico (Condon 2002; Katz and Katz 2001:Table III-35) suggest that the exploitation of mescal and other succulents may have began as early as 3500 rcy BP, became more common after about 2500 BP, and increased sharply during the Ceramic period. At least in the southern part of the region, this intensification of wild resource procurement may have been a successful enough response to population packing to obviate the need to adopt cultigens.

Further north, where succulents are less abundant, the response may have been different. Subsistence data are available for three late Archaic components Roswell area. The Townsend Site (Akins 2003) is located in semi-desert grassland in the lower Salt Creek drainage. Evidence for a late Archaic occupation comes primarily from Area C of Townsend East and Area D of Townsend West. Two stratified cultural horizons were found in the latter area, the uppermost of which is radiocarbon dated to 320 rcy AD (Akins 2003:301). Earlier test excavations in the same area (Maxwell 1982:22) uncovered a hearth containing rounded limestone cobbles which yielded a radiocarbon date of 2320±120 rcy BP (490–250 BC). In Area C of Townsend East, Feature 39 is radiocarbon dated to 650 rcy BC (Akins 2003:301). Archaeobotanical remains associated with the Archaic occupation at Townsend are limited to charred goosefoot seeds recovered from one of the nine flotation samples and a single walnut hull (McBride and Toll 2003:292–293). Faunal remains from the site are more common but admit two opposing interpretations.

During testing, interest focused on the bison bone bed at Townsend West, which was partially exposed in a channel cut. The deposits in which the bone bed occurred had clearly been affected by fluvial action and, except for a single projectile point, no cultural materials were associated with bison bone. Nevertheless, Maxwell (1982:90–93) argued that Townsend was probably a bison kill site dating at least in part to the late Archaic period. The primary evidence cited in support of this hypothesis was that 51 small tooth enamel fragments and one long bone shaft of a very large mammal, probably bison, were found near the hearth radiocarbon dated to 2320 rcy BP. Akins, on the other hand, argues that the elements in the bison bone area represent a range of parts representing no more than one or two animals; that all of the bone is fragmentary with no evidence of burning, breaking, or processing by humans; and that the deposits in which the bone was found contained no charcoal and exhibited clear evidence that the bones had been oriented by fluvial action. She therefore concludes that there is no unambiguous evidence that the bones were deposited by humans, and that the bison represented by the assemblage may have died naturally (Akins 2003:271–272).

The non-bison faunal assemblage from Towsend West consists of 217 bone fragments recovered during the testing program (Rayl 1986) and 152 fragments recovered during the data recovery program (Akins 2003:272–275). More than a third of the assemblage (38%) are large mammals, primarily artiodactyls. Identifiable elements include both deer and pronghorn. About a quarter of the assemblage is identifiable as rabbit, with cottontails slightly outnumbering jackrabbit. Another quarter of the assemblage are rodents, most of which Akins feels are naturally occurring. The identified species include prairie dogs and pocket gophers, however, which are potential food resources. Significantly, there is no evidence for the use of freshwater mussels or other aquatic resources. Akins (2003:277) interprets this evidence as indicating that late Archaic groups made balanced use of large and small game species. The large game included deer, pronghorn and, if Maxwell's arguments are accepted, bison, while rabbits were the primary small game. Some rodents may also have been exploited for food, but they were likely a relatively minor dietary component.

The Sunset Archaic Site and Sunset Shelters (Wiseman 1996) are situated in the Rio Hondo drainage about 50 km west of Roswell. In this area, the vegetation on the north-facing slopes is desert grassland dominated by black grama, tubosa, and creosote bush, while the south-facing slopes support a Chihuahuan Desertscrub vegetation with sotol and mesquite. A riparian community is present along the river in the valley bottom. The Sunset Archaic Site is dated AD 1–425. Occupation of the shelters dates mainly to the Ceramic period, but a probable Archaic component was identified in the lowest level of Tintop (South) Cave. Macrobotanical remains from these components include a variety of weedy annuals (chenopod, purslane, tansy mustard), perennials (pinyon hulls, yucca, walnut, oak, squawberry), grasses (dropseed), and cultigens (corn and beans). Pollen from the seven large storage pits at the site also indicate the presence of corn and suggest the use of cactus (Toll 1996). The faunal assemblage from the Sunset Archaic Site consists predominantly of small mammals (89%); large mammals make up only 9% of the collection (Mick-O'Hara 1996:161). Of the 404 identifiable specimens, 79% are lagomorphs, about three-quarters of which are cottontail; 10% are artiodactyls, including both deer and pronghorn; 9% are rodents, the most common of which are prairie dogs and woodrats; and 1% are birds, turkey and scaled quail.

Although the comparisons are tenuous, it is tempting to interpret the subsistence remains from the Sunset Archaic Site as an end point of intensification during the late Archaic period. Looking first at Fresnal Shelter, which is located in a similar environmental setting but dates to the earlier part of the late Archaic period (ca. 2100–925 BC), the contrasts are striking. Whereas hunting at the Sunset Archaic Site appears to have focused on rabbits, approximately 90% of the faunal remains recovered from Fresnal are large mammals, and almost all of the identifiable bone fragments are deer (Wimberly and Eidenbach 1981). Hooper Canyon Cave, which is also in a environmental setting similar to the Sunset Archaic Site but dates slightly later than Fresnal (ca. 1000–400 BC), also has a faunal assemblage dominated by large mammal bone, predominantly deer. The apparently contemporary occupation at Honest Injun Cave, which is situated at a lower elevation, suggests a focus on small game, however. Finally, the evidence from the Townsend Site – also at a low elevation and probably dating slightly earlier than the occupation at the Sunset Archaic site – suggests a balanced emphasis on both large and small game. The problem, of course, is that a valid comparison of hunting strategies should be based on knowledge of the full seasonal round of hunter-gatherers and not single sites. Nevertheless, the trend appears to be toward an increasing emphasis on small game, which is consistent with the hypothesis that late Archaic groups were progressively intensifying resource exploitation in response to population packing.

The archeobotanical evidence is even less complete than the faunal evidence, but it is also suggestive of intensification. Most obviously, the ubiquity of corn cupules and pollen at the Sunset Archaic Site and the presence of several large storage pits suggest that maize cultivation was an important component of the subsistence system, whereas Bohrer considered maize to be a minor dietary component at Fresnal. Further, the wild plant resources utilized by the residents of the Sunset Archaic Site are in large part the same resources that Bohrer identifies as minor dietary components because their availability varied with annual weather conditions. They are also the type of plant resources that Binford identifies as most amenable to intensification. The archeobotanical evidence from the Sunset Shelter Site may therefore be indicative of an alternative intensification strategy to the processing of succulents, one that focused on a series of seasonally-abundant, storable plant resources similar to the serial foraging strategy posited for the late Archaic period in the San Juan Basin (Elyea and Hogan 1983; Hogan 1994). In the latter area, I argued that a reliance on storage as an over-wintering strategy would have favored the adoption of cultigens but, given the milder climate in southeastern New Mexico, serial foraging may have provided a viable response to population packing for a much longer period.

The last issue related to Archaic subsistence introduced by Sebastian and Larralde is the presence-absence of bison in southeastern New Mexico. The problem arises from an influential paper by Dillehay (1974) that analyzes the faunal lists from 160 archaeological and paleontological sites in the Southern Plains. Based on that analysis, he identifies successive long-terms periods of presence or absence of bison in the region: Presence Period I – 10,000 to 6000–5000 BC; Absence Period I – 6000–5000 to 2500 BC; Presence Period II – 2500 BC to AD 500; Absence Period II – AD 500 to 1200–1300; and Presence Period III – AD 1200–1300 to 1550 (Dillehay 1974:181). The presence or absence of a highly-ranked and potentially abundant prey species like bison has clear implications for reconstructing prehistoric subsistence systems but, given the limited data available to Dillehay, his periods may not be equally applicable to all parts of the Southern Plains (Lynott 1979).

For the Llano Estacado, in particular, data from Lubbock Lake indicate that at least some bison were present throughout Dillehay's Absence Period I (Johnson and Holliday 1986:47–48). They further argue that bison hunting was a relatively important component of the subsistence system between 4500 and 1000 BP, an interval spanning most of Dillehay's Absence Period II (Johnson and Holliday 1986:48). The data supporting the latter argument appears to come largely from the eastern Llano Estacado in the Texas Panhandle. For that area, Hughes suggests that during the late Archaic period

> … groups who had developed typical Archaic foraging efficiency during the Altithermal in surrounding regions less hostile than the Southern Plains grasslands began to return to the region with the onset of modern Medithermal climate and to redevelop bison-hunting skills reminiscent of their Paleoindian predecessors. Weapons, tools, faunal remains, and grinding implements indicate extensive exploitation of food resources – game animals both large and small as well as wild plants… (Hughes 1989:23).

Other than the purported association of bison bone with the late Archaic component at Townsend, there is currently little evidence that bison were exploited by Archaic hunter-gatherers in southeastern New Mexico. This could be an indication that bison were rare or absent in the Pecos River and Sacramento Sections, and that bison were present but not abundant in the Llano Estacado (a possibility suggested by the broad-spectrum subsistence strategy posited by Hughes for the late Archaic period in the eastern Llano Estacado). Under these conditions, the high transportation costs associated with bison hunting may have precluded their use by most groups residing in southeastern New Mexico. On the other hand, the little Archaic subsistence data currently available comes mostly from temporary or seasonal camps sites situated west of the Pecos River. The evidence from these sites is relevant only to a part of the annual round and does not discount the possibility that these same groups may have moved seasonally to the western Llano Estacado to hunt bison. The dilemma highlights the need to reconstruct the full annual round for Archaic groups in the region, and the importance of dating bison remains in southeastern New Mexico to assess fluctuations in their distribution and abundance during the Holocene.

Ceramic

Archaeological research in southeastern New Mexico has focused on the Ceramic period, and sufficient data have been collected to permit some generalization about subsistence patterns in the region. As summarized by Sebastian and Larralde (1989:80–83), the evidence from Lincoln phase sites in the Sierra Blanca region suggests a primary dependence on the cultivation of maize, beans, and possibly squash supplemented by the collection of wild plant resources, the most important of which appear to have been cheno-am, pinyon nuts, and acorns, although walnut and cacti are also reported. The hunting component of the subsistence system appears to have focused on small game, especially rabbits, in the immediate vicinity of the site; on deer or antelope in the general environs of the settlement; and on the procurement of bison either by hunting or through trade. The ubiquity of corn pollen at the structural sites investigated by Jelinek also suggests that Ceramic period populations in the middle Pecos valley were also at least partly dependent on agriculture after about AD 800. Following this period of intensive farming, Jelinek (1967:162) argues that there was a basic shift in the economic from sedentary farming to nomadic bison hunting between about AD 1250 and 1350.

Outside of these two areas, there is little evidence for the adoption of agriculture by Ceramic period groups in southeastern New Mexico. In the Santa Rosa area, 12 Puebloan sites have been documented along Pintada Arroyo, including one large adobe pueblo. These sites were documented during the 1930s and few other details are available, but there presence suggests that the area was occupied by agriculturalists sometime between AD 1200 and 1450 (Stuart and Gauthier 1981:305). In the Los Esteros area, however, Mobley (1979) argues that the Ceramic period occupation continued the hunting and gathering lifeway established during the Archaic period.

In the Eastern Jornada area, Leslie (1979) also contends that the Ceramic period economy was based on hunting and gathering, with a shinnery oak as the primary vegetable food and a lesser reliance on mesquite and other wild plant resources. Antelope and jackrabbit were the major meat resources, with lesser amounts of cottontail, deer, various rodents, and a small number of bison. Seasonal camps in the shinnery oak area are predominant during the early part of the period, but after about AD 1100–1150, pithouse villages are built in favorable locations suggesting a more sedentary settlement pattern. Archeobotanical data supporting this settlement-subsistence strategy are largely lacking, however, and Sebastian and Larralde (1989:82) question whether a nonagricultural sedentary adaptation was feasible in southeastern New Mexico.

Finally, no evidence of agriculture has been found in the Guadalupe Mountains. Applegarth (1976) suggests that a mobile hunting and gathering lifeway persisted during the Ceramic period, with hunting focused on small game, especially rabbits, while leafy succulents were a major plant resource. The latter hypothesis is supported by the radiocarbon dates on ring middens, which are predominantly dated between AD 500 and 1450 (Katz and Katz 2001:Table III-35).

More recent research has provided more detailed subsistence data, primarily from sites in the Rio Hondo region-Sierra Blanca region. As summarized by McBride and Toll (2003), corn has been recovered from 10 of the 11 Late Archaic and Ceramic period sites in that region for which botanical data are available. Three of those sites also yielded beans and two others squash, but only three of the sites (Beth Cave, Fox Place, and Robinson Pueblo) have yielded remains of all three cultigens comprising the triad of Southwestern agriculture. The ubiquity of maize at these sites is generally lower than at Formative sites at Chaco Canyon and in the Rio Grande valley, however. This evidence suggests that populations in the Rio Hondo-Sierra Blanca region were less dependent on agriculture than other Southwestern groups, although maize was clearly a dietary staple.

Wild plant resources exploited during the Ceramic period typically include a variety of weedy annuals – goosefoot, pigweed, purslane, sunflower, tansy mustard, globe mallow, and seepweed – and diverse perennials – pinyon, juniper, cacti, mesquite, walnut, yucca, wild grape, and oak. The exploitation of weedy annuals is widely practiced in the Southwest. These annuals are common on disturbed ground and in agricultural fields, and would have been available in the immediate vicinity of the sites. The prevalence and diversity of perennials, however, appears to be characteristic of human adaptations to the Chihuahuan Desert floristic community (McBride and Toll 2003:293).

Faunal remains from Ceramic period residential sites in the area of the Pecos and Hondo rivers are typically diverse, with a variety of rodents, birds, fish, turtles, and mussels. Akins (2002:155) argues that sedentary groups tend to hunt a variety of species in the immediate vicinity of their settlements, and that the diversity of the faunal assemblage reflects the richness of the local environment. Sedentary groups tend to be more selective when hunting at some distance from their settlements, and Akins suggests that the higher proportion of artiodactyls at Ceramic period camps like Tintop Cave and Los Molinos may reflect this tendency (2002:156).

Despite the diversity of the assemblages, hunting of a relatively few species seems to have contributed the bulk of meat to the diet. The small game species most commonly recovered from Ceramic period sites are rabbits and some of the larger rodents – prairie dogs, woodrats, and pocket gophers. The ratio of cottontail to jackrabbits varies by site, with the genera most common in the local environment being predominant. The most common large game species are deer or antelope, with the predominant genera again varying with local availability. Bison are often present but, in terms of NISP, it is only a minor component of faunal assemblages dating earlier than about AD 1300.

At the Townsend Site, changes in the artiodactyl index (ratio of artiodactyl to rabbits) suggest a sharp drop in large game hunting during the early Ceramic period and an increasing emphasis on small game, particularly rabbits. That trend is partially reversed in the late Ceramic period (i.e., after AD 1050–1100), and hunting large game again becomes a significant component of the subsistence system. The evidence from Henderson Pueblo (Speth 2004) then indicates a dramatic increase in the importance of bison hunting after about AD 1300, which is probably a response to the increased abundance of bison on the Southern Plains. However, more data are needed to determine whether these patterns hold for the entire Rio Hondo-Sierra Blanca area.

Sebastian and Larralde (1989:85–86) interpret the evidence from southeastern New Mexico as indicating that the region was occupied by both farmers and hunter-gatherers during the Ceramic period, and that these two basic adaptations reflected alternative strategies of intensification. The evidence now available indicates that this intensification process began by 3000–2500 BP and possibly earlier, at least in the Brantley Reservoir-Guadalupe Mountain area, and that maize cultivation had been adopted by some groups in the Sierra Blanca area by AD 1–200. Judging from the number of sites, population densities continued to increase during the Ceramic period, so the pressures to intensify resource procurement almost certainly continued to be a major factor conditioning human adaptations in the region. If current interpretations of the subsistence strategy in the Rio Hondo-Sierra Blanca area as a mixed horticultural/hunting and gathering economy are correct, however, then population packing in the region may never have reached the level favoring adoption of a predominantly agricultural subsistence strategy.

Assuming that cultivation was an important but not predominant component of the subsistence strategy employed by horticultural groups in southeastern New Mexico, two critical subsistence questions that remain to be addressed are:

- ***How were scheduling conflicts between agricultural tasks and wild resource procurement resolved?***
- ***Does the continued dependence on wild plant and animal resources result from limited demographic pressure to intensify resource procurement, or from some environmental factor limiting agricultural productivity?***

Scheduling conflicts affect hunter-gatherers particularly in highly seasonal environments. Among the tactics for minimizing scheduling conflicts are division of labor by gender, age and/or task group to facilitate the concurrent procurement of multiple resources, and the use of storage to prolong the availability of some resources. In many cases, though, scheduling conflicts are resolved by choosing to exploit one resource and ignore another. Optimal foraging theory suggests that such decisions will be made in favor of the subsistence resource that provides the greatest return for the effort.

The introduction of cultigens to a hunting and gathering economy could precipitate additional scheduling conflicts depending on the labor devoted to cultivation. Given the growth requirements of maize, it seems likely that cultivation would minimally require an initial labor investment during the early spring to prepare the fields, plant the crop, and protect the newly emerging seedlings from marauding animals and encroaching weeds. A second labor investment would then be needed during the late summer and early fall to protect the ripening ears and harvest the crop. Those labor requirements would inevitably conflict with the procurement of some wild resources, and resolving those conflicts would necessitate some changes in the settlement-subsistence strategy.

At the household level, one possible response is to have the younger and older members of the group in tending the crops, while the adults were engaged in hunting and gathering (Hogan 1994:173; Wills 1988:40). In general, however, the productivity of cultigens can be expected to vary in direct proportion to the labor invested in cultivation. Consequently, with continued demographic pressures toward intensification, more adults would have to be involved in cultivation. Freeing task groups for this labor would probably require organization and cooperation at the inter-household level. Even then, decisions would have to be made concerning how much labor to allocate to cultivation as opposed to wild resource procurement, and I would expect those decisions to be based on the expected return for the labor investment. Exploring this decision-making process would therefore require answers to two more specific questions, which also have implications concerning the areas of southeastern New Mexico in which cultivation would have been a viable intensification strategy:

- ***How might the distribution of soils, precipitation, surface water, and temperature have limited agricultural potential of the region under the climatic regimes that prevailed during the Ceramic period?***
- ***How do potential agricultural yields compare to the yields from hunting and gathering in terms of calories/nutrients relative to the labor effort expended?***

Current interpretations of the subsistence patterns in the Rio Hondo-Sierra Blanca area appear consistent with accommodation to an increasing labor investment in cultivation. The emphasis on the exploitation of weedy annuals may, as Toll and McBride suggest, be related to abundance of these taxa in disturbed areas and agricultural fields in the immediate vicinity of the settlement, while the most common perennials exploited are those that are either have long periods of availability or that are available during periods that do not conflict with critical periods of crop growth. The greater emphasis on small game and exploitation of riverine resources during the early Ceramic period also suggests that hunting was largely restricted to areas in close proximity to the settlements. That large game hunting becomes more important during the late Ceramic period may be an indication that inter-household cooperation had developed to the point where task groups could be more readily organized to procure more distant resources without impacting agricultural activities.

The prevailing view that southeastern New Mexico was occupied by both farmers and hunter-gatherer groups during the Ceramic period also raises issues about competition between groups employing different subsistence strategies that have yet to be explored. Bettinger and Baumhoff (1982:486) argue that because competitive situations among hunter-gatherers are, by definition characterized by high population densities [relative to resource availability], groups that are more willing or able to engage in high-cost strategies will generally displace groups less willing or less able to do so. Subsistence cost is defined in terms of the diet breadth model discussed previously. As high-ranked resources become scarce through depletion or increased number of consumers, the search time for those resources increases and it may become more profitable to broaden the diet to include lower-ranked resources that require more time to extract and process. Since resource and extraction costs increase as the diet becomes broader, those costs are a direct measure of overall dietary costs (Bettinger and Baumhoff 1982:487).

In competition between one group employing a low-cost strategy (travellers) and another employing a high-cost strategy (processors), Bettinger and Baumhoff (1982:488) predict that the processors would prevail. In competitive situations, the search time invested in locating high ranked resources will increase for both groups but, because travellers are more dependent on high ranked resources, they will be more affected than the processors whose labor is invested primarily in processing lower-ranked resources. Perhaps more important, the two groups would be competing for all of the food resources exploited by travellers, but there would be no competition for many of the lower-ranked resources used by the processors but ignored by the travellers.

In applying these arguments to competition between horticulturalists and hunter-gatherers in southeastern New Mexico, we are presumably dealing with groups that both employ relatively high-cost subsistence strategies. Nevertheless, the horticulturalists would appear to have an advantage because the two groups would compete for a wide range of wild plant and animal resources but not for agricultural produce. How much of an advantage horticulturalists would gain depends of course on the productivity of the cultigens, which cannot be assessed at present. The horticulturalists would have a second advantage in occupying the river valleys of the middle Pecos and its major tributaries in the Sierra Blanca region, which are among the more diverse and productive areas of the region.

Under these conditions, the long-term options open to hunting and gathering groups would be to adopt agriculture or withdraw to areas where they were not in competition with the horticulturalists. The available evidence suggests that those areas were probably east of the Pecos River, in the Guadalupe Mountains, and possibly in parts of the northern Pecos Slopes. Little subsistence data are available for these areas, especially relating to the plant resources utilized. The subsistence issues for these areas are therefore essentially the basic questions posed for the problem domain.

- ***What wild plant and animal resources were exploited by Ceramic period groups in each of these areas?***
- ***Which resources were dietary staples?***
- ***What seasonal variability is there in the availability of those resources?***
- ***Were any food resources stored?***
- ***Could the available mix of food resources in the area support a year round occupation, or would resources in other areas have to be exploited at some point in the annual round?***

There is good inferential evidence for the processing of succulents in the Guadalupe Mountain area, although direct evidence of mescal or sotol has rarely been obtained from ring midden sites. A continued effort should be made to recover macro-botanical or phytolith evidence from these features, but greater priority should be given to assessing the quantity of material being processed at one time, as well as to identify other plant resources being utilized. Similarly, shinnery oak and mesquite are presumed to have been important plant resources exploited in the Mescalero Sands area. The inference is reasonable given the site locations but direct evidence is needed to verify the hypothesis. Interestingly, there appears to be little evidence for storage of subsistence resources outside of the horticultural settlements which, given the discussion in the previous section, I would expected to be a component of the intensification strategy employed by Ceramic period hunter-gatherers. Some reliance on storage seems particularly likely in the Eastern Jornada if Leslie (1979) is correct in his assertion that hunter-gatherer groups in that area were semi-sedentary by AD 1100 or 1150. In order to address this problem, greater effort needs to be given to the identification of storage facilities during excavations. In support of this effort, more emphasis also needs to be given to a functional analysis of the pit features commonly associated with sites in the region.

The last question is fundamental to addressing the larger issue of whether southeastern New Mexico was occupied by both horticulturalists and hunter-gatherers during the Ceramic period. Although this proposition has been accepted by most researchers, it remains a working hypothesis. Testing of that hypothesis will first require determining whether the subsistence resources necessary to support hunter-gatherers during an annual cycle were available in areas not occupied by horticulturalists. Direct evidence of a viable settlement-subsistence strategies distinguishable from that employed by horticultural groups must then be obtained.

For the late Ceramic period, the two critical subsistence issues are:

- ***why was agriculture abandoned in the mid-late fourteenth century?***
- ***how did subsistence strategies change in response to the increased abundance of bison beginning in the late thirteenth century?***

Jelinek (1967:155–159) argues that the answers to these two questions may be linked. At P4C, the only relatively large site dating to the Late McKenzie phase (ca. AD 1250–1350), Jelinek uncovered the remnants of a rectangular block of contiguous rooms. The faunal assemblage associated with the roomblock was dominated by bison bone, and the high ratios of side-notched projectile points and small end-scrapers suggested a heavy emphasis on hunting relative to earlier Ceramic period occupations in the Middle Pecos area. The pollen evidence also showed a drop in *Zea* pollen and marked rise in grass pollen. Jelinek speculates that this dramatic change in the subsistence system was triggered either by a deterioration in agricultural productivity or by "an intrusion of a new resource (i.e. *Bison*) in sufficient quantity to encourage the abandonment of the marginally successful cultivation which had been practiced in the valley, in favor of hunting" (1967:157). He favored the latter explanation largely because the increase in grass pollen was interpreted as evidence for a slight increase in precipitation as well as an indicator of improved grazing conditions. Thus, as bison became more abundant on the Southern Plains, Jelinek contends that farmers in the Middle Pecos area abandoned their sedentary lifeway and, within a period of no more than a century, became nomadic bison hunters (1967:162).

A similar adaptive shift is suggested by Ochoa phase (AD 1350–1450/1500) sites in the Eastern Jornada area. As summarized by Leslie (1979:192) and Hughes (1989:33–34), the Ochoa phase seems to represent a development similar to but less spectacular than that of the Antelope Creek focus in the Panhandle Plains. The phase is marked by a shift from pithouses to jacal surface rooms, and by an increased dependence on bison. The flaked lithic assemblage consists of side-notched arrowpoints, beveled knives, large numbers of small thumb-nail end scrapers – a tool kit characteristic of Plains bison hunters. Shaft smothers also appear for the first time [possibly indicating adoption of the compound bow and wood-shaft arrows]. Ochoa Indented Brown replaces earlier plainwares and decorated intrusive ceramics make up only about 2% of the ceramic assemblage.

The most detailed evidence for the increasing importance of bison hunting comes from Henderson Pueblo, located near the confluence of the Rio Hondo with the Pecos near Roswell. Henderson is a moderate-size pueblo with possibly 100–130 rooms. The early phase occupation of the site is dated AD 1250–1270, the late phase occupation to AD 1270–1300+, and an ephemeral terminal occupation to about AD 1400 (Speth 2004:20). The faunal assemblage from Henderson is dominated by bison, although the diverse species habitually utilized by earlier Ceramic period horticulturalists continue to be exploited. Speth (2004:128–131) argues that bison were hunted largely if not entirely in spring, probably because bison were not present within range of the village during the late fall and winter. Butchering patterns reflect both a preference for fat and the selection of high utility elements for long-distance transport. The proportion of rib and vertebral elements declines sharply during the late phase which, combined with the predominance of those elements in the bison assemblages from Lincoln phase sites in the Sierra Blanca region, suggests an increase in the exchange of dried bison meat and products. That most intrusive ceramics from the site date to the late period provides further evidence for the development of exchange relations. Finally, Speth notes an increase in the communal processing of bison during the late phase occupation, which both underscores the growing importance of bison in the subsistence system and indicates a possible shift in the size of the basic subsistence unit beyond the household to an extended family group.

Speth documents changes in the procurement of non-bison faunal resources that appear to be adjustments to potential scheduling conflicts arising from the growing importance of spring bison hunting. He notes, however, that there are no major changes over time in the density of small starchy seeds (e.g., chenopod and amaranth) or of maize, which was clearly a dietary staple, so the increased importance of long-distance bison hunting does not appear to have disrupted maize cultivation (Speth 2004:423). Nevertheless, in the absence of evidence for hunting during the late fall and winter, he suggests that most able-bodied adults left the village during this period to exploit bison and other resources in areas far from the settlement (Speth 2004:422). Further, he suggests that as Henderson emerged as a source for trade in bison meat, robes, and hides, the residents were well on the way to becoming bison specialists. With the scheduling conflict between spring bison hunting and spring planting, he speculates that Henderson's residents may have taken the short step to becoming fully nomadic bison hunters (Speth 2004:426).

An alternative interpretation of the Henderson data is that the village was not partially abandoned during the late fall and winter but that the group relied primarily on stored food resources. The evidence suggests that the subsistence system was based on a combination of maize cultivation and bison hunting, supplemented by a variety of wild plant and animal resources. In short, the subsistence strategy may have been similar to that employed by contemporary Plains Village groups in adjacent areas of the Southern Plains (Hughes 1989). This seems a more viable subsistence option, especially if Speth is correct in his suspicion that bison were only seasonally available in southeastern New Mexico, but it does not account for the disappearance of sedentary or semi-sedentary communities in the region.

Dillehay's (1974) generalizations about the presence and absence of bison on the Southern Plains has been criticized primarily because he did not give adequate consideration to the environmental heterogeneity of the Southern Plains region (Baugh 1986; Lynott 1979). Nevertheless, the scarcity of bison remains in early Ceramic period sites in southeastern New Mexico and the Panhandle Plains (Hughes 1989:25) suggests that bison were present but not abundant in the westernmost parts of the Southern Plains during his Absence Period II (AD 500–1200/1300). The evidence is even more compelling that the numbers of bison on the Southern Plains increased sharply after about AD 1200–1300 (Presence Period III), and their range was greatly expanded (Hughes 1989; Prewitt 1981). Although the reasons for this dramatic increase in the southern bison herds has not been fully explained, climatic change was almost certainly a major factor.

In contrast to Jelinek, Hughes (1989:39) argues that the climate was warmer and drier after about AD 1100. He speculates that bison herds began returning to the Southern Plains, attracted by the renewed dominance of nutritious short grasses favored under those climatic conditions. Hughes further suggests that herds may have begun spreading southward from the Northwestern Plains where they were abundant during the first millennium AD. That southward movement was marked by the emergence of successive complexes of Plains Village complexes: the Upper Republican and Apishapa in southwestern Colorado and northeastern New Mexico; the Antelope Creek and Buried City in the Texas Panhandle; and, somewhat later, the Ochoa phase (Hughes 1989:42). Henderson and the late McKenzie phase sites in the Pecos River valley can tentatively be added to this list.

With increased availability, the diet breadth model predicts that high ranked resources like bison will be preferentially exploited and lower-ranked resources will be dropped from the diet. That response is a reversal of the intensification process described earlier, both in terms of decreasing diet breadth and in the trend toward increasing the net amount of food that can be extracted from a given geographical area. Binford (2001:346–347) defines this alternative process as *extensification*, and he argues that groups employing this strategy are characterized by relatively large group size, utilization of huge geographic areas, and the simultaneous presence of indicators of complexity and very low population densities. In contrast to intensification, extensification does not appear to co-vary with population density. Instead, Binford argues that extensification is a possible response to any circumstances in which a new niche appears that could result in a relatively rapid dispersion of peoples into areas that were minimally used or unoccupied by hunter-gatherers (2001:442). For example, Binford contends that the extensification strategy employed by the mounted plains bison hunters was made possible by the acquisition of domestic horses, which allowed them to increase their scale of range use and their transportation capability.

The increasing abundance of bison on the Southern Plain after about AD 1200 appears to have created precisely the kind of new niche that would favor extensification by hunter-gatherer and horticultural groups on the plains margins. That opportunity may not have been open to groups in the southeastern New Mexico whose ranges did not extend onto the plains, however. Further, as Binford's mounted hunter example suggests, the ability for any group to exploit that new niche would have been limited by foot travel and transport capability. Even with the use of dogs to enhance transport capacity, the dual dependence on bison hunting and cultivation by Plains Village groups in the Texas Panhandle, where bison were probably most numerous, strongly suggests that the opportunity for extensification could not be fully exploited.

For groups in the Pecos Valley, the options may have been even more limited. Given Speth's arguments that bison at Henderson were procured largely if not exclusively during the spring and that only high utility elements been transported, it appears that the bison herds were only seasonally within range of even long-distance hunting parties. The strategic position of the Pecos Valley settlements for providing bison meat to the Sierra Blanca pueblos may explain why they adopted an extensification strategy but, under these circumstances, it is doubtful that hunter-gatherers or horticulturalists with ranges further up the Sacramento Slope would have either the opportunity or incentive to alter their subsistence strategy toward an emphasis on bison hunting. Some other explanation is therefore needed to account for the disappearance of sedentary populations in these areas, and the shifting climatic conditions that enabled bison to expand on the Southern Plains seems a likely contributing factor.

High-resolution paleoclimatic data is lacking for southeastern New Mexico, but Stuart and Gauthier (1981:418) argue that the Pueblo III settlement patterns statewide are characterized by a rapid movement to higher elevations between AD 1125/1150 and 1200, and a shift to lower elevation settings at AD 1275–1300, after which nearly all Pueblo occupations are in riverine settings. In general, those shifts appear to be a response to changing climatic conditions affecting agricultural productivity. Although settlement patterns in the Sierra Blanca area are consistent with movement to higher elevations by AD 1200 (Kelley 1984), the later shift to lowland riverine settings is not evident and may have been precluded by the occupation of the Pecos River valley by other groups. If climatic conditions for agriculture were deteriorating, then the renewed emphasis on hunting large game and the increasing trade in bison meat may have been tactics to offset declining crop yields. Given prior intensification of wild resource procurement and higher population densities, the opportunities for further increasing wild resource yields were probably limited, however, and the quantities of bison meat obtained through exchange would have been restricted by transport costs. Ultimately, the Lincoln phase population may have had no option but to abandon the region and move to an environment more favorable for agriculture, most likely in the Chupadero Mesa-Gran Quivira region. Any hunter-gatherer populations in adjacent areas would have been less severely affected by changing climatic conditions, and would have benefited from partial abandonment of the region. The semi-sedentary bison hunter in the Pecos River valley would have lost their strategic position in the exchange system for bison meat as the center of Pueblo population shifted northward, however. Consequently, given their marginal access to the bison herds, they may have elected to cut their transportation costs by moving the residential groups nearer to the hunting areas; that is, by adopting a nomadic bison-hunting adaptation.

The above scenario is grounded in concepts from ecological and hunter-gatherer theory, but it is clearly speculative. The hypotheses developed here must be tested using archaeological data. At the most basic level, chronological, subsistence, and settlement data are needed from a wide range of late Ceramic sites in order to reconstruct the settlement/subsistence strategies employed by the various groups in the region, and the changes in those strategies through time. In addition, high-resolution paleoclimatic data are needed to reconstruct climatic conditions during this period. These intermediate questions must be answered in order to provide the higher-level data needed to address the more general questions posed at the regional/integrative level.

Protohistoric

Relatively few Protohistoric sites have been identified in southeastern New Mexico and fewer still have been excavated. Assumptions about Protohistoric subsistence strategies in the region are therefore based almost exclusively on ethnographic analogy and the meager evidence from historical accounts. The accounts of Coronado's expedition describe two groups of nomadic bison-hunters on the Llano Estacado, both of which had base camps or villages located in Texas. Those groups, the Querechos and Teyas appear linked to the archaeologically defined Tierra Blanca and Garza complexes, respectively (Boyd 2001; Habicht-Mauche 1992).

As described by Hughes (1989:35), the Tierra Blanca Complex (ca. AD 1450–1700) is characterized by two classes of sites, large villages marked by stone foundations – located mainly along Tierra Blanca Creek and Palo Duro Canyon – and hunting camps scattered over the Panhandle Plains. The lithic assemblage includes Washita, Harrell, and Fresno arrowpoints; beveled knives; and Plains-style end scrapers. Ceramics are a utility ware resembling Apachean Perdido Plain and various Pueblo tradewares. Hughes speculates that the complex represents a semi-nomadic, semi-sedentary population who hunted bison and possibly grew corn. He suggests that the Querecho dog nomads that Coronado encountered on the Plains and the corn-growing Faraones described by Onate might be eyewitness accounts of the two aspects of the Tierra Blanca settlement system. Boyd (2001:8–9), however, argues that the complex reflects a population of semi-nomadic hunters whose yearly movements were probably dictated in large part of the movement of bison, which were clearly the focus of their subsistence system.

The Garza Complex (ca. AD 1450–1700) occurs south of the Tierra Blanca Complex and appears centered in the upper Brazos drainage near Lubbock. The lithic assemblage is similar to that of the Tierra Blanca Complex with the addition of triangular, basally notched Garza and Lott points. Although no evidence for fixed dwellings has been found at Garza sites, Hughes speculates that they may have had the same kind of hunting/base village settlement pattern inferred for the Tierra Blanca Complex (1989:36). Habicht-Mauche (1992:251) also argues that there are a few references in the early Spanish records suggesting that the Teya may have cultivated some crops at semi-sedentary villages along the eastern edges of the Llano Estacado. Boyd challenges the latter point, arguing that there is currently no substantive archaeological evidence indicating that horticulture was practiced by Tierra Blanca or Garza peoples (2001:10).

While the evidence remains inconclusive, there is a possibility that common perception of protohistoric groups on the Southern High Plains as nomadic hunters following the bison herds is overstated and describes only one component of the settlement-subsistence system. Although bison hunting was clearly the focus of the subsistence strategy, protohistoric groups appear to have been operating from seasonal basecamps or even semi-permanent villages on eastern edges of the Llano Estacado. In these areas, subsistence pursuits seem to have been more varied and may have included some cultivation. The general subsistence questions relating to the protohistoric period are therefore:

- ***what subsistence resources other than bison were exploited by protohistoric groups?***
- ***did the Plains Village subsistence pattern persist into the protohistoric period?***
- ***how were scheduling conflicts between bison hunting and other subsistence activities resolved?***
- ***to what extent was the exploitation of non-bison food resources a response to the constraints on the extensification strategy imposed by the limitations of foot travel and dog transport?***
- ***how did subsistence strategies change following the introduction of the horse?***

Given the mobility constraints discussed in the previous section and the probability that the Pecos River valley was on the margins of the bison range, the emergence of the Plains drainage valleys in the Texas Panhandle as the population center for protohistoric bison hunters seems a logical consequence of the extensification strategy. Whether these centers arose as a result of intensification of the local Plains Village populations, an influx of population into the region from other areas including the Pecos River valley, or both is uncertain. In any case, it is clear that the opportunities for researchers in southeastern New Mexico to address the question posed above are limited. Because it appears that the Plains area of southeastern New Mexico was probably in the westernmost part of the hunting range for bison hunters, protohistoric sites are likely to be limited to hunting camps and processing localities similar to those described for the Garza occupation at Lubbock Lake (Johnson et al. 1977), and kill sites like those at Garnsey Springs (Speth and Parry 1980) and LA 22107 (Staley et al. 1996). Consequently, the most appropriate subsistence issues that can realistically be addressed are:

- ***what hunting and butchering/processing tactics were employed by protohistoric bison hunters in southeastern New Mexico?***
- ***what were the seasons of use?***
- ***how do sites in the region fit into the larger settlement-subsistence strategy?***
- ***is movement through the region related to the development of exchange relations with Pueblo groups in the Gran Quivira area and upper Pecos drainage?***

There is also the general question of whether hunting and gathering groups persisted in the areas west of the Pecos River that were not heavily dependent on bison. Late dates on ring middens in the Guadalupe Mountains (Katz and Katz 2001) suggest this possibility, but too little data are available for any speculation about the nature of the subsistence strategy beyond the suggestions that 1) the hunting and gathering strategies developed during the late Archaic and Ceramic periods would probably have remained viable options; and 2) that declining population densities in the area by the mid-late fourteenth century may have opened new options for any hunting and gathering groups that remained in the region. Finally, ethnographic accounts of the Mescalero Apache in southeastern New Mexico (Basehart 1974) document an adaptation focused on wild resources in the mountains and adjacent lowlands of the region. The time depth for this adaptation is unknown, but it presumably developed during the eighteenth century as plains Apache groups were displaced by the Comanches. Evidence for this transition should be part of the archaeological record in southeastern New Mexico but, until more reliable criteria are applied to the identification of early Apache sites (e.g., Seymour 2002), the question cannot be investigated.

SETTLEMENT SYSTEMS/MOBILITY STRATEGIES

The overall objective of research under this problem domain is to understand how prehistoric and protohistoric groups positioned themselves on the landscape in adapting to the changing natural and cultural environment of southeastern New Mexico. Again, the basic questions that must be addressed for each cultural-temporal period vary depending on the level of inquiry. At the site/component level, the basic question are:

- ***what activities were conducted at the site?***
- ***what was the probable size and composition of the resident group?***
- ***what was the season and duration of the occupation/activity?***

At the area/generalization level, the questions are:

- ***what kinds of sites associated with each cultural/temporal period?***
- ***what patterning is there in the spatial distribution of contemporary sites?***
- ***what are the environmental variables conditioning site location?***

At the regional/interpretive level, the basic questions are:

- ***what are the boundaries of the settlement systems?***
- ***what mobility strategies were employed during each temporal period?***
- ***how and why did those strategies change through time?***

The approach to settlement systems adopted for this research design is predicated on evidence that the basic cultural adaptation in southeastern New Mexico from the Paleoindian through Protohistoric periods was hunting and gathering, except for a few centuries during the Ceramic period when agriculture was practiced by at least some segment of the local population. The analyses used in reconstructing settlement systems in the region are therefore grounded in theories of hunter-gatherer mobility strategies and site structure patterns.

At the site/component level, the basic objective is to obtain as much information as possible about the activities conducted at the site, the probable size and composition of the prehistoric group, and the season and duration of the occupation. The analysis of subsistence resources will contribute the bulk of information relating to on-site activities and may provide some evidence for seasonality. Analysis of the debitage assemblage should indicate the range of lithic tool manufacture, repair, and refurbishment activities undertaken at the site, as well as whether lithic raw materials were procured locally. Functional analysis of the artifact assemblage, including wear patterns, may provide evidence of other activities such as woodworking, hide preparation, and ceramic manufacture.

A survey of hunter-gatherer ethnographies (Binford 2001:232–233; Kelly 1995:262–270) suggests that there is generally a complementary division of labor between men and women in the groups. Men are generally more involved with longer distance hunting, especially of larger game, and tasks involving short periods of heavy labor. Women are responsible for child care and most food preparation/processing tasks and, as a result, they are primarily involved in procuring plant resources and possibly the opportunistic hunting and trapping of small game within relatively close proximity to the residential camp. Consequently, functional analysis of the artifact assemblage is also expected to provide the basic information needed to address the question of group composition. Data concerning group size and occupational intensity, as well as information on how activities were organized at these sites, can be obtained through an analyses of assemblage diversity and the spatial patterning of artifacts and facilities.

Assemblage size (i.e., the number of artifacts found at a site) provides a rough indicator of occupational intensity, which is a function of three major factors – the duration of the occupation, the size of the group, and the number of use episodes. Small assemblages most probably indicate short-term use by small groups. Interpreting larger assemblages, however, also requires an analysis of site structure to estimate the relative influence of the three factors affecting assemblage size. Site structure analysis uses generalizations about the settlement behavior of ethnographic groups to interpret the spatial patterning of artifacts and features at prehistoric sites. Activities at most sites tend to be organized around facilities (i.e., structures and lesser features); consequently, mapping those facilities defines the underlying framework of the site structure and provides a basis for interpreting the patterning of artifacts.

The labor invested in the construction of facilities provides a relative measure of the anticipated duration of the occupation. Ethnoarchaeological observations (Binford 1983:144–192; Gamble and Boimier 1991; Kroll and Price 1991; O'Connell 1987; Yellen 1977), for example, suggest that minimally any residential occupation will be marked by one or more hearths, which serve as focal points for food preparation and consumption, as well as a variety of other activities. Some type of shelter will probably be built if the camp is occupied for more than a few days. For shorter stays and in warm weather, the shelters might be simple shades or windbreaks but for longer occupations, they may be more substantial. During cool weather, the structure will generally be larger with an interior hearth, and space for sleeping, food preparation, and storage. The presence of exterior storage pits is also characteristic of longer occupations, as is the segregation of areas on the periphery of the camp for activities that require considerable space or generate large quantities of debris (e.g., lithic tool manufacture, hide working, pit roasting).

Refuse disposal patterns are another indicator of the duration of an occupation. Refuse disposal is unlikely to be a major concern at sites occupied for brief periods. At these sites, refuse will probably be discarded at or near the location of use, possibly with some size sorting of materials into what Binford (1978) describes as "drop and toss zones" within activity areas and around features. At sites occupied for longer periods, more effort is invested in clearing debris from living and work areas. Periodic cleaning of structures may result in the accumulation of "door dumps" near structure entrances, but most refuse tends to be concentrated on the periphery of the camp or settlement. Depending on the length of the occupation, this debris may be characterized as a discontinous scatter, sheet midden, or midden deposits.

The "household" or "hearth group" is the smallest settlement unit that can be defined consistently using archaeological data, and it is generally the basic subsistence unit (Johnson and Earle 1987:19). Based on general ethnographic analogy, the household is assumed to be roughly equivalent to a nuclear family or small extended family group. At Puebloan sites, the household is defined archaeologically as a pithouse, a suite of surface rooms, or some combination of both. At sites occupied by mobile groups, the household may be marked by a hearth and associated activity area or by a structure and associated extramural facilities depending on the duration of the occupation. In either case, the size of the household group can be estimated based on the size of the residential structure and/or the total occupation area. At larger settlements, multiple households will generally be arrayed at some socially-prescribed interval, often surrounding a communal space. Group size can therefore be estimated by counting the number of households and multiplying by the estimated size of the household group. If multiple households are widely and irregularly spaced, however, then the site was likely reoccupied by household groups, particularly if evidence of communal facilities is lacking. Superimposed features or refuse deposits, structural additions and, at a coarse level, varying occupations dates also provide evidence that a location was reoccupied.

In extreme cases, favorable locations may have been occupied repeatedly over long periods partially or wholly obscuring the patterning of individual households. This is particularly likely when the occupations are on land surfaces that are either eroded or have been stable for long periods. In such "palimpsest" situations, it may be possible to discern some aspects of the site structure through distributional analysis of artifacts and features (e.g., differential distribution of temporally diagnostic artifacts, lithic raw materials, etc.) but the success of such analyses will depend in large part on knowing what household from different time periods are supposed to look like. An initial emphasis is single-component sites is therefore recommended to provide the initial definitions of household site structure.

Research at the area/generalization level is largely a matter of settlement pattern analysis. As suggested by the questions posed for this scale of work, that analysis involves three related tasks. The first task is to generalize from the information gleaned from individual sites to classes of sites evidencing the similar occupations or activities; in other words, to define site types. The site types defined in Chapter 3 represent a very preliminary attempt at such a classification and, as more excavation data become available it is expected that this typology will be tested and refined. That typology is morphologically based in that the type definitions are based on the presence of particular kinds of features but, like most site classifications, it has functional implications based on general ethnographic analogy. In this case, behavioral implications for the non-architectural site types are derived largely from Binford's (1980) discussion of hunter-gatherer mobility strategies.

Based on that discussion, five general classes of sites are potentially present in the archaeological record of southeastern New Mexico – residences, field camps, stations, caches, and locations. In general, residences are expected to contain debris from a variety of manufacturing, food processing, and domestic activities. Field camps, the temporary operational centers for task groups, are also expected to yield habitation debris, but the material remains at these sites should reflect short-term occupation, and there should be ample evidence of the dominant procurement and processing activities in which the group was engaged. Stations are sites where task groups are engaged in information gathering, the best example of which is the game overlook. These sites should yield some debris from food preparation and consumption, and from tool maintenance and unrelated craft activities. Consequently, their environmental setting is likely to provide the most reliable evidence of site function.

Caches represent temporary storage locations for equipment, raw materials, or subsistence resources. Caching may occur at residences, field camps, and stations or in isolated locations. The latter should have minimal debris, so unless the stored items are still in place, the only material evidence of the cache will be the storage facility. The major behavioral implication of caches is the expectation that the cached materials will be retrieved. That expectation may be definite in instances where subsistence resources are cached for later transport, or when equipment is cached at sites that the group expects to return to the following year, or it may be indefinite as when materials are cached in case they are needed in an emergency (i.e., Binford's "insurance caches"). Locations, the last site category, are the actual loci of resource procurement. These may be obvious in certain cases, such as kill sites and lithic procurement areas, but most often the only material remains are the debris from sporadic tool maintenance, or tools that are broken and discarded or lost. Most locations therefore have very low visibility in the archaeological record, and they tend to be recorded as isolated occurrences rather than sites.

The preliminary site typology included three categories of residential sites – single residences, multiple residences, residential complexes – all of which have architectural evidence (i.e., structures) evidencing a residential occupation. The three categories are distinguished based on the estimated number of households that occupied the sites. Most of the sites classified as residences date to the Ceramic period and appear to be permanent or semi-permanent farmsteads or settlements. Residential sites dating to the Protohistoric period are marked by tipi rings and probably represent short-term or seasonal camps. Most of the possible structures also date to the Ceramic period and probably represent permanent residential sites. If horticulturalists in the region had a land-extensive agricultural strategy (i.e., fields in widely scattered locations), however, then some of these sites could be either seasonal residences (fieldhouses) or field facilities, which can be field camps or locations depending on their distance from the residence (Sebastian 1983). Components classified as domestic features, ring middens, and bedrock mortars as well as many of the components with charcoal/ash stains classified as miscellaneous features could be either residential camps of varying duration, or field camps. Caves and rockshelters not classified in one of the preceding categories and a subset of the miscellaneous features are potentially either caches or ceremonial/ritual locations. The quarry/lithic procurement areas are mostly locations although a few have associated domestic feature components. The bone beds classified as miscellaneous features also represent locations, although I suspect that most of them are associated with nearby residential or field camps. Finally, the artifact scatters probably include a number of short-term field camps as well as stations and locations.

Once site types are defined, the second task is to examine the mix and spatial distribution of site types for each temporal period. The preliminary temporal periods defined here are too coarse to permit any meaningful analysis. Ideally, the analysis should examine sites known to be contemporaneous, but practically the time scales used for this analysis are likely to be limited to something like the revised temporal divisions suggested in the chronology and culture history section of this chapter. The spatial relationships among the different site types can provide a general impression of land use patterns and the mix of site types associated with each period provides some indication of the mobility strategies being employed. Data on the season and relative duration of the occupations are needed to begin reconstructing annual rounds, however.

The third task in the settlement pattern analysis is analysis of the association of site locations with various environmental variables. The summaries of site types by temporal period and physiographic/drainage basin units presented in Chapter 3 provide a first-level approximation of such an analysis, but more detailed environmental stratification is needed before any meaningful patterning is likely to be discernible. The models formulated for the Loco Hills and Azotea Mesa areas during the Pump III project illustrate the level of environmental stratification needed, but those models were intended to predict site location. They do not provide the break-down of sites by temporal period and type needed for settlement pattern analysis, however.

A final requirement for settlement pattern analysis is a representative sample of sites from the area being analyzed. Ideally, that sample would consist of excavated sites, and the sampling strategy proposed for the selection of sites for data recovery is directed toward that long-term objective. Initial analyses will have to rely on survey data, however, which requires completion of a minimum representative sample survey of the area being modeled. As discussed in Chapter 3, none of the regional sampling units now defined have the survey coverage generally considered necessary for initial modeling. In the short-term, excavation to recover chronological, subsistence, and site structure data is more likely to significantly advance our understanding of adaptive strategies employed by prehistoric and protohistoric sites in New Mexico. As research moves beyond the area/generalization level, however, additional survey will need to be completed to provide the data needed to reconstruct settlement systems in the region.

Given the semi-arid to arid climatic conditions prevailing in the region, water is expected to be a critical factor conditioning the location of residential sites and field camps. Both perennial and ephemeral sources need to be considered including perennial and intermittent streams, springs and seeps, playa basins, and tanks. Vegetation and land forms channeling the movement of game will probably be important factors conditioning the locations of sites associated with the procurement of wild food resources. The strength or scale of those associations is expected to vary with site type, however. Locations and stations should be most closely associated with environmental variables reflecting the distribution of the wild resources being procured. Field camps and the residential camps of foraging groups should also be generally associated with those environmental variables, but other contributing factors such as the availability of water, shelter, and firewood will also come into play. Collector basecamps may be only indirectly associated with resource distribution, as these sites tend to be positioned to minimize travel and transport costs for task groups and/or in locations where mobility options are limited by stored food resources. The settlement locations of horticulturalists are expected to be in proximity to the primary agricultural fields but again other contributing factors will affect the actual site locations. The locations of agricultural fields, in turn, are likely to be conditioned by factors directly affecting crop growth – temperature and the length of the growing season, which is a function of climate, elevation, and landforms; moisture, which is a function of direct precipitation, indirect precipitation (runoff, drainage, proximity to streams and springs); and soils.

At the regional/integrative level, research is concerned with explaining the settlement patterns observed at the area/generalization level, and with explaining changes in those patterns through time. Because the primary adaptation to the region during the prehistoric and protohistoric periods is hunting and gathering, studies of hunter-gatherer mobility strategies provide a logical explanatory framework on which to base that research.

Fundamentally, mobility strategies are concerned with positioning consumers with respect to the distribution of food resources in the environment (Binford 1980). It is also the primary through which the abundance and future availability of food resources is monitored, and the primary risk minimization strategy for avoiding local food shortages (Binford 1983:204–208). As illustrated by the discussion in the previous section, mobility strategies are therefore integrally linked to the subsistence strategies employed by hunter-gatherers. As also discussed in the previous section, the primary factors limiting mobility options are population packing, the distribution of critical resources (e.g., water), and the use of storage to even out temporal incongruities in resource availability.

Binford (1980) has characterized hunter-gatherer mobility strategies as a continuum between foragers and collectors, the primary dimensions of which are residential and logistical mobility. Foragers, by definition, predominantly employ residential mobility. That is, the entire group moves their camp among a series of resource patches, moving the consumers to the resources. At each location, group members spend the day foraging, and return to the camp each night to process and consume the food they collect. The residence is moved to a new resource patch whenever the subsistence resource return falls below some perceived minimum. Logistical mobility among foragers is therefore limited largely to daily forays to and from the camp and to occasional long-distance hunting trips. At the opposite end of the continuum, collectors limit their residential mobility to seasonal moves among a few selected locations. Instead of moving the consumers to the food resources, task groups are dispatched to procure specific resources, which are then transported to the residence for consumption. As resource patches may be some distance from the residence, preliminary processing of the collected resources is often done in the field to reduce the weight of material that must be transported. For our purposes here, Binford’s continuum can be extended beyond collectors, whose mobility strategy involves few residential moves, to sedentary or semi-sedentary groups like agriculturalists whose mobility strategies are characterized by little or no residential mobility and who rely exclusively on logistical mobility to move wild resources to the consumers.

Archaeologically, foraging and collecting are expected to have distinctive signatures. For foragers, resource procurement locations will be largely invisible or evident only as a discontinuous scatter of isolated occurrences. Except for lithic procurement areas and perhaps a few hunting camps, the great majority of sites will be residential camps. Because roughly the same range of activities would be performed at each camp, this mobility strategy should be reflected by a relatively high assemblage diversity and low inter-site variability (Vierra and Doleman 1994). Differences among the site assemblages should be largely a function of assemblage size. In contrast, most of the sites produced by collectors should be specialized resource procurement and processing loci (i.e., field camps and stations). The artifact diversity at these sites should be low, evidencing a relatively narrow range of activities. Because different resources were collected at different locations, however, the inter-site assemblage variability should be relatively high. Collector basecamps are expected to have the same general characteristics as forager residential camps, although they will typically have larger assemblage owing to the longer duration of the occupation and possibly larger group size.

Paleoindian

As discussed previously, the subsistence strategy employed by Paleoindian groups was most likely focused on the procurement of bison and other large game. This adaptation suggests a mobility strategy characterized by high residential and logistical mobility over large territories, a strategy described by Kelly and Todd (1988) as high-technology foraging. They argue that high-technology foraging was technology- rather than place-oriented, and relied on a generalized knowledge of animal behavior rather than the detailed knowledge of the spatial distribution of food resource characteristic of modern hunter-gatherers. Taking this model as a hypothesis to be tested, the primary question relating to Paleoindian mobility strategies is:

- ***did Paleoindian groups in southeastern New Mexico employ a high-technology foraging strategy?***

Among the implications of the high-technology foraging model suggested by Kelly and Todd (1988:234–239) are: use of the landscape in a short-term and redundant fashion, sites limited to kill sites with associated camps, sites used repeatedly for short-periods, selective butchering of prey with no evidence of intensive processing for storage. In general, the available data seem consistent with these implications. Paleoindian kill and butchering sites in the Southern High Plains are most commonly preserved in draws and playas, while campsites tend to be in upland setting overlook former streams or ponds at a distance of several hundred yards to a mile (Holliday 1997:198). Although outside of the region, Stewart's Cattle Guard in southern Colorado (Jodry and Stanford 1992) has yielded information about how these two types of sites are related. At Cattle Guard, the evidence indicates that at least eight bison were killed by Folsom hunters in one or a closely timed series of events near the campsite. Front and hind quarters, rib slabs and some high value axial elements were then transported to the camp for further processing to strip the meat from the bones and recover marrow. The interpretation is a close match to Kelly and Todds' prediction that high-technology foragers camped near a kill and hunted in the immediately surrounding area until the declining availability of game precipitated a residential move. The selective use of high value meat elements from the bison and lack of intensive processing also appears consistent with the high-technology foraging model.

Archaic

Given the near absence of evidence relating to the early and middle Archaic occupations in southeastern New Mexico, speculation on the mobility strategies employed by Archaic groups is limited to the late Archaic period. Assuming that climatic conditions after 4500 BP were relatively close to those prevailing at present, general analogy with modern hunter-gatherer groups (Binford 2001; Kelley 1995) suggests that late Archaic groups in southeastern New Mexico are most likely to have employed a foraging strategy, emphasizing residential mobility. That assumption is supported by the predominance of domestic features and artifact scatters among Archaic sites documented in the region (Chapter 3). The movement of residential groups during an annual cycle is likely to have varied in different parts of the region, however, owing to environmental variability affected the distribution of food resources. Further, as discussed under the subsistence problem domains, mobility options may have been progressively constrained during the period as a result of increased population pressure.

Shelley (1994) has proposed a general model of Archaic land use for the Llano Estacado and adjacent Pecos Valley. He suggests that in these areas, the limited occurrence of reliable surface water in combination with the relative homogeneity of the environment results in an oasis type landscape in which plant and animal resources tend to be clumped and separated by broad expanses of less hospitable land (Shelley 1994:373). Given these conditions, Shelley argues that hunter-gatherers moved seasonally from node-to-node, and that this pattern would have produced "relatively continuous and intensive archaeological deposits at the nodes with transient and extensive deposits between nodes" (1994:383).

Although lacking in specifics, the "oasis" model probably provides a general description of the movements of hunter-gatherer groups in the areas east of the Pecos River, and possibly in the broad stretches of grassland in the northern part of the region. In the latter area, Mobley (1979, 1981) argues that, during both the Archaic and Ceramic periods, hunter-gatherers established semi-permanent basecamps in rockshelters along the Pecos River and its major tributaries. He suggests that foragers from those basecamps collected a variety of plant and animal resources from four vegetation zones: riparian, mixed shrub, pinyon-juniper, and grassland. As all four of these vegetation zones are within close proximity to the river, Mobley contends that the annual movement of these groups was probably restricted largely to a core area within a radius of 10-12 miles from the basecamp.

Schelberg and Akins (1987) challenge this interpretation, arguing that the faunal materials from the three rockshelter sites investigated by Mobley suggest a late spring through early fall occupation. Based on this and other evidence, they provide a convincing argument that there is no evidence for a semi-permanent occupation at the Los Esteros sites and that the area was used by hunter-gatherers on a seasonal or occasional basis. As Mobley's (1981) survey data also document short-term residential occupation at playa basins in the grasslands, the available data suggest that hunter-gatherer groups in this area employed a more mobile foraging strategy.

In the southwestern and west-central parts of the region of the Pecos, vegetation communities are arrayed along an elevation gradient rising from the Pecos River to the crests of the Guadalupe, Sacramento, and Capitan Mountains. These communities are cross-cut by riparian vegetation along the major tributaries of the Pecos. For these areas, seasonal moves along the drainages to exploit resources at different elevations is the more likely pattern. Although Katz and Katz (1985) argue that the late Archaic settlement pattern in the Brantley Reservoir area was riverine focused, those sites together with Honest Injun Cave (Applegarth 1976) and Hooper Canyon Cave (Roney 1995), are consistent with this suggested pattern of movement. The Archaic occupations at the Sunset Archaic Site and Tintop Cave (Wiseman 1996), Los Molinos (Wiseman 2004), and Townsend West (Akins 2003) may indicate a similar pattern for the Roswell area.

Sebastian and Larralde (1989:85) suggest that intensification of wild resource procurement near the end of the late Archaic and into the Ceramic period was accompanied by a shift toward a collector strategy; that is, toward a strategy emphasizing logistical mobility. This postulated shift in the settlement pattern may have been facilitated by a reduction in the size of the territories utilized by hunter-gatherers as a result of increased population packing. Decreased residential mobility may also have been a necessary precursor to the adoption of cultivation as an alternative intensification strategy (Wills 1988:41).

From the above discussion, then, the basic questions relating to late Archaic settlement/mobility strategies are:

- ***was the mobility strategy based predominantly on residential mobility?***
- ***how did the annual rounds of late Archaic groups differ in the different parts of the region?***
- ***is there evidence for a reduction in the size of the territories used by hunter-gatherer groups during the late Archaic?***
- ***was there a shift toward a greater dependence on logistical mobility as intensification pressures increased near the end of the period?***

Ceramic

Given the working hypothesis that southeastern New Mexico was occupied by both horticulturalists and hunter-gatherers during the Ceramic period, a variety of settlement patterns can be expected. Residential sites attributed to agriculturalists are concentrated in the middle Pecos valley, the Rio Hondo-Arroyo del Macho drainage basin, and in the Rio Peñasco drainage. Assuming a subsistence strategy based primarily on agriculture, two basic land-use strategies can be suggested. The first is a land-intensive strategy in which the labor effort is focused on agricultural fields in close proximity to the permanent farmsteads or villages. Mobility is largely limited largely to day-long logistical forays to tend crops and collect wild resources in close proximity to the settlements and to occasional logistical trips by task groups to hunt or procure other resources at more distant localities. The second is a land-extensive strategy in which field are planted at a variety of locations, often at some distance from the settlement. This strategy involves periodic logistical trips to more distant agricultural fields, which may therefore be marked by field houses, and it can result in a dual residence pattern in which families are dispersed at agricultural fields during the growing season and aggregated during the winter. The positioning of settlements along streams or at higher elevations is suggestive of a land-intensive agricultural pattern, but the evidence is not conclusive. The initial questions concerning Ceramic period settlements systems are therefore:

- ***did horticulturalists in the area employ a land-extensive or land-intensive agricultural strategy?***
- ***were these groups sedentary?***
- ***were communities dispersed or aggregated?***
-

The answers to these questions are expected to differ in different environmental settings, and probably also varied through time.

Given evidence suggesting that horticultural groups in southeastern New Mexico employed a subsistence strategy based on a mix of cultivated crops and wild plant and animal resources, two possible settlement/mobility strategies have been suggested. The first assumes that the groups were sedentary; that is, that the residential sites were occupied throughout the year. Under this model, the procurement of wild resources at any distance from the village would have been undertaken by task groups in logistical forays to collect the targeted resources and transport them back to the settlement. Clearly, this strategy would involve cooperation and coordination above the household level.

The alternative strategy assumes that the wild resources were harvested by seasonally mobile household groups. Under this alternative, the primary residences would have been unoccupied for part of the year or occupied by only some segment of the residential population. If agricultural production was centered at the household level, then a strategy of household mobility is theoretically feasible under three conditions: 1) that groups employed "plant it and leave it" approach to cultivation, 2) that crops were planted at locations in close enough proximity to the locations where wild resources were collected that the fields could be tended, or 3) that the household groups returned to the settlements periodically to tend the crops.

The first option seems unlikely if cultivation were adopted as part of a resource intensification strategy, since agricultural productivity is generally proportional to the labor effort invested in cultivation. The second option is also improbable unless both agricultural lands and the areas of greatest wild resource abundance were concentrated in a relatively small area. If this were the case, then this would seem the logical location for the primary residential base. The third option is therefore the most likely. Based on this discussion, the following additional questions are suggested:

- ***were household groups or some larger organizational unit primarily responsible for agricultural production and the procurement of wild plant and animal resources?***
- ***was residential or logistical mobility employed in the procurement of wild plant and animal resources?***
- ***were different settlement/mobility strategies employed by groups in different environmental settings and/or at different time periods?***

For the Ceramic period hunter-gatherers, the settlement/mobility strategy issues are largely the same as those suggested for the Archaic period.

- ***was the mobility strategy based predominantly on residential or logistical mobility?***
- ***what were the annual rounds of Ceramic period hunter-gatherers in the different parts of the region?***
- ***can the territories utilized by hunting and gathering groups be distinguished from those of the horticultural groups?***

There is one unique issue of particular interest, however. Leslie (1979) speculates that pithouse/pueblo settlements in the Eastern Jornada area were occupied by hunter-gatherer groups for whom shinnery oak and mesquite took the place of maize. As emphasized by Sebastian and Larralde (1989:82), examples of largely sedentary hunter-gatherers are rare in the ethnographic record, and those few cases are either primarily dependent on aquatic resources or are in contact situations with agricultural or industrial societies. Assuming that Leslie is correct in his interpretation of the subsistence strategy, the settlement/mobility options available for implementing that strategy are essentially the same as those outlined above for the horticultural groups. The questions relating to the Ceramic period occupation in the Eastern Jornada are therefore a mixture of those already posed.

- ***Were pithouse/pueblo settlements in the Eastern Jornada occupied seasonally or year-round?***
- ***Was residential or logistical mobility employed in the procurement of wild plant and animal resources?***
- ***If household groups were seasonally mobile, what was the annual round?***
- ***Were mobility options limited by a heavy reliance on storage?***

Protohistoric

Settlement patterns during the Protohistoric period were discussed under the subsistence problem domain and will be only briefly reviewed here. Based on archaeological evidence from the Panhandle area of Texas, the settlement pattern of protohistoric groups on the Southern High Plains is characterized by short-terms camps and kill/butchering sites on the Plains and by residential basecamps in drainage basins along the eastern margins of the Llano Estacado. This pattern suggests that these groups were sedentary or at least foraged within a much more restricted range during a part of the year, and were only seasonally mobile. Southeastern New Mexico is on the margins of the hunting territories for these groups, so only the mobile hunting component of the settlement system is likely to be represented.

Acquisition of the horse would have allowed these groups to cover a much wider range and provided the transportation capacity needed to support the highly mobile settlement strategy employed by ethnographically-documented Plains groups. The residential mobility of these groups was probably dictated as much by the need to provide grazing areas for the horse herds as by subsistence concerns, however.

The few documented Protohistoric components west of the Pecos River are almost all attributed to the nineteenth-century Apachean occupation. The initial date for this occupation is unclear, but given historical accounts of the Apaches being pushed off the Plains by the Comanches, it may be as late as the mid-eighteenth century. This leaves open the issue of whether local populations of hunter-gatherers or horticulturalists turned bison hunters continued to occupy parts of southeastern New Mexico into the Protohistoric period. In order to address this or any other problem relating to the Protohistoric occupation of the region, the fundamental question that first must be addressed is

- ***what criteria can be used to identify Protohistoric occupations during survey?***

ENVIRONMENT

This problem domain was added at the request of the Southeastern New Mexico Overview (SENMO) group. I had not included it in the original draft largely because environmental studies are integrally linked to the development of diet breath models in the subsistence strategies problem domain and to settlement patterns analyses proposed in the settlement systems/mobility strategies problem domain. Also, I had included environment as a separate problem domain in the research design for the Fruitland Coal Gas Development Area, and little of the proposed research was completed. In retrospect, the problem seems to have been that excavations at archaeological sites generally have a limited potential to contribute information about past environmental conditions, and no alternative means of pursing that research were formulated. The various modeling efforts proposed for southeastern New Mexico are intended in part to correct that problem. Although these studies will probably have to be funded as a separate component of the research, the collection and analysis of environmental data will necessarily be completed if this part of the research design is implemented because they are essential steps in the model development.

Given this approach, the basic research questions to be addressed under this problem domain are:

- ***how are key plant resources distributed in the region?***
- ***what is their relative abundance and seasonal availability?***
- ***how are key faunal resources distributed in the region?***
- ***how are arable soils distributed in the region?***
- ***what variability is there in the climatic conditions affecting crop growth?***
- ***how are perennial and seasonal sources of water distributed in the region?***
- ***what sources of lithic raw materials are there in the region?***
- ***how have climatic conditions varied over time?***
- ***how would those changing climatic conditions have affected the distribution and abundance of key wild resources and agricultural productivity?***

As discussed in the previous sections of this chapter, the first three questions relate to the distribution and abundance of wild plant and animal resources, two of the key factors that probably conditioned the subsistence strategies employed by prehistoric and protohistoric groups in southeastern New Mexico. The next three questions relate primarily to potential agricultural activities, which are relevant to the subsistence strategies employed during the Ceramic period. All of these questions are also relevant to reconstructing the annual rounds and settlement/mobility strategies employed by prehistoric and protohistoric groups in the region. The distribution of lithic raw material sources is also important to this research because, once those sources are mapped and described, they are potentially useful in tracking the movements of prehistoric groups.

The data needed to address these first seven questions will probably be derived exclusively from studies of the modern environment. Maps of vegetation, soils, and hydrology are readily available, and probably provide enough detail for at least preliminary pattern recognition studies. More detailed information on the distribution of potential plant and animal resources, as well as information about relative abundance and seasonal availability can probably be gleaned from range and wildlife management studies. Meteorological data and climatic summaries for the region are also available and can be used in conjunction with elevation and topographic models to extrapolate spatial variability in temperature, precipitation, and growing season.

Some published information may also be available concerning the caloric yields from potential food resources and the labor effort required to process those resources, but I suspect that a special project will have to be funded to collect the specific data needed to formulate the diet breadth model. Other fundamental research is needed to identify the phytolith and lipid signatures of potential plant food resources. The latter projects are part of the overall effort to enhance the recovery of subsistence remains from excavated sites in the region.

The last two questions relate to paleoenvironmental reconstruction. Katz and Katz (2001:6–11) provide a short summary of paleoenvironmental studies in the region and of general environmental change since the Pleistocene. The most dramatic climatic change occurs at the Pleistocene-Holocene transition, and much of the paleoenvironmental research has focused on this period. Conditions during the middle Holocene are marked by widespread erosion that is generally interpreted as evidence of a warm-dry climate, the Altithermal drought. The effects of this climatic interval on resource distribution remain largely unknown as mid-Holocene deposits are absent in most of the region. Consequently, research to locate deposits spanning this period and analyses of the both the sediments themselves and any paleoenvironmental materials that can be recovered would contribute significantly to our understanding of human adaptations during the middle Archaic.

By 4500–4000 BP, Katz and Katz suggest that climatic conditions ameliorated and modern plant communities became established. Modern resource distributions should therefore be useful for analyses of late Archaic and later adaptations to the region. There were significant climatic fluctuations during this interval that would have affected resource distribution, however. Thus there is a critical need for high-resolution paleoclimatic data, particularly for the Ceramic period. Palynological studies of pond sediments and alluvial deposits can potentially provide a record of meso-scale changes in the regional vegetation and, if the sampling localities are in environmentally sensitive areas (e.g., upper and lower tree lines), then general precipitation and temperature trends can also be reconstructed. High resolution paleoclimatic data is probably best obtained from dendroclimatic research, which might be feasible in the Sacramento and Capitan Mountains provided that wood from climatically sensitive species can be obtained from archaeological sites or some other source to extend the record. Failing this, data will have to be extrapolated from studies in adjacent regions.

In using modern environmental data as a proxy for past environmental conditions, the impact of recent human activities also needs to be considered. Dick-Peddie (1993:20), for example, attributes the expansion of juniper, mesquite, cholla, and creosote-bush into former grasslands to cattle grazing. The most pervasive effects, however, are probably the result of groundwater pumping. Fielder and Nye (1933) noted a noticeable drop in groundwater levels and artesian pressure beginning in about 1905, and it may be possible to model the effects of higher groundwater tables on springs and seeps. As Wiseman and Speth have demonstrated, historical records are also useful in assessing the environmental changes resulting from Euro-American settlement of the region.

RESEARCH PRIORITIES

In the scope of work for this project, the BLM stipulated that the research design should identify specific research questions that can be successfully addressed by through study of archaeological sites in southeastern New Mexico, and particularly research issues that are better addressed in this region than in other parts of New Mexico. It is clear from previous overviews of the region (Katz and Katz 2001; Sebastian and Larralde 1989; Stuart and Gauthier 1981) that the study of Paleoindian occupation is one area where research in southeastern New Mexico has made and should continue to make a significant contribution. It is also clear that the Archaic and Ceramic period occupations in southeastern New Mexico differ from contemporary occupations in adjacent areas of the Southwest. The primary explanation offered for those differences has been that cultural developments in southeastern New Mexico are peripheral or marginal expressions of developments in the greater Southwest culture area, and this perception of marginality has had a stultifying effect on research.

It seems to me that southeastern New Mexico is more properly conceptualized as an ecological and cultural frontier – a region of transition – between the Basin and Range and Plains physiographic provinces, and between the Southwest and Plains culture areas. The duality of this definition emphasizes the point that any frontier situation includes many dimensions (Parker and Rodseth (2005), which is consistent with Katz and Katzs' (2001) characterization of southeastern New Mexico as an intersection of several physiographic and culture areas. Culturally, frontiers can be conceived as an area of overlapping but not congruent political, economic, linguistic, and ethnic boundaries that serves as a zone of contact between different population, and which may give rise to hybridized cultural forms. Building on Wolf's (1982:387) definition of culture, Parker and Rodseth (2005:4) argue that frontiers are best viewed as a series of processes [largely distinct from those operating in core areas] that "construct, reconstruct, and dismantle material culture in response to identifiable determinants." They stress that historical processes of this kind can be understood only through analysis of the empirical evidence from many intensively studied cases (Parker and Rodseth 2005:4). Viewed in this context, the archaeological record in southeastern New Mexico provides a rare opportunity to investigate the historical processes operating on frontiers over a time period measured in millennia.

Given our rudimentary understanding of the prehistoric and protohistoric occupations in southeastern New Mexico, the research design has been structured to provide the basic data on chronology, subsistence, and settlement that are a necessary precursor to an analysis of the cultural dynamics operating on the frontier. This research emphasizes two aspects common to most frontier studies – physical geography and demography. Parker and Rodseth (2005:13) suggest that topography, climate, vegetation, and the availability of water and other strategic resources condition the various social and cultural boundaries within a frontier to a greater or lesser degree. Demography also plays a critical role as frontiers tend to be defined either as a transitional area of low population density between two more densely populated regions, or as an uninhabited or sparsely populated area at the edges of a population center. In either case, population shifts on various scales within or through the frontier are an important component of the overall cultural dynamic.

Most frontier studies deal with agrarian or state societies, and southeastern New Mexico is unusual in that hunting and gathering appears to have been the predominant cultural adaptation for all but a few centuries during the Ceramic period. Even during that period, hunter-gatherers may have been present and sedentary groups appear to have had a mixed farming/foraging economy. Consequently, environment and demography are expected to have been the major factors conditioning cultural adaptations to the region, and I have suggested that the processes of intensification and extensification may be useful in explaining the interplay of those two factors.

Because we are dealing primarily with mobile groups, the settlement-subsistence strategies employed by those groups must be understood in order to define the social boundaries between ethnic groups. Basic research to reconstruct those strategies and to identify how they changed through time must therefore be completed before any detailed examination of the interaction between groups can be initiated.

A series of basic questions, applicable to all temporal periods, were formulated for the chronology, subsistence strategies, and settlement system/mobility strategy problem domains (Table 4.1) to ensure that the data needed for these reconstructions are obtained. More specific questions relating to each temporal period and broader culture history questions posed by previous researchers (Table 4.2) were also incorporated into the research design. The questions posed under the environment problem domain (Table 4.3) are integrally linked to the investigation of settlement-subsistence strategies, but much of the data needed to address those questions will be collected in conjunction with model development or special studies rather than through excavation.

The first consideration in prioritizing those research questions is that they constitute a nested hierarchy. That hierarchy is explicit in the general questions summarized in Table 4.1. Three scales of inquiry are defined, the most specific of which is the site/component. The intermediate area/generalization scale is intended to represent investigations within a single regional sampling unit (RSU). At this scale, research is concerned with generalizing from the specific data obtained from excavated sites in the RSU. At the regional/integrative scale, data from all of the RSUs are used to address broader questions, including most of the questions summarized in Table 4.2. Research at this scale is also intended to move beyond generalization to explanation.

The implication of this hierarchy is that the lower scale questions must be answered before the higher level questions can be addressed. In the short term (ca. five years), it is unlikely that an adequate or representative sample of sites for the entire region can be intensively examined to answer many of the higher level research questions. Priority should be given to addressing the basic questions in Table 4.1 under the site/component and area/generalization scales of inquiry. Question blocks in Table 4.2 marked by a superscript "g" may also be addressable in part with data obtained at the site or area scale of inquiry.

The second consideration in prioritizing the research questions is the likelihood that the relevant data can be obtained from the sites being investigated. This consideration cannot be addressed definitively since the samples of sites selected for excavation are chosen independently for each RSU. The site distribution data presented in Chapter 3, however, indicates that relatively few sites dating to the Paleoindian and Protohistoric periods have been documented in the region. Because of their rarity, those sites, along with sites dating to the early and middle Archaic, should be given a priority for excavation. Nevertheless, the resulting sample is likely to be too small to address questions above the site/component scale of inquiry. As the greatest number of excavated sites will be those dating to the late Archaic and Ceramic periods, priority at the area/generalization scale of inquiry should be given to the general and specific questions relating to those periods.

Table 4.1 Priority General Questions Applicable to all Temporal Periods.

Problem Domain	**Scale of Inquiry**		
	Site/Component	**Area/Generalization**	**Regional/Integrative**
Chronology and Culture History	When was the site occupied?	Which sites are contemporary?	When do observable changes in the cultural adaptations occur? Are they associated with environmental change, demographic pressure, or internal/external cultural developments?
Subsistence Strategies	What plant and animal food resources were collected, processed, and/or consumed by the site's inhabitants?	What seasonal variation was there in the procurement of food resources? What were the subsistence resource staples? What areas were the foci of subsistence activities?	What was the relative contribution of hunting, gathering, and cultivation? What strategies were used to buffer against periods of low resource availability? How were scheduling conflicts handled? Were different subsistence strategies employed by contemporary groups? How did subsistence strategies change in response to environmental fluctuations and demographic pressure? How did subsistence strategies change with the introduction of various technological innovations?
Settlement System/ Mobility Strategies	What activities were conducted at the site? What was the probable size and composition of the resident group? What was the season and duration of the occupation/activity?	What kinds of sites associated with each temporal period? What is spatial patterning of sites during each temporal period? What environmental variables conditioned site location?	What are the boundaries of the settlement systems? What mobility strategies were employed during each temporal period? How and why did those strategies change through time?

Table 4.2. Crosstabulation of research questions by problem domain and temporal period. Questions with a superscript “g” are addressable in part at the area/generalization scale of inquiry.

	Chronology and Culture History	**Subsistence Strategies**	**Settlement/Mobility Strategies**
Paleoindian	What is the dating of Midland and its relationship to Folsom?^{g} What is the age of Plainview and its relationship to Folsom?^{g} What are the ages and typological relationships among Plainview and the other unfluted point series?^{g} Do the different point styles represent different cultural adaptations and/or different populations?	To what extent were subsistence strategies focused on hunting large game animals? What was the relative importance of small game and wild plant resources in the diet?	How can sites lacking conventional diagnostic artifacts be identified? Did groups in southeastern New Mexico employ a high-technology foraging strategy?
Archaic	What are the ages and typological relationship among the projectile point forms found in the region? Can projectile points be used to refine Shelley’s chronology for the Archaic period?^{g} Does the variability and spatial distribution of point styles in southeastern New Mexico indicate the presence of populations affiliated with multiple Archaic traditions/adaptations? What is the nature of the transition from Paleoindian to Archaic? Does the early Archaic represent a cultural adjustment by Paleoindians to the Holocene environment or population replacement as other hunter-gatherers moved into areas abandoned by Paleoindian groups? How did changing environmental conditions during this transistion period affect the critical resources used by early Archaic groups? Is the patterning in the radiocarbon record a reflection of demographic trends or a function of differential preservation and site visibility? Was the region sparsely settled or sporadically utilized during the early and middle Archaic periods? Does the population increase in the late Archaic reflect intrinsic growth or an influx of groups from adjacent regions?	What seasonal variation is there in the availability of plant and animal resources? Is there a protracted period of low resource availability? Is the abundance of a food resource affected by annual fluctuations in precipitation and temperature? Can its future availability be predicted? Is there evidence of food storage facilities at Archaic sites? What food resources were being stored? Does the reliance on food storage change over time?^{g} Did late Archaic hunter-gatherers intensify resource procurement in response to subsistence stress? When did groups in southeastern New Mexico have access to cultigens and when were they actually adopted? What other intensification options were open to hunter-gatherers in New Mexico? What, if any, selective advantages would have favored the adoption of agriculture over those other options?	Was the mobility strategy based predominantly on residential mobility?^{g} What was the annual round? Did annual rounds differ in the different parts of the region? Is there evidence for a reduction in the size of the territories used by hunter-gatherer groups during the late Archaic? Was there a shift toward a greater dependence on logistical mobility as intensification pressures increased near the end of the period?
Ceramic	To what extent can the date ranges for ceramic types be refined? Can local phase sequences be reconciled and a single regional chronology formulated?	How do potential agricultural yields compare to the yields from hunting and gathering in terms of calories/nutrients relative to the labor effort expended?	Does the continued reliance on wild plant and animal resources by horticultural groups result from limited demographic pressure to intensify resource procurement, or from some environmental limiting agricultural productivity?

	Chronology and Culture History	Subsistence Strategies	Settlement/Mobility Strategies
Ceramic	Was agriculture adopted by some segments of the local population or did Anasazi and/or Jornada farmers expand into the region? Was there a single adaptation based partly on agriculture and partly on the exploitation of wild plant and animal resources, or was the region occupied by both farmers and hunter-gatherers? Are the differences in material culture and settlement and subsistence patterns a reflection of ethnic differences? Is the local population Puebloan, Plains, or a mixture of both? What are the relative influences of cultures in adjacent areas of the Southwest, Southern Plain, and Trans-Pecos? How do those patterns change over time? Did agricultural groups eventually withdraw from southeastern New Mexico, or did they abandon farming and focus on bison hunting? If the latter, was the transition fostered by the development of Pueblo-Plains trade?	How were scheduling conflicts between agricultural tasks and wild resource procurement resolved?[g] What wild plant and animal resources were exploited by Ceramic period hunter-gatherers? Which resources were dietary staples? What food resources were stored?[g] How did subsistence strategies change in response to the increased abundance of bison beginning in the late thirteenth century?[g] Why was agriculture abandoned in the mid-late fourteenth century?	How might the distribution of soils, precipitation, surface water, and temperature limited agricultural potential of the region under the climatic regimes that prevailed during the Ceramic period? Were horticulturalists in the region sedentary or seasonally mobile? Did they employ a land-extensive or land-intensive agricultural strategy? Were communities aggregated or dispersed? Was the household or some larger organizational unit primarily responsible for agricultural production and/or the procurement of wild plant and animal resources? Was residential or logistical mobility employed in the procurement of wild resources? What were the annual rounds of Ceramic period hunter-gatherers in the different parts of the region? Was the mobility strategy based primarily on residential or logistical mobility? Can the territories of hunting and gathering groups be distinguished from those of the horticulturalists? Were pithouse/pueblo settlements in the Eastern Jornada occupied seasonally or year-round? Was residential or logistical mobility employed in the procurement of wild resources? If household groups were seasonally mobile, what was the annual round? Were mobility options limited by a heavy reliance on storage?[g]
Protohistoric	Can Protohistoric groups in the region be distinguished? Are there differences in the settlement and subsistence strategies of those groups? Can those groups be tied to late prehistoric complexes on the Southern Plains? Can they be tied to the historical groups mentioned in the Spanish records?	What subsistence resources other than bison were exploited by protohistoric groups? How were scheduling conflicts between bison hunting and other subsistence activities resolved? What hunting and processing tactics were employed by bison hunters in southeastern New Mexico?[g] Was the exploitation of non-bison food resources a response to the constraints on the extensification strategy imposed by the limitations of foot travel and dog transport?	What criteria can be used to identify Protohistoric occupations during survey?[g] Did the Plains Village subsistence pattern persist into the protohistoric period? How do sites in southeastern New Mexico fit into the larger settlement-subsistence strategy? What were the seasons of use? Is movement through the region related to the development of exchange relations with Pueblo groups in the Gran Quivira area and upper Pecos drainage?

	Chronology and Culture History	**Subsistence Strategies**	**Settlement/Mobility Strategies**
Protohistoric	When did Apachean groups arrive in southeastern New Mexico? How did Apache settlement-subsistence strategies change as a result of conflict with the Comanches?[g] To what extent did groups in southeastern New Mexico participate in the Plains-Pueblo exchange networks? What impact did introduction of the horse have on regional settlement-subsistence strategies?	How did subsistence strategies change following the introduction of the horse? Did hunter-gatherer groups without access to the Southern High Plains continue to employ the subsistence strategies developed during the Ceramic period?[g]	Were there local hunter-gatherer groups in the region that were not primarily dependent on bison hunting? If so, what was the mobility strategy employed by those groups? What was their annual round?[g]

Table 4.3. General question posed under the Environment Problem Domain.

How are key plant resources distributed in the region?
What is their relative abundance and seasonal availability?
How are key faunal resources distributed in the region?
How are arable soils distributed in the region?
What variability is there in the climatic conditions affecting crop growth?
How are perennial and seasonal sources of water distributed in the region?
What sources of lithic raw materials are there in the region?
How have climatic conditions varied over time?
How did changing climatic conditions affect the distribution and abundance of key wild resources and agricultural productivity?

An additional consideration raised by the BLM in their review comments on the draft research design was whether particular site types were more likely than others to yield basic chronological, subsistence, and settlement data. The review of excavated sites in Chapter 3 was intended in part to address that question. The sample is too small to provide any definitive answer to this question, but the analysis suggests that site condition rather than site type is the better indicator of data potential. With improved excavation methods (Chapter 6), all of the site types have the potential of yielding settlement data, and analysis of the settlement patterns will ultimately require investigation of a representative sample of all site types. Except for artifact scatters, all of the site types are also likely to yield charred organic material for radiocarbon dating, which is encouraging given the large proportion of sites in the region with unknown cultural/temporal affiliations. Not surprisingly, faunal and macrobotanical remains were recovered from the residences with substantial architecture and the one rockshelter site in the sample. The two bedrock mortar sites (one rockshelter and one open site) also yielded significant faunal and macrobotanical assemblages, which leads me to suspect that these features are not indicative of specialized processing facilities but of favored residential camp locations in areas with suitable rock outcroppings.

Faunal remains were recovered from fewer than half of the sites (47%), and condition again seemed more important than site type. Recovery was lowest for quarry/lithic procurement areas and ring middens, which is consistent with the specialized functions proposed for those component categories. Most of the ring midden and miscellaneous feature components (all with visible ash/charcoal stains or midden deposits) also yielded subsistence remains, as did about 40% of the domestic features. With improved sampling and analysis methods (Chapter 6), those proportions can probably be improved. Artifact scatters and quarry components did not yield macrobotanical remains.

Based on the information now available, I recommend that the sites selected for excavation in any RSU ultimately include a representative sample of all site types present from each temporal period. Within each temporal/site type category (i.e., each cell of the sampling matrix) the sites selected should be those that are best-preserved as indicated by their geomorphological context [note that the geoarchaeologic units are not a reliable indicator of site condition at the scale mapped in Chapter 2], the presence of buried features, and the presence of charcoal/ash stains or midden deposits. During the initial phases of excavation, the sample should also be weighted in favor of sites with visible features, since they appear to have a greater potential of yielding absolute dates and archeobotanical remains.

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CHAPTER 5

RESEARCH DESIGN IMPLEMENTATION

by Patrick Hogan and Richard C. Chapman

The research outlined in Chapter 4 proposes to treat southeastern New Mexico as a laboratory for the long-term study of Native American cultural adaptations in the ecological and cultural frontier of southeastern New Mexico. The initial phase of that research focuses on 1) refining the cultural chronology for the region; 2) identifying changes in subsistence and settlement strategies in response to changing demographic and environmental conditions during the late Pleistocene and Holocene; and 3) defining the cultural/ethnic/economic boundaries of contemporary groups. Emphases during that research are given to pattern recognition and temporal sequencing.

RESEARCH STRATEGY

Sampling Design

The research strategy for this investigation relies on a sampling approach that is both cost-effective and well suited for integrated research at a regional scale. Full implementation of the research design will require survey of an area representative of environmental variability in the region and data recovery at a representative sample of sites from each temporal period. Adequate survey coverage is needed to ensure that the sample of sites selected for excavation reflects the full range of temporal and site type variability within each RSU. Further, initial settlement pattern analyses and predictive models of site location will necessarily be based on survey data. A representative sample of excavated sites is needed to provide the basic chronological, subsistence, and settlement data required to address the research issues outlined in Chapter 4.

As a first step in the environmental stratification process needed to support this sampling strategy, southeastern New Mexico was divided into nine Regional Sampling Units (RSUs). As discussed in Chapter 2, the western portion of the region was divided into four RSUs encompassing drainage basins flowing from the Sacramento and Guadalupe Mountains to the Pecos River. From north to south, those RSUs are the Pintada Arroyo-Yeso Creek basin, the Rio Hondo-Arroyo del Macho basin, the Rio Penasco-Rio Felix basin, and the Seven Rivers-Dark Canyon basin (Figure 2.8). The eastern portion of the region was divided into five RSUs on the basis of physiographic differences: the Pecos River Valley, the Upper Canadian River drainage, the Llano Estacado, the Mescalero Plain, and the Portales Valley. The regional sampling units reflect gross physiographic and hydrological variability across the region that may have played a role in conditioning the character of prehistoric and protohistoric human settlement of the region through time.

As research progresses, a more detailed stratification of environmental variability in each RSU needs to be developed. Suggested variables for this second-level stratification include vegetation, elevation, topography, soils, and hydrology. We anticipate that this second-level stratification will occur in conjunction with the development of predictive models of site location. These data can also be used to develop a stratified survey sampling design for the RSU.

NMCRIS data indicate that survey coverage in the RSUs as of October 2004 range from 0.52% for the Llano Estacado to 8.2% for the Mescalero Plain, with most of the survey in the region concentrated in the southern part of the Mescalero Plain and the Seven Rivers-Dark Canyon drainage basin (Chapter 3). These figures are below the 10% coverage generally considered the minimal sample size for model development, which suggests that the sample of known sites associated with the individual RSUs may not be representative of the full range of temporal periods and site types within the unit. Consequently, a more detailed evaluation of the survey coverage and sample of known sites in each RSU is needed, and additional surveys in some RSUs will probably be necessary before the research design can be fully implemented.

Samples of sites for excavation will be selected independently for each RSU using a cross-tabulation of known site by temporal period and site type as a sampling matrix. Provisional temporal periods and site types were identified in Chapter 3, but these categories will be refined as work progresses. More fine-grained temporal divisions for the Archaic and Ceramic periods were suggested in the Chronology and Culture History problem domain in Chapter 4, and those refinements should be incorporated into the sampling matrices. In addition, the data coded in NMCRIS did not permit reclassification of the artifact scatters into more specific morpho-functional categories. Development of an expanded classification for artifact scatters, based on variability in the artifact classes present, should therefore have a high priority as an initial refinement of the site type categories.

In order to determine if particular site types were more likely to yield data needed to address the research questions, a preliminary assessment was made of the kinds of data recovered from excavated sites in the region (Chapter 3). Although the sample was too small to provide a definitive answer to the question, the analysis suggests that all of the site types are likely to yield some level of settlement data and, with the possible exception of artifact scatters and quarry/lithic procurement areas, all site types have an even or better chance of yielding chronological data. The recovery of subsistence data was more variable. The recovery rate for pollen was low for all site types except the long-term residences and the bedrock mortar sites, all of which had buried refuse deposits. Faunal remains were recovered from less than half (47%) of the excavated sites, and their presence or absence appeared more related to preservation conditions than site type. Macrobotanical remains were recovered from the two long-term residential sites, the two bedrock mortar sites, and high proportions of the ring midden and miscellaneous feature sites (all of the miscellaneous feature sites in the excavated sample had either ash/charcoal stains or midden deposits). The proportion of domestic scatters yielding macrobotanical remains was slightly lower (41%), and none were recovered from the artifact scatters or quarries. Overall, the results of the assessment suggest that site condition and the field methods employed during excavation were more important factors than site type in assessing the potential for yielding data relevant to the research design.

Field and analytical methods designed to meet the data requirements of the research design are discussed in Chapter 6. In order to further ensure that the sites selected for excavation yield the required data, site condition should be considered in choosing the sample. Specifically, the sample of sites selected for excavation from each cell of the sampling matrix should be those least affected by erosional processes. The two best indicators of site condition that we were able to identify are 1) geomorphological setting and 2) the presence of charcoal/ash stains or midden deposits.

A geoarchaeologic map of southeastern New Mexico was formulated during development of the research design (Chapter 2) in an effort to provide a general indicator of site visibility and site condition. The major limitation of this approach is the coarse scale at which geomorphological deposits in the region are mapped (Figure 2.2). With respect to survey, the geoarchaeologic units are useful for defining broad areas where buried sites may be present but small areas of Holocene sediments that might contain buried cultural deposits (e.g., Holocene alluvium in drainages and shallow colluvial and eolian deposits) cannot be shown. The geoarchaeologic units also permitted us to make some broad generalizations about average site condition in the RSUs but, based on our assessment of the excavated sites, they are a poor predictor of the condition of individual sites. These results indicate that geomorphological investigations and mapping of Holocene deposits at a larger (1:24,000) scale should be a high management priority. They also indicate the need for subsurface testing, either during survey or in a separate testing program, in order to provide the data on site-specific geomorphological context required to evaluate site condition when a sample of sites is selected for excavation.

Modeling

A second critical component of the research strategy is the use of modeling in conjunction with data recovery. Specifically, we envision an initial stage of pattern recognition studies using available data and concurrent development of preliminary models. The implications of the preliminary models would be tested using data collected through excavations at an initial sample of sites. The models would be refined based on the results of the tests, new test implications would be generated, and data recovery at a new sample of sites would be undertaken. This cycle would be repeated until the input of new data failed to improve the predictive or explanatory power of the models.

This iterative process highlights two advantages of integrating modeling into the research. First, it provides a framework mandating periodic syntheses of the data and research. Second, in refining the models, new test implications are generated that guide future research. Modeling also makes maximum use of sites with limited data potential, an important consideration in southeastern New Mexico. Associations between sites and environmental variables in the region can be investigated even if nothing is known about the site other than its location. If enough information can be gleaned from the site to estimate its age and character (i.e., site type), then the utility of the model for discerning settlement patterns is increased significantly. As settlement patterns characteristic of each temporal period are recognized, sites of unknown age and cultural affiliation that conform to a particular pattern can also be identified.

Similarly, the development of a diet breadth model for potential food resources in the region, in conjunction with information about the spatial distribution and seasonal availability of those resources, will allow the development of general models of subsistence strategies. Those models, in turn, can be used to predict which subsistence resources were being procured in different parts of the region, as well as the seasonality of occupation. When combined with the settlement pattern data, those predictions can be used to generate models of the settlement-subsistence strategies employed during each temporal period. The models will, of course, need to be tested against the settlement and subsistence data recovered from a representative sample of sites, but they provide a secure basis for generalizing from that site-specific data to similar sites from which no direct evidence of subsistence activities can be obtained.

Finally, and perhaps most importantly, modeling provides a mechanism for introducing dynamic explanatory concepts into the research. As discussed in Chapter 4, modeling of subsistence strategies is based on optimal foraging theory and general hunter-gatherer theory. Among the relevant explanatory concepts arising from these theories are diet breadth; risk-minimization strategies – diet diversification, the use of storage to even out temporal incongruities in resource availability, division of labor, and intra-group sharing; intensification of resource procurement in response to demographic pressure, including cultivation; competition among groups for resources; and extensification. In reconstructing settlement systems, we have focused on modeling mobility strategies using Binford’s distinction between residential and logistical mobility, and the implications of transportation costs. For horticulturalists, we also introduced the concept of land-extensive versus land-intensive agricultural strategies.

Addressing the Research Questions

The research questions presented in Chapter 4 are addressable only in part through the model development and model testing process. Some relate to group identity, the movement of groups, or the sequencing of historical events – questions that complement and extend the issues of settlement and subsistence strategies. Consequently, although the iterative modeling process provides clear landmarks for assessing the progress of research, it does not fully provide the proposed mileposts requested by the BLM “to judge when particular research questions have been adequately addressed” or when “the data potential of a particular site type has been adequately utilized and applied to appropriate research questions.”

In archaeological research, there are no definitive answers to research questions, in part because the scientific method is based on hypothesis falsification. Alternative hypotheses inconsistent with the data are rejected during testing, but the remaining hypotheses are not proven since there is always the possibility that new data inconsistent with those hypotheses will be uncovered. Progress in archaeological research therefore proceeds explicitly or implicitly through an intermittent cycle of hypothesis or model formulation, testing, and refinement. It therefore seems to us that sampling fractions could serve as mileposts for judging the progress of the research. An initial sampling fraction would be proposed that would provide a minimum ample of excavated sites to provide the data needed for initial model refinement and hypothesis testing. New hypotheses and test implications would be generated and another sample of sites would be excavated to provide data for further testing.

The BLM argued that this proposal was inconsistent with their cultural resource management objectives, however, and we have struggled to come up with an alternative approach to the problem. We began by rephrasing the questions as *when do we have sufficient data to address the question?* Conceptually, excavations to recover data relevant to a particular research problem can be envisioned as a logarithmic curve of labor effort to information. In the early stages of research, new information accumulates rapidly but at some point, the curves nearly levels off and considerable effort must be expended to obtain any new information. The objective, then, is to identify that point of information fall-off. For this research design, that point can be approximately defined as when we can begin moving from site-specific data to justifiable generalizations about the nature of prehistoric and protohistoric occupations in some part of the region (i.e., in an RSU). In other words, it is the point at which new observations provide data that reinforce patterns that have been recognized previously rather than illuminate new patterns.

In establishing priorities for the research questions (Chapter 4), we argued that they form a nested set such that questions at the highest scale of inquiry (regional/integrative) could not be addressed until questions at the intermediate area/generalization scale had been answered. Those questions, in turn, could not be addressed until questions at the site/component scale had been answered for a representative sample of sites in the RSU. Applying the reasoning in the preceding paragraph to these different scales of inquiry, it seems probable that decisions about when research questions have been adequately addressed will be made at an intermediate scale during the early stages of research design implementation, at the level of the RSU or some equivalent management unit. It is also clear that the decisions will have to be made independently for each temporal period.

The question of when an area was occupied, for example, would be adequately addressed when the culture chronology for the area had been refined to the extent possible and when enough sites had been dated to clearly indicate trends in the intensity of occupation across the refined temporal periods. The question of which sites were contemporary, in turn, would be adequately addressed when there were enough dated sites associated with each refined temporal period to characterize the settlement patterns. Questions about subsistence strategies at the area/generalization scale would be adequately addressed when there was sufficient data to warrant generalizations about the dietary staples, the food resources being targeted in the area, and any seasonal variation in subsistence activities during each of the refined temporal periods.

With respect to settlement/mobility strategies, question at the site/component scale would be adequately addressed when generalizations could be warranted about the variability in the kinds of sites associated with each refined temporal period. The first level of generalization under this problem domain is the definition and refinement of site types, which are intended to reflect patterns of variability in the range of activities conducted at the site, the size and composition of the resident group, and the duration of the occupation. The site typology proposed in this research design represents a very preliminary step towards this objective, and it is expected that excavation data from the first sample of sites will exhibit considerable variability along these three behavioral dimensions within any one site type. As the site type definitions are refined, that variability should diminish until all sites in each site type evidence a uniform core pattern of behavioral attributes. Once this point is reached, the questions at the area/generalization scale can be addressed. As those questions relate directly to discerning spatial patterns in the distributions of site types during each refined temporal period, they would be adequately addressed once the patterning is recognized and verified.

Once questions at the area/generalization scale are adequately addressed for a particular problem domain, research can potentially consider questions posed at the regional/integrative scale. Because the research design is integrated, however, some of those questions are addressable only after all questions at the area/generalization scale are answered. Many others require comparable data from multiple RSUs. Consequently, investigations may have to be refocused periodically on different areas or particular problem domains before significant progress can be made toward answering the major regional research issues.

RESOURCE MANAGEMENT PLAN

Ideally, implementation of the research design would be an orderly staged process in which the research effort was spread more or less equally among all parts of the region. Sample surveys within each RSU would be completed before excavations were initiated, and priority would be given to filling major data gaps such as the identification of sites dating to the early and middle Archaic and Protohistoric periods. Preliminary work to refine the temporal periods and site types would also be completed before excavations to allow the formulation of more precise sampling matrices for the RSUs. Concurrently, a diet breadth model for the region and preliminary predictive models of site locations for the RSUs would be developed. As needed, test excavation programs would also be completed before the initial samples of sites were selected for excavation, and large-scale mapping of geomorphological deposits would proceed. Excavation of a representative sample of sites in each RSU would then begin, initiating an iterative cycle of model development, testing, and refinement.

If past events are any indication, then nothing like this orderly process is likely to occur. Archaeological research in southeastern New Mexico is driven largely by energy development in the southern part of the region, and by sporadic transportation, water, and municipal development project elsewhere in the region. Most cultural resource management projects are surveys and opportunities for excavations outside of the oil and gas fields are limited. Bowing to this reality, we propose that the RSUs be used as provisional management units and, in the case of the Mescalero Plain, that it be divided into northern and southern management units. This will allow the initial phases of the research design to be fully implemented in units where there is rapid development (i.e., the southeastern New Mexico oil and gas fields), while research in the rest of the RSUs progresses as opportunities for research arise.

There are two major shortcomings to this management strategy. First, although progress toward answering lower-scale research questions could be relatively rapid in the southernmost parts of the region, few of the questions posed at the regional/integrative scale – including most of the major cultural historical questions – are addressable until basic chronological, subsistence, and settlement data are obtained from most or all of the regional sampling units. Second, implementation of the research design will require adaptive management of cultural resources in all of the management units, even those in which there is little or no ongoing development.

At a minimum, there should be an initial assessment of previous surveys and excavations in each RSU to determine base-line data currently available. A GIS database should also be developed for each RSU showing the areas surveyed and the locations of known sites by temporal period and site type, as well as geoarchaeologic units and other environmental strata (e.g., vegetation, geomorphology, soils, hydrology). The latter data can then be used to develop a stratified survey design to sample environmental variability in the RSU. Finally, a sampling matrix should be developed for known sites in the RSU with annotations concerning which site types from which temporal periods have been investigated by previous excavations. With these baseline data, managers can monitor progress toward the basic management objectives listed in Table 5.1.

For the few RSUs/management units with intensive ongoing development, active management will be necessary. Most of the RSUs, however, will probably require only annual reviews by the cultural resource manager to track progress toward the management objectives, and to update the GIS database and sampling matrix to incorporate any work completed during the year as well as any refinements to the temporal periods and site types.

The modeling projects proposed as part of the research design are intended in part to compensate for uneven progress of research in the region. Development of the diet breadth model, in particular, will allow predictions about the kinds of food resources likely to be targeted in a particular area and the most likely season or season of resource procurement activities. Predictive models of site locations developed to inform cultural resource management decisions in the RSUs can also be used to provide clues about settlement patterns in the region, particularly as refinements to the temporal periods and site types resulting from excavations in areas of ongoing energy development are applied to the other RSUs. The success of this approach will depend heavily on the quality of the survey data, however, since survey data will have to be substituted for excavation data for most of the RSUs in order to address any of the regional research issues in anything like a reasonable time frame. For that reason, the final section of this chapter provides recommendations for improving the quality of the data during surveys in the region.

The management strategy proposed here presents a number of challenges if the research design is to be implemented successfully. First, southeastern New Mexico and the individual RSU encompassed lands falling under multiple jurisdictions including the BLM lands, Forest Service lands, State Trust Lands, tribal lands, and private landholdings. Close coordination among these various stakeholder is necessary to ensure that all parties are working toward common objectives. Second, sustained funding is needed for the proposed research. Although much of the survey and excavation can probably be completed in the context of developer-funded cultural resource management studies, separate funding may be needed for the model development projects, geomorphological studies, and paleoenvironmental research that are critical components of the research design. Third, assuming that most of the research is conducted in the context of compliance-driven projects, the research strategy must be fully integrated into the Section 106 compliance process. Finally, there must be some single entity that is responsible for coordinating and sustaining the long-term research effort, which could be either a lead agency or an oversight committee with some institutional support.

Table 5.1 Basic Management Objectives for Each Regional Sampling Unit or Equivalent Management Units.

Initial Priorities

1. assess previous surveys and excavations in each RSU to determine base-line data currently available.
2. compile GIS database

Survey

1. develop survey sampling design – stratified random sample based on selected environmental variables
2. complete sample survey

Geoarchaeology

1. use geoarchaeologic units to determine where subsurface survey and testing techniques should be employed
2. complete large-scale mapping of geoarchaeologic deposits, giving priority to drainages and areas of mixed sediment (Units IIA then IIB)

Excavation

1. develop site sampling matrix for RSU using current temporal divisions and site types
2. complete excavations of a minimal representative sample of known sites to obtain base-line chronological, subsistence, and settlement data

Modeling

1. as survey coverage approaches target for minimal representative sample, develop preliminary models correlating site locations with environmental variables
2. as data become available, refine temporal periods and site types
3. develop preliminary settlement and subsistence models
4. generate test implications to guide future survey and data recovery
5. refine models based on results of testing
6. repeat cycle

Recommendations for Survey

One of the biggest stumbling blocks in trying to use the corpus of survey data compiled thus far for southeast New Mexico in modeling past human settlement is the inconsistent nature of observations made of that record at the level of discovery survey. These inconsistencies are documented in Chapter 3, and relate to a clear lack of commonality among field researchers in defining and mapping site boundaries, feature locations, or artifact distributions; or commonality in describing features and artifacts. Fully 60% of the site records lack counts of artifacts for example, and less than 25% of the site records contain notes on the artifact assemblage characteristics. Further, terminology used to describe some kinds of features (such as charcoal/ash stain or midden) have no commonly agreed definitions.

Key elements that need to be emphasized in developing a “best practices” survey documentation strategy include the definition of site boundaries, mapping the locations of features within those boundaries, developing a common and replicable lexicon of descriptive terms to characterize features, and documenting the association of artifacts and features at sites.

Artifact assemblages need to be described, preferably using forms which document basic attributes of chipped stone (cores, debitage, tools) and ground stone (manos, metates, pestles, mortars etc.) that can be used to assign both functional and cultural meaning to the assemblages. A significant improvement would be the production of a manual of lithic materials types and known sources, following the lead of that presented by Wiseman in Chapter 6, so that a common basis for materials could be used. Ideally, independent studies directed toward identification of geological sources of lithic raw materials could result in the compilation of descriptions and type collections made available for use by field researchers. Similarly, manuals of projectile point styles, and ceramic types, designed to reflect the sub regional variability found in the southeastern New Mexico study area, would be invaluable.

It should be emphasized that for many of the land surfaces in southeast New Mexico, the surface visible archeological record being documented during survey is in fact the *entire* record—no subsurface remains exist for many parts of the region. Survey activities need to regarded as primary data acquisition, not just a documentation of places with sites.

Finally, we would argue that discovery survey should, where appropriate, entail a program to conduct geomorphological testing in selected geomorphic units to refine the classification scheme identified by Hall in Chapter 2. This work can be done at any point in the assessment-survey-mitigation process. In terms of research priorities, targeting selected alluvial settings to search for buried sites, and to gain a better understanding of the chronological sequencing of valley sedimentation, could productively be done in conjunction with initial surveys, or as survey projects themselves. Another useful application of geomorphic sediment testing would be to select a sample of previously documented “lagged out” sites in Unit IB and IIA surfaces, to identify areas that might contain additional buried sites. A concerted program of training for field archeologists in recognition and description of surface geomorphology would provide great benefits in future modeling efforts using the results of survey data.

SUMMARY

The recommendations offered here basically propose to establish a management process wherein data gathered through continued archeological survey, geomorphological testing, and site excavation can be brought into an ongoing evaluation of redundancy among the different dimensions of human settlement and subsistence behavior reflected through time across physiographic strata and geoarchaeologic units. In this conceptualization, continued refinement of the geomorphological model would be made possible through data input both from trained observations made by archeologists during field survey, and from results of targeted soil testing. Refinement of the chronology of site occupancy in different regional sampling units would be made through the addition of data derived from targeted archeological site excavations, as would refinement of behavioral dimensions of subsistence (resource acquisition, processing and consumption), residential group size, and repetitive site reoccupation. Overlying these site-specific dimensions of past behavior would be information bearing upon regional settlement reflected in source materials for artifact manufacture, projectile point styles, and ceramic type variation.

Using these variables, the present model of site typology could be refined along several dimensions which would more accurately reflect variation in the nature of prehistoric and protohistoric settlement. As new information is added to the database, the array of variables characterizing each site could be examined for redundancy with other sites both within and between physiographic strata and geomorphic units. Ultimately, these levels of redundancy could be defined such that patterning in spatial distributions of sites, chronological terms of occupancy, specific subsistence behaviors, and interregional relationships could be identified. These patterns could then serve as the basis for developing a comprehensive modeling tool for future management decisions.

CHAPTER 6

STANDARDS AND GUIDELINES FOR TESTING AND DATA RECOVERY

Assembled by Richard Chapman and Peggy Gerow with Contributions by
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This chapter presents general standards and guidelines for archaeological excavations in southeastern New Mexico. Comparable field methods are required to facilitate Bureau of Land Management evaluation of data recovery plans, and to establish minimal standards for excavation that maximize the chances of obtaining the basic chronological, subsistence, and settlement data needed to address the research issues identified in Chapter 4. Comparable field and analysis methods will also facilitate the intersite comparisons that are critical to the successful implementation of the regional research design.

The chapter is divided into three sections. The first section outlines excavation strategies, the basic approaches employed in the investigation of different kinds of sites. The second section provides more detailed guidelines for the field methods employed during those excavations. The third section provides data comparability guidelines for the collection and analysis of different classes of samples and artifacts expected to be found among the Southeastern New Mexico site types.

EXCAVATION STRATEGIES

by Patrick Hogan

As a preface to the discussion of excavation strategies, it is worthwhile to review the overall sampling strategy advocated in the research design. Briefly, a long-term goal of the research design is to obtain basic chronological, subsistence, and settlement data through the excavation of a representative sample of sites in southeastern New Mexico. As a first step toward that goal, we have divided the region into a series of regional sampling units (RSUs) that reflect coarse-grained environmental variability that may have conditioned human adaptations in the region through time. As research progresses, it is expected that other environmental variables will be employed to subdivide each RSU into strata that can be used to more precisely sample environmental variability within the unit.

The next step in the process is to select a sample of sites for excavation that reflect the variability of the known sites within each environmental stratum. To facilitate that process, we have grouped the sites in southeastern New Mexico into provisional temporal period and component type categories. Again, as research progresses, both the temporal periods and site types should be refined providing an increasingly detailed characterization of site variability. For this initial effort, however, a sampling matrix for each RSU can be obtained by cross-tabulating our preliminary temporal and component type categories. Using this matrix, cultural resource managers can calculate the proportion of sites in each category needed to provide a minimum representative sample of site variability within the RSU – a long-term target for excavations within the unit. Those figures will be a more significant factor as the number of excavated sites in the RSU increases. In the early stages of work, however, site condition is likely to be the overriding factor in determining which sites in any given group should be excavated since subsistence and chronological data are most likely to be recovered from the better-preserved sites. In addition to choosing the best-preserved sites in each category, managers may elect to sample higher proportions of the site categories most likely to yield these data (i.e., residential sites and sites with thermal features).

As with the selection of sites, the excavation strategy employed for data recovery is driven by the data requirements of the research design and the nature and condition of the site being investigated. The priority given to the recovery of chronological and subsistence data mandates an emphasis on the investigation of features where organic materials are most likely to be preserved. Similarly, the priority given to acquiring settlement (site-structure) data and the need to recover large artifact assemblages dictate areally-extensive excavations and, with some exceptions, the investigation of entire sites. How these general approaches are applied varies with the class of sites. For southeastern New Mexico, the relevant classes are caves and rockshelters, sites with substantial architecture, and open sites.

Caves and Rockshelters

(Cave and Rockshelter Component Types)

Caves and rockshelters provide a protected or partially protected depositional environment that potentially contains stratified cultural deposits and in which organic materials are more likely to be preserved. The excavation strategy for these sites therefore emphasizes vertical exposures and the recovery of subsistence data. Prior to any excavations, a 1 by 1 m grid system and an elevation datum should be established at the site, encompassing both the sheltered area and the open area immediately fronting the shelter opening or cave mouth. Typically, the elevation datum is permanently marked at a convenient point on the cave or shelter wall. The site is then mapped. Maps should include both a plan and profiles of the shelter or cave and a finely scaled topographic map of the modern ground surface.

Most cave and shelter sites in southeastern New Mexico have been vandalized, so after mapping, the first step in the excavation is often to clear the spoil dirt from the excavation area and to face up any looter’s pits. Screening the spoil dirt may recover substantial materials, albeit of uncertain provenience, and examination of the looter’s pits may be useful in discerning the site stratigraphy. After clearing any looter’s spoil or initially if the site is undisturbed, one or more trenches should be dug across the drip line and into the shelter interior. Excavations should be dug in 1 m grid units and natural stratigraphic levels if at all possible or 10 cm arbitrary levels oriented on the same plane as the modern ground surface. All excavated sediments should be screened through 1/8 in mesh hardware cloth. Any features encountered during the excavation of the trench(es) that extend into adjacent units may be pedestalled if they do not interfere with exposure of the profile. Once the trenching is completed, the trench walls should be carefully examined, preferably by a geomorphologist or geoarchaeologist, to define and describe the site stratigraphy. Trench walls should be thoroughly documented using a combination of narrative description, profile drawings, and photographs. If deposits in the cave or shelter are much more than 1 m deep, the trench walls will either have to be shored in accordance with OSHA guidelines or the excavation will have to be “stepped back,” expanding the trench width. This will require that the excavator maintain one or more “floating profiles” to document the site stratigraphy, which requires particularly careful attention to elevation controls.

Once the site stratigraphy is established, the emphasis shifts to horizontal exposure of the successive occupation levels. Ideally, this will be a top-down process, beginning with the uppermost occupation level and working downward through the deposits. Excavations are expanded outward from the trench wall following the natural stratigraphic units to expose the occupation surface and any associated features, including any refuse deposits or work areas on open areas and slopes beyond the shelter or cave. This ideal is rarely achievable. Strata may pinch out or be interrupted by aboriginal excavation or animal burrowing, or the sediments may be thoroughly mixed by burrowing rodents and other pedo-turbation processes. Excavation areas might be blocked by outcropping bedrock, rock-falls, or features originating at higher levels, or the need to stair-step excavations in deep deposits will preclude the full exposure of the entire occupation surface. All of these potential impediments emphasize the need to maintain careful three-dimensional provenience controls for all excavated sediments and to continually update maps and profiles for each excavation units as well as master maps for each occupation surface.

In excavating the individual units, the excavator is first concerned with maintaining stratigraphic control; that is, with the removal of a single stratigraphic unit or, if the stratigraphic unit is thick, with the removal of 5–10 cm arbitrary levels within that unit. The plane of these excavations should conform to the dip and strike of the stratigraphic unit. During excavation, any obvious animal burrows or other areas of disturbance should be plotted in plan and profile, and the materials recovered from those areas should be kept separate from the materials recovered from the natural stratum. Any artifacts encountered during the excavations should be piece-plotted in three dimensions, while materials from the screen are provenienced to the grid square and stratum or level. If features are encountered during the excavations, then the excavations in that unit should be halted whenever practical, and excavation should shift to adjacent units to fully expose the feature and any activity area surrounding it before the feature itself is excavated and sampled.

Dating is a particular concern with stratified deposits. Ideally, samples for dating should be collected from the base and top of each stratum to date the depositional events in addition to the multiple dates collected from each occupation surface. Samples for radiocarbon dating should be collected away from any obvious areas of disturbance and preference should be given to charred materials from annuals or short-lived shrubs to minimize the interpretative problems associated with cross-sectional effect and the old wood problem. With the ready availability of AMS dating, there is rarely a need to rely on samples of mixed charcoal collected from multiple excavation units within a stratum. Such samples are likely to included some displaced materials and at best provide a mean date for the depositional event. Dating of occupation surfaces should ideally be based on multiple samples from hearths or other clear cultural contexts to determine if the occupation represents single or multiple occupational episodes. Although radiocarbon dating is likely to be the principal method employed, the opportunity to employ other dating methods should also be exploited, particularly the more precise methods such as dendrochronological and archaeomagnetic dating. Direct dating of artifacts or subsistence remains, particularly cultigens, should also receive priority whenever appropriate.

Organic preservation at shelter and cave sites generally ranges from good to excellent, so sediments should be sampled liberally to recover archeobotanical and faunal remains. Generally, the entire fill from thermal features should be bagged for flotation, as should large samples from any refuse deposits. If organic materials are well preserved, then samples should also be taken from activity areas associated with the occupation surfaces to recover organic materials trampled into the sediments. Coprolites should be collected whenever present. Pollen and phytolith samples should be collected from the same contexts as the flotation samples, and also by column sampling of strata exposed in soil profiles. Any ground stone recovered from the deposits should also be bagged for pollen/phytolith washes. In processing flotation samples, the heavy fraction should be routinely screened through window screen to recover small bone fragments and artifacts.

Shelter and cave sites are a relatively rare and potentially extremely valuable cultural resource. For that reason, excavations at these sites should be undertaken with exceptional care and, if preservation and protection of the site is practical, then a portion of the deposits should be preserved for future research. In those cases, the excavator needs to be particularly careful in backfilling the site to avoid damaging the remaining deposits either directly or indirectly by altering the conditions that preserved those deposits in the first place. The ground surface should be contoured to direct runoff away from the shelter, and geo-cloth rather than plastic should be used to protect profiles to avoid concentrating soil moisture in the remaining deposits. Excavated areas should be clearly marked so they can be distinguished during future excavations, and permanent grid and elevation data should be placed so that provenience controls can be re-established.

Architectural Sites

(Single Residence, Multiple Residence, Residential Complex/Community, and Possible Structure Component Types)

The strategies employed in the excavation of sites with substantial architecture (i.e., pithouses, surface rooms, and roomblocks) are familiar to most archaeologists working in southeastern New Mexico and require only a cursory review. After mapping and surface collection, excavation efforts are typically directed first at locating buried structures and features using a combination of backhoe trenches and auger holes or shovel test pits. Systematic tests using the latter techniques are generally effective in these situations because the areas involved are relatively small, while the structures are relatively large and frequently marked by areas of ash and charcoal stained sediments.

Once the structures are located, the framework of the site structure is discernible, and the level aboriginal ground surface can be estimated using the levels of origin for the pithouses and surface structures. Areas surrounding the structures can then be cleared to the aboriginal ground surface by shovel scraping and, if necessary, mechanical stripping to expose outdoor work areas and midden deposits. Although many past excavations have tended to focus on the investigation of architectural features, equal attention should be given exterior areas and features, which often yield the bulk of subsistence remains. If organized midden deposits are present, they should be trenched to identify any discernible stratigraphy. The refuse deposits should then be excavated in natural stratigraphic units or arbitrary levels if no stratigraphic breaks are evident in order to recover artifact samples and subsistence remains associated with the different occupation periods. Similarly, the fill of structures should be explored initially by trenching to determine if any post-occupational refuse deposits or structural elements are present. When refuse deposits are found in the structure fill, they should be excavated and sampled in the same manner as midden deposits before proceeding with investigation of the structure. After testing, mechanical equipment can be used to remove the sterile fill from pitstructures down to a level within 10 cm above the roof fall, if present, or the floor fill. The fill of surface rooms must generally be removed by hand, but sterile fill can be removed as a unit, screening only a sample of the fill.

The regional sampling design uses sites as the sampling unit, which generally means that sites selected for data recovery should be fully excavated to provide the site structure data needed to address research questions posed under the settlement/mobility strategies problem domain. The larger Ceramic period sites make up only a small fraction of sites in the region, however. Given this fact, the inherent value of those cultural resources, and the effort involved in full excavation, sampling may be an advisable option at the larger multiple residences and residential complexes in areas where the site can be protected and preserved for future researchers. In such cases, the data requirements of the research design dictate that households and exterior activity or refuse disposal areas should be the basic sampling units, and that the entire site be carefully mapped to document the site structure and to provide a context for the sampled features. The definition of household is expected to vary at different sites. It may be a pitstructure and its immediately adjacent outdoor work areas, a combination of a pitstructure and associated surface rooms, a small, multi-room surface structure, or a suite of rooms within a larger roomblock. One of the goals of excavations at single-component, single residences is to refine the definition of households for different periods so that the can be applied to the investigation of multiple residences and residential complexes.

Open Sites

The great majority of known sites in southeastern New Mexico are broadly classified as open sites. They include a variety of component types – *artifact scatters, domestic features, ring midden/burned rock midden, bedrock mortar, quarry/lithic procurement, and miscellaneous features* – but the excavation strategies employed in their investigation are similar and vary primarily with respect to whether the site is surficial or buried.

The overall excavation strategy for open sites is based on the general model of site structure discussed in Chapter 4. Open sites are expected to be the remnants of camps occupied by residential groups or task groups, both of which may be associated with specialized processing facilities (e.g., ring midden/burned rock middens and bedrock mortars), or the remnants of limited activity areas (e.g., lithic procurement/workshop areas and hunting stands) that may also have associated camp components. In either case, the sites are expected to consist of one or more activity areas. Most often, those activity areas will be centered on some type of feature. Minimally they should be evident from the artifact distribution, which is expected to reflect refuse disposal patterns, although this patterning may be partially obscured by overlapping occupations at sites that were utilized repeatedly and by the effects of post-occupational erosion and pedo-turbation processes.

One implication of this general model is that excavations are most productively focused in the general area of features and artifact concentrations. Although obvious to any archaeologist, this observation has implications for the regional sampling design that are not as apparent. We have argued previously that sites are the basic sampling units and that the sites included in the sample need to be fully excavated in order to achieve the objectives of the research design. Implicit in this argument is the assumption that the boundaries defined for sites on survey generally correspond to artifact concentrations and/or feature clusters; that is, to the areas most intensively used or occupied by prehistoric groups. Review of the survey records suggests that this assumption is incorrect for many of the larger open sites identified in southeastern New Mexico, however. As mapped during survey, many of those sites encompass several widely spaced artifact concentrations and/or feature clusters, often with little or no cultural material in the intervening areas. In dunes, the concentrations may be exposed in several adjacent blowouts, while the blowouts between clusters are devoid of cultural materials. At these large sites, the artifact/feature clusters rather than the site are the logical units of study. Consequently, those clusters should be treated as separate sites in selecting the data recovery sample.

The general site structure model also has implications for the scale of the excavations. For features, any artifacts are expected to exhibit a drop zone-toss zone discard pattern, so excavation of an area extending at least 2-3 m from the feature would be necessary to recover discarded artifacts and food refuse associated with the use of that facility. A larger area would have to be cleared to locate structures or sleeping areas that might be associated with hearths marking food preparation areas. Further expansion of the excavation would be needed to locate any other households occupying the camp, and activity areas and refuse deposits on the periphery of the living space. For hunter-gatherers in semi-tropical environments, camp size is reported as 44–531 sq m for the Efe (Fisher and Strickland 1991), 550–1,250 sq m for the Hadza (O'Connell et al. 1991), 175–896 sq m for the !Kung, and 9,496–152,776 sq m for the Western Aborigine (Gould and Yellen 1987). As the Aborigine camps are semi-permanent settlements near homesteads or on government preserves, their size is probably outside the range for prehistoric camps in southeastern New Mexico, although possibly not for some repeatedly occupied locales. The figures for the other groups, however, are relatively consistent and suggest that an area of 500–1000 sq m should be excavated in investigating residential sites.

Surface Sites

As defined here, surface sites are sites on old erosion surfaces mantled by shallow (0–30 cm) accumulations of more recent sediments. There appear to be two general processes through which these kinds of sites were formed. The first is that materials at the site were originally deposited in deeper sediments covering the erosion surface that were subsequently worn away. Sites formed by this process are therefore secondary deposits, potentially consisting of materials from multiple occupation episodes of varying age. It seems unlikely that datable materials and subsistence remains would be preserved at these sites but, where wind was the dominant erosive agent, elements of the site structure may be discernable.

Based on the discussion of regional geomorphology in Chapter 2, it appears that surface sites formed by this process are probably those dating from the Paleoindian through middle Archaic period. Despite their limited data potential, sites with temporally-diagnostic artifacts characteristic of those periods are therefore likely to be selected for data recovery under the regional sampling design proposed here.

Alternatively, surface sites may be the remnants of occupations occurring on the erosion surface itself, which is more probable for sites dating to the late Archaic through Protohistoric period. As discussed by Hall (Chapter 2), cultural materials at sites will have remained at or near the surface since they were deposited, and been subject to pedoturbation and localized erosion. Turbation processes tend to obscure occupation surfaces and feature margins, and to displace artifacts and other cultural materials both downward into the underlying sediment matrix and upward into any post-occupational sediments that may have accumulated. This process will result in a mixing of materials associated with different occupational episodes at multi-component sites.

The scale of displacement tends to be on the order of centimeters, however, so the basic framework of site structure is likely to be obscured but not destroyed, particularly in cases where features at the site were dug into the erosion surface. Datable materials and subsistence remains will be subject to some degradation depending on the age of the site and the degree of protection offered by post-occupational sediment accumulations. Nevertheless, there is a possibility that these materials can be recovered, as illustrated by the discovery of substantial refuse deposits at the Los Molinos site (Wiseman 2004:15–65).

At these sites, the data requirements of the research design dictate an emphasis on the investigation of features and extensive excavations around features to recover representative samples of the associated artifacts. At open sites, structures and thermal features are the locations most likely to yield archeobotancial and faunal remains, and samples for absolute dating. The artifacts provide information about the range of activities conducted at the site, and the assemblages may include temporal diagnostics that can be associated with absolute dates. Because the analysis methods advocated here rely heavily on comparison and pattern recognition, both the size of the assemblages recovered from individual occupation areas and the number of occupation areas investigated must be large enough for statistical study. Finally, data concerning the spatial patterning of artifacts and features is needed for the site structure analysis, which is expected to provide information about group size and composition, as well as the probable duration and intensity of the occupations.

Given the shallowness of the deposit at open surface sites, the most effective excavation strategy for recovering those data is surface-stripping a large, contiguous area as advocated by Wiseman. As applied at Bob Crosby Draw, that strategy involves broad-scale excavation, “opening up vastly larger areas [in 1 by 1 m grid squares], consistently using finer screen sizes [i.e., eighth-inch mesh] to recover cultural materials, and dating large numbers of carbon samples” (Wiseman 2000:116). Although surface stripping an area of 1000–2000 sq m is labor-intensive, Wiseman argues that “recent projects conducted in this manner by the OAS have shown that such efforts are well compensated in terms of artifact-recovery rates, discovery of site features (including structures), and elucidation of intrasite patterning, even at sites where the excavation depth averages as little as 5 cm, and even at sites that have been heavily surface collected” (2004:145–146).

We can suggest only a few refinements to this approach. First, an additional element of the strategy should be the collection of large sediment samples from feature fill and other cultural deposits to recover subsistence remains, and the sampling of ground stone for pollen, phytoliths, and lipid residue. Second, the initial effort directed toward surface stripping can be reduced by excavating a checkerboard grid of 1 by 1 m squares. The probability that any features will be missed using this method is relatively low, and a large enough area is excavated to ensure the recovery of an adequate sample of artifacts. When subsurface features, cultural deposits, or artifact concentrations are found, the adjoining squares should be excavated to fully investigate those materials.

Buried Sites

Buried sites are wholly or partially covered by recent sediments, so the patterning of artifacts and features is obscured to a much greater extent than at the surface sites. Compared to surface sites, buried sites tend to be better protected from the effects of erosion and bioturbation, but they are not necessarily intact. Unless they were covered quickly, the sites are likely to have been subject to these processes before being buried. Consequently, the initial objectives in investigating buried sites are 1) to evaluate their condition, and 2) to determine the nature and extent of the cultural materials present. The primary impediment to the achievement of these objectives, and to the subsequent data recovery effort, is the depth of sediments covering the site.

Determining site condition is generally a priority since the sample of sites selected for excavation should include the best-preserved examples of the component types in each temporal category. An assessment of the geomorphological context provides an efficient means of evaluating the integrity of the cultural deposits at these sites. Ideally, this evaluation should be completed as part of the survey documentation or during a separate testing program, but it can also be done during the early stages of data recovery. If the geomorphological history of an area is known, as it is for the Mescalero Sands, then site integrity can usually be evaluated during survey through the excavation of a few 1 by 1 m test pits or a short hand-dug trench supplemented by auger holes or shovel test pits. If it is not, then the evaluation is best accomplished through backhoe trenching during a testing program or in the early stages of data recovery. Those evaluations should be made by a qualified geomorphologist or geoarchaeologist.

In his “Field Guide to the Geoarchaeology of the Mescalero Sands, Southeastern New Mexico”, Stephen Hall (2002) suggests that the Mescalero Sands comprises three eolian stratigraphic units which he labels Units 1, 2 and 3. *It is important to note that Hall’s (2002) Unit 1, Unit 2, and Unit 3 classification of stratigraphic units is not to be confused with his classification of Unit I, II, and III land surfaces identified in Chapter 2 of this volume.* Unit 1, the basal stratum, dates to the Pleistocene. It is capped by a paleosol that was partially eroded between 15,000 and 9000 years ago, exposing the red Bt horizon. Paleoindian materials occur on this erosion surface both *in situ* and as lag deposits. Unit 2 was deposited between about 9000 and 5000 years ago, and potentially contains intact late Paleoindian and early Archaic sites. There appears to have been little deposition or erosion between about 5000 to 500 years ago. Consequently, sites dating from the middle Archaic through Protohistoric periods are expected to occur on the upper surface of Unit 2. This surface is further marked by the Loco Hills soil, an A-horizon that appears to have developed between about 500 and 100 years ago. Unit 3, the uppermost eolian stratigraphic unit, was formed by deflation of the sand sheet and the formation of parabolic and coppice dunes as much as 2 to 3 m high. Hall estimates that deposition of Unit 3 was initiated within the last 100 years.

This ongoing period of localized deposition and erosion has differentially affected the integrity of sites on the upper surface of Unit 2. In some cases, sites have been completely deflated, leaving only lag scatters of artifacts and fire-cracked rock/burned caliche that may or may not retain some of their original patterning. In other cases, the deflation may have affected the artifact scatter but portions of features cut into Unit 2 have been preserved. Finally, some sites remain largely intact except for the effects of bioturbation, which tends to incorporate artifacts into the sediments in the upper part of Unit 2. At multi-component sites, another effect of deflation and bioturbation is to mix the artifacts associated with the different occupational episodes. Although sites buried by Unit 3 deposits are not necessarily intact (they may have been eroded before being covered), there is a higher probability that organic materials will be preserved in these protected contexts, and that the artifacts will retain some behaviorally-meaningful patterning. Further, there is little chance that the artifact assemblages have been picked over by modern artifact collectors.

If Unit 1 deposits are exposed, then all prehistoric sites should be on the surface unless the area is partially covered by recent Unit 3 dunes. Early Paleoindian sites might be partially intact in this context but, if Hall's assessment is correct, all later prehistoric sites will be eroded lag deposits. The information potential of these sites is limited to the data that can be obtained from the artifacts themselves. Consequently, unless Paleoindian or early Archaic materials are present, the sites would have a low priority for data recovery, and further testing would not be warranted except to determine the extent of the scatter. If Unit 2 deposits are present, then there is a good chance that any middle-to-late Archaic, Formative, or Protohistoric period sites are at least partially preserved, especially if the Loco Hills soil is evident. More deeply buried early Archaic and Paleoindian sites might also be present. Additional testing to determine the extent of the cultural deposits is warranted in this context.

Once the condition of the sites has been determined, priorities for data recovery can be established. With respect to site condition, the priorities would be 1) intact and partially intact buried deposits, 2) intact and partially intact surface deposits, and 3) eroded deposits. Although data recovery should focus on the better-preserved occupation areas, the condition priorities must be balanced against the need to obtain a large representative sample of the full range of occupations. Consequently, rare site types such as Paleoindian, early-middle Archaic, or Protohistoric components would be investigated regardless of condition. The need to sample the full range of morphological variability may also require that some of the more poorly preserved occupations be included in the sample.

The next problem is determining the nature and extent of the cultural deposits at the buried sites selected for data recovery. A variety of techniques have been employed in this effort, including systematic and judgmental tests with auger holes and shovel test pits (STPs), 1 by 1 m test pits, backhoe trenching, and mechanical stripping. Remote sensing techniques – ground-penetrating radar, resistivity, and magnetometer – are also available, but these methods have been rarely used in southeastern New Mexico, and their effectiveness cannot be evaluated here. Their potential should be explored in future projects, however.

Staley (1996:234–237) evaluated the effectiveness of the subsurface testing methods employed at 11 sites along the Potash Junction to Cunningham Station Transmission Line in Eddy and Lea Counties. Specifically, he compared auger holes (16 cm diameter), shovel test pits (44 cm diameter), shovel scrapes (upper 5–10 cm of loose sediments), test trenches (0.5 m wide, hand dug trenches of varying length), test units (1 x 1 m), block excavations (2 x 2 m), and backhoe trenches (0.7 m wide trenches of varying length). Except for backhoe trenches, he found that all of these methods were effective in recovering subsurface artifacts, although the test units and shovel scrapes had the highest recovery rates. In terms of the number of subsurface features discovered per volume of excavated sediments, block excavations and shovel scrapes were the most effective methods. The discovery rates per volume of excavated sediment were low for all other methods. In terms of discovery/recovery rates factored by average cost per unit volume of excavated sediment, shovel scrapes were the most cost-effective method; shovel tests, test trenches, and test units were moderately cost-effective. For discovering features, backhoe trenching was the most cost-effective method, and shovel scrapes and block excavations were moderately cost-effective. Based on these results, Staley (1996:236–237) suggests that the most cost-effective approach to testing and data recovery would be to employ shovel scrapes and backhoe trenching in the early stages of field investigations. Block excavations and test units could then be used sparingly during the later stages of the investigation to sample the cultural resources identified.

Staley (1996:234) emphasizes that his evaluation is not an independent test of the effectiveness of these methods, however, as they were used in combination in a step-wise strategy during the excavations. Auger holes and shovel test pits were used initially to probe for buried features or cultural deposits, and to provide information on site stratigraphy. Tests were typically conducted with a grid spacing of 10 m, but intervals were decreased in areas with evidence of cultural activities and increased to 20 m between the loci of large sites (Staley 1996:26). The placement of other units was heavily influenced by the locations of surface artifact scatters. Backhoe trenches and additional auger holes were used to identify cultural horizons adjacent to the scatters, and test units, block excavations, and additional backhoe trenched used to investigate those cultural horizons (Staley 1996:234). Shovel scrapes were placed in impact areas, in blow-outs with surface features, and within artifact concentrations. Test units and test trenches were used primarily to investigate features, and block excavations were placed in areas with known cultural deposits during data recovery (Staley 1996:27–28). Given this step-wise strategy, the effectiveness of auger holes and shovel test pits relative to the other manual excavation techniques may be under-rated and conversely, the effectiveness of shovel scrapes and backhoe trenches may be over-rated. The effectiveness of excavated 1 x 1 m and 2 x 2 m units, and hand-dug test trenches in locating buried cultural materials cannot be evaluated except in the context of recovering artifacts and discovering features within known cultural horizons.

Except for large-scale stripping, all of the excavation techniques involve sampling space to locate buried artifacts and features. Consequently, there is always some probability that some cultural materials at the site will not be found during testing. That probability is a function of the intensity of the testing effort and of the nature of the cultural deposits. Typically, buried open sites in southeastern New Mexico are expected to consist of a low-density artifact scatter with one or more localized concentrations of artifacts and/or features. The most common features are ash/charcoal stains usually a meter or less in diameter and fire-cracked rock or burned caliche concentrations that generally range from two to five meters in diameter. Less often, there are extensive cultural deposits marked by organic-stained sediments with charcoal and ash.

Based on the formulas presented by Krakker, Shott, and Welch (1983), the probabilities that features will be discovered using shovel test pits or auger holes dug in a 10 m grid are approximately .01 for features with a diameter of 1 m, .03 for features with a diameter of 2 m, and .20 for features with a diameter of 5 m. In order to increase the probability of discovery, the spacing of the test units should be reduced to a dimension approaching the diameter of the features being targeted. An initial reduction can be achieved without increasing the number of tests by staggering the test units in every other row (Krakker et al. 1983:472–473). The offset reduces the interval between tests to the height of the resulting equilateral triangles and therefore the probability of discovery is higher. Even with this improved sampling design, however, the probabilities for the discovery of feature 1 m, 2 m, and 5 m in diameter are approximately .10, .25 and .95, respectively for a sampling interval of 5 m, and .40, .78, and >.95 for a sampling interval of 2 m. A sampling interval of 1 m is required to ensure that all features are discovered.

The probability of discovering subsurface artifact concentrations would seem to be higher since the targets are larger, but the additional factor of artifact density must be considered. In the example used by Krakker, Shott, and Welch (1983:476), the probability of locating a scatter with an average density of 1 artifact/sq ft (ca. 9 artifacts/sq m) using a 1 sq ft shovel test pit is .63, which means that at least three test pits would have to dug into the scatter to ensure that an artifact is recovered from one of those units. The authors therefore argue that the size of the shovel test unit should be no smaller than the area in which there is a high probability of finding one item. Given the low artifact densities typical of open sites in southeastern New Mexico, this would probably require the use of 1 x 1 m or larger test units, and those units would have to be closely spaced to ensure the discovery of buried features.

Backhoe trenching is less costly than manual excavations, and trenching tends to be a more effective discovery method than circular or square test units because of edge effect. Assuming a random distribution of features, the probability of discovering buried features is roughly proportional to the area excavated relative to the area actually covered by features. Again, this would dictate extensive excavation of closely spaced trenches. With mechanical excavations, however, there is little chance of recovering subsurface artifacts, and trenching at a sufficient intensity to ensure that most buried features are discovered would preclude any analysis of artifact patterning. Widespread mechanical stripping seems a better option than large scale backhoe trenching. This method has proven effective in locating buried features on several projects (Akins 2003; Evaskovich et al. 1992; Simpson 2004a) but there are two problems. First, the artifacts associated with those features are displaced by the stripping process, so few artifacts are recovered and the site structure data provided by the artifact distribution is destroyed. Second, the stripping of large areas removes the vegetation, damages wildlife habitat and destabilizes the sediments, which accelerates soil erosion.

The sobering truth is that there is no low-cost method of systematically sampling a large area that has both a high probability of discovering any buried features, cultural deposits, and artifact concentrations, and that allows recovery of the full range of data needed to address the basic questions posed in the research design. The most appropriate approach available for reducing cost is therefore to reduce the size of the area that needs to be tested. This is probably best achieved using the methods employed on most excavation projects in southeastern New Mexico. Focusing the testing effort on areas with visible features or artifact concentrations is one part of this process. The second is the use of backhoe trenches and shovel test pits and small excavation units to determine the depth and extent of the cultural horizon in which the surface materials were originally deposited.

At this point, most data recovery projects employ either backhoe trenches or mechanical stripping to probe for buried features. Excavations by hand are generally limited to small block excavation and scattered test units, most of which are employed in the investigation and sampling of features. This approach is relatively effective in recovering datable materials and archeobotanical remains, but it provides little site structure data and may not yield a representative sample of artifacts or faunal material. A more effective approach once the depth and extent of the cultural horizon is known is to use mechanical equipment to strip away the overburden from a large area to a level about 10 cm above the cultural horizon. With the sterile overburden removed, the excavation strategy is the same as that employed at surface sites – manual excavation of a broad area. Based on the size of ethnographic documented hunter-gatherer camps the scale of the excavation are likely to be on the order of a 30 by 30 m area centered on the feature cluster, and could be larger at repeatedly occupied locations. The mechanical stripping and subsequent manual excavations could be staged, however, working outward from the features if the cultural deposits appear to have a more limited extent. Minimally, a 3 x 3 m area around small features and a 10 x 10 m area around larger features and structures needs be excavated. These units should be expanded to encompass the full extent of the artifact scatter and associated features within the occupation area. In defining the extent of the artifact scatter, however, the investigator must keep in mind that the living space in camps occupied for extended periods is often nearly devoid of artifacts since refuse is periodically cleared from these areas and dumped at the perimeter of the camp. The perimeter of the camp may therefore be marked by a relatively high artifact density that drops off sharply both toward and away from the camp.

FIELD METHODS

The following pages present excavation strategies for prehistoric open sites in southeastern New Mexico. Open sites are the most prevalent sites in the region and range from short-term single component use areas to palimpsests of repeated occupations spanning several hundred years. The sites include resource procurement loci, hunting overlooks, campsites, seasonal residences, and longer-term residences, and cross-cut all temporal periods. The excavation methods presented here are compiled primarily from data recovery projects conducted in the region within the past five years (e.g. Akins 2003; Condon 2002; Phippen et al. 2000; Simpson 2004b; Speth 2004; Wase et al. 2003; Wiseman 2004, 2002, 2000; Zamora 2000; Zamora and Oakes 2000). Wiseman's (2003) preliminary statement on excavation strategies prepared for the "Big Picture Committee" also served as a guide. The format used here follows that developed in “Standards and Guidelines for Archaeological Field Methods: Fruitland Coal Gas Research Design Cultural Advisory Group (FRACAG N.D. 2-6).

Mapping

A. Site Boundaries
  1. Locate and flag features and artifact concentrations noted during survey
  2. Flag any new features exposed since survey fieldwork

B. Cartesian Coordinate System
  1. Established over entire site area using a total station or a theodolite and tapes
  2. Grid system tied to a site datum (rebar stake with an aluminum cap stamped with site number) that is placed in a location that is unlikely to be disturbed (if on private land, may need to get permission of landowner)

C. Elevation Control
  1. Elevations measured relative to an arbitrary elevation datum designated 100 m to avoid negative numbers. Datum also placed in an area that will not be disturbed.

D. Mapping Points
  1. Shoot hundreds or thousands of points on site surface using a total station. Critical aspect is to define all subtle undulations in site surface, especially in seemingly flattest areas.
  2. Once point data are entered into mapping software, then maps can be generated using contour intervals as fine as 5 or 10 cm. Micro-rises are best starting places for evaluating site potential and for locating buried features (Wiseman 2003).
  3. In addition to contours, map should include location of drainage rills, trees, and other natural features that may have affected the artifact distribution, site boundary, and grid data points.
  4. Map is updated throughout the excavation to record the locations of all surface collection units, test pits, excavation units, and features in order to provide a summary record of the site structure.

Proveniencing

A. Grid System
  1. A Cartesian coordinate (3-dimensional) grid system capable of documenting locations of artifacts, samples and excavation units to the nearest centimeter should be established for all excavations. Collection and excavation grid unit size should be 1 x 1 m. Unit size greater than 2 x 2 m within the grid should be justified by the archaeological contractor in the data recovery proposal.
  2. The unit designator should be the southwest corner and should be numeric (i.e., 100North 40East), corresponding to distance from grid origin.
  3. All measurements should be metric. English units of measure may be used for Historical sites.

B. Point Provenience
  1. Applicable to structural floors, use areas, diagnostic artifacts, and prepared surfaces. Optional for surface collections and other purposes.
  2. Point proveniences should be oriented to the grid system (i.e., 110.35North, 115.50East, 95.52 Elevation)

C. Vertical Provenience
  1. Natural and cultural stratigraphic units will be excavated, otherwise arbitrary levels are required.
  2. Arbitrary levels should be no greater than 10 cm units.

D. Field Labeling of Artifact Bags
  1. Permanent ink (Sharpie) must be used.

2. Large artifacts should be tagged, not written on. The artifact and tag should be placed in a box or the tag should be tied on to the artifact with string. If tied on, tag should have reinforced holes to prevent it from tearing away during transport.
3. If artifact is to be subjected to special treatment (i.e., pollen wash), write "do not wash" on bag or tag.
4. If artifact(s) must be left in the field (i.e., bedrock mortar, ground stone), it should be mapped, drawn to scale, measured, photographed, and described.
5. Minimum Label Requirements
    a. Project name
    b. Site number
    c. Provenience
        1. F.S. number
        2. Horizontal unit designation (NGrid, EGrid)
        3. Vertical unit designation (arbitrary level or strat)
    d. Screen mesh size
    e. Material contents (sherds, chipped stone, etc.)
    f. Excavator's name/initials
    g. Date

E. Field Provenience Catalog

1. To assure computerized data base compatibility, all archaeological contractors should follow the following procedures throughout the site and the project. If using their own system, contractors need to describe how it works and to define terms and concepts used.

2. The following field proveniencing system that may be used to describe and record materials and observations is flexible enough to incorporate the variety of archeological remains encountered and is standardized to allow for computerization and comparison. The system is based on the Field Specimen (FS), which refers to the minimum unit of provenience for description, illustration, sampling, or materials collection. Field Specimen (FS) varies from a point-provenienced item to a three-dimensional unit of volume. The artifacts from each minimal provenience unit (1 m square) are bagged and labeled with the necessary provenience information. Each bag is assigned a "field specimen" (FS) unique to that unit. The numbers and provenience information are then logged onto the FS Catalog form, which is later entered into the computer data base for the site once the artifacts are brought to the laboratory.

Excavation

A. Complete (100%) excavation, <u>Working Definition</u> - The excavation of entire site areas to sterile soil or bedrock is generally considered to be impractical due to the amount of field time this would require and to the redundancy of information returned. Consequently, the following <u>minimum</u> standards should be met.

1. Complete excavations should be conducted on all structures, features, and artifact concentrations, which are identified by surface manifestation or exploratory methods.
2. Excavations at structures and features should be expanded to adjacent areas to determine stratigraphic and cultural contexts. The minimum acceptable requirements are as follows:
    a. 10 x 10 m block over small (ca 4 sq. m in size or less) surface structures
    b. Larger surface structures or any pitstructure, at least 10 m beyond perimeter
    c. 3 x 3 m block for small features or no less than 3m radius beyond the periphery of the identified feature; not necessarily a block but any shape.
    d. Expansion of the excavation block to link features in order to define stratigraphy and locate activity areas is recommended where feasible

e. Exploratory units should be applied to a 30 x 30 m area surrounding/centered on surface structures. The 30 x 30 m block area is not necessarily subject to complete excavation but represents the area within which shovel tests and other exploratory methods are applied.
The method chosen is largely dependent upon the thickness of overburden deposits. If the overburden deposits are shallow (<15 cm thick), we have found that the surface stripping of 1 by 1 m units in a checkerboard pattern allows us to strip a large area in a short period of time. If features are uncovered, then checkerboarding ceases and the area around the feature is stripped to expose the feature.

f. On sites having a thicker overburden, systematic auger testing (tube auger or bucket auger) is an effective method to use to probe for buried features with auger holes placed along a staggered grid line spaced one meter apart. For example, the first line of auger holes may be dug at every even meter while the second line is dug at every odd meter. A tube auger can reach depths up to a meter deep in the right matrix and a bucket auger can be dug even deeper.

g. Systematic shovel test pits are dug using the same strategy as auger testing. A line of shovel tests is alternately dug on grid corners and the midline of the next 1 m grid line. In this way, a staggered grid of test pits spaced a maximum of 1.4 m apart is established. The individual shovel test pits are small circular holes, approximately 30–50 cm in diameter and up to 1 m deep. Approximately 10 cm of sediments are removed at a time, and these materials are screened through 1/8 in mesh.

h. If features are found with the auger and/or shovel test pits, the overburden is removed to expose the feature and at least a 3 by 3 m area around it. The feature is then excavated following the methods outlined below.

f. Justify in the data recovery plan any deviation from the block excavations and exploratory procedures in the vicinity of structures and features.

3. Features
   a. Intra-mural features will be excavated in their entirety.
   b. All extra-mural features that indicate primary storage, processing, manufacturing and cooking activities will be excavated in their entirety.
   c. At least 50% of the fill will be excavated from secondary features such as borrow pits and amorphous pits with natural sediment fill.
   d. All features, whether partially or fully excavated, will be excavated to the extent that plan and profile renderings are possible, and the appropriate samples collected (e.g. pollen, flotation, radiocarbon, etc.)
   e. Post holes, or post molds may occur in extreme frequencies at individual sites. All post holes will be documented in plan view, however, sample fractions are acceptable for profiling and sampling post hole interiors.
4. Structures
   a. Remove any loose surface sediments, working outward from the center, to define edges/wall alignments.
   b. Once outline of structure is established, one or more 1 x 1 m units will be excavated to the floor to determine the depth and character of the fill.
   c. If warranted, the test pits will then be expanded to expose and to document a cross-section of the fill.
   d. The remainder of the fill will then be removed to a level 10 cm above the floor.
   e. The floor will be excavated in 1 x 1 m or smaller grid units.
   f. Special attention will be given to piece-plotting any floor artifacts and structural debris, and to recovering samples for dendrochronological or radiometric dating. Pollen and flotation samples are also collected from each excavation unit as it is exposed.
   g. Once the entire floor is exposed, any floor features will be excavated and sampled.

    h. Subfloor tests will be dug to determine if any additional floors or subsurface features are present.

5. Small Features (Hearths without fire-cracked rock, storage pits, etc.)
    a. Strip surface sediments to define feature in plan.
    b. Next, fill from one-half of the feature is removed to expose a cross-section of the fill, which is then photographed and profiled.
    c. The remainder of the fill is then removed either as a single level or in stratigraphic units, depending on the nature of the fill.
    d. If present, charcoal suitable for dendrochronological or radiometric dating will be collected throughout the excavation. Samples for archaeomagnetic dating, if available, will also be collected from features exposed to intensive burning.
    e. For small features with a uniform matrix, the entire fill is bagged for macrobotanical and pollen/phytolith analysis. For larger features, a sample of at least 5 liters of fill is collected from the bottom and sides of the feature. If the fill appears to be stratified refuse, then several samples from the individual strata should be collected.
6. Small Fire-cracked Rock/Burned Caliche Features
    a. Small (<1 m diameter) fcr/burned caliche features excavated following methods discussed above.
    b. Special attention, however, given to the rock/caliche fragments in order to distinguish pit roasting activities from stone boiling activities, which can provide another means of addressing resource procurement strategies. In-field analysis of fcr/caliche follows experiments conducted by Duncan and Doleman (1991) for similar facilities found on White Sands Missile Range and used successfully during the Cox Ranch Exchange Lands data recovery project in the Mesilla Bolson, Hueco Bolson, and Tularosa Basin (Gerow 1994).
    c. First, excavator separates fire-cracked rock by material type.
    d. These material types are then recorded on a form along with the weight of each type. This latter attribute provides an indication of the proportion of each rock type present and a measure of the total quantity of fire-cracked rock.
    e. Under each material type, excavator also records the number of fragments falling within each of three size categories: less than 5 cm maximum dimension, 5–15 cm, and greater than 15 cm. (These divisions are based on Draper and Stanfields [1987] volume estimates for cobbles used for stone boiling.
    f. Finally, excavator notes the type and proportion of fracture patterns exhibited by the rock, and the kind and degree of discoloration. These variables—material type, quantity of fire-cracked rock, fracture patterns, and discoloration—form a polythetic set that can be used for a probabilistic determination of feature function. (For example, a feature consisting of less than 2 kg of limestone rock fragments but no sooting and little discoloration would be interpreted as evidence of stone boiling. Conversely, a feature composed of 20 kg of quartzite cobbles, which were larger than 15 cm and had angular fractures and sooting would be interpreted as evidence of pit roasting.)

7. Large Fire-cracked Rock/Burned Caliche Features
    a. The first step in excavating these large features is to make a detailed plan, especially the discard pattern(s) of the fire-cracked rock. (Carmichael and Unsinn (2000) report that fire-cracked rock features consisting of a central pit surrounded by four discrete piles of discarded burned rock are indicative of Mescalero Apache roasting activities. The piles are aligned along the intercardinals, maintaining the harmony and balance that is important in Mescalero Apache cosmology. These features are relatively smaller (5–10 m in diameter) than other pit-baking facilities such as ring middens and sheet middens, and generally represent a single use episode. Thus, these features are an identifiable type of fire-cracked rock features and may provide significant information regarding cultural affinity.)

   b. Once the feature is mapped, the excavation methods basically follow those already described.
   c. Whether or not the entire feature is excavated largely depends on its size. At a minimum, a series of 1 by 1 m units will be positioned to bisect the feature and to expose the cross-section of the fill. Depending upon the depth of the fill, each unit will be excavated either as a single unit, in arbitrary levels, or in stratigraphic units.
   d. Charcoal suitable for radiocarbon dating will be collected throughout the excavation and a sample of at least 5 liters of fill is collected from the bottom and/or sides of the feature as appropriate. If the fill appears to be stratified refuse, then several samples from the individual strata may be collected.
   e. Once the bisecting trench is completed, the cross-section profile will be drawn and photographed.
   f. If further excavation is warranted, then units will be placed in areas of the feature that appear to have the potential to yield the maximum amount of information.
8. Middens
   a. Middens should be excavated to the extent that the plan and profile can be rendered.
   b. Site specific sampling rationales should be based on the size and expected depth of midden deposits. The sampling rationale to be employed should be explicitly stated in data recovery plans.
   c. For middens that appear to have structured deposits, excavation methods that produce extensive vertical faces are recommended. The purpose of these vertical faces is to provide stratigraphic control.
   d. For less structured, more diffuse middens, it is recommended that more surface area be subjected to data recovery to obtain larger artifact samples.
9. Artifact Concentrations
   a. On sites that appear to be largely surficial, limited surface stripping should be conducted to determine if the surface artifacts are representative of the assemblage, and to probe for buried features.
   b. Areas where major concentrations of artifacts were noted during the surface collection should also be surface stripped. Larger artifacts tend to "float" at the ground surface, while smaller items tend to become buried within the upper 1 to 8 cm of soils. Small microflakes offer one of the best means for identifying exact locations of tool manufacturing activities because they cannot be readily cleaned up, and tend to remain in situ. Undertaking surface stripping, then, will ensure that a sample of the full spectrum of artifact sizes and types will be recovered for intra- and intersite analyses.
   c. Test pits (at least 1 by 1 m) are opened either within the concentration itself or, if the artifacts are concentrated in an eroded area, in areas adjacent to the concentration where intact subsurface deposits might be present. If features are found, the excavation strategies outlined above should then be followed.
10. Featureless landscapes within sites should be systematically or randomly sampled. Minimally site boundaries are defined by documentation provided on site inventory forms. For logistical reasons, the sample fraction should be graduated, relative to site size (e.g. higher sample fractions for small sites, lower sample fractions for large sites). Sample fractions should be justified in the individual site data recovery plans. Field methods may also be selected relative to specific site sampling scenarios.
11. Geomorphology
   a. On-site geomorphology studies provide critical stratigraphic interpretation that leads to an understanding of site formation processes. The added control this provides for the interpretation of archaeological collections is useful for addressing the research problem domains. Geomorphological studies provide an independent cross check that can be used to critically evaluate the results of paleo-environmental studies. Stratigraphy assessment should follow the geomorphological study conducted by Hall (2002).

    b. 1 x 1 m grids and/or backhoe trenches should be dug to assess site stratigraphy. These units should be placed near the edge of a site or in areas devoid of features. Any surface artifacts should be collected prior to digging stratigraphic trenches.
    c. Trenches are generally 0.8 m to 1.0 m wide and must conform to OSHA standards. Scaled illustration of each trench profile is drawn and soil and cultural strata are described. Munsell colors are described for each stratum and photographs (black and white and color) are taken of all trench profiles.

12. Human Burials
    a. Treatment of human burials found on BLM lands will follow requirements of the Archaeological Resources Protection Act and the Native American Graves Protection and Repatriation Act. Treatment of human burials encountered on New Mexico State land and private land is dictated by 4.10.11 NMAC; Statutory Authority: Section 18-6-11.2 of the Cultural Properties Act NMSA 1978.
    b. If human remains are encountered, notification procedures and treatment guidelines outlined in these laws and statutes will be adhered to.
    c. When burials are encountered, the excavation of the features that contain the burials will cease while the appropriate agency archeologist is notified. State regulations (4.10.11 NMAC) stipulate excavation procedures and minimal documentation for burials on state and private lands. NAGPRA procedures will be followed on federal lands.
    d. If permitted, field procedures will consist of a general description and documentation of the burials, including determination of approximate age at time of death, gender, and recording of obvious pathologies.
    e. Description and documentation will be noninvasive and all burials will be treated with dignity and respect. An inventory and description of all associated funerary objects and their contents will be included in the field documentation.
    f. All burials and associated funerary objects will be left on the site premises until consultation with appropriate authorities has been undertaken to determine their disposition.

B. Exploratory Methods for Sampling Featureless Landscapes
    1. Surface collection (identify concentrations)
    2. Auger probes (see A 2.f above)
    3. Shovel tests (pits, trenches, surface stripping) (see A 2.g above)
    4. Mechanical surface stripping and trenching (see mechanical excavation techniques)

C. Optional Exploratory Methods for Sampling Featureless Landscapes
    1. Magnetometer
    2. Phosphate sampling
    3. Soil resistivity
    4. Ground penetrating radar

Manual Excavation Procedures

A. Manual excavation procedures should conform to stratigraphic and arbitrary level constraints except where noted.

B. Selection of appropriate tools is relative to the character of the cultural remains.
    1. Hand tools are required for the excavation of floor surfaces, activity surfaces, and other sensitive features.
    2. Soft tools (e.g. wood, plastic) are recommended for the excavation of bones and other perishable objects.

C. Formal Excavation Units
  1. Units should be a minimum of 1 m x 1 m in size. The use of excavation units greater than 2 x 2 m in size should be justified in the data recovery proposal.
  2. Designated archaeological units such as structures, features, and activity areas may supersede regularized excavation units (grid units).

D. Exploratory Excavation Units
  1. Shovel tests
    a. Test Pits - 50 cm x 50 cm excavated by strats or arbitrary levels, all material screened (see A 2.f above)
    b. Shovel trenches - width of shovel and length is discretionary, usually 1 thin arbitrary level, partial to 100% screened.
    c. Surface strip or broadside, usually 1 thin arbitrary level or strat, aligned to grid, partial to 100% screened.
  2. Shovel Probes - used to find features, document stratigraphy, or collect phosphate samples - not screened and not subject to stratigraphic or arbitrary level constraint.
  3. Bucket Auger or Press Auger - used for exploratory purposes only; should be combined with other excavation strategies; not to be used as a mitigative tool.
  4. Locations of on-site and off-site shovel tests should be mapped in relation to the site map. GPS readings of horizontal and vertical locations of off-site tests and trenches may be appropriate means of documenting locations depending on their proximity to sites.

E. Screening Procedures
  1. Size applicability
    a. 1/8" for standard excavation procedures
    b. 1/16" water screen samples are recommended for temporally or functionally sensitive features.
    2. Situation applicability
    a. 100% screening is recommended for all identified cultural deposits
    b. Justify percentage screening for post-abandonment, non-cultural deposits, and exploratory units.

Mechanical Excavation Techniques

A. Pertains to backhoes, blades, front end loaders, etc.; rotating power augers are not recommended.

B. Mechanical excavation techniques are generally exempt from screening and strat/level constraints; but sample screening of back dirt may prove informative.

C. Application
  1. Use for exploratory purposes after manual excavations. Justify in data recovery proposals the use of heavy equipment when used before other, less destructive exploratory techniques.
  2. Use for removal of non-cultural sediments or post-abandonment fill (e.g., pit structure fill)
  3. Use for removing deep overburden over cultural materials. If mechanically scraping, should be done in incremental levels to avoid disturbance to buried cultural materials (Zamora 2000).
  4. Use for digging stratigraphic trenches (backhoe)
  5. Use for backfilling and handling of backdirt
  6. All mechanically excavated trenches and stripped area should be mapped.

Geophysical Remote Sensing

Geophysical remote sensing is another method that may be employed to probe for subsurface features. This method includes magnetic, electrical conductivity, and ground penetrating radar studies and is conducted after surface vegetation is removed.

Magnetometer Survey

Magnetometers detect differences in the magnetic property of the target feature compared with the soil matrix in which the feature is buried. Equipment has two magnetic field sensors mounted about 50 cm apart in a vertical tube and detects differences in the strength of the magnetic field at the height of each of the two sensors. While magnetometers are quite sensitive to the anomalous magnetic fields that surround iron and steel objects and to alternating-current power lines, they can also detect the much weaker changes in magnetic fields associated with subtle cultural modification of natural soils. Care must be taken to remove any iron from a pre-contact site if the magnetometer is being used to discover subtle soil features such as human-made pits.

Measurements are acquired using a magnetometer and are made approximately every 0.3 m along parallel traverses separated by 0.5 m. The magnetic sensor is held ca. 1 m above ground surface and can detect burned adobe, hearths, and possibly cobbles up to 0.5 m below modern ground surface.

Electromagnetic Conductivity (EMC)

EMC surveys are directed toward documenting variation in sediment compactness that result in differential moisture content. Cultural alteration of sediments through construction of pits, hearths, structures, post holes, etc. which are subsequently buried by human or natural processes, will result in those features being filled with sediments that are less compact than the surrounding undisturbed and naturally consolidated sediments. These differences in consolidation or compaction will result in a higher moisture content in the feature fill, which in turn will yield a higher electrical conductivity. In contrast more compact soils (such as an activity surface) or underlying bedrock, will yield lower electrical conductivity.

Data are acquired using a ground conductivity meter along parallel transects across the site surface. The meter deploys a transmitter antenna separated by 3.7 m and measures the apparent conductivity to approximately 6 m depth. Electrical conductivity will detect hard packed floors, alignments, and pit features which are represented as anomalies in conductivity readings. Electrical conductivity studies cannot be done near a pipeline as the pipe will obscure the readings.

Ground Penetrating Radar (GPR)

Most GPR units transmit a short pulse of radio-frequency energy into the ground that detect the strength of the reflections during a series of short time intervals. In a uniform soil there would be little energy reflected (except at the air/soil interface) and the bulk of the energy would be absorbed within a short distances. Objects included in the soil or strata with contrasting electrical properties may result in reflection of enough energy to produce a signal that can be detected back at the antenna. The amount of time between transmission of the pulse and the receipt of a reflection provides a measure of the depth of the reflecting source.

Data are collected using an instrument consisting of an antenna, digital video logger and associated electronics. The instrument operates at 250 MHz and is mounted on a cart with spatial control provided by an odometer wheel. GPR traces are acquired every 5 cm along parallel traverses separated by 1 m. GPR will detect alignments, walls, excavations, and floors. Actual maximum depth of the detection depends upon the electrical properties of the soil. GPR data are generally post-processed to provide both plan view and profile representations of anomalies.

Geophysical remote sensing is relatively inexpensive and can reveal buried materials that might otherwise not be found. OCA recently used this method to probe for subsurface materials during the data recovery program at a Jornada-Mogollon (early AD 1100s) residential site near Alamogordo. This method successfully located buried remains (pithouse, hearths, and storage features) in areas that appeared to have nothing (Elyea in prep; Hyndman and Brandwein 2004). Aside from brush clearing, geophysical remote sensing studies are far less destructive to the archeological site than mechanical excavation.

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CHRONOLOGICAL SAMPLING

General Guidelines

Independent dating is an important key to the development of a reliable chronology and is a basic research design-driven requirement for Southeast New Mexico. Because of the need to build an absolute chronology, the primary use of relative dating techniques - projectile point typologies and cross-dated ceramics, is less desirable than employing independent chronometric dating techniques. General requirements for independently assessing the chronometric age of any given site or provenience within the site should follow these general guidelines.

1. Sample sets applicable to two or more chronometric methods must be collected and submitted for analysis.
2. If samples applicable to only one chronometric method are available, then at least two sample sets must be collected and submitted for analysis.
3. If only one sample set is available, this sample must be collected and submitted for analysis.
4. If a site contains two or more components, then guidelines #1–#3 apply to each component.
5. Provide basic environmental and provenience data with each sample submitted. Be sure to include specialized data as needed by a specific lab.
6. Clearly label each sample with full provenience information before leaving the field and maintain a complete set of information for each sample collected and submitted.

Specific Guidelines

Radiocarbon (from Dean 2003)

1. Definition and Purpose
   A radiocarbon sample consists of organic material, preferably charred, or sediment containing charred organic material, collected for its potential to contain sufficient carbon for obtaining a radiocarbon date. Charred plant material is the preferred material type for sampling, such as charcoal, corn, seeds, or other plant parts. Charred propagules, annual plants, or shrubs are especially good for radiocarbon samples because of their potential to more closely date the use episode of the feature being sampled. Sediment samples have proven useful for extraction of carbon suitable for AMS radiocarbon dating and should be collected if more appropriate material is absent. Sample collection is largely dictated by research questions.

   Although radiocarbon samples are routinely collected by archaeologists, their submittal to the archaeobotanist prior to processing at a radiocarbon lab is recommended so that the botanical materials can be identified and dating of non-relevant material is avoided.

2. When to Collect
   Collect samples when a date for a cultural context is desired, and when appropriate material is available. The determination to collect is dependent upon the research design.

3. Where to Collect
   Collect samples from cultural contexts. Such contexts most commonly are features, especially in situ thermal deposits, specific cultural strata or sequence of strata, construction materials, and other clearly cultural vegetal material. Although unburned material can be used to obtain a radiocarbon date, charred materials are preferred because a smaller volume of material is needed, and the likelihood that the material is a modern contaminant is minimized.

4. Size and Number of Samples

   a. A sample weight of 30 grams (Beta Analytic, Inc. 1997 guidelines) of charcoal or other charred vegetal material is recommended. If the sample is charcoal fragments and flecks mixed in sediment, a larger sample (about 60 grams for Beta Analytic) is needed. For uncharred material, a 100-gram sample is recommended. If only a small volume of material is available, such as a few corn kernels, extended counting or Accelerator Mass Spectrometry (AMS) dating can be obtained. Samples of bulk soil have proven useful for extraction of samples suitable for AMS dating if no macroscopically visible charcoal is available.

   b. The number of samples is dependent upon the amount of material available, and on the research questions. Commonly, one sample per feature or use episode is taken. Larger contexts may warrant collection of more samples. If the feature is stratified, take a sample from each cultural stratum. Check with crew chief before collection.

5. Field Sample Preparation

   Collect the sample with a clean trowel or hands (if necessary) and place it into a double-thickness aluminum foil envelope. Include sediment if necessary or if most expedient. Handling of the material should be kept to a minimum. Label sealed foil envelope and put into a bag with full provenience labeling.

6. Laboratory Methods

   a. Give samples to archeobotanist for species identification.
   b. Once identified, give priority to samples of annual plants.
   c. Submit multiple samples from same provenience to allow for more accurate dating.
   d. Wrap samples in aluminum foil and place in zip-lock bag to send.
   e. Send samples as early as possible.
   f. Give highest priority to samples from proveniences with other datable materials, e.g., archeomagnetic, obsidian hydration, thermoluminescence, tree-ring.
   g. If possible, submit at least 3–5 grams of good charcoal per sample. Larger samples are preferred.

Material	**Typical Carbon Content**	**Optimum Weight**	**Minimum Weight**
Clean charcoal	25–75%	10–20 grams	3 grams
Dirty charcoal	10–25%	10–50 grams	5 grams
Wood	20–30%	30–100 grams	5 grams
Shells	8–12%	50–100 grams	5 grams
Limestone	5–10%	100–200 grams	25 grams
Bone	0.5–4%	200–500 grams	150 grams
Peat	5–20%	100–200 grams	70 grams
Humus soil	0.2–4%	200–800 grams	150 grams

7. Interpretation and Reporting Guidelines

   Radiocarbon determinations are probability statements that in many ways are raw data. Almost without exception, a C-14 determination will be older than the target event. Interpretations of radiometric data, or at least providing a context of such data, is the responsibility of the investigator. Presentation of these data requires an interpretative framework. A protocol must be followed to report radiocarbon determinations. It is especially critical to present such data correctly when performing C-14 data manipulations. In particular, the following precautions must be addressed when reporting and interpreting C-14 dates.

a. Conversions of Radiocarbon Years Before Present (RCYBP) to calendrical years by simple arithmetic subtraction of 1950 are inappropriate.
b. The RCYBP date ranges become more significantly underestimated as age increases. Thus calibration protocols are required.
c. The reporting of decay curve intercept data as dates are inappropriate.
d. Combining an intercept with a RCYBP sigma is inappropriate.
e. Weighted frequency curves of C-14 data mask actual chronological trends.

Although radiometric data may be expressed in several ways, the protocol for reporting such data is fairly rigid. When a date is presented formally it should be expressed in the following fashion:

> "A radiocarbon sample from Feature 4 yielded a date of 550±90 B.P. (Beta-39597, Appendix X)."

They may be variously phrased, but in all cases the data must be expressed in a range of years. For example:

> "The date thus has a 95% probability of being between 730 to 370 BP. The calibrated date calculated by Beta ranges from cal 680 to 470 BP or cal AD 1270 to 1480."

Archaeomagnetism

Archaeomagnetic dating requires a relatively time-consuming process in order to collect the necessary suite of samples. However, the results are generally good. This technique has had limited success in southeast New Mexico (i.e., Wiseman 2002) if burned clays can be found in protected, in situ contexts. For the most part, the majority of datable features lack the necessary clay content to obtain good archeomagnetic samples.

For a short but clear review of archaeomagnetic dating, see Joukowsky (1986:454–455). The best source to begin with is Eighmy (1980). Although actual suites of data are not included, excellent background information and both field and laboratory methodologies are presented. In addition to an informative glossary, this source identifies and explains many of the problems you are likely to encounter attempting to comprehend archaeomagnetic data.

There are several problems associated with archaeomagnetic studies. Movement of the geomagnetic pole is not unidirectional or constant. Modeling this movement results in a recurvate looped figure. That is, your paleopole reading may intersect the figure in more than one place, which results in several possible dates. Additionally, the calibration of the geomagnetic movement is subject to both revision and dispute among researchers. Finally, conventions for the calculation and interpretation of error terms are not clear. Error measurements for archaeomagnetic dates actually denote geographic areas which have been indirectly translated into years. As a result, archaeomagnetic data are difficult to manipulate and it is easy to misinterpret them, even when one has the necessary background.

Be sure to include the actual polar path graphics from the laboratory. Report all possible dates and clearly explain choice of date.

1. Field Methods
   a. Samples should be collected only by properly trained personnel.
   b. Try to collect samples in good association with tree-ring samples.
   c. Collect multiple samples from a given provenience when possible.

2. Laboratory Methods
    a. Give highest priority to samples from proveniences with associated tree-ring samples.
    b. Give next highest priority to samples from proveniences with other datable materials, e.g., radiocarbon, obsidian, thermoluminescence.
    c. Send samples as soon as possible.

Thermoluminescence

Thermoluminescence (TL) is a radiometric dating technique. The following definition is from Joukowsky (1980:449–450):

Materials: rocks, minerals, and pottery.

Principle: almost all natural minerals are thermoluminescent to some extent. Imperfect atoms and structural defects distort the electrical fields holding the crystal together and form sites that can attract and trap electrons. When ionizing radiation (alpha or beta particles, or gamma rays) passes through the crystal, electrons are knocked loose from atoms, and a fraction of these are trapped. When the material is heated, the crystal lattice vibrations become sufficiently violent so that the trapped electrons are released and recombine with lattice atoms. In this process they emit light. The amount of light released is proportional to the dose of radiation absorbed by the sample material since it was last heated. Thus, the older the material, the greater amount of thermoluminescence will be produced. In the case of TL dating of pottery, the emitted light is related to dose by calibration with known doses of beta and alpha radiations; the radiation dose rate (dose accumulated each year) is measured (U, TL, and daughters by alpha counting, K^{40} by potassium analysis, and the environmental gamma dose contributor by analysis of soil or direct measurement by placing an efficient TL phosphor at the sample site for a month or a year to avoid seasonal variation), and the age found to be:

$$\text{Age} = \frac{\text{accumulated dose (rads)}}{\text{dose rate (rads/year)}}$$

There are two known laboratories in the United States which can perform this analysis. One is at the University of Washington and the other is at the University of Missouri-Columbia

1. Field Methods
    a. Minimum sample size should measure 3 mm in diameter and 5 mm thick; larger samples are preferred and are more accurately dated.
    b. Samples that have been buried to a depth of at least 20 cm should be given priority in collection.
    c. Samples removed from a uniform soil matrix that is relatively free of other materials (e.g., rock, building debris, bone) are easier to date.
    d. For sites where the moisture is clearly known (e.g., where it can be assumed that both sherd and soils are saturated), no special precautions are necessary other than to avoid using any additives during washing. For sites where the level of moisture is unknown, the sherds or other samples should not be washed but put directly into a plastic bag, along with any accompanying soil, within a few minutes of removal from soil, and tied up tightly. This bag should be put inside a second outer bag which should also be tied tightly.
    e. 100 g of earth matrix from the area surrounding the sample should be collected with each sample. This earth sample should contain a sample of each type of material occurring within 30 cm of the TL sample. Double-bag the sample of earth to allow for a determination of its water content.

f. Samples should not be exposed to excessive heat (over 100 degrees Celsius), or to direct sunlight, ultraviolet, infrared, X-rays, gamma-rays, or beta radiation.
g. Collect multiple samples from a given provenience when possible.

2. Laboratory Methods
   a. Samples that appear to have been refired should not be submitted.
   b. Submit multiple samples from the same provenience and from different ceramic vessels.
   c. Give highest priority to samples from proveniences with other datable materials.
   d. When sending samples in for analysis, be sure to include all written information as requested by the TL laboratory.

Dendrochronology

Dendrochronology is another method to use for absolute dating. Tree-ring dates have a potential resolution of one year to a few decades, so it is clearly the most reliable method for determining whether sites or features within a site are contemporaneous. Tree-ring dates are best when recovered from sites dating to the seventh century or later. Although dendrochronology is a well known botanical dating technique in the Southwest, there has been only limited success with this technique in southeast New Mexico owing to complacent growth of riparian species, and a lack of tree species over wide areas of the region. Prior to collecting dendrochronological samples, it is best to check with the Tree-Ring Laboratory in Arizona to determine if the samples are viable.

As with radiocarbon samples, dendrochronology samples are collected in the field. Samples should have intact outer rings in order to obtain cutting dates. Samples should be tied with a string to maintain stability.

Once back in the laboratory, highest priority should be given to samples from proveniences with other datable materials. As many samples as possible from a given provenience will be submitted in order to increase precision. All dendrochronology samples will be sent to the Laboratory of Tree Ring Research at the University of Arizona, Tucson.

1. Field Methods
   a. Try to obtain samples with intact outer rings in order to get cutting dates.
   b. Collect as much as possible of a single beam in order to obtain enough rings. Take the largest beams and collect as many samples as possible. Unsuitable samples should be retained for Ethnobotanical Studies.
   c. Avoid pretreatment of samples with paraffin and gas to the extent possible so as to allow for possible radiocarbon dating later.
   d. To maintain sample stability tie with string.
   e. Obtain as many different samples as possible from a given provenience.
   f. Collect all tree species present. All woody species, including sagebrush, oak, cottonwood, pinyon, and juniper are potentially datable.

2. Laboratory Methods
   a. Submit as many samples as possible from a given provenience in order to increase precision.
   b. Send samples as soon as possible - tree ring lab has a huge backlog.
   c. Give highest priority to samples from proveniences with other datable materials, e.g., radiocarbon, obsidian, archaeomagnetic, thermoluminescence.
   d. Submit all samples collected.

e. Contractors are urged to contact the tree ring lab for the most up-to-date information concerning requirements and forms.

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LITHIC ARTIFACT ANALYSIS

The goals of the lithic analysis are to identify cultural/temporal markers, subsistence-related function, and activity diversity. Listed below are minimum guidelines designed to achieve these objectives.

Scaled photographs/drawings of all tools and projectile points with measurements (length, width, thickness; minimum stem width for projectile points). Plan, longitudinal and, when appropriate, transverse cross sectional views must be shown.

Material Types

See the attached codes developed by Wiseman based on his extensive work in southeast New Mexico.

Projectile Points

Projectile points will be assigned temporal classifications using comparative literature from the general region, such as Turner and Hester (1993) for Texas, MacNeish and Beckett (1987) for the Archaic Chihuahua Tradition, and Irwin-Williams (1973) for the Oshara Tradition. For those points that cannot be assigned to a named type, Katz and Katz's (1985) metric neck-width criteria may help in assigning them to cultural periods:

1. Arrow points (late prehistoric period), 9.0 mm or less
2. Early arrow points (transitional dart to arrow), 9.0 to 8.0 mm
3. Dart points (terminal Archaic), 9.0 to 14.0 mm
4. Dart points (late Archaic period), 13.0 to 16.0 mm.

While the groupings do overlap, in part, their basic validity and utility appear to be reliable (Wiseman 2004).

Overall, there needs to be a critical refinement of projectile point typologies, stylistically and, more importantly, chronometrically (Alldritt and Oakes 2000). Because we cannot be certain that these intrusive artifacts have the same temporal span as in their areas of origin, the entire sequence must be verified by a local suite of chronometric dates. The problem is particularly acute for the Archaic period, since none of the relevant projectile point typologies are well dated in the regions where they were originally formulated.

Lithic Artifact Coding Guide: Cores, Debitage and Flaked Tools

Assembled by Cynthia Herhahn
Office of Contract Archeology, University of New Mexico
November 2006

Technological Type Descriptions

Code	lithic_term	Definition
1	Angular Debris	No definable ventral surface
2	Flake, nfs*	Flake, *not further specified
3	Flake, Bifacial Thinning	recognized by retouched platform, parallel dorsal scars, lipped platforms, concave flake curvature, even edge outline, weak bulb of percussion (Acklen et al 1984)
4	Flake, Sharpening	has retouched platform with usewear on platform/dorsal surface interface. Be careful to distinguish use wear from platform preparation
5	Flake, Bipolar	recognized by the absence of bulbs of percussion, flat bulbar aspects, rings of force originating from proximal and distal ends, and crushing at both ends (Sliva 1997)
6	Flake from Groundstone	flake that has ground or polished dorsal surface
7	Flake from Hammerstone	flake with battering on platform or dorsal surface
8	Flake, Other	describe in comments
9	Tested Rock	Objective piece with fewer than 4 flake scars
10	Core, Bidirectional	two platforms not oriented opposite each other (Andrefsky 2005).
11	Core, Bifacial	core with flakes originating from a single margin removed from two surfaces. Not shaped or flaked around their entire perimeter.
12	Core, Bipolar	core with flake scars showing rings of force from proximal and distal ends.
13	Core, Multiplatform	cores with more than 2 platforms from which flakes are removed (Appendix 1 from OCA-UNM 185-584). Irregular; may be exhausted
14	Core, Unidirectional	Flakes removed from a single striking platform
15	Stage 1 Biface	Has evidence of unretouched blank on both surfaces; flake scars with pronounced negative bulbs; no thinning of either face.
16	Stage 2 Biface	Most of original blank morphology has been removed; may have some cortex still; controlled reduction and thinning has not started; flake scars removed from both sides of biface; piece has oval or pear-shaped outline
17	Stage 3 Biface	Initial thinning and regularization of margin has begun; may still have cortex; margins somewhat irregular, sinuous; flake scars at least to center of biface. Width/thickness ratios 3.0-4.0
18	Stage 4 Biface	secondary thinning of biface. Scars may be patterned and travel past center of surface. Grinding common on platforms. W:t >4.0
19	Stage 5 Biface	Final shaping of biface before hafting or notching; exhibit marginal retouch to create sharp, regular, straight margins.
20	Stage 6 Biface	Finished bifacial tool with completed hafting elements or notching
21	Uniface	Artifacts exhibiting retouch scars over one-third or more of only one surface.
22	Manuport, cobble	Non-locally occurring rock with waterworn cortex but with no evidence of human modification
23	Manuport, mineral	Non-locally occurring geological sample consisting of a relatively pure mineral composition (e.g., hematite, quartz crystal, limonite, galena, gypsum, calcite, etc.) lacking evidence of human modification

24	Manuport, tabular	Non-locally occurring tabular rock.
25	Groundstone	Any stone item that is primarily manufactured through abrasion, polish, or impaction, or is used to grind, abrade, polish, or impact.

Functional Type Descriptions

Code	Functional Type	Description
1	Angular debris, retouched	Detached piece lacking identifiable ventral surface exhibiting a series of small negative scars that extend from the edge perimeter.
2	Angular debris, utilized	Detached piece lacking identifiable ventral surface exhibiting edge damage attributable to human usage. Edge damage may consist of microflaking, edge rounding, ridge or edge frosting, polish, striations. or battering.
3	Chopper, Bifacial	Tool with bidirectional flakes scars along one or more edges and use wear in the form of battering.
4	Chopper, Unifacial	Tool with unidirectional flake scars along one or more edges and use wear in the form of battering.
5	Core, retouched	Objective piece exhibiting a series of small negative scars extending from edge perimeter.
6	Core, utilized	Objective piece exhibiting edge damage attributable to human usage. May consist of microflaking, edge rounding, ridge or edge frosting, polish, striations. or battering.
7	Drill, nfs	tool characterized by a long narrow projection used for drilling somewhat harder materials such as soft stone or bone. Wear, if present, would result from rotary motion (tip or edge rounding, microflaking, striations perpendicular to tip.
8	Drill, expanding base	parallel or roughly parallel sided drill with basal extensions for hafting
9	Drill, straight	parallel or roughly parallel sided drill with no lateral or basal extensions for hafting
10	Flake, retouched	detached piece with identifiable ventral surface exhibiting a series of small negative scars that extend from the edge perimeter.
11	Flake, utilized	Detached piece with an identifiable ventral surface exhibiting edge damage attributable to human usage. Edge damage may consist of microflaking, edge rounding, ridge or edge frosting, polish, striations. or battering.
12	Flaked Tool, Other (specify in comments)	
13	Graver	tool characterized by a short edge projection which has been produced by unidirectional or bidirectional flaking; used for incising or perforating soft materials (hide, bone, wood).
14	Knife	items with a low edge angle (less than 40 degrees) produced by unidirectional or bidirectional flaking; edge rounding, polish, or microflaking if present may appear on both surfaces, striations will be parallel or oblique; production input may be minimal but some is required to distinguish knives from utilized flakes. May be hafted
15	Projectile Point	Unifacial or bifacial tool that was made to be hafted onto a projectile
16	Scraper, nfs	artifacts with high edge angle (>50 degrees) formed by contiguous or overlapping flake scars. May be straight, concave or convex. Microflaking and striations may be present on one edge surface. Striations perpendicular to edge.
17	Scraper, end	tool with consistent steep unifacial or marginal unidirectional flaking on the edge located at the end of the tool's longest axis
18	Scraper, side	tool with consistent steep unifacial or marginal unidirectional flaking on one or more edges that run parallel to the tool's longest axis
19	Scraper,	a disc-shaped scraper

	discoidal	
20	Scraper, beak	Transverse end scraper with one or more spurs on the lateral edges
21	Spokeshave	tool characterized by a concave notch. Retouch or use should be visible on the interior of the notch.

Platform types

platform_code	platform_term	Definition (clh)
0	N/A	
1	collapsed	identified on whole flakes that lack a clear platform and any traces of crushing
2	cortical	unprepared and situated on cortex
3	single facet	consists of single flake scar
4	multi-facet	consists of multiple flake scars; facets do not originate from edge of platform
5	prepared	evidence of grinding, crushing, retouching, or other platform preparations
99	not recorded	Not recorded for this project

Use Location code and terminology for Tools and Utilized Flakes/Debris/Cores

useloc_code	useloc_term
0	N/A
1	left
2	distal
3	right
4	proximal
5	unknown
6	left+rt.+dis
7	dorsal ridge

Edge shape code and terminology

edgeshape_code	edgeshape_term
0	N/A
1	straight
2	concave
3	convex
4	wavy
5	denticulate
6	tip
7	Other (specify in comments)
8	Indeterminant
99	not recorded on this project

Use wear codes, terms and descriptions

wear_code	wear_pattern_term	Description
0	N/A	
1	Microflaking	multiple, contiguous or overlapping scars, usually less than 2mm in length, along artifact edge, often concentrated on slight margin projections or irregularities
2	Edge rounding	resulting from abrasion. Usually detected dulled edge angle.
3	Polish	areas of increased light reflectivity or decreased irregularity in surface microtopography.
4	Striations, perpendicular	small lines/scratches perpendicular to the edge of an artifact (assoc. with scraping)
5	Striations, parallel	small lines/scratches parallel to tool edge (assoc. with sawing)
6	Striations, oblique	small lines/scratches at an oblique angle to edge (assoc. with cutting).
7	Battering	edge crushing and a series of microflake scars of predominantly step terminations
8	Other	any other use wear evidence, specify in comments
99	not recorded for this project	

Use direction codes and terms

direct_code	direct_term
0	N/A
1	dorsal
2	ventral
3	bidirectional
4	unknown

Hammerstones

1. Material type
2. Morphology
3. Measurements (mm)

Groundstone

(from Wiseman 2003)

1. Source Material
   a. Rock group (igneous, sedimentary, metamorphic, etc.)
   b. Material identification (quartzite, sandstone, monzonite, syenite, etc.)
   c. Characteristics to help identify source or geologic derivation (including but not limited to):
      - colors, combination of colors, color patterns including mottling versus phasing of shades, etc
      - inclusions, including mineral crystals (quartz, feldspar, hematite, magnetite, etc.) and non-crystalline minerals (hematite, etc.)
      - presence of natural vugs or holes

    - cement type: for sandstones– silica, carbonate; and including known variations of "dirty" sandstone, white sandstone, red sandstone
    - degree of cementation/induration (readily crumbles, very hard and compact, splits along bedding planes, etc.)
    - structural properties, such as bedding planes, texture, etc.

2. Artifact Type
    a. Basin Metate
        - Small basin (10–20 cm long, 1–3 cm deep)
        - Large basin (20–40 cm long, 3–10 cm deep)

    b. Trough Metate
    c. Slab Metate
    d. One-hand Mano
    e. Two-hand Mano
        - Generalized two-hand
        - Trough-metate mano
        - Slab-metate mano
        - Loaf-shaped mano

    f. Mortar
    g. Pestle
    h. Nutting stone
    i. Other

3. Data Needs (specific to artifact type)
    A. Metate
        1. Type (including number of grinding surfaces)
        2. Material Type
        3. Original morphology of stone
            a. blocky
            b. boulder/large cobble
            c. slab
            d. bedrock
        4. Degree and type of shaping of stone in addition to grinding surface
            a. flaking of corners and/or edges to reduce bulk and/or shape stone
            b. grinding to smooth finish
        5. Total length, width, thickness of stone
        6. Total length, width, and maximum depth of grinding surface
        7. Comments
            a. grinding surfaces well-developed as opposed to showing minimal wear
            b. presence of tiny sharpening pits
            c. presence of coloration/pigment stain
            d. discoloration and spalling caused by burning
            e. etc.
        8. Samples to take (metate must come from a protected situation such as from structure floor or bottom of storage or cache pit)
            a. pollen wash
            b. macrobotanical
            c. residue
        9. Photographs and/or scaled drawings

B. Mano
   1. Type
   2. Material type
   3. Original morphology of stone
      a. blocky
      b. boulder/large cobble
      c. slab
   4. Degree and type of shaping of stone in addition to grinding surface
   5. Outline in transverse (short) and longitudinal (long) sections
   6. Number of surfaces showing grinding (for trough manos, separate into major grinding surface(s) and edge wear)
   7. Total length, width, thickness of stone
   8. Total length, width, thickness of grinding surface
   9. Comments
      a. grinding surfaces well-developed as opposed to showing minimal wear
      b. presence of tiny sharpening pits
      c. presence of coloration/pigment stain
      d. discoloration and spalling caused by burning
      e. etc.
   10. Samples to take (mano must come from a protected situation such as from beneath a metate or bottom of storage or cache pit)
      a. pollen wash
      b. macrobotanical
      c. residue
   11. Photographs and/or scaled drawings

C. Mortar (most of this work is done in the field during excavation)
   1. Type
      a. bedrock
      b. portable boulder
   2. Material
   3. Dimensions
      a. Orifice length and width
      b. Total depth
      c. Change in dimensions with depth (cross-section profile)
   4. Nature of fill (if any), including plants growing within mortar (specify species)
   5. Remove fill only during excavation
   6. Take samples of rock from lower sides and bottom for lipid residue analysis
   7. Number of mortars present
   8. Multiple mortars
      a. arrangement (i.e., dispersed or clustered)
      b. distribution of arrangement (i.e., spaced along edge of bedrock outcrop, clustered on boulder or section of outcrop, two or more clusters)
      c. distances between individual mortars (center to center [draw map]
      d. distances between clusters (draw map)
   9. Physically associated cultural materials, both on surface surrounding or covering mortars and in fill

D. Nutting Stone
   1. Same as mortar

E. Pestle
    1. Material
    2. Length, width, thickness
    3. Weight
    4. Use-wear
    5. Comments (see metate and mano)
    6. Samples (see metate and mano)
    7. Photographs and/or drawings

F. Other
    1. Number of ground surfaces
    2. Material
    3. Original morphology
    4. Degree and type of shaping of stone and ground surface
    5. Total length, width, thickness of stone
    6. Total length, width, and depth of ground surface
    7. Comments (see metate and mano)
    8. Samples (see metate and mano)
    9. Photographs and/or drawings

Lithic Sourcing Studies

It is critical to determine if the assemblages of tools and manufacturing by-products found at the site represents manufacture of locally available raw materials, or if some portion of those assemblages represent manufacture (or tool use) of lithic materials which have been imported to the sites. Knowledge of the kinds and artifact types represented in the non-local assemblage will play a critical role in determining the kinds of lithic procurement activities conducted in the area, their roles in the exploiting systems, and the degree of mobility or exchange.

For the most part, local and regional lithic sourcing is limited. The identification of material sources would entail communicating with collectors, rock hounds, geologists, and ranchers. It would also require field work to verify data. One of the end results of lithic sourcing studies would be a materials collection to be kept at each BLM field office (and other publicly accessible museums or universities) for use by researchers and analysts. The following “Lithic Material Code Sheet” prepared by Regge Wiseman offers a beginning point for this kind of research. It is recommended that concerted program of lithic source identification survey be undertaken to collect examples from these (and other) material types to compile comparative collections.

Obsidian sourcing has been successful using X-ray florescence (XRF). A select sample of obsidian from within features, concentrations, and/or different site areas will be submitted for XRF analysis.

The use of shortwave and longwave UV light on selected cherts (i.e., Edwards Plateau, San Andres) has been successful in distinguishing Edwards Plateau cherts from look-a-likes and to aid in recognizing subregional varieties within the San Andres gray cherts. Selected cherts, then, will undergo UV light analysis.

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PROPOSED LITHIC MATERIAL CODE SHEET

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The following material types and codes were developed over a period of decades through my work on collections from archaeological sites in southeastern New Mexico for the OAS. The only important difference is that the order of materials, colors, and code numbers have been rearranged to remove the inevitable incremental growth pangs expressed in the original code sheets. It should be noted that this arrangement is new as of the above date, and it does not apply to any of my projects or reports for the OAS. However, for tracking purposes, my original code numbers are included in parentheses following the color scheme description.

The purpose of such a detailed list is to make record of the variety of materials used for chipped stone manufacture by the Prehistoric and Early Historic peoples of southeastern New Mexico. Many archaeologists will consider the categories to be excessive. However, the material types and colors of lithics used by past Native Americans is great. They derive from a myriad of mostly unknown sources and potentially embody much information useful to our eventual understanding of prehistoric lifeways of the past. As we eventually learn more about specific sources, we should be able to go back through analyzed assemblages, more correctly identify the sources represented, and update our interpretations on a site by site basis.

The process has already started with the black and red chert that we now know probably came from a source tandem to Tecovas (or Quitique) chert of the Texas panhandle. Without this type of discrimination, and especially resorting to simply calling materials only by their rock type as most archaeologists tend to do, we lose a large amount of potentially useful information. After all, how many researchers are going to go to repositories to pull out assemblages to reanalyze them beyond the categories of non-specific chert, chalcedony, quartzite, and the like? Having recorded color data available on work sheets, in lithic data bases, or in whatever form beyond the actual collections themselves will encourage additional research.

Other factors important to the interpretation of raw material usage can be delineated by recording more specific information about material types, and specifically, coloration. For instance, an initial evaluation of the arrowpoint preform assemblage at Sitio Creston near Las Vegas, New Mexico (Wiseman 1975) suggested that the red variety of Tecolote (or Madera) chert was a favored material. However, as the result of analysis, it was a concluded that the red Tecolote material was conducive to a higher rate of breakage during the final stages of projectile point production. If I had merely classified the materials as Tecolote chert (but had not distinguished red versus gray varieties), tan-white cherts, etc., or worse yet, as cherts versus quartzites versus chalcedonies, etc., an important perspective on the materials would have been missed.

Materials List

Local Gray Cherts (San Andres Formation ? west of Pecos river ?)

1	light to medium gray, fairly homogeneous color (2)
2	light and dark gray, shades contrasting but not banded (8)
3	medium to dark gray (9)
4	dark gray to black (6)
5	fine-grained, solid medium gray (61)
10	orange or reddish-gray (heat treated) (1)
11	yellowish-gray (gray with yellow cast) (64)
12	yellow and gray (indistinct zoning) (10)
13	tan (17)
18	fingerprint (or zebra) with well-defined alternating light and dark gray lines (7)
19	light gray banded (4)
23	red and gray (60)
24	light and dark mottled reddish-gray (3)
30	light to medium gray with white speckles (5)
35	coarse gray or gray-brown (62)
36	coarse gray "limey" (coarse-grained but nonsilicious or not shiny in appearance) (15)
37	coarse fingerprint (or zebra; coarse variety of #7) (11)
38	coarse gray with wide bands of very similar color (12)
39	gray-brown with abundant dark brown, pen-point-size inclusions (Seven Rivers drainage ?) (68)
40	dappled gray with white or light gray (occasional red) (Seven Rivers drainage ? or possibly Delaware mountains, TX, south of Carlsbad) (69)
45	possible Rock House Canyon chert (65)
59	undifferentiated gray (63)

Other Cherts (possibly from west of Pecos river)

60	brown (but not gray-brown) (16)
61	dark brown (19)
62	mottled light and dark brown (71)
63	medium brown with white and black dapples (20)
70	red and yellow (75)
71	red, reddish-orange, red and yellow (73)
75	white chalcedonic (70)
76	white and brown chalcedonic (14)
80	gray and black chalcedonic (76)
89	white (burned to state of dehydration; often crazed) (18)

Local Chalcedonies (presumed)

90	clear to off-white (81)
91	clear to off-white with brown areas (84)
92	clear with solid white inclusions (83)
100	white to yellowish-gray cherty (85)
101	off-white with traces of brown-red inclusions (24)
105	light yellow with white inclusions (80)
106	light gray with black inclusions (23)
107	light gray with light gray-brown cherty areas (28)

108	light gray with profuse red (26)
109	light and dark gray or brownish gray (27)
115	medium gray (86)
116	medium to dark gray (22)
117	medium gray-brown (21)
118	medium-dark gray with white and/or red areas (82)
125	fingerprint (or zebra) (translucent #7 chert) (25)
130	red to orange (29)

Limestones/Dolomites

140	medium gray (42)
141	medium brown (45)

Siltites/Quartzites

150	igneous quartz/siltite?? (72)
151	medium gray-brown siltite (92)
152	black siltite (46)
153	black and red siltite (96)
158	white siltite/fine quartzite (33)
159	light to medium gray siltite/fine quartzite (32)
160	light to medium brown siltite/fine quartzite (31)
165	medium red-brown fine quartzite (94)
166	medium brown and dark gray fine quartzite (36)
167	dark brown to black fine quartzite (93)
172	off-white quartzite (34)
173	light tan to yellow quartzite (95)
174	gray quartzite (97)
175	brown and gray quartzite (35)
176	dark gray-green quartzite (37)
177	dark purple quartzite (39)
180	yellow quartzite with red areas (91)
181	orange-red to orange quartzite (38)
182	orange-red quartzite with white mottles (90)

Known or Possible Intrusives and Their Look-alikes

190	orange-red Alibates (51)
191	purple Alibates (49)
192	possible Alibates (78)
193	Alibates look-alike (79)
200	Tecovas (or Quitique) (53)
201	possible Tecovas (77)
202	Tecovas look-alike (79)
203	red and black jasper (probably a variety of Tecovas) (13)
210	Edwards chert (67)
211	possible Edwards chert (66)

220	clear black obsidian (47)
221	hazy black obsidian (--)

Other Materials

250	light gray sandstone (44)
251	medium gray sandstone (41)
252	medium brown sandstone (48)
253	red sandstone (--)
260	calcrete (from the Caprock) (50)
265	white to clear massive quartz (52)
270	silicified palm wood (55)
271	silicified wood (56)
280	black basalt (57)
281	amygdaloidal basalt (54)
290	rhyolite (58)
295	dark gray-black igneous (43)
300	indeterminate (99)

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CERAMIC ANALYSIS

The goals of the ceramic analysis are to identify cultural/temporal markers, site activities, and mobility and exchange. The following pages identify analytical procedures that will be required for all ceramic analysts working under the Southeastern New Mexico Research Design. By identifying these procedures, all ceramic analysis data will be comparable at a general level. The following outline includes a list of research goals and directions for ceramic analysis, a procedure for sampling, and a list of attributes that must be analyzed and addressed by the ceramic analysts.

Directions and Procedures for Ceramic Analysis under the Southeastern New Mexico

Research Design

I. The following research goals and directions have been identified as pertinent to the ceramic analysis undertaken for sites excavated under the Southeast New Mexico Research Design (Wiseman 2003).

    A. Continue discovering material sources and manufacture areas, especially for Chupadero Black-on-white, El Paso Polychrome, the various brown wares, and Sierra Blanca Gray syenite.

    B. Further investigate the efficacy of Jelinek (1967) various pottery types.

    C. Learn more specifics about the technology employed, including the meaning of shifts in temper types (materials, fineness of grind, etc.).
        1. Experimental work regarding implications of vessel/paste types and vessel forms relative to function will be a necessary component of this research.

    D. Need to examine what socio-economic processes were responsible for the sudden influx of numerous pottery types into southeastern New Mexico from areas throughout the Southwest about AD 1250–1300 and their equally rapid decline. Intrusive ceramics are listed in Table 6.1.
        1. Requires an evaluation of trade networks–reasons, dynamics, routes–between Southwest, Southern Plains, Caddoan, etc.

    E. A critical need with respect to all pottery types is improved dating. None of the regionally made types commonly found on sites in the southeast have been well dated, especially the inception dates.
        1. Dating by radiocarbon and archeomagnetism are currently the best available means, especially by radiocarbon. Large suites of radiocarbon dates appear to be the most likely answer to meeting this critical need.

    F. Identification of raw material sources (clay, temper, etc.). This objective relates directly to expanding the knowledge and understanding of prehistoric ceramic technology and the pottery types common to southeast New Mexico, as well as determining regional variability and mobility and trade.

G. Spatial and temporal analysis of the distribution of ceramic types across a site must be undertaken. These data will assist in determining occupation and abandonment sequences and may also be used to elucidate intra-site settlement patterns and social organization.

H. Spatial and temporal analysis of the distribution of ceramic types on an inter-site level across a geographic area or region.

II. All ceramics recovered from a site should be analyzed. If a sampling strategy is proposed (i.e., for a large assemblage that may result in a redundancy of information), it must be thoroughly described (methods, justification, etc.) in the data recovery plan and approved.

III. Ceramic Attributes to be Recorded

A. Type (recognized ceramic types are listed here)

Indigenous Pottery Types of Southeastern New Mexico

Pottery from Gran Quivira area
Alma Plain
Tabira Plain
Tabira Black-on-white
Tabira Polychrome
Salinas Red

Sierra Blanca Region (includes Northern Pecos Slopes and Rio Hondo-Arroyo Del Macho area [Kelley 1984])
Three Rivers Red-on-terracotta
San Andres Red-on-terracotta
Lincoln Black-on-red
Lincoln Polychrome
Lincoln Red-on-red
Lincoln Black-on-red, Glaze Variety
Jornada Brown
Jornada Brown, Roswell Variant
Jornada Brown, Gallo Micaceous Variant
Jornada Red-on-brown
Corona Plain
Corona Corrugated
Corona Rubbed-Indented

Middle Pecos Valley (includes upper part of Mescalero Plain, Portales Valley, and Pecos Floodplain [Jelinek 1967, Burns 1980, Wiseman 2004])
Middle Pecos Black-on-white
Micaceous brown
Roswell Brown
Roswell Red-on-brown
Roswell Corrugated
Jornada Brown
Jornada Brown, Roswell Variety
Jornada Red

Jornada Red Tooled
Jornada Corrugated
Jornada Red-on-brown
Jornada Black-on-brown
Jornada Polychrome
Coarse Jornada Brown
Alma Brown
Plains brushed
McKenzie Brown
McKenzie Red-on-brown
Corrugated Brown
Chupadero Black-on-white
Middle Pecos Micaceous
Middle Pecos Micaceous (Red Wash)
Middle Pecos Micaceous Brown
Middle Pecos Micaceous Red-on-brown
South Pecos Brown
South Pecos Red-on-brown
Crosby Black-on-gray
El Paso Brown
El Paso Brown, Tooled Variety
El Paso Brown, Corrugated Variety
El Paso Red-on-brown
El Paso Black-on-brown
El Paso Polychrome
Corona Corrugated
Three Rivers Red-on-terracotta, Roswell Variety
Plain Terracotta, Roswell Variety

Eastern Extension (includes the Mescalero Plain and southern Llano Estacado areas [Leslie 1979])
Northern Area Brown
Northern Area Red-on-brown
Central Area Brown
Central Area Red-on-brown
Southern Area Brown
Ochoa Plain Brown
Ochoa Brown Indented
Ochoa Corrugated Brown
McKenzie Brown

Table 6.1 Intrusive Pottery Types Reported for Southeastern New Mexico (from Wiseman 2003).

Origin	Pottery Type
Valley of Mexico	Cuahuatitlan Burnished
State of Chihuahua, Mexico	Playas Red-Incised ** Anchondo or Victoria Red-on Brown Madera Black-on-red Villa Ahumada Polychrome Carretas Polychrome Babicora Polychrome Ramos Polychrome
Southwestern New Mexico	El Paso Brown Seco Corrugated Alma Plain El Paso Polychrome *** Mogollon Red-on-brown Reserve Black-on-white Mimbres Black-on-white, Style I (Mimbres Boldface) Mimbres Black-on-white, Style II (Mimbres Transitional) Mimbres Black-on-white, Style III (Mimbres Classic) Salado Red (plainware) Pinto Polychrome Gila Polychrome Tonto Polychrome Tucson Polychrome
Eastern Arizona	Springerville Polychrome Pinedale Polychrome Cedar Creek Polychrome
Northeastern Arizona	Jeddito Black-on-yellow
Northwestern New Mexico	Hunter Corrugated Red Mesa Black-on-white Cebolleta Black-on-white Socorro Black-on-white St. Johns Polychrome Heshotauthla Polychrome
Rio Grande Valley of North Central New Mexico	Lino Gray Los Lunas Smudged Pitoche Rubbed-ribbed Kwahe'e Black-on-white

	Santa Fe Black-on-white Galisteo Black-on-white Wiyo Black-on-white Rio Grande Glazes: Los Padillas Polychrome Rio Grande Glaze A Red (Agua Fria Glaze-on-red; Rio Grande Glaze I) Rio Grande Glaze A Yellow (Cieneguilla Glaze-on-yellow; Rio Grande Glaze I) Rio Grande Glaze A Polychrome (Arenal Polychrome and San Clemente Glaze-Polychrome) Rio Grande Glaze B Glaze-on-yellow (Largo Glaze-on- yellow; Rio Grande Glaze II) Rio Grande Glaze C Polychrome (Espinoso Glaze-Polychrome; Polychrome; Rio Grande Glaze III) Rio Grande Glaze F (Kotyiti Glaze-on-red; Rio Grande Glaze VI) Tewa Polychrome Tewa Red (Posuge Red)
Southern Plains (Kansas, Oklahoma and Texas)	Ochoa Indented McKenzie Brown, in part Plains Village-like (cf. Bluff Creek or Pratt or Washita) protohistoric ware(?) (rough-surfaced plain ware)

** A variety of Playas pottery was also made in the Sierra Blanca region of southeastern New Mexico (**Wiseman 1981**).

*** A polished variety of El Paso Polychrome was evidently also made in the Sierra Blanca region of southeastern New Mexico. **Mera (1943)** subsumed at least some of this material under a type he called Jornada Polychrome. The latter term has seen little if any use.

B. Morphology
  1. Vessel form (bowl, jar, ladle, etc.)
  2. Vessel part (body, rim, handle, etc.)

C. Rims Only
  1. Form (direct, inverted, everted, etc.)
  2. Thickness (mm)
  3. Orifice diameter

D. Temper (using a microscope with a minimum of a 20 power lens)
    1. Type
    2. Size

E. Paste
    1. Color (Munsell)
    2. Density
    3. Hardness

F. Surface Treatment
    1. Interior Finish
    2. Exterior Finish
    3. Corrugation
    4. Other (incised, appliqué, punctuate, impressed, etc.)

G. Slip (interior and exterior)
    1. Color
    2. Quality

H. Paint Type (organic, mineral, glaze)

I. Stylistic Analysis of Painted Wares

J. Use-Wear (incidental grinding, mend holes, etc.)

IV. Modified Sherds (intentional)

Evidence of use alteration can be assessed in a number of different ways. Because of the relatively soft nature of ceramic materials, use-wear in the form of abrasion is often present. While most ceramics have been subjected to some abrasion patterns through normal vessel use, those ceramics that have been intentionally modified through grinding will be recorded separately.

    1. Type (spindle whorls, pot lids, pendants, gaming pieces, etc.)
    2. Size
    3. Photograph and/or scaled drawing

V. Minimum Number of Vessels

The minimum number of vessels (MNV) represented for each type will also be calculated to provide a more accurate assessment of the number of vessels represented at a site, which can aid in examining such things as intensity of exchange, degree of reliance on pottery, and mobility. MNV determinations can also provide an idea of the relative amount of disturbance that has occurred within site deposits, especially at sites with deep deposits, and can help in assessing the distribution of sherds from specific vessels across the site area or from within features.

A. Determining MNV
    1. Sherds that fit together
    2. Using multiple criteria (temper, wall thickness, paste color, slip color, surface treatment, design style)

VI. Whole Vessels
    1. Vessel height
    2. Volume
    3. Photograph

VII. Specialized Analyses (conducted on a select sample)

    A. Petrographic
    B. Refiring
    C. Apparent Porosity
    D. Residue Analysis (whole pots, large sherds recovered from protected location)

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FAUNAL STUDIES

Faunal remains, whether introduced into sites as food residues, pets, feather sources, implements and their manufacturing debris, ritual paraphernalia, curiosities, or as incidental co-inhabitants or postoccupational residents, are anticipated to be an important source of environmental, subsistence and behavioral information retrieved during the proposed excavations. The following pages present general research issues and data needs, field methods, and analysis methods.

General Research Issues and Data Needs

(from Speth 2003)

1. How can results of faunal analyses become most useful for other researchers?

Data Needs

- A. Detailed discussions of methods used to generate reported results and conclusions
- B. Presentation of raw data so that researchers can recast the data in other formats
- C. Refinements of accepted analytical protocols (e.g., numbers of faunal remains per volume of sediment excavated/century of sediment accumulation)
- D. Invention and adoption of new analytical protocols
- E. Re-examination of analyzed collections to generate additional data using modern analytical protocols
- F. Explication and addressing of interpretive problems unique to faunal analysis

2. How can analysis of the taxonomic composition of a faunal collection be refined to address questions about paleoenvironment?

Data Needs

A. Common usage of more sophisticated theoretical constructs regarding assumed correlations between prey abundance and hunter preferences

- Determination of whether optimal foraging theory and diet breadth models give suitable analytical tools to researchers in SE NM archaeology or if other constructs are needed to address unique hunter behavior or preservation factors
- Discussion of issues such as the seasonal availability of fat and palatability of elk fat as factors affecting prey choice regardless of prey abundance
- Increasing the sophistication of prey species rankings presently based largely (solely?) on body size and return rates

- B. Ratio of jackrabbits to cottontails
- C. Trends in body size (combined with evidence from pollen, wood charcoal, etc.)
- D. Changes of the average rate of tooth wear in animals belonging to the same age class (where age is assessed on the basis of stage of tooth eruption)

3. How can analysis of the taxonomic composition of a faunal assemblage be refined to address questions about human diet and economy?

Data Needs

A. Usage of more sophisticated approaches to determine taxonomic density
- Analysis of the largest possible samples size (sample in the lab, not the field)
- Use of many forms of quantification (NISP, MNE, MNI, etc.)
- Abandonment of the use of percentages to express faunal density
- Expression of faunal data at least in terms of items per unit volume of sediment excavation
- Expression of faunal data in terms of items per unit volume per century if possible to determine
- Assessment of taphonomic changes to a faunal collection by using element-by-element density values, calculating the ratio of proximal to distal humeri and tibias, noting the presence and frequency of carnivore gnawing, noting signs of bone weathering, noting under-representation of immature animals, and other potential indicators of bias or loss in the assemblage
- Explicit assessment *and reporting* of screening bias by conducting regular comparisons of recovery of faunal remains from excavation with those recovered from flotation samples
- Explicit recognition and discussion of the impact of scavenging dogs on the faunal assemblage, including accounting for remains completely consumed by dogs, not just gnawed

B. Usage of more sophisticated approaches to determine skeletal element frequencies
- Routine consideration of carcass culling and long-distance transport as a possible influence in the faunal assemblage
- Use of high-, intermediate-, and low-utility indices to inform observations of skeletal element frequencies and interpretations of hunter choices
- Exploration of group behavior, such as sharing of meat from larger game and disposal of remains in a communal midden, that could have systematically affected intra-site preservation and distribution of faunal remains
- Exploration of the frequencies of projectile points, in terms of items per square meter of surface collection or per unit volume of sediment excavation per century as appropriate, to indicate the degree to which large mammal procurement was an important economic activity
- Examine the correlation between element frequency and grease utility in prairie dogs versus that of rabbits and jackrabbits for evidence of roasting of prairie dogs (ethnographically a male and female activity) or stewing of rabbits and jackrabbits (ethnographically a female activity)

C. Usage of skeletal element frequencies to explore patterns of human behavior
- Determination of patterns of faunal processing and discard in communal versus individual/family loci to explore patterns of use of site space
- Determination of effects on the frequency of ribs and vertebrae of heavier species (e.g., bison) by comparison of expected numbers with recovered numbers of ribs and vertebrae of lighter species (e.g., antelope or deer), with any differences possibly attributable to trade of dried meat products of heavier species “on the bone”

4. How can analysis of a faunal assemblage be refined to address questions about seasonality of procurement?

Data Needs

A. Routine determination and reporting of the presence of fetal or newborn individuals in the assemblage (deer, antelope, bison, etc.)
B. Routine determination and report of the stage of tooth eruption and wear (deer, antelope, bison, etc.) or premolar gap (prairie dogs)
C. Routine determination and reporting of the proportions of males and females in the assemblage
D. Routine thin-section analysis of tooth cementum of ungulates and carnivores
E. Routine thin-section analysis of catfish pectoral spines for incremental banding

F. Routine examination of deer crania for evidence of shed or unshed antlers
G. Analysis of the presence or absence of various species of migratory birds
H. Examination of the proportion of immature to mature lagomorphs
I. Routine analysis of incremental banding in mollusks and determination of oxygen isotope ratios of individual bands

5. How can analysis of a faunal assemblage be refined to address questions about individual versus communal procurement?

Data Needs

A. Routine determination and reporting of the proportions of animals in various age classes
B. Analysis of those data for reflection of non-selective communal kills (animals occur in various age classes expected in a living population) or selective individual kills (age profiles are biased toward prime or older adults)

6. How can analysis of a faunal assemblage be refined to address questions about hunting pressure?

Data Needs

A. Trends in body size (combined with evidence from pollen, wood charcoal, etc.)

Field Methods

From FRACAG (n.d.: 59–60)

1. The bulk of the faunal remains are anticipated to be encountered and recovered during the course of routine excavation procedures. These materials should be segregated from other recovered cultural debris (e.g., lithics, ceramics) and packaged separately. Packaging should be sufficient to protect the faunal remains from breakage and mold or mildew. Bone artifacts or other modified faunal remains should be segregated and packaged as a separate class of archaeological remains.

2. Because some faunal remains may represent natural intrusions into cultural deposits, excavators must be cognizant of, and document, the context of discovery. That is, care must be taken to note when and where bioturbation or other natural processes have, or may have, affected the occurrence of faunal remains. These would include situations where faunal materials are recovered from krotavena (filled-in rodent burrows), badger burrows, other contexts where they may represent natural intrusions (e.g., in structure walls or in food storage facilities) and situations where the faunal remains may be contained in postoccupational fill.

3. Special recovery methods should be incorporated into standard excavation procedures where the provenience may be conducive to the occurrence or preservation of various classes of faunal remains. These proveniences should minimally include hearth features, the area immediately surrounding hearth features (i.e., within a 1 m radius), storage facilities, the corners of rooms, and suspected "domesticated" fowl confinement areas. Recovery techniques and rationale may vary from site to site and context to context

4. When discovered, animal burials should be exposed, mapped, photographed, and removed and packaged as a unit. The context of discovery should be thoroughly documented along with associated artifacts.

5. The determination to wash the faunal remains prior to submission to the analyst should be contingent on the condition of the specimens, the amount of adhering soil and distance and packaging requirements. Scrubbing should be minimized. Washing will be necessary for any analytic methods requiring weight.

Analytical Requirements

From FRACAG (n.d.:60–61)

The following are considered essential attributes that should be documented by the faunal analyst for each faunal specimen:

1. Identify type of faunal material (e.g., bone, shell, feather).
2. Identify the animal represented by the faunal specimen. This should be as specific as possible and should be ordered by taxonomic classification. That is, when possible species (or subspecies) should be identified. Where species identification is not possible the identification should be made, in descending order, to genus, family, order or class. For those remains that cannot be identified, an effort should be made to identify the relative size and kind of organism (e.g., large mammal).
3. Identify the element or anatomical part represented. Again, this should be as specific as possible and include left or right designations for paired elements, location of element relative to others in a serial arrangement (e.g., third thoracic vertebra). If the specific element cannot be identified, an attempt should be made to identify the type of element (e.g., long bone, vertebra, cranial element).
4. Identify the portion of the element represented (e.g., entire element, proximal articular end, medial shaft, lateral process, splinter, chip).
5. Identify the natural condition of the specimen. That is, does the specimen appear fresh, weathered or desiccated, rotted or deteriorated, crushed or shattered?
6. Identify any modification evident on the specimen that may have resulted from human agency or be indicative of disruptive post-discard agents. That is, is the item burned, are butchering marks or impact scars visible, is spiral - fracturing or breakage when green evident, is modification for tool use or use wear evident, is there evidence for non-human modification (i.e., rodent or carnivore gnawing or damage)?

Apropos to the identification of modification is the need for bone tools and other modified faunal specimens to be included in the analysis of unmodified faunal remains. The modified remains are as much a part of the faunal assemblage of a site as the unmodified remains and should be included in the general faunal analysis. Modified faunal remains should, however, be further analyzed as artifacts and accorded the same degree of analysis as other artifact classes (e.g., lithics, ceramics). Also, the individual performing the faunal analysis may not be proficient in the analysis of bone tools or other modified faunal remains and a separate analysis of these items may be necessary.

In addition to specific attribute identification, when possible, the age and sex of the animal should be noted. Age, particularly when based on tooth eruption in larger mammals (e.g., artiodactyls), can be an important source of seasonality information or, in the case of domesticated turkeys, can be a source of information on dietary selection and animal maintenance. Also, because the nutritional potential of male and female animals (particularly the larger mammals like deer or elk) can vary, sexing individuals can contribute to an understanding of hunting strategies and seasonality.

The faunal materials should not be analyzed in a vacuum. That is, it is important that the analyst be cognizant of the context of discovery and the rationale for establishing context groupings for analysis.

Also, essential to any faunal analysis is an estimate of relative category abundance. A number of techniques have been proposed for measuring faunal remains, their frequency of occurrence and relative contribution to the diet. Because faunal analysts do not always agree on the appropriate methodology, no one specific technique is recommended. It is strongly recommended, however, that some measure of faunal assemblage diversity be included in each report and that the rationale for its selection be explicitly identified. Measures frequently used include: minimum number of individuals, category abundance (bone volume, bone weight, total number of fragments), relative frequency or weighted abundance of elements, and utility indices.

Finally, the faunal analysis should include an evaluation of the environmental setting and catchment represented by the faunal remains. Also, depending on the condition of the remains, evaluation of the post-discard setting and processes affecting the site may be appropriate.

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ARCHEOBOTANICAL STUDIES
(from Dean 2003)

Through systematic collection of flotation, pollen, and vegetal (macrobotanical) from archaeological sites, archaeologists seek to recover evidence of past behavior, living conditions, and subsistence. Remains from collection, processing, storage, consumption, and discard of botanical resources by site occupants are recovered in a matrix of sediment from specific locations within a site. Flotation and pollen samples are collected, frequently in tandem, from contexts most likely to contain these remains. Taking both types of samples enhances recovery of botanical information and provides two independent sets of evidence for use in interpretation and comparison across time and space (Adams and Gasser 1980). Collection of sediment samples for phytoliths, microscopic siliceous plant remains, is less common, but is becoming increasingly recommended. Guidelines for collecting phytolith samples mirror those for collecting pollen.

These following guidelines advise Southwestern archaeological project directors, and crewmembers on the retrieval of samples to maximize recovery of archaeobotanical remains. A well-deliberated collection strategy can increase the amount and consistency of botanical information obtained from a site. Consistency in sampling can reduce variability in sample collection, treatment, and analysis, and provide more uniform results, allowing greater intersite and regional comparability.

Pre-field recommendations stress to project directors the importance of incorporating botanical specialists into the development of the research design and the botanical sampling strategies into the sampling strategy. Involvement of specialists in the initial planning of the research design can ensure relevance and efficiency of field and laboratory procedures, help develop more accurate budgets, and assure maximum recovery of information relevant to the research questions.

Definitions of sample types and field procedures are provided for flotation, vegetal, and pollen/phytolith radiocarbon samples. Table 6.2 outlines recommended number and contexts of flotation and pollen samples. Provision of an exact numbers of samples is avoided because this number is dependent upon research questions, site size, preservation, condition, sediment type, and budgetary constraints.

PRE-FIELD PROCEDURES

I. Specialist/Project Director Communication:
    A. Encourage botanical specialist participation in the development of research questions, especially those concerning subsistence, and in the development of specific research and sampling designs, especially for large-scale projects.
    B. Arrange for specialists' visits to project area: a preliminary visit prior to excavation; one or more visits during excavation.
    C. Supply specialist with the following information: project location; sites under investigation; vegetation, land forms, and water sources; disturbance; quality of site preservation; topographic and site maps; site chronology and radiocarbon dates and their contexts, correct feature and structure proveniences, and site stratigraphy. Post-field changes to proveniences should be submitted to specialist immediately.

II. Specialists' Preliminary Recommendations:
    A. Collect samples during testing to assess presence, preservation, and density of botanical materials, and to refine (or establish) the sampling strategy based upon the preliminary results.

B. Train one person (analyst or crew chief, for example) to conduct all sampling.

C. Provide (these) guidelines for collection procedures for flotation, pollen, vegetal, and radiocarbon samples, and structural remains not sent to tree-ring lab.

D. Provide thorough guidelines for sample handling and labeling.

Flotation Samples

I. Definition

A flotation sample is a sediment sample collected from selected locations in archaeological sites expected to contain culturally, and possibly environmentally, informative botanical remains. The name is derived from various water flotation processes by which botanical remains are concentrated from the collected sediments.

II. Purpose

Flotation samples are collected to efficiently recover botanical remains from cultural contexts. Analysis of these remains enables the archaeologist/ specialist to determine the nature of plant resource utilization by human occupants, distinguish between naturally and culturally introduced remains, determine feature function, and to assess preservation of organic remains at a site.

III. When to Collect

A. When cultural features, surfaces, and deposits are first exposed during excavation. Prolonged exposure can contaminate the cultural deposits with modern pollen and seeds.

B. When potential for good preservation and distinct context and stratigraphy are recognized. Good preservation of plant remains is fostered by minimal exposure to cycles of wetting and drying or freezing and thawing, and limited oxygen. Such conditions are found in less permeable sediments, deep strata ($\geq$ 1 meter), and in rock shelters. Open, shallow surface deposits, on the other hand, have the least potential for preservation of perishable remains, although well-preserved remains can be recovered from such contexts. Additionally, regardless of depth of deposition, burned deposits tend to preserve through carbonization.

C. When the cultural context is undisturbed. Bioturbation, erosion, pot hunter activity, and other human and natural disturbances cause mixing and loss of stratigraphic integrity, making interpretation of botanical and other remains unreliable.

IV. Where to Collect

A. Collect one or more surface control samples prior to groundbreaking activities or outside the site boundary to identify the modern seed assemblage. The sample may be collected as a surface scrape or “grab” sample from specific locations outside the site, or it may be a composite of “grab” samples collected from representative locations across the site or in the site vicinity. Bulk samples can also be collected.

B. Collect from cultural contexts as they relate to research questions (see Table 6.2), such as hearths, thermal and nonthermal pits, bins and cists, ash and charcoal lenses, floor surfaces, activity areas, midden strata, roof fall, burials (in accord with Native American requirements), ceramic vessel contents, agricultural features, and other contexts

C. Collect samples from (e.g.) 10-cm increments from a column in a trench wall to identify past seed assemblages (optional).

V. Sample Size and Number

- A. A recommended standard sample size is two liters. More than one 2-liter sample can be collected from contexts in which cultural deposition is thought to be sparse, preservation is poor, or if analysis of larger amounts is desired. In some regions of the Southwest, one 2-liter sample is insufficient. Rather than increasing the sample size, we recommend increasing the number of 2-liter samples taken from a single context. One sample can be floated and the results evaluated to determine the number of additional samples required to yield a sufficient volume or quantity of botanical material for analysis. These 2-liter samples can be combined if desired without loss of size comparability. If feature volume is less than two liters, collect as much as possible remembering to reserve enough in situ sediment for pollen and other samples if applicable.
- B. Sample number will vary according to site type, context, deposit volume, preservation, and research questions (see Table 6.2). A single 2-liter sample is usually sufficient for a feature (see exceptions above). Evidence for multiple episodes of use, floor surfaces, and large features may require collection of several samples to adequately represent the botanical materials associated with those contexts. Samples can be collected adjacent to features to recover accidental deposition, and from secondary deposits in a feature to verify the unique nature of the sampled context. Control samples also should be collected from the modern ground surface or, if identifiable, the prehistoric ground surface, to identify the local seed assemblage.
- C. Number of samples will vary according to research questions, site type, context, preservation, and budget. Consistent sampling from a recurrent feature type is advised.

VI. How to Collect

- A. Using a clean trowel, remove sediment from context and place into heavy duty paper bags or one-gallon zip lock bags. Filled one-gallon zip lock bag is about 2 liters. Double bag all bags and seal securely to prevent contamination by other samples during transport.
- B. Label bags completely; may also insert a completed identification tag inside bag. Labels should include sample, site, and feature numbers, level, depth, and specific context of sample.
- C. If sample is damp, note WET SAMPLE on bag and in sample log so laboratory technicians will know to open the bag to dry the sample to prevent molding.
- D. Treat samples carefully. Botanical materials are fragile so the samples should be boxed separately from heavy artifacts.
- E. Record sample locations on site, feature, and profile maps, and in sample log.

VII. Other Sampling

- A. Vegetal samples from cultural contexts or recovered in excavation screen.
- B. Pollen samples can be collected in tandem with flotation samples or from independent locations. (See pollen sample collection guidelines.)
- C. Radiocarbon samples, usually charcoal and occasionally other charred vegetal items.
- D. Locations of all samples should be plotted on site/structure maps and documented in sample logs.

VIII. Record Keeping/Sample Logs (from Fruitland Data Comparability Guidelines)

A. Do every analyst a favor and keep a sample log. In the opinion of the compilers of this document, it would behoove all excavation crews to keep a log book that would be divided by sample category (e.g. flotation, pollen, dendro, C-14) and, within each category, give each sample a sample or collection number.

B. Regardless of how the log is set up, information to be recorded for flotation samples is:

1. Sample #
2. Complete provenience which includes site #, study unit, horizontal-vertical position, depth below ground surface (not datum), feature #, feature type, or surface;
3. Fill assemblage type (e.g. primary, secondary)
4. Where within the feature or horizontal unit was the sample collected, i.e. on the bottom of the hearth, against the wing wall.
5. Condition - area burned, disturbed etc.
6. Associated sample numbers if multiple samples collected from a context or if a suite of samples (e.g. feature fill, surface adjacent to the feature) is collected.

C. Copies of the logs should be sent to the analyst. In addition, one should expect to provide a general location map, some sort of site map showing sampled proveniences and if possible, profiles of samples features. It is also helpful, when dealing with a lot of samples from a large excavation, to provide information on stratigraphy, geomorphology, and the excavator's understanding of the site formation and taphonomy.

D. Processing

1. This should be obvious, but flotation samples are to be processed by some type of water separation technique, not by dry-screening or water screening.

2. However, water screening is a recommended technique to recover small scale faunal and lithic materials from features and activity areas. For water screening procedures, first collect flotation, pollen, vegetal and whatever samples as appropriate, then take the remainder of the fill as a whole sample. The bag should be clearly marked as a water screen sample. Process the sample by placing it in a 1/16th inch screen and hosing out the dirt. The residue in the screen can be packaged as is, to be sorted by laboratory personnel, or the residue can be sorted at the time of water screening and cultural material extracted and packaged, with the noncultural residue discarded.

IX. Analysis and Data Return

A. There are two levels of sorting/analysis that most macrobotanical analysts utilize for flotation samples. Archaeological contractors should keep these two methods in mind when requesting analysis.

1. Scanning. Although execution of this method will differ slightly depending upon the analyst, scanning provides a rough sort of botanical materials, emphasizing seeds, from flotation samples. The method is used to assess the level of preservation of botanical remains from the sampled context and usually consists of a quick sort that records presence of taxa, with rough estimate of quantity and condition. Identification of wood may or may not be done. This sorting method is used for samples that are collected from less well preserved contexts than optimally desired, but which may still yield significant information. Scanning is quick and cost about 1/2-1/3 of a fully analyzed sample. If the sample appears to have data potential, the analyst will recommend full analysis.

2. Full Sort. This method is complete analysis/sort of the floated residue (light fraction), or a representative subsample of the light fraction, and usually a scan of the water screened residue (heavy fraction) that is left after the floated material has been retrieved. Full sort implies taxon and plant part identification of all types of botanical remains recovered, quantification of each taxon and notation of various descriptive information recorded that will assist the analyst in assessing the significance of the remains relative to the sampled context and the site as a whole. Full sort is better applied to samples that are from contexts with good-to-high integrity with cultural fill that have the potential to provide good preservation of botanical remains.

B. Data return is dependent upon preservation, the contexts sampled and the number of samples analyzed. No one has control over preservation, and the excavator is ultimately responsible for assessing the sampling situations and subsequently the number of samples analyzed. However, the application of the macrobotanical data will be greatly enhanced if the analyst knows what research questions are being asked, in addition to having been provided adequate provenience information. Therefore, it is in the best interest of each archaeological contractor to provide the analyst, regardless of what archaeobiological material type is being analyzed, with a copy of the research questions posed in the data recovery plan of each site.

POLLEN SAMPLES
(from FRACAG n.d.)

The following section concerning pollen samples and collection of such samples has been compiled from information distributed by the Castetter Lab for Ethnobotanical Studies (Dept. of Biology, University of New Mexico) at the January 1991 New Mexico Archaeological Council quarterly meeting and from Paleoethnobotany: A Handbook of Procedures by Deborah M. Pearsall (1989). There are two location strategies relative to pollen collection: stratigraphic and archaeological. Stratigraphic pollen columns accompanied by geomorphic data can provide the background vegetation/environmental data for archaeological sites. Collection of stratigraphic pollen columns can occur prior, during or after excavation but it is best done when open trenches, road cuts, arroyos or cores are convenient and available for use. Archaeological pollen collection predominately consists of on-site collections to investigate cultural activities as well as to gain insights as to the prehistoric environment during occupation of the site. Collection of archaeological pollen samples is generally determined by the research design and available contexts. As stated in the introductory remarks regarding archeobotanical studies, it is advisable to consult with specialists prior to excavation to assess the potential for specific sites to contain archeological contexts that might be expected to yield productive pollen samples.

I. Collection of Samples
  A. Size of pollen samples collected:
    1. There is some controversy on sample size. Sample size is dependent on sediment composition. Clays can trap and keep more pollen than sand. Some deposits, bogs for instance preserve pollen very well whereas sand dunes do not. The range of sizes suggests 2 cups to 1/3 of a cup is sufficient based on sediment composition.
    2. For southeast New Mexico, ½ to 1 cup of sediment should be sufficient. If a context contains less than ½ cup of available sediment, collect it all.
  B. When to collect a pollen sample:
    1. As with flotation samples, context, preservation potential and purpose for sampling are factors to keep in mind when collecting a pollen sample.
    2. Do not take a pollen sample as a means to define the function of a feature; samples will provide information concerning items within the feature or can possibly confirm the field identification of a feature, but contents of the sample will rarely be able to define what the feature is.
    3. Do not take pollen samples from every level within an excavation area/study unit unless each level is a cultural deposit with potentially datable (relative or absolute) remains in association or the goal is to analyze a column.
    4. Take samples from secure contexts whenever possible. Secure contexts mean defined features, use surfaces, cultural levels, etc.. In most cases, the archaeologist should be taking samples to secure information that will address research questions (e.g. what resources were

exploited). If samples are collected from noncultural or poorly defined areas within a site, their information potential is limited.

5. The better preserved the sampling context, the better the information retrieval. Highly disturbed or eroded contexts will have a lower preservation potential for pollen and will also have a higher level of contamination.
6. If fill from features is sampled, emphasize collection of pollen samples from primary, secondary or de facto cultural fill. Wind/water lain deposits and other noncultural deposits have low potential for yielding pollen data applicable to understanding the cultural occupation.

C. Where to collect samples:

1. A sample from the modern ground surface is highly desirable; this should be taken away from the actual site area if possible (note on the bag where it was taken in relation to the site). The sample is usually taken as 30-50 pinches from the ground surface, distributed over an area of about 100 m^2 or so, totaling about 1/2 cup in volume. This sample is a way to measure the dynamics of pollen transport in the site area today, and is a rough measure of the pollen signature of the current vegetation. The differences in pollen concentrations between the modern and prehistoric pollen spectra can help spotlight cultural influences in the archaeological samples.
2. As noted above, pollen samples should be collected from cultural contexts with integrity and cultural fill. In addition, some other factors to keep in mind are:
   a. Pollen grains can be destroyed by exposure to heat/flames, therefore thermally altered locations (hearths, burned floors) may reduce the representation of pollen in a sample. This is not to say that there will be no pollen in samples from such locations, but that the pollen content may be biased towards more durable grains.
   b. Samples with a high charcoal content are difficult to clean and analyze and therefore will affect pollen representation.
   c. Stratified cultural fill within any sampled context should be sampled in discrete, stratigraphic units.
   d. Choose locations most likely to have been exposed to and to have trapped the pollen associated with cultural activities such as, storage areas, against walls and in corners, low traffic areas.
   e. Choose locations which reduce the possibility of ambiguous interpretations.
3. Well preserved use surfaces and activity areas around processing features. Scrape surfaces horizontally, don't gouge out the sample. Take more than one sample from floors, especially if wingwalls or other features indicate the division of floor space. Sampling can be done on a grid system or randomly.
4. Burials. Any pollen sampling in the context of human remains should only be performed following consultation with the BLM or other appropriate agency for federal public lands and with the NM SHPO for state and private lands. Such pollen collection should only be carried out in accordance with data recovery plans that have been the subject of consultation under the Archaeological Resources Protection Act, the Native American Graves Protection and Repatriation Act, or applicable State statutes. Take more than one sample, e.g. abdominal area, under the body, but specify exactly where the sample was collected from in order to assist the analyst in distinguishing pollen associated directly with the body versus the burial pit or grave goods, etc.
5. Cists, pits, mealing bins, storage areas. The bottoms and in corners are the best sampling areas if interested in use of the feature. If interested in the pit fill, which usually represents post-use of the feature unless it is primary fill, sample it incrementally, not as one big bag.
6. Vessels. Sample the lowest part of vessel fill (you may wish to use some of the vessel fill as a comparative sample; value of information return will be determined by your research design).

    Or submit the vessel for a pollen wash/scrub of the interior. Samples should also be collected from large basal sherds of broken in situ vessels.
  7. Manos and metates. These artifacts may be similarly washed/scrubbed for pollen. Wrap manos in foil and note which surface was down.

  (Note: Pollen remaining from the use of vessels and groundstone will be adherent to the pores of the ceramic or stone; casual exposure of the sampling surface to the open air is not catastrophic; even artifacts that have been <u>gently</u> cleaned of overlying dirt may still be good candidates for pollen washes [a process done with toothbrush and dilute acid or water]; be sure to notify the pollen lab that the artifact was exposed under such-and-such conditions for such-and-such a period of time, or that it received cleaning--be specific).

  8. Plaster from walls may have trapped pollen ambient inside the structure while the plaster was drying. If more than one layer is present, try to sample each plaster layer separately in the field (be sure to indicate which layer was outermost, and which were behind it, in order).
  9. Mortar from between adobe bricks, as well as the bricks themselves, may yield information on ambient indoor pollen (mortar samples) or sources of the adobe (brick samples), although pollen preservation is often less than best. Sun-dried adobe bricks are referred to here; the recovery of pollen from fired bricks is problematical.
  10. Some researchers use "control samples" to evaluate the pollen spectra from cultural contexts; at one extreme, a control sample from fill is said to invalidate a targeted cultural sample if the pollen spectra are similar. Some analysts believe that if the cultural sample is well-considered and well-taken, little or nothing will be gained by comparing its pollen spectrum to that from a post-depositional or post-abandonment context, however, other analysts considered "control samples" valuable. Confer with the analysts who will be analyzing the samples.

D. Contamination:
  1. Not a serious problem usually unless the context to be sampled is repeatedly disturbed and left open to the air before the sample is collected.
  2. The use of distilled water to clean your trowel is unnecessary; it is recommended that the trowel does not have dirt from some other context adhering to it.
  3. The use of sterile sample bags (whirl-pacs) is not necessary, although sample bags should be clean and not have been used before.
  4. Target each sample locus -- do not include non-target sediments.
  5. Help the pollen analyst account for non-archaeological pollen types -- note what plants were in bloom during work at the site; whether it was windy when the sample was taken; and any other information that may be helpful.

E. Number of recommended samples: see Table 6.2

F. Packaging:
  1. Although whirl-pacs are not required, they are convenient because one bag equals approximately 1/2 cup, the preferred sample size.
  2. Some analysts recommend that samples be collected in paper sacks because moist samples can dry without opening the bag again. Coin envelopes (4"x6"?) are one suggested type of paper sample bag.
  3. If plastic bags are used and the samples are moist, microbes can grow in the sample and destroy the pollen. Therefore, moist samples in plastic bags should either be treated with several drops of ethanol, which prevents microbial growth, or the bag pricked numerous times with a pin (without creating holes large enough to lose the sample) and allowed to dry out.
  4. Regardless of which type of bag is used to collect the sample, double bag it with a paper sack that will have the provenience information recorded on it.

Table 6.2 Guidelines for Collecting Flotation and Pollen Samples from Archaeological Contexts in the American Southwest.

Context	# Flotation Samples	Flotation Samples: Comments	Pollen Sample Type (see key)	Pollen Samples: Comments
Activity/use surface	1+	One sample sufficient; multiple samples can be taken if surface is extensive.	S-MS or MP	
Agricultural feature/ rock alignments, clusters	1	Under, around rocks.	S, MP	Under, around rocks.
Artifact (ceramic vessel, lg. sherd, pipe)	1	Retain contents; under artifact if in situ.	PW	Artifact interior/use surface (including ca. 2 mm adhering sediment); under artifact if in situ.
Artifact (mano, metate, palette)	1	Sediment assoc. w/ use surface; under metate if in situ.	PW	Cover use surface to minimize contamination, collect. Wash from scrubbed use surface
Artifacts, rocks on floor, etc. (under)	1		S	Excellent, protected from contamination, degradation.
Ash/charcoal lens (see Thermal feature)	1+	Darkest concentration.		Consult palynologist.
Bench	1+	Bench surface.	S-MS, MP	Bench surface.
Bin	1+	Fill (not postoccupational), sides, base. Take > 1 sample if multiple uses expected.	S-MS	Base and sides.
Burial: skeletal remains	1-4	Head, abdomen, adjacent to remains; control from just above.	MS	Around head, feet, inside abdominal/pelvic area; control sample from fill just above.
Burial: artifacts	1+	Artifact contents.	S, PW	Note orientation: inverted metates/vessels best contexts; bag or cover exposed use surface; sediment assoc. w/ use surface for control; wash from scrubbed use surface.
Canal, possible water control features	1+	Multiple samples depends on feature size	S, MP	(see Stratigraphic column)
FCR cluster	1+	Around, under rocks.	S-MS	Around outer edge, or past oxidized zone.
Fields (agricultural)	1+	Multiple samples depends on field size.		Consult palynologist.
Floor	1-4+	Surface, corners, edges; by unit; sample multiple floors individually; control sample(s) from overlying fill.	S-MS, MP	Corners, around hearths best; avoid doorway/entry; sample multiple floors individually.
Hearth	1	Hearth fill by strat.(not post occupational fill), base, sides; floor surface surrounding hearth.	S-MS	Beyond oxidized zone or under hearth rocks (pollen destroyed by extreme heat); floor surface outside hearth edge.
Kiln	1+	Each level.		
Midden	1+	By strat, possibly a column.	S-MS	
Modern surface	1+	Document modern vegetation (control sample).	MS	Document modern vegetation (control sample).

Context	# Flotation Samples	Flotation Samples: Comments	Pollen Sample Type (see key)	Pollen Samples: Comments
Niche			S-MS	Base, sides.
Pit, thermal	1+	Fill by strat.(not postoccupational fill), base, sides.		Base, sides, outside oxidized zone; beneath and between slabs if slab-lined; around outside edge.
Pit, non-thermal: cist; storage, other	1+	Fill by strat.(not postoccupational fill), base, sides.	S-MS	Base, sides.
Post hole	0-1	If suspect floor sweepings, ritual offering; if post remnant present, use for C^{14}, dendro.	S	Base, sides.
Prehistoric ground surface		As control sample for prehistoric seed assemblage.		Good control sample.
Rock alignment		Under, around rocks	S, MP	Under, around rocks
Roof fall	1+	Strata, if present and relevant		
Stratigraphic column		In middens, or in on- or off-site trenches.	S	Sample lowest stratum first; avoid sampling across strat. contact; if seds. homogeneous, sample at regular intervals, (e.g.) ea. 10 cm
Structure, feature fill	1/strat.	Cultural deposits, in situ feature fill, middens, roof fall, etc., (relevance depends on research questions).	S-MS	3-5 cm above use surface, sterile, fill excellent for postoccupational environmental pollen.
Ventilator shaft			S-MS	Base, sides.

Key: S = single location or point sample; MS = multiple single point samples; MP = multiple pinches across surface; PW = pollen wash

II. Record Keeping/Sample Logs
  A. Note Section B under Flotation Samples; the same information pertains to pollen samples.
  B. On large scale excavation projects, it is also recommended that if possible, arrange for the pollen analyst to visit the site/project area during excavation to assess area vegetation, take ancillary modern samples, assist in collecting samples from the excavations and generally gain a first-hand familiarity with the project.

III. Analysis and Data Return
  A. Pollen samples are prepared and analyzed by specialists. However, some laboratory techniques will influence representation of pollen in a sample.
    1. Pollen grains are resistant to acids and susceptible to bases. Therefore, alternation of acids and bases during laboratory extraction can exacerbate degradation and influence representation. If pollen samples are frequently noted as pollen deficient, check the extraction process being used.
    2. The use of spike (<u>Lycopodium</u> spores) during extraction will allow assessments of pollen abundance and degradation to be made during analysis. Check that your selected analyst uses spike.
  B. Data return is dependent upon preservation, the contexts sampled and the number of samples analyzed. The application of the pollen data will be greatly enhanced if the palynologist knows what research questions are being asked, in addition to having been provided adequate provenience information. Therefore, it is in the best interest of each archaeological contractor to provide the analyst with a copy of the research questions posed in the data recovery plan for each site.
  C. At present, it is considered more appropriate to present pollen data in tabular form, histograms, pie charts, scatter plots, etc. Saw-toothed pollen diagrams are not appropriate for archeobotanical analysis. These diagrams were designed for closely-spaced vertical column samples, taken for paleoenvironmental studies, where continuity from one sample to the next could be demonstrated. Such continuity cannot be assumed in archaeological sediments because of cultural activity.
  D. Also, a more accurate means of presenting the pollen data is as <u>concentration values, not as only percentages</u>, with some expression of pollen degradation. If only percentages are presented, request that concentration values also be provided.

Phytoliths

Phytoliths are plant crystals that are formed by plants from excess silicon dioxide, calcium oxalate, and other minerals and stored within specialized cells. Some plants form characteristic phytoliths unique to family, genus or species. Collection of phytolith samples is similar to collection of pollen samples and procedures previously described above. Pearsall (1989) and Pearsall and Piperno (1993) present detailed information concerning phytoliths. It should be noted however, that phytoliths, unlike pollen grains, are not destroyed by heat/burning and therefore can be retrieved from fire-altered proveniences.

Vegetal (Macrobotanical) Samples

I. Definition

Vegetal samples are collected as potential indicators of botanical resource utilization, processing, or use by site inhabitants. Such samples include specimens of corn cobs, kernels, squash rind, acorns, other seeds, charcoal, leaves, cordage, vegetal matting, wood from roof fall, and other plant parts, charred or uncharred. They do not require concentration by flotation procedures. These are recovered from the screen or directly from the cultural context. Other vegetal samples might include “quids”, sandals, digging sticks, textiles, and basketry. Although the latter may be catalogued as artifacts, they should be accompanied by a notation for them to be routed to the botanical specialist for treatment and identification.

II. Collection

These samples can be fragile and should be removed from the sediment and packaged with care because they can disintegrate with exposure to air and sun. Do not remove contents of ceramic vessel but secure vessel with sediment in place. Wrap vegetal specimen in tissue or foil and place in vial, small box, or similar protective container padded with tissue and label completely and legibly. If item is very large, affix it with a fully labeled tag. Use of cotton batting for vegetal samples is discouraged because it adheres to the sample and its subsequent removal can damage the specimen. These fragile samples should be boxed separately from heavy sample bags and artifacts.

III. Documentation

All samples should be given a sample number and provenience information, entered into the sample log, and documented on all appropriate forms. Specimens should be marked “FRAGILE” when applicable.

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