

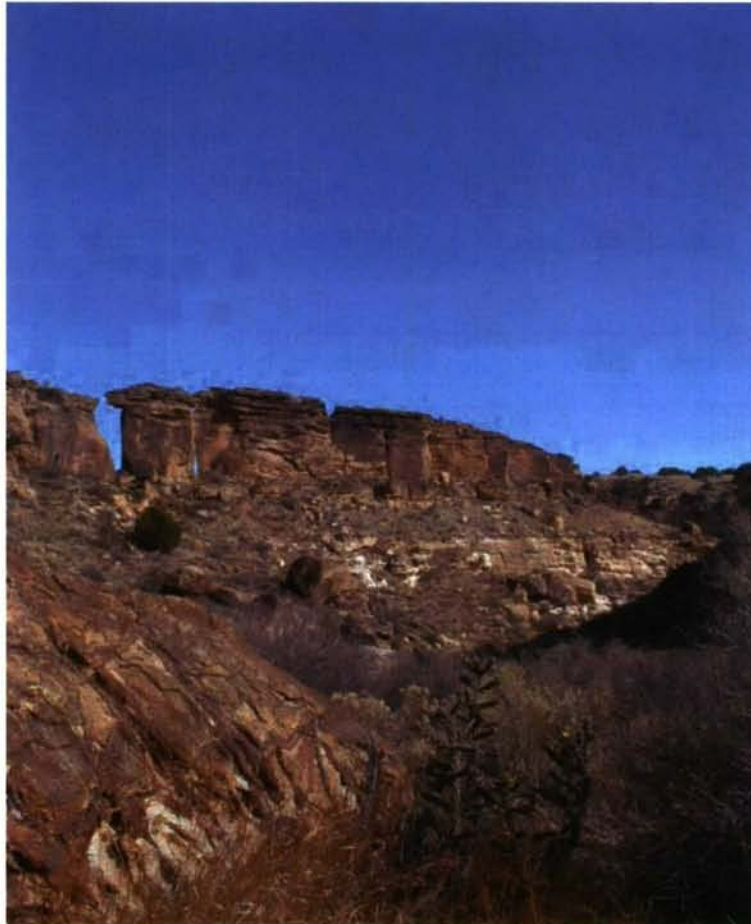
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A Model for Predicting Late Prehistoric Architectural Sites at the Pinon Canyon

Maneuver Site in Southeastern Colorado

by

Mark Owens



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INTRODUCTION

This project examines the relationships between technological, functional, chronological, and environmental/geographic variables and their influences on the placement of architectural sites of the Late Prehistoric stage in the southern Plains region. To build a predictive spatial model, the project compares a number of variables taken from sites at the Pinon Canyon Maneuver Site (PCMS), a large military base in southeastern Colorado. This study integrates several factors, including processual archaeology, behavior theory, principals of pattern recognition, and modern Geographic Information Systems (GIS). Guiding this work is the established archaeological theory that prehistoric people choose locations for both permanent and temporary campsites near the resources that they need to live, and to interact in social situations.

Many years of archaeological survey projects have taken place on the PCMS and these have identified over 100 distinct locations with Late Prehistoric stage architecture. The architectural sites seem to exhibit limited variation in environmental setting and geographic positioning and, in general, start to exhibit some variations in functional categories, as shown by performance characteristics, during the period of time between AD 100 and AD 1450. Because of this, variables for known sites such as slope, aspect, proximity to water, site setting, and elevation seem useful for locating undiscovered structures and structure sites. Several habitation types were identified by these variables and used to construct a settlement model that can be tested against information recovered from future archaeological surveys on the PCMS. If settlement trends are indeed apparent, this model's ability to predict hypothetical habitation locations would be a key tool for future archaeological inventories in southeastern Colorado, or in most any location where hunter-gatherer groups display sedentary tendencies.

In southeast Colorado, and the southern Plains states in general, most property is under the control of private landowners. Because of this, very little data has been forthcoming regarding the type and nature of Late Prehistoric stage architectural sites. It is the hope of this author that the publication of the data derived from this project will contribute greatly to the overall knowledge base of the region. In addition, information derived from this work may be extended to all areas where hunter-gatherers and sedentary societies have occupied space upon the land.

PROJECT BACKGROUND

Over the past several years, there have been numerous archaeological predictive models designed for both cultural resource management and research oriented projects (Kohler and Parker 1986; Kvamme 1984). One of these was developed for determining high site-density areas at the PCMS (Kvamme 1984). Like other models, Kvamme's was developed to elucidate prehistoric settlement behavioral patterns while minimizing archaeological survey project costs by concentrating work in locations where sites were more likely to be found. In hindsight, it has been an effective planning instrument that has been used by archaeologists and other cultural resource personnel for over 20 years. The model exhibits a moderate degree of accuracy when

applied to locating prehistoric archaeological sites, but it is limited in that it cannot predict certain types of sites (e.g., tipi ring locations) or more importantly to the current project, Developmental and Diversification period architectural sites. Because earlier modeling approaches focused exclusively on the management of cultural materials, they contrast sharply with the many aims and goals of modern researchers. Put another way, these models are very efficient for creating large site inventories, but they don't necessarily help archaeologists answer local and national research questions relating to population dynamics, technology, settlement and subsistence strategies, economy, or in this case architecture.

Architectural features have many implications for the study of regional settlement, and in many cases, the patterning of architecture may be ultimately used to answer questions regarding the research themes listed above. In theory, and with the proper variables in place, this predictive model seems beneficial for distinguishing between temporary field camps, and highly structured or patterned habitation sites.

Most of the Late Prehistoric age architectural data recovered from the southern Plains states and the eastern portion of the American Southwest culture area has been derived from large-scale survey projects. Archaeologists recognize habitation features as surface, semi-subterranean, and subsurface structures. In this investigation, the focus is on spatial patterning of semi-subterranean and surface structures in southeastern Colorado (specifically those between the Purgatoire and Arkansas Rivers).

A primary assumption of this study is that prehistoric people locate themselves to interact in social settings, and to be near the resources they need for survival. I posit this type of behavior can be reflected in the spatial organization of architecture and to a lesser degree in artifacts. If true, by focusing the research on environmental and geographic factors, one should be able to pattern all types of cultural materials.

THEORETICAL ISSUES

As a research theme, architectural studies can be used to address questions regarding demography, community development, cultural boundaries, technology, function, and social organization. To understand the role of architecture in larger cultural systems, several concepts, both theoretical and methodological, have to be considered. The first concept guiding the current investigation is that of processual archaeology. Processual archaeology seeks to find universal laws; those verifying that material culture remains found on archaeological sites have been ordered or patterned through the behavior or organization of a society (Binford 1962; Longacre 1970). Under this paradigm, the structure of an archaeological site, therefore, provides information on the way it functioned. Based on this assumption, an archaeologist will need to find correlates in the material remains that can be patterned. From these, the archaeologist will then offer testable hypotheses regarding social organization and/or related patterns of individual or group behavior.

The above concept must be treated with caution, however, because many, if not all, artifacts originally deposited on a site will not maintain their original prehistoric context. In survey and excavation projects, material remains are found in "archaeological context" (Schiffer

1972:157-158), indicating simply that they passed through a cultural system and have been impacted by natural and cultural formation processes. To understand how objects or artifacts come to be found in “archaeological context,” we need to understand how formation processes factor into data collection.

As noted above, the recognition of patterns is of paramount importance in archaeology, but the archaeological record, to quote Schiffer (1979:22), “is not a fossilized sociocultural system.” To get at actual patterns of behavior, archaeological remains cannot be viewed through the processual synchronic lens because site formation processes have altered both their provenience and physical make-up. Formation processes consist of the cultural practices of ancient or modern people and the natural environmental conditions that effect what remains of old sites (Stiger 2001:13). In viewing archaeological site forms and cultural resource management reports, it seems that most archaeologists know little about site formation processes, and those who actually do, believe that prehistoric occupations exposed on the modern ground surface are more contextually disturbed than buried ones. In many instances, however, natural processes such as pedogenesis (soil formation), post abandonment sediment mixing, multiple occupations, erosion, bioturbation, and compressed stratigraphy can bias buried horizontal archaeological remains even more than those found in surface context. While it is not the intent to argue sources of bias in the archaeological record, the point is that archaeologists should not look past the valid and abundant data collected during surface reconnaissance work. As long as the researcher takes into account the effects of site formation processes, the patterned layout of surface features and sites can often be recognized.

In recent surveys on the PCMS, archaeologists have started to note some patterning in the shape and layout of Late Prehistoric stage habitation locations. It must be cautioned, however, that surface features and lithic artifacts sometimes only a few meters apart may not be temporally associated. Despite this drawback, artifacts and objects on archaeological sites can be purposely separated into discrete temporally related assemblages or units by considering carefully the four types of variability that Schiffer (1987:23) observes in archaeological materials.

Regarding this report, formal variability is of little relevance and no data is presented for the size, shape, etc., for Late Prehistoric architectural units. Spatial variability, referring to the location of an artifact, site, or feature, is of the most concern, though frequency (number of occurrences in a data set), relational (associations with other material remains), and chronological variability were also used for patterning the project sites.

Returning to the concept of patterning, whether related to the archaeological paradigms of processual or behavioral archaeology, it should be pointed out that patterns cannot be defined for single artifacts or events. According to Wilcox, archaeologists should strive to establish relationships between comparable objects or events:

Similarity is of two types: the first by demonstrating that a certain set of static relations exist in a series of situations, artifacts, or events; the second, is established by demonstrating that the same set of actions, either behavioral, non-behavioral, or both occurred in a regular way to generate a patterned set (Wilcox 1975:125-128).

For the purpose of this project, Wilcox's concepts are applied to the location of architecture. Prehistoric architectural features represent objects produced by inhabitants who make order and meaning of random space by physically arranging natural, and locally available materials, into functional forms.

A key theory in the current work is that functional forms, whether artifacts or architecture, have behaviorally relevant performance characteristics (Schiffer and Skibo 1997:30). This includes sensory performance characteristics (visual and acoustic) and physical performance characteristics. Acoustic performance characteristics, in this case the way sounds travel and echo around an architectural site, appear to have little relevance for the study of prehistoric architecture itself (the individual "buildings"), but must be considered in cases when architectural features are placed near or within large rockshelters, or in areas where a line-of-sight relationship may exist between architectural features.

Prehistoric builders would have utilized sensory performance characteristics by constructing an aesthetically pleasing domicile. They have also been noted to erect structures in areas of high terrain for several reasons: to watch game, observe enemy movement, or to simply enjoy the view. The first and last reasons would have heavily weighted sensory performance characteristics when considering structure placement. A prehistoric group's religious practices might affect structure placement and this, too, could be considered a sensory deliberation.

Visual performance characteristics, in the case of architecture, could include a domicile's ability to: (1) stand out from its surroundings; (2) blend in with surroundings; (3) be easily distinguished from dissimilar structures at long distance; and (4) serve religious functions. As an example, line-of-sight communication would be weighted factors for the first and the third characteristic. Architectural features in these cases would be placed next to a cliff and direct line-of-sight observation would be critical. Other structures, notable houses or hunting blinds, would likely have been constructed to blend in with the landscape – to hide from prehistoric raiders or large herds of animals that they would exploit.

Manufacturing (or physical) performance characteristics should receive top consideration in any study of prehistoric architecture. Performance characteristics here, though not all inclusive, would include resistance to weather, transport characteristics (house transportability in the case of a tipi, for example), and thermal performance (ability to retain heat).

This discussion shows that numerous factors must be considered when studying architectural placement. What was the impetus for the production of Late Prehistoric stage architecture? Who manufactured it and why? The next section of this report introduces the members and material remains of the Late Prehistoric stage.

THE LATE PREHISTORIC STAGE

The Late Prehistoric stage (AD 100 to 1725) observed important changes in subsistence patterns, artifact complexes, and demographics on the southern Plains. The beginning of the stage coincides with innovations like the bow and arrow, ceramics, and permanent or semi-permanent houses (Piper et al. 2006:3-7). The use of cultigens reached a significant level during this time, though few pollen or macrobotanical samples attest to this change in southeastern Colorado. Recently, however, excavations along the Purgatoire River have produced significant maize pollen (Scott-Cummings and Varney 2003) at the Developmental/Diversification period boundary.

The final centuries of the Late Prehistoric stage reflect the affects of European incursions, including both direct intrusions by Europeans, and the diffusion and spread of material goods of European origin by indigenous groups (Secoy 1953; Zier and Kalasz 1999).

The Developmental period (AD 100 to 1050) corresponds with what has traditionally been referred to by archaeologists as the Plains Woodland period (Winter 1988) or the Early Ceramic period (Eighmy 1984). At this time, cordmarked and plain pottery, small corner-notched arrow points (Scallorn, Reed, Bonham, Alba, Washita, Fresno, Chaquaqua types), circular slab masonry architecture, and some agriculture first appeared. Ground-stone tools are more common than chipped-stone in this period when compared to the Archaic. This suggests that vegetal materials, possibly including maize, and other cultigens probably constituted larger portions of the human diet (Piper et al. 2006:3-8). Faunal remains from excavated sites indicate that animals like deer and antelope were exploited, as well as small animals like cottontail rabbits and prairie dogs (Zier and Kalasz 1999:178). Aquatic species such as fish, frogs, and freshwater mussels were also consumed (Sanders 1983; Zier and Kalasz 1999:178).

Developmental period sites are much more numerous in southeastern Colorado than those of earlier periods. It has been noted that this increase in the number of recorded sites could be the result of improved site visibility due to the presence of architectural features (Zier et al. 1997). Observed site types include circular masonry architecture, rockshelters, brush and hide shelters with circular rock foundations, and open camps (Zier and Kalasz 1999:174-175).

The Diversification period (AD 1050 to 1450), also termed the Middle Ceramic (Eighmy 1984), marks the local variant of the Plains Village tradition. It is subdivided into the Sopris (AD 1050 to 1200) and Apishapa phases (AD 1050 to 1450) in southeastern Colorado. The Sopris occurs in the area around Trinidad, Colorado, and relates to the Pueblo Indian occupation of New Mexico. Known sites of this phase have never been found at the PCMS.

Around AD 1050, groups of hunter-gatherers began establishing their villages along major river systems on the southern Plains. These semi-sedentary people began farming domesticates, but still retained a reliance on the gathering of wild plants and the hunting of large ungulates like bison, deer, and antelope (Lintz 1984). Villages were primarily established on river terraces, but domiciles are also found on areas of high terrain. Depending on cultural affiliation, houses can be temporary shelters or semi-permanent or permanent dwellings. Often

these are small and isolated dwellings (Gunnerson 1989). On the southern Plains, wall construction typically consisted of the vertical or horizontal stacking of unmodified or modified rock (Campbell 1969), though upright poles interlaced with branches or brush are also known (Brooks 1987). House floors vary in depth in relation to the modern ground surface; some domiciles appear to have had their floors even with their modern ground surface, while others are clearly subterranean.

The first archaeologist to publish descriptions on what would later become Apishapa phase sites was E. B. Renaud (1931). He called the architectural remains “Indian Forts” and noted they were often found in pairs on opposite sides of the canyons in which they were situated (1932:15-18). Withers (1954) assigned the remains to the “Apishapa focus” of the Panhandle Aspect and noted stylistic similarities in material remains with Upper Republican materials (Gunnerson 1989:7).

The southernmost of the Plains Village tradition sites have more recently been grouped within the Upper Canark variant (Lintz 1984:25). There are three geographically distinct phases within the variant – Apishapa, Antelope Creek, and Zimms (Baugh 1994:282). Sites of the Upper Canark variant exhibit dual foraging and horticulture economy, architectural sites found on high terraces and points, houses with vertical rows of stone slabs, the presence of storage features, single, flexed pit burials, cord-marked pottery, and triangular side notched points.

The Apishapa phase, representing the southwestern-most Plains Village manifestation, is likely related to the Central Plains tradition based on technological similarities (Gunnerson 1989:11). Occupants of the Apishapa phase lived in southeastern Colorado, specifically the area east of the Sangre de Cristo Mountains and south of the Arkansas River. It is likely Apishapa peoples also lived along the northwestern edge of the Oklahoma panhandle, but Antelope Creek sites dominate the landscape in this area. The Apishapa phase ranges in age from AD 1050 to 1450 (Zier and Kalasz 1999:69), but there is a high density of sites until about 700 years ago, then an apparent lack of material culture remains. Two recent reports (Gardner et al. 2005; Schiavitti 2003), however, publish radiocarbon dates for Apishapa phase materials that may push the beginning date for the Apishapa phase back another century or more to AD 900.

Subsistence practices among the Apishapa appear to give an equal emphasis to agriculture and foraging. Exploited animal species include rabbits, prairie dogs, gophers, rats, deer, antelope, and bison, while wild plant foods include choke cherry, *Artemisia*, *Chenopodium*, *Eriogonum*, wild plum, grapes, yucca, cactus, and pinon. Cultigens in the form of maize and beans have also been identified (Campbell 1969; Gardner et al. 2005; Lintz 1984).

Technological items for the Apishapa phase include chipped- and ground-stone tools, ceramics, bone implements, and shell ornaments. An abundance of Harrell, Reed, and Washita type projectile points are found on sites of the Apishapa phase, though Developmental “diagnostic” Scallorn types have also been encountered. Typical pottery jars are globular cord-marked vessels with outcurved rims, although the “type” site of Snake Blakeslee has sherds of the Upper Republican aspect and pieces of Taos Black-on-White (Gunnerson 1989:8). Coiled basketry, rabbit fur cordage, and yucca fiber sandals have been found in rockshelters assigned to the Apishapa phase (Campbell 1976:59).

Apishapa architectural remains typically contain three types of sites – rockshelters, surface encampments, and stone/slab enclosures ranging from single room sites to “villages” containing nearly 60 rooms (Campbell 1969:20, 393). Rockshelters are typically found in the area of villages, especially when they are situated along the larger canyons of southeastern Colorado. Both surface encampments and stone/slab enclosure sites are found in upper canyons or on landforms like mesas or large ridges where surface water sources can be found nearby.

Houses of the Apishapa phase are primarily contiguous wall architectural units that are circular in shape. They exhibit tremendous variability in size and geographic location within sites (Kalasz 1989:86-110). According to Lintz (1984:28), some rooms may also be D-shaped or semi-circular in planview, but rectangular rooms, like those of the Sopris or Antelope Creek phases, are rarely identified. Floors are semi-subterranean and are primarily the unprepared prehistoric ground surface.

Numerous theories have been presented to explain why Apishapa architectural units were built; most are reliant on site setting. Because most of the more robust features are found on isolated points, defense appears as a common explanation (Campbell 1976; Chomko and DeVore 1990; Chomko et al. 1990; Renaud 1942). Signaling systems were another early hypothesis (Renaud 1932:15-18). It is possible that some served as storage features, astronomical observation areas, locations for ceremonial activities (Gunnerson 1989; Renaud 1931, 1942), or for escaping the biting gnats that plague the region (Gunnerson 1989:115). Campbell (1976:60) hypothesizes that defensible sites may have been built near farmland to project a sense of military vigilance.

For unknown reasons, peoples of the Apishapa phase disappeared around AD 1450. Hughes (1974) suggests they moved to the Central Plains and are of the Caddoan language stock. Gunnerson (1989:13) also suggests the descendants of the Apishapa are the Arikara, Pawnee, and Wichita. If the Apishapa are truly Caddoan, it would be important to know who might have pushed them out of southeastern Colorado and onto the Central Plains. Researchers like Haskell (1987), Kingsbury and Gabel (1983), and Gulley (2000) suggest that Athabaskans replaced the Apishapa at the end of the phase. Some rock art sites along the Purgatoire River display Rio Grande rock art tradition elements (warriors with weaponry and shields) and suggest Puebloan peoples may have driven out the Apishapa.

The Protohistoric period extends from roughly AD 1450 to 1725. The earliest European incursions into the region occurred during the first half of the sixteenth century, and the material cultures of indigenous populations were altered significantly over the course of the ensuing three centuries. Three principal indigenous groups entered southeastern Colorado during this period. In chronological order of appearance, they are the Apache, Comanche, and Cheyenne-Arapaho (Zier et al. 1997). In addition, southeastern Colorado was on the margin of Ute territory throughout Protohistoric times.

The Protohistoric period marks the start of the Plains Nomad tradition (Gunnerson 1969, 1984). Material remains include metal artifacts, micaceous pottery, Pueblo pottery, chipped-glass artifacts, and side-notched points. Most sites dating from this period are tipi encampments

found along canyon heads, though some earthen ovens have been found (Winter 1988:77-78). Spanish expeditions onto the southern Plains reported meeting groups of nomadic bison hunters (Athabaskan speaking Querechos) that also subsisted on corn, other large and small game, native plant seeds, greens and tubers, mussels and fish. The Caddoan-speaking Teyas, Escanjaques, and Quiviras are also reported. These Indians which grew corn, beans, and squash, also hunted buffalo and frequently moved their villages (Winter 1988:111).

In eastern Colorado, the Dismal River aspect has been proposed for the remains associated with the time period between AD 1675 and 1725. The Dismal River aspect has been associated with Plains Apachean peoples based on the previously mentioned Spanish accounts (Anderson 1990; Gunnerson 1960). Recently, Gulley (2000:7) has called into question the validity of these accounts and has determined that sites attributed to Dismal River actually represent a local manifestation of a Plains lifeway, rather than a definitive Apachean presence.

Tipi-ring sites are common throughout the southern Plains, but only a few of them can be attributed to the Protohistoric. Sites on the Carrizo Ranches near the Colorado/New Mexico border have tipi rings and diagnostic pottery (Kingsbury and Gabel 1983). Protohistoric ceramics have also been found at two sites on the PCMS (Loendorf and Kuehn 1991).

PROJECT AREA BACKGROUND

The PCMS is located south of the Arkansas River and along the northern boundary of Las Animas County in southeastern Colorado (Figure 1.1). This property is on the western margin of the southern Great Plains and just to the east of the Rocky Mountain physiographic region. Topography in the project area consists of flat-topped hills, grassy steppes dissected by numerous canyons, and an igneous hogback ridge (Schuldenrien et al. 1985). Local relief is approximately 427 m (1,400 ft), and ranges from a high of 1,768 m (5,799 ft) in the Big Arroyo Hills to a low of 1,341 m (4,398 ft) at the confluence of Minnie Canyon and the Purgatoire River floodplain at the northeast edge of the PCMS. The area is best characterized as a grassland/desert transition zone and the temperature and moisture of the area is highly dependent on landform elevation and the seasonal position of the Polar, Pacific, and Gulf air masses.

Most of the sites on the PCMS are insignificant lithic scatters, though cultural material scatters with architectural or habitation features, quarries, and historic homesteads are also abundant. Prehistorically, most of the sites date to the Late Prehistoric period, though Archaic and Paleoindian sites have also been identified (Owens and Loendorf 2004).

RESEARCH DESIGN

To examine the patterning of Late Prehistoric stage habitations, basic statistical procedures were used to identify relationships between a series of variables. GIS data are combined with statistical procedures to supplement the work. All of the 102 sites to be examined in this report were compared using numerous variables, including various landscape attributes and technological, functional, and chronological data.

The landscape attributes used in the analysis are site setting, geophysical setting, elevation, slope, aspect, distance to water, plant community, and line-of-sight relationship. This last category is based on map analysis and actual site inspection(s) to determine spatial relationships between the project sites.

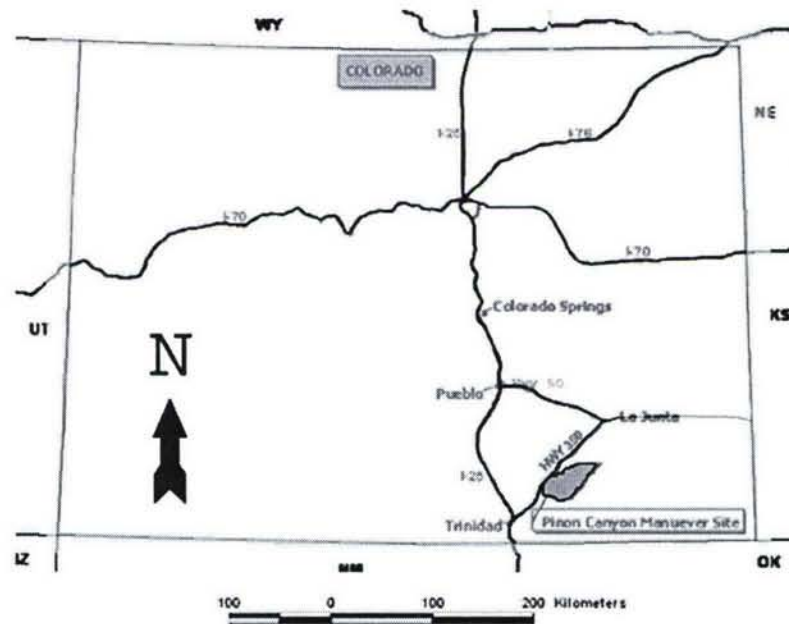


Figure 1.1: Location of the PCMS within Colorado.

Site setting relates to its “local” placement on the modern ground surface and the categories used in this project are canyon edge, canyon wall, flats, floodplain, prominent point, ridge, shelf, slope, and terrace. This data should reveal distinct settlement patterns because certain structures would have been preferred on specific topographic features. A similar variable to be explored is geophysical setting. This relates to “large-scale” landform diversity within a geographic area and was taken from Schuldenrein et al. (1985:25). Designated units of analysis are steppe, Hogback, arroyo/canyon, and hill.

I predict that site elevation will be an easily patterned variable linked to food and water resources. Relating to water availability, the facies contact between the Morrison and Dakota formations results in seeps and flowing springs. If this is a useful variable, then there should be little deviation in minimum and maximum elevation where these seeps occur. Elevation should also strongly correlate to the variable of plant community. Plant communities key exploitable food and fuel resources and should help to pattern special purpose habitation sites, like those related to hunting. Twenty-six plant communities are found within the PCMS boundary (Shaw et al. 1989), though only 11 were recorded at the sites visited during this project (Table 1.1). Of the four grassland plant communities, only blue grama/galleta (BOGR/HIJA) was assigned to a project architectural site. Woodland plant communities for one-seeded juniper/black grama

(JUMO/BOER), one-seeded juniper/mountain mahogany (JUMO/CEMO), and one-seeded juniper/littleseed ricegrass (JUMO/ORMI) were also recorded. Shrubland plant communities include Bigelow sagebrush/blue grama (ARBI/BOGR), Bigelow sagebrush/winterfat (ARBI/CELA), fourwing saltbush/alkali sacaton (ATCA/SPAI), rabbitbrush/tree cholla (CHNA/OPIM), tree cholla/blue grama (OPIM/BOGR), common hoptree/New Mexico needlegrass (PTTR/STNE), and skunkbrush sumac/wax currant (RHTR/RICE).

Table 1.1: Plant Communities Identified on Project Sites.

Plant Community	Overstory	Understory	Other Plants
ARBI/BOGR	Sagebrush	Blue Grama	<i>Opuntias</i> , Juniper, Galleta
ARBI/CELA	Sagebrush	Winterfat	Grama Grasses
ATCA/SPAI	Saltbush	Alkali Sacaton	Wolfberry, <i>Opuntias</i> , Rabbitbrush
BOGR/HIJA	Blue Grama	Galleta	Snakeweed, Wolfberry, Saltbush, <i>Opuntias</i>
CHNA/OPIM	Rabbitbrush	Cholla	Blue Grama, Kochia
JUMO/BOER	Juniper	Black Grama	<i>Opuntias</i> , Currant, Wolfberry, Skunkbrush
JUMO/CEMO	Juniper	Mountain Mahogany	Pine, <i>Opuntias</i>
JUMO/ORMI	Juniper	Ricegrass	Sagebrush, Skunkbrush, Wolfberry, Grama Grasses
OPIM/BOGR	Cholla	Blue Grama	<i>Opuntias</i> , Winterfat, Sagebrush
PTTR/STNE	Hoptree	Needlegrass	Wolfberry, Grama Grasses, Ricegrass
RHTR/RICE	Skunkbrush	Currant	Grama Grasses, Galleta

The slope on a site has been the focus of earlier settlement studies (Judge 1973; Jochim 1976) as prehistoric people would not have placed architecture on radically uneven ground. This particular variable should be easy to pattern for this reason; however, many of the larger project sites exhibited varying degrees of slope. In these cases, the maximum slope was recorded. To make the project data more manageable, seven examples of slope were recorded using a simple numerical designation for each:

- 1 – slope $\leq 2.5^\circ$
- 2 – slope between 2.6 and $\leq 5^\circ$
- 3 – slope between 5.1 and $\leq 7.5^\circ$
- 4 – slope between 7.6 and $\leq 10^\circ$
- 5 – slope between 10.1 and $\leq 15^\circ$
- 6 – slope between 15.1 and $\leq 20^\circ$
- 7 – slope $> 20^\circ$

The exposure or aspect of a location is the cardinal compass bearing in which water would flow off of a location. Because south facing slopes tend to offer greater warmth from the sun, these slopes were preferred for cold weather habitation (Kvamme 1984:26). If aspect is to be a useful variable in this study, then one would expect aspects from 90 to 270° for most of the habitation sites.

Water resources are also a very important consideration for prehistoric locational studies. Jochim (1976:55) indicates proximity to water as a primary factor in determining site and

habitation placement. If this is the single most important factor for prehistoric site selection, then water sources should be in close proximity.

Technological data recorded for this project are not related to the architectural features themselves, but rather the lithic technologies found in direct association. Questions regarding raw material procurement strategy and tool design and manufacture tell us that raw material availability can constrain an artifact's final form. Technological data can also be informative as to site function and prehistoric residential mobility; important information when attempting to pattern trends in prehistoric behavior and, in the case of this project, site function. Technological data recorded for this project include debitage count, chipped tool count, ground-stone tool count, dominant material, debitage/chipped tool ratio, chipped tool/ground-stone tool ratio, number of bifaces, number of cores, total artifact count per site, and biface/core ratio.

The relationship of site function and the placement of habitation sites seem clear. To accumulate additional information relating to function, feature and tool presence/absence data was also recorded for each of the 102 sites. Presence/absence was recorded for the category of hearth, roasting pit, contiguous wall architecture, rockshelter, architecture within rockshelter, spaced-stone circle, bedrock metate, rock art, tool grooves, non-local material, edge-ground cobble, storage feature, and raw material procurement.

After the presence/absence of features and specific tools were calculated, this information was combined with the lithic technology data to assign each site to one of five site classifications. A modified version of Binford's (1980) general site types for hunting and gathering groups (Table 1.2) was selected for the project.

RESULTS

The results of the statistical comparisons are presented in the following figures, discussed in detail below. Both significant and insignificant results are presented, with more time spent on the former.

Chronological Data

The project dating methods include cation ratio, obsidian hydration, radiocarbon techniques, and relative age estimates acquired by the visual comparison of time-diagnostic projectile points and ceramics with known specimens from other projects in the southern Plains. The first three provide date ranges, the last two broad age ranges. Inherent with each method are two kinds of dating issues – dating error and not truly knowing the association between dates and events because of formation processes.

Architectural contexts are dated with different levels of accuracy; some with radiocarbon range dates, but most with relative mean dates. Regarding the latter, a problem occurs when trying to assign a single cultural event to an artifact with a broad time range. For example, Scallorn points have a date range between AD 700 and 1500 (Bell 1985:84). This places their manufacture and use from the late Developmental period to the early part of the Diversification

period. For the purpose of this project, point date estimates were generated as the average of the medians of the ranges of diagnostic projectile point and ceramic types.

Table 1.2: Project Site Type and Economic Focus Attributes (adapted from Binford 1980 and Reed and Horn 1995).

Site Type	Focus/Function	Observed Cultural Materials
Residential Base	Complex Habitation	Many architectural features; high artifact diversity; debitage produced by tool manufacture and maintenance; thermal features; subsistence remains; storage features; large site size; high number of artifacts; diverse artifact assemblage.
	Simple Habitation	Few architectural features; high artifact diversity; debitage produced by tool manufacture and maintenance; thermal features; subsistence remains; storage features; smaller site size; high number of artifacts; diverse artifact assemblage.
	Defensive Habitation	Few architectural features including linear walls; few artifacts; low artifact diversity; intense reuse of thermal features; cached artifacts; storage features; good views in many directions; site on pointed projection or other defensible landform.
Location	Lithic Procurement	Limited tool diversity; debitage produced by core reduction; few thermal features; no subsistence remains.
	Food Procurement	Limited tool diversity; debitage produced by tool maintenance; expedient tool production and use; few thermal feature; subsistence remains; exhausted tools; presence of ground stone.
Field Camp	Lithic Procurement	Moderate tool diversity; debitage produced by both core reduction and tool manufacture/maintenance; thermal features; temporary architecture; smaller site size and lower artifact count than residential sites.
	Food Procurement	Same as above, but more subsistence related evidence like roasting features, ground stone, or tools with sickle sheen or meat polish.
Caches	Lithic Procurement	Concentrations of tested cores, or flake blanks; very low tool diversity; no thermal features or subsistence remains.
	Food Procurement	Contiguous wall storage features; cairns; few artifacts.
Stations		Very low artifact density diversity; debitage produced by tool maintenance; thermal features; temporary architecture; multiple temporal components.

Although the data set is relatively crude with respect to temporal variation, the data in Appendix A and Figure 1.2 supports the general trends known for the Late Prehistoric stage in southeastern Colorado. Eighteen sites have at least one radiocarbon assay assigning age to the remains and 42 contain temporally diagnostic projectile points that allow them to be placed into either the Developmental or Diversification period. Obsidian hydration, ceramic cross-dating, and cation ratio datings have single occurrences.

The histogram (Figure 1.2) indicates two major occupation periods for the architectural sites. A distinct mode between AD 800 and 1000 shows that most sites were occupied later in the Developmental period, though a Diversification period mode is quite distinct.

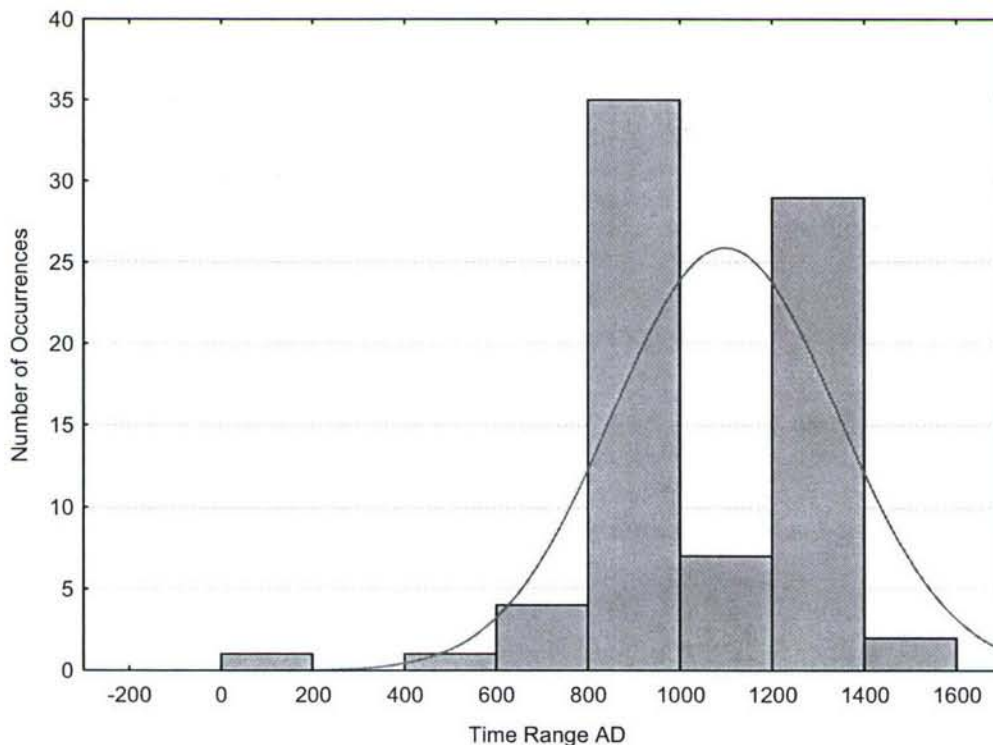


Figure 1.2: Histogram of temporal range for project sites.

Landscape Data

Architectural placement is determined by several environmental and geographical factors, such as site setting, geophysical setting, elevation, slope, aspect, distance to water, and plant community. Histograms are again used to examine these variables at the project sites.

Figure 1.3 was generated using ten different local landscape settings. In the Late Prehistoric stage, canyon edge settings were preferred and this is likely related to the presence of many different resources, including water and excellent tool stone. Landscape settings like arroyo terrace, terrace, and floodplain key upper and lower canyon areas where water can also be

easily obtained. Of note are the 12 ridge sites and seven sites found on prominent points. Technically, these are canyon edge settings too, but these areas also offer good views and constrained access.

Also related to landscape setting is the larger-scale variable of geophysical setting (Figure 1.4). Again, the selection preference for canyon settings is highlighted, but the presence of 19 sites in the hills and 17 sites in the open steppes suggests that distance to critical water resources and tool stone are not always the overriding considerations for site placement.

Figure 1.5 is generated from elevation data recorded at the datum of every project site. Over 60 of the sites can be found at elevations between 4,900 and 5,100 ft, which is where the upper canyons of the PCMS are situated. The upper canyon areas provide access to many different plant communities, grading between woodland, grassland, and riparian. The higher elevations, 5,100 to 5500 ft, were recorded from sites in the Black and Cedar Hills and on the Hogback. Lower elevations, like those between 4,400 and 4,800 ft, were recorded inside the canyons.

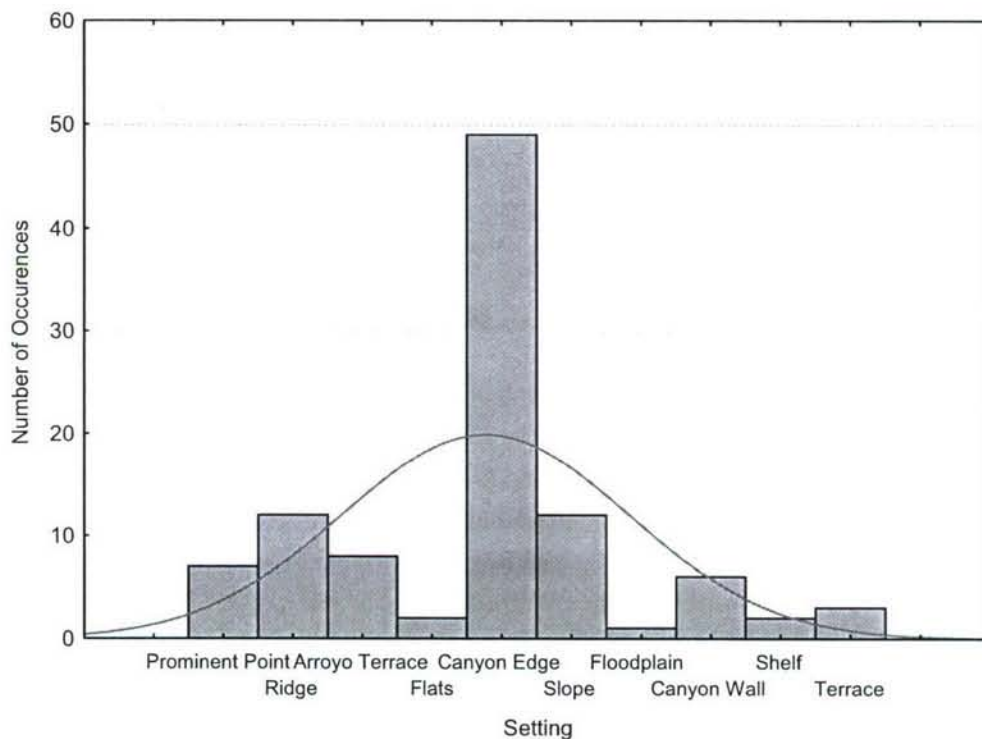


Figure 1.3: Histogram of local landscape settings for project sites.

Figure 1.6 was generated by tabulating slope information taken from the State of Colorado Management Data Form for each site. In the majority of the cases, sites exhibited extreme internal slope variation owing to their placement near canyon edges. It would become too cumbersome to calculate every site elevation in a data table, so midpoint estimates for each site were generated. Because of this, no sites were reported as being level, however, over 80 of

the sites were found on relatively flat ground. Of note are the four sites with slopes greater than 5°. Three of these, 5LA3189, 5LA5326, and 5LA5622, are on the edges of canyons, so it is not surprising that their slopes are so dramatic. Site 5LA5838 was found at the edge of the Purgatoire River floodplain and some of its architectural features are found above on the canyon slope.

Figure 1.7, generated from site aspect, illustrates that the project sites faced all directions. At least five modes were noted: 1-64° (northeast), 109-136° (southeast), 163-198° (south), 216-288° (west/southwest), and 306-333° (northwest). Most face to the south and those at extreme south may be related to winter habitation. Those generally facing north may be summer activity areas.

Figure 1.8 was produced by tabulating each site's distance to a permanent water source. It should be noted that seasonal water catchments can be found less than 200 m from all of the project sites, but during times of drought, or during the drier times of year, water might not be available. Most of the project sites were found within 500 m of permanent springs, seeps, streams, or rivers, and 27 sites are within 120 m of permanent water.

Clearly, water is of great concern when a site is established, and the few project sites over a km from water were not permanent residential sites and were likely related to food procurement activities or some other unknown activity. The relatively dry conditions found in southeastern Colorado appear to have existed here since the Late Prehistoric stage. For example, Schuldenrein et al. (1985) and McDonald (1992), indicate that the Developmental period conditions were characterized by high levels of aridity. Scott-Cummings and Moutoux (2001:262), in a local pollen study, indicate a period of decreased moisture near the end of the period as well. Towards the end of the Diversification period, a drought has been suggested sometime around AD 1200 (Baerris and Bryson 1965:216; Bryson et al. 1970; Schiavitti et al. 2001:237; Wendorf 1960:62). Schuldenrien et al. (1985) and Scott-Cummings and Moutoux (2001:262) provide supporting evidence for xeric conditions on the PCMS at this time. Dry and warm conditions continued until the Little Ice Age (400 to 100 BP) when the climate became moister and colder. At the Crow's Roost site 200 mi north of the PCMS, McDonald (1992) recovered supporting evidence in his Component A sediments. Feiler (1994:44) identifies cooler temperatures around 430 BP.

Given these data, water would have been an important commodity, and the project sites far from water sources represent a quandary. Figure 1.27 shows that extreme distance to water cannot be tied to any one temporal period. Developmental period sites are somewhat more likely to be found some distance from water and these may date to the early part of the period before the xeric conditions set in.

Given the known arid conditions, a look at modern plant communities within the project area seems to make sense when patterning human use of the landscape. Current PCMS plant communities are those that generally thrive in drought conditions, and there is no paleoclimatic information (i.e., wet and cold conditions) that negates use of modern vegetation reconstructions for the project site's periods of habitation.

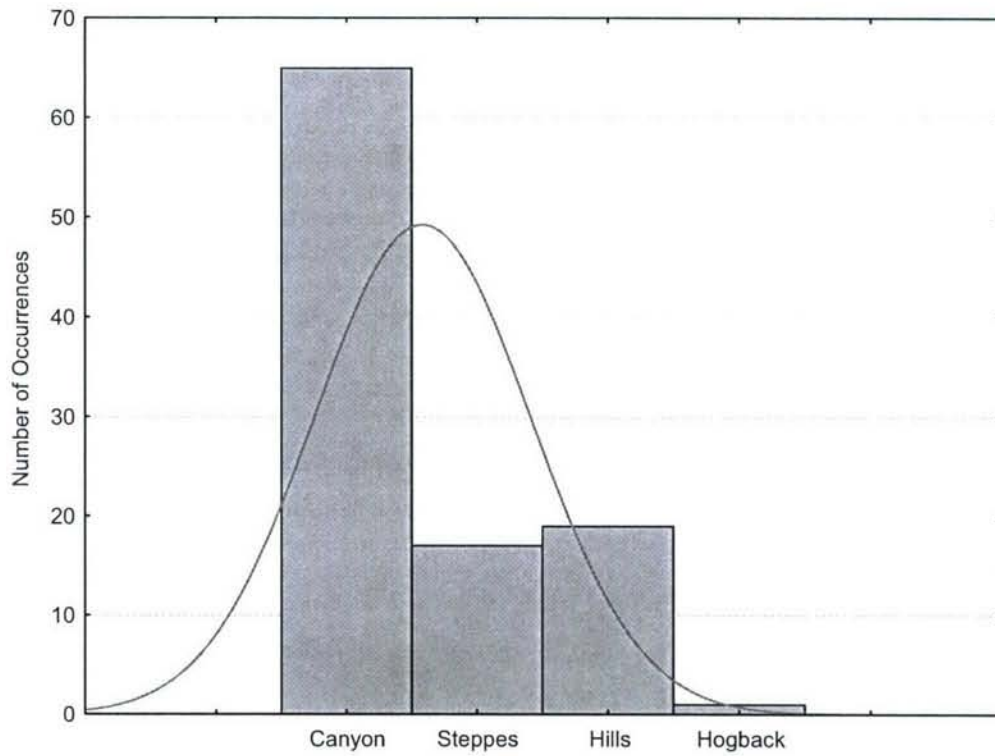


Figure 1.4: Histogram of large-scale geophysical settings for project sites.

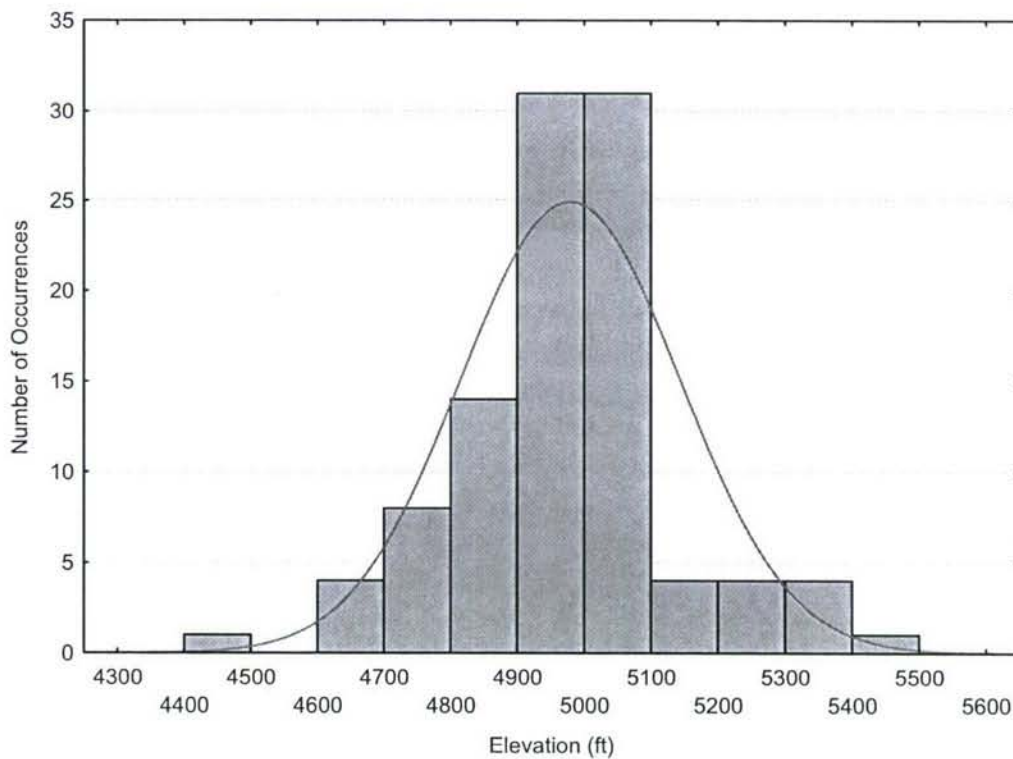


Figure 1.5: Histogram of datum elevations recorded for project sites.

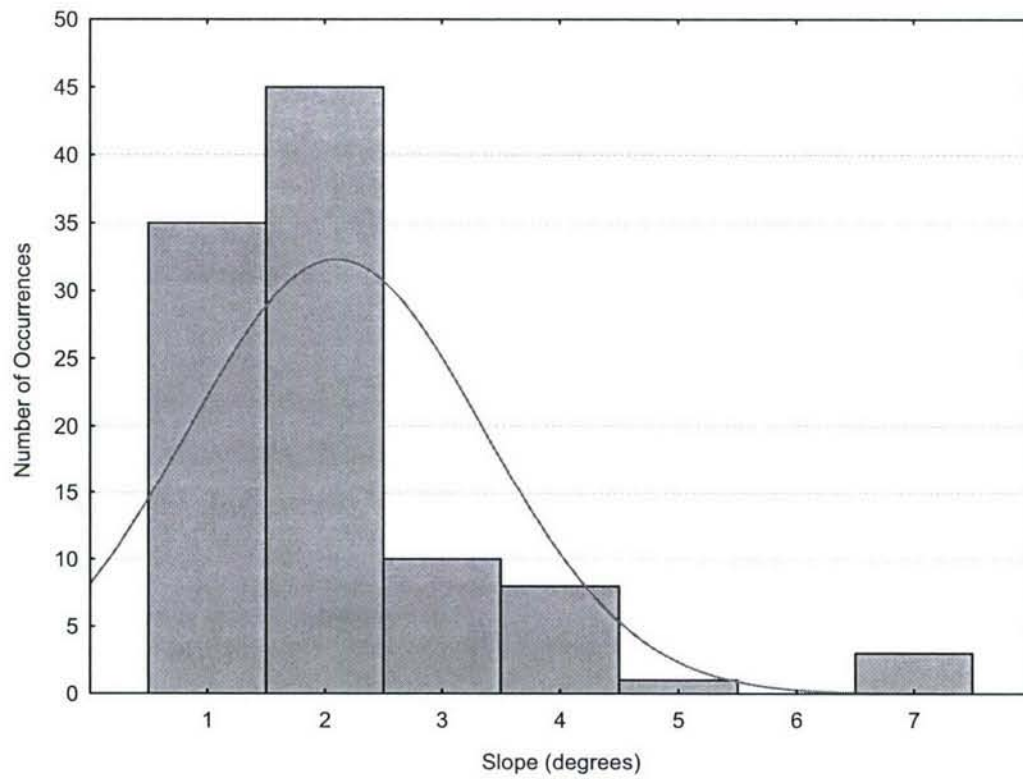


Figure 1.6: Histogram of slope midpoint for project sites.

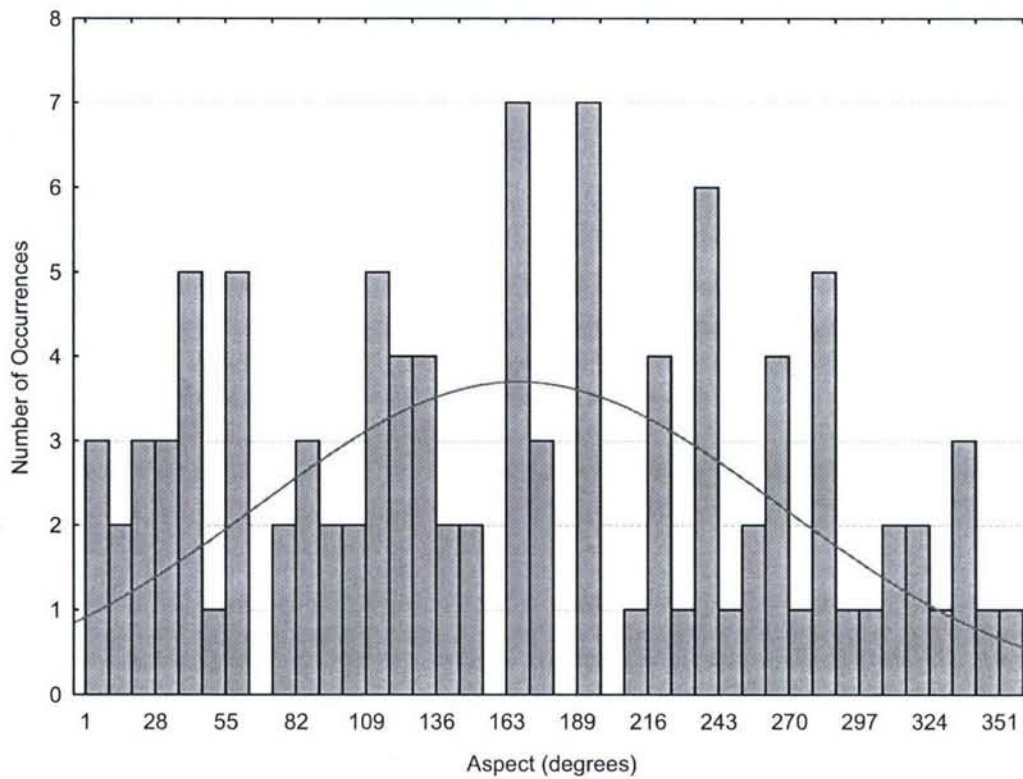


Figure 1.7: Histogram of project site aspect.

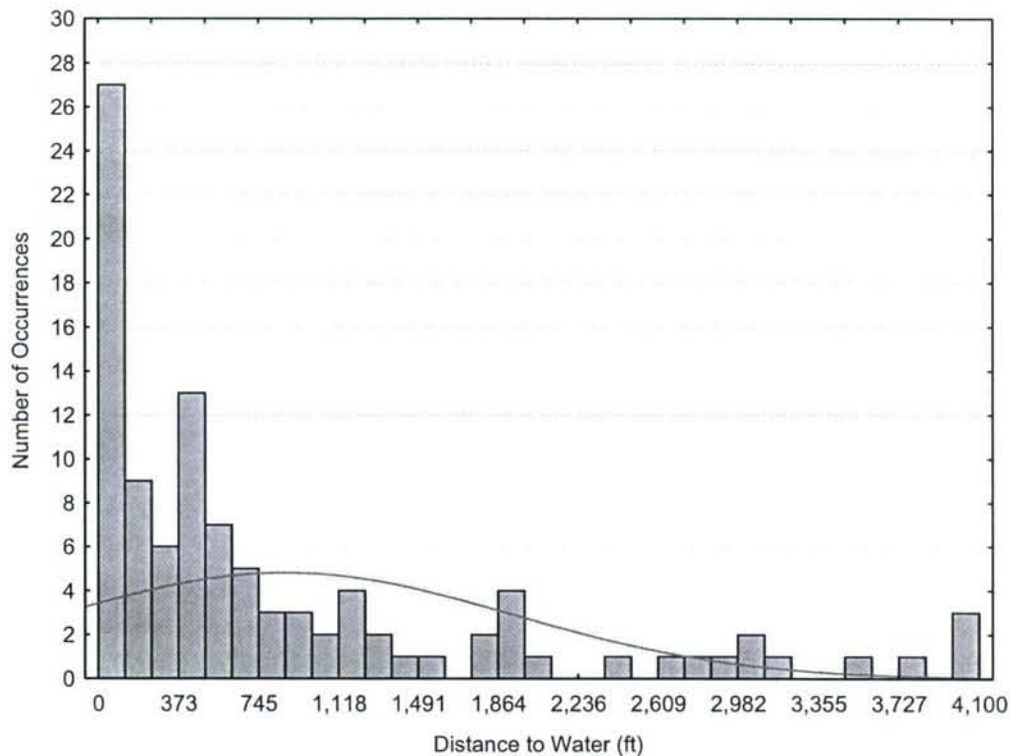


Figure 1.8: Histogram of distance to water for project sites.

Figure 1.9 was generated from the 11 PCMS plant communities recorded from the project sites. The juniper/black grama (JUMO/BOER) plant community clearly is the most common. Exploitable species within the community include juniper, the grama grasses, winterfat, soapweed, currant, mountain mahogany, pale wolfberry, skunkbrush, and galleta. The chenopods are also found in abundance and these are species exploited heavily by Late Prehistoric peoples in the past (Van Ness 1985; McDonald 1992; Gardner et al. 2005).

Likely the presence of usable plant species within the JUMO/BOER plant community was a significant factor in site placement. At the same time, this community is primarily found in PCMS canyon settings which helps to explain its prevalence.

Technological Data

As noted earlier, the project technical data was not taken from the architectural features themselves, but from their associated lithic artifact assemblages. For a good synthesis regarding technological data on PCMS architecture sites, consult Kalasz (1989).

Several characteristics make lithic artifacts useful for studying prehistoric behaviors. Details regarding morphology, parent piece, and material type selection preference are learned from debitage. Chipped tools and ground stone provide data relating to mobility, subsistence strategies, procurement strategies, curation tendencies, trade and exchange, and material replacement strategies.

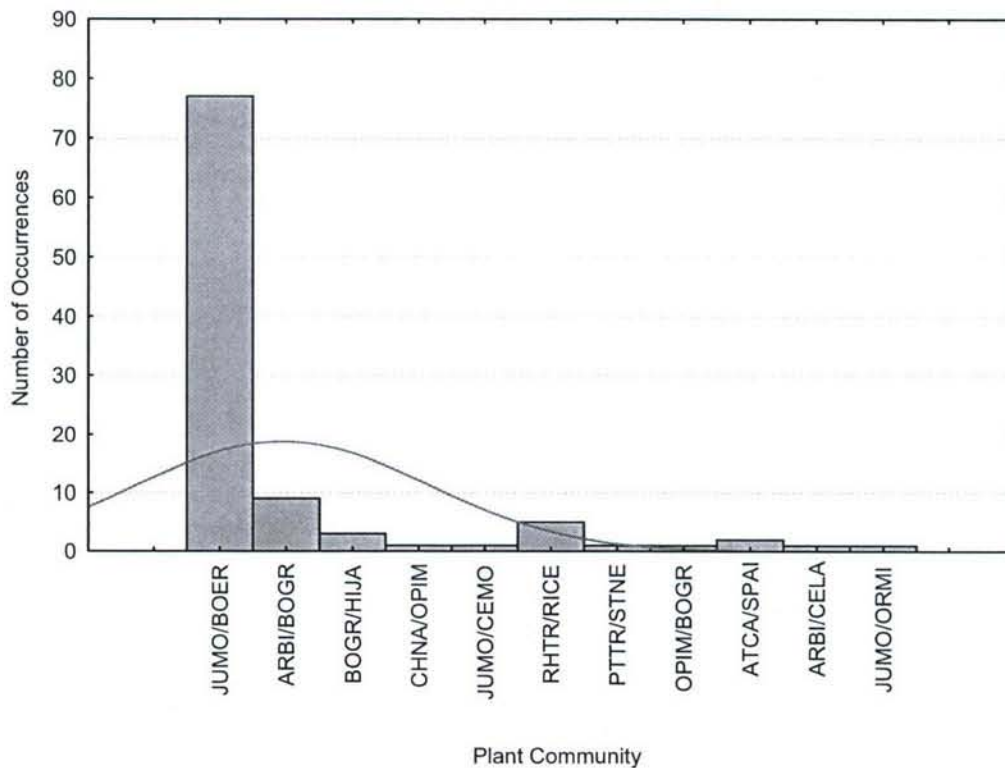


Figure 1.9: Histogram of plant community recorded on project sites.

Figures 1.10 through 1.12 are histograms of artifact class (i.e., debitage, chipped tool, ground stone) counts for the project sites. Regarding the debitage, our sample is biased and may not reflect the spectrum of actual site activities. Since 1997, PCMS archaeologists have recorded every piece of surface flaking debris on small sites, but because of time and financial constraints, have only recorded a 150-piece sample on large or artifactually dense sites. Several of the current project sites were recorded in the 1980s and sampling strategies were very different. As a result, there is tremendous variation in debitage counts with a high incidence of 150-piece samples. Prior to 1997, the chipped and ground artifacts were sampled too, but not all site artifacts (or activities) will be accounted for.

In addition, archeological work was performed by a variety of entities and lithic analysis was performed by a number of personnel with differing analytical skills. Because of this, very general artifact classifications like biface or core are used without getting into any specific functional designation.

Recognizing these shortcomings, several generalizations can be made. First, debitage counts are quite high for all of the project sites, suggesting longer-term or intensive periods of use. These data are supported by the high number of chipped and ground tools, though their proportion is much lower. The sites with high ground-stone tool counts are related to site location – proximity to bedrock outcrops and vegetal food sources. This information will be addressed in more detail later in this report.

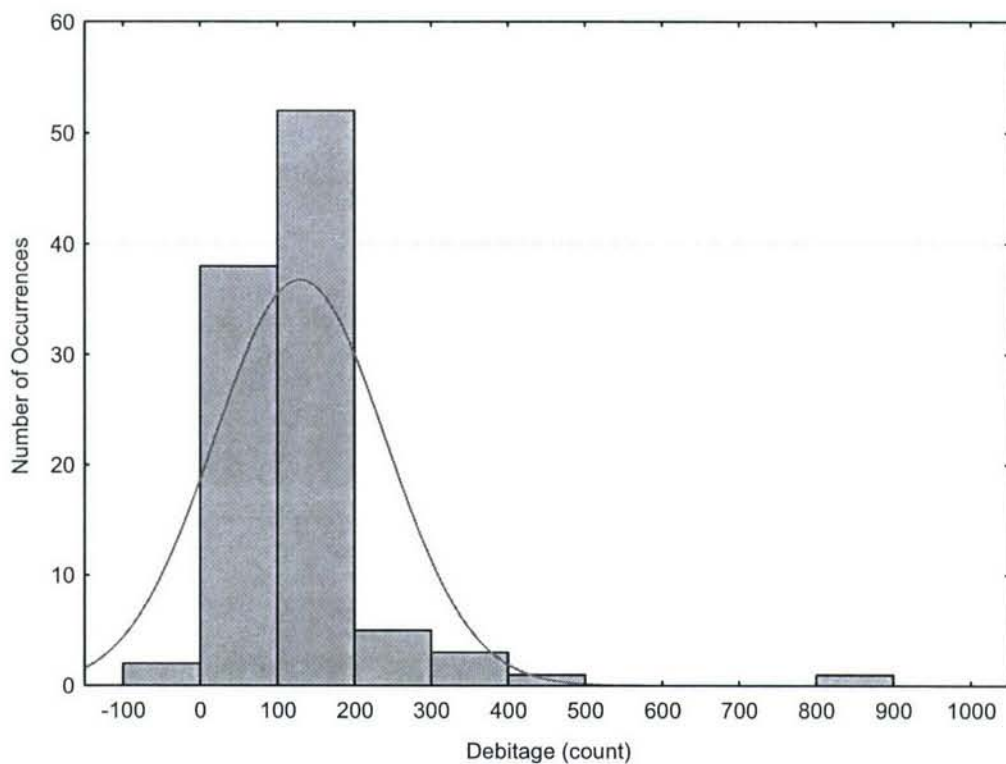


Figure 1.10: Histogram of debitage count for project sites.

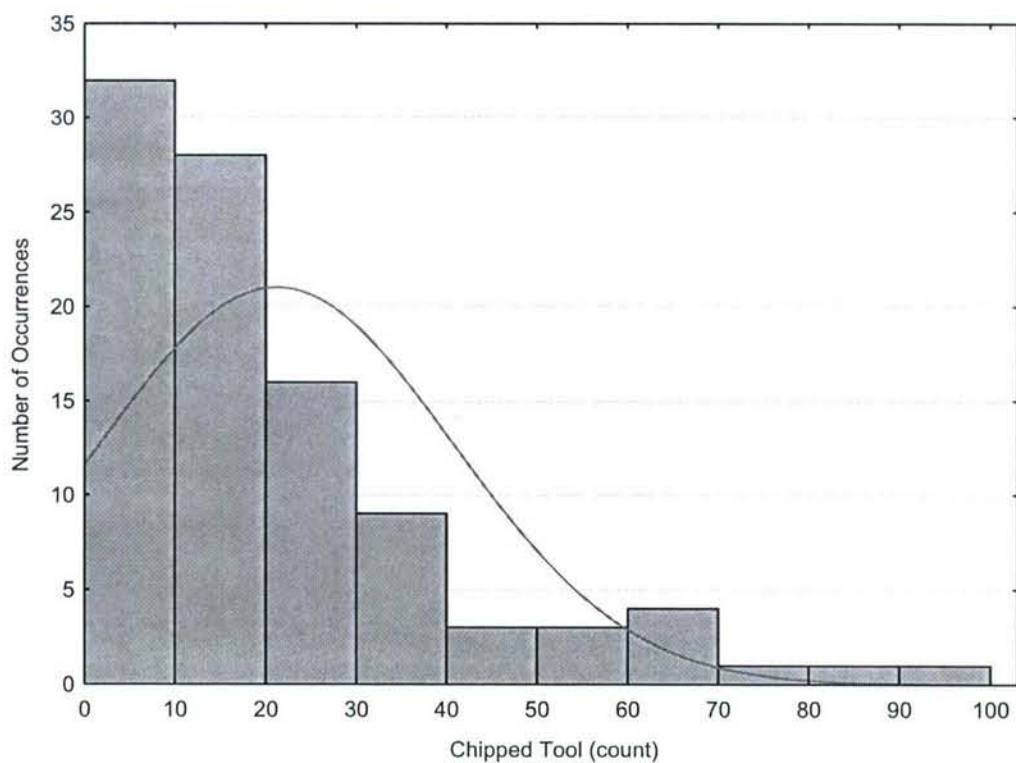


Figure 1.11: Histogram of chipped tool count for project sites.

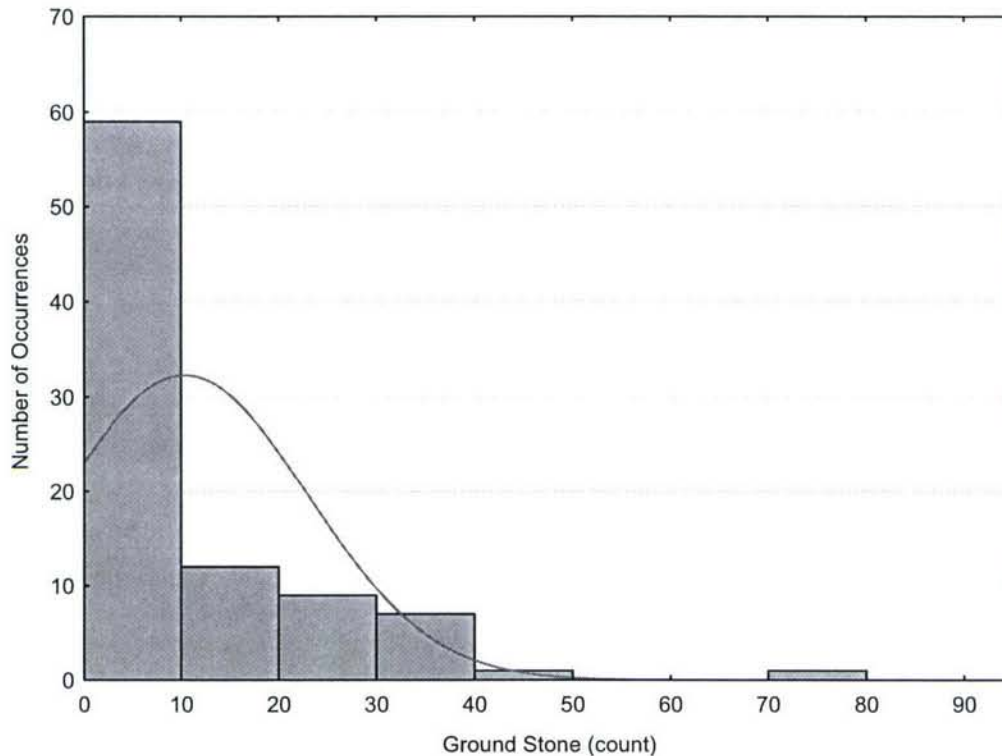


Figure 1.12: Histogram of ground stone count for project sites.

Figure 1.13 presents the dominant material types for project sites. Quartzites, outcropping in canyon settings, are found in the highest proportions. Chert is also a semi-local material as it can be obtained in the canyon side walls. The argillite and hornfels/basalt materials were principally found on five Hogback area sites – 5LA5385, 5LA5402, 5LA5403, 5LA5503, and 5LA5554 and are local materials.

Figure 1.14 is a scatterplot with debitage count and chipped-tool count displayed. Those sites clustered along the fitting line likely represent more permanent residential bases and long-term use field camps. Those sites below the fitting line, and with higher debitage counts, likely represent quarry areas or places where flake blanks were being produced. Those above the line, especially sites with more than 45 tools, likely represent locations where food procurement/processing activities occurred more often.

The same general trends are seen in Figure 1.15, though inferences regarding food procurement target can be made. Sites along the fitting line are those where emphasis on food procurement types are relatively equal. On those sites where more ground tools were found, the economic focus seems to have been vegetal materials. Those sites with high numbers of chipped tools in relation to ground tools likely represent areas where hunting activities dominated, especially those sites with chipped-tool counts greater than 35. Figure 1.16 shows the same general trends, with mixed economy sites clustered together.

Issues regarding residential mobility can be addressed through the data presented in Figure 1.17. PCMS cores are expedient tools in the Binfordian (1977) sense because they are not

modified, display little platform preparation, and in some cases exhibit light use on an edge. Bifaces, on the other hand, are more formalized tools; used as multifunctional implements that do the work of many expedient tools including being used as a core (Parry and Kelly 1987:298). All things being equal, a bifacial technology is more portable and its presence can key mobile prehistoric site occupants.

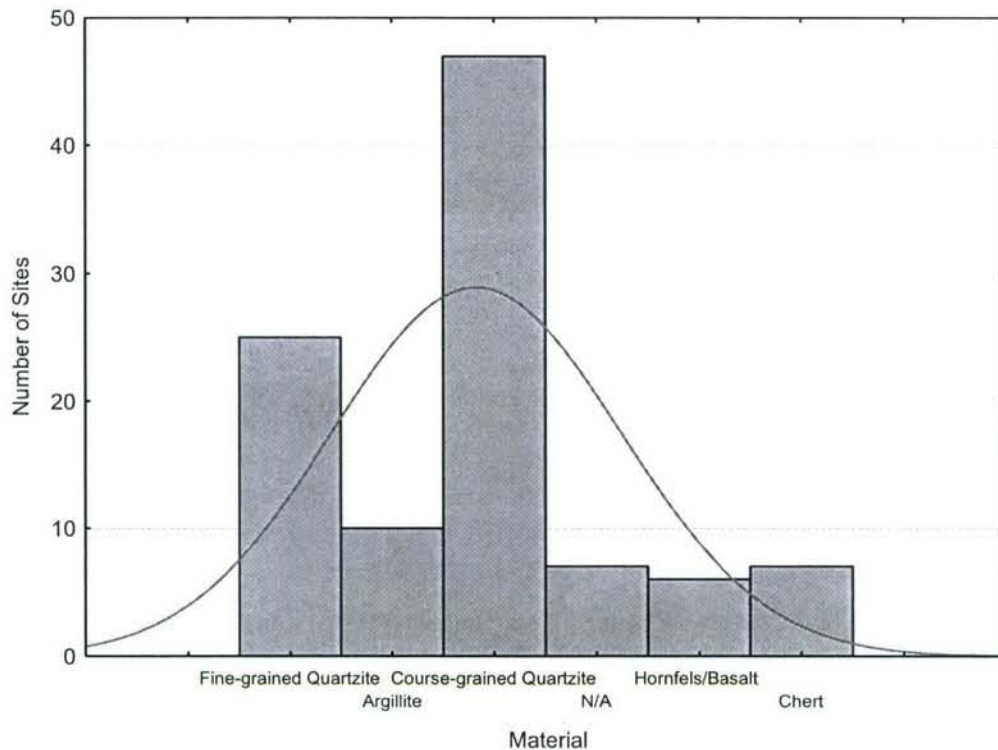


Figure 1.13: Histogram of dominant material type for project sites.

More of the project area sites have bifaces than cores, though they are found in equal proportions on sites with less than 20 specimens of each. Sites with higher proportions of bifaces, those below the fitting line, likely were used by mobile peoples and those above the line may have been more sedentary.

Figure 1.18 presents the biface/core ratios for the project sites. Parry and Kelly (1987:290-291) have noted a biface/core ratio of 1.3:1 for Plains Village sites. Discounting the antiquated nomenclature – the Plains Village equates to the Diversification period of the Late Prehistoric stage – these data correlate well with most of the project sites.

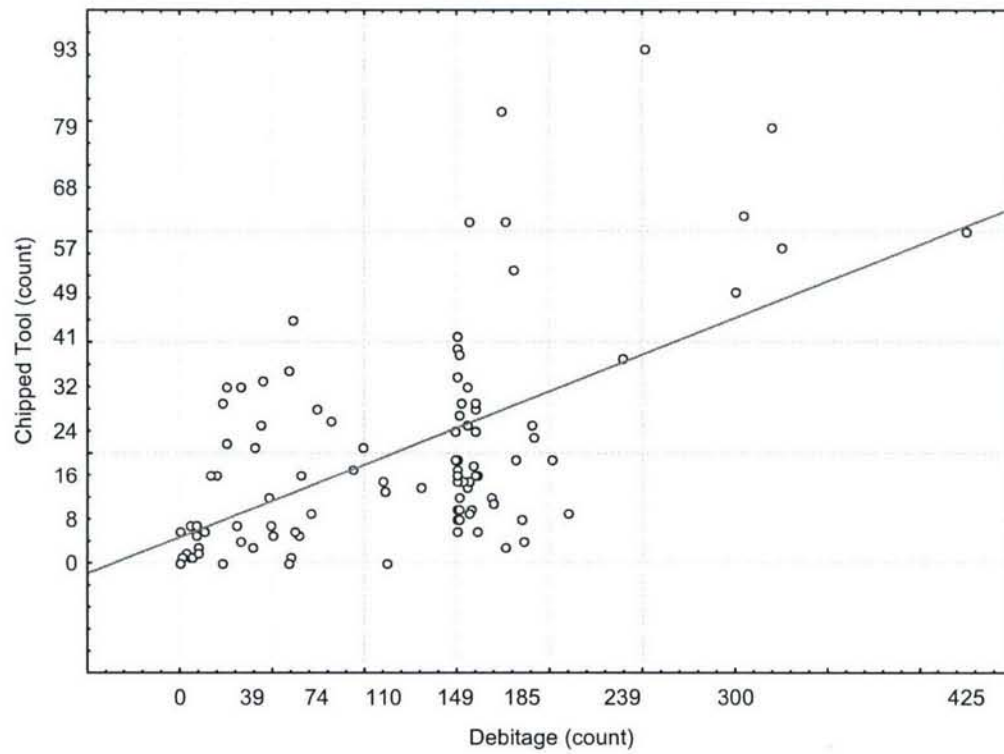


Figure 1.14: Scatterplot of debitage count by chipped tool count for project sites.

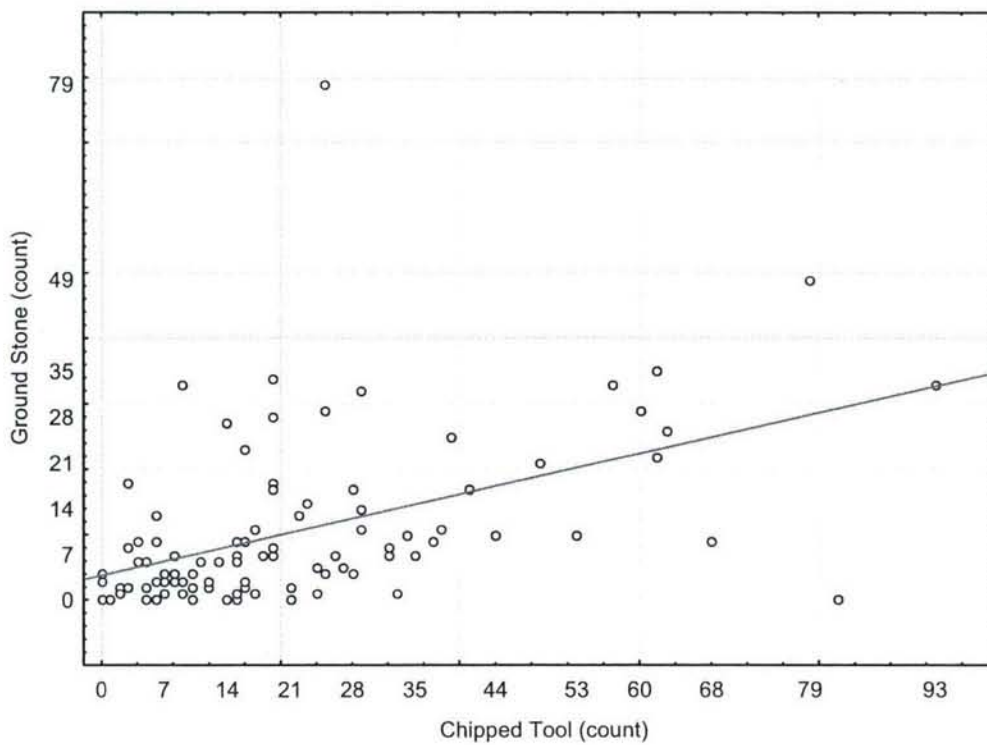


Figure 1.15: Scatterplot of chipped tool count by ground stone count for project sites.

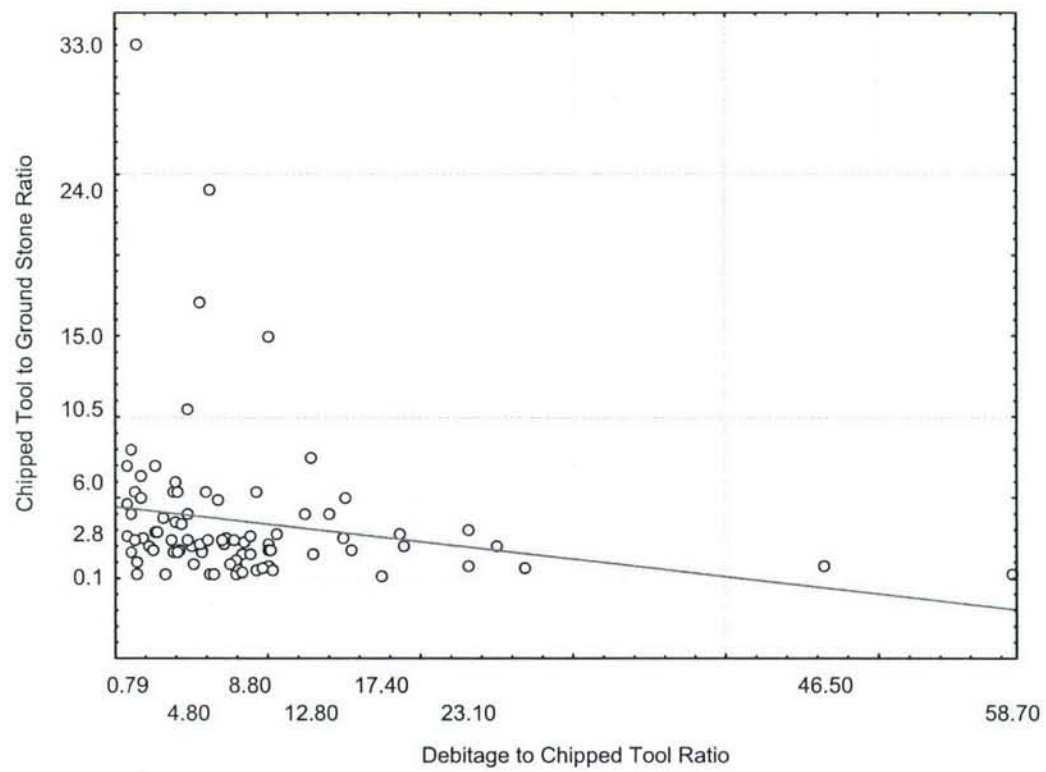


Figure 1.16: Scatterplot of debitage/chipped tool ratio by chipped tool/ground stone ratio.

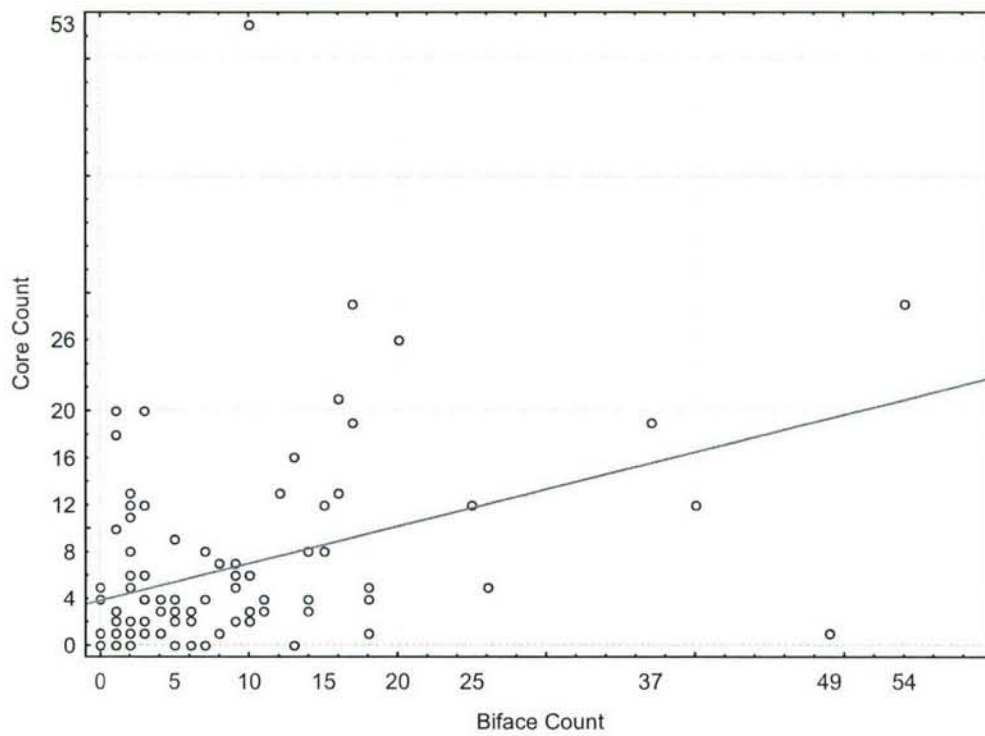


Figure 1.17: Scatterplot of biface count by core count for project sites.

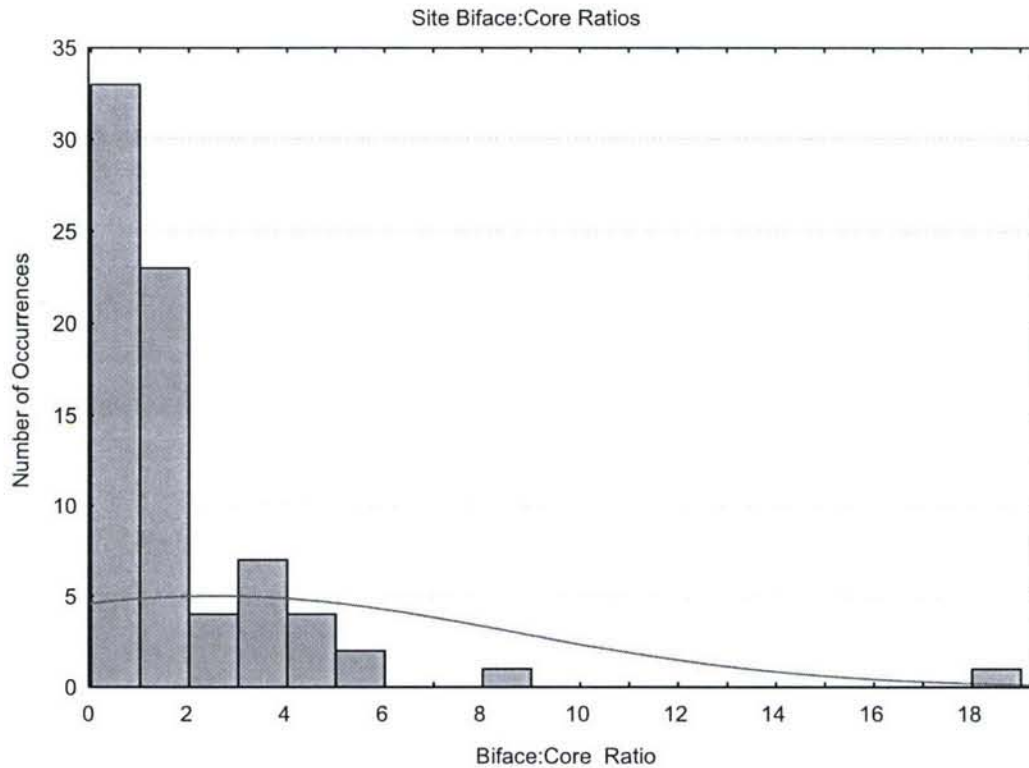


Figure 1.18: Scatterplot of biface/core ratio for project sites.

Functional Data

Function represents an activity – an ordered series of enactments (Wilcox 1975:131). To the limited extent that activities can be identified from surface artifact assemblages, feature and artifact variability were examined and a standard, but slightly modified for this project, classification system (Binford 1980; Reed and Horn 1995) was used to identify which feature/artifact sets regularly co-occurred (1.2). Most of the architectural sites investigated during this project lack storage pits or horticultural tools such as digging sticks or the bison scapula hoes found on Panhandle aspect sites in the southern Plains. To key vegetal food procurement locations, the distribution and presence of ground-stone tools were considered reliable indicators. Hunting and meat-processing tools like bifaces key a hunting site function and cores identify raw material reduction locations.

Figure 1.19 presents the site functional data classifications. Most sites are residential bases; simple habitations are the most common, but complex habitations also comprise a large percentage of the assemblage. Most of the sites were artifactually rich, even when a single, small habitation feature was identified. Given the abundance of resources in the area of the project sites, it is likely that most are of mixed cultural assemblage and functional assumptions are, therefore, erroneous. Still, the sites are clearly residential in nature with a few discrete field camps.

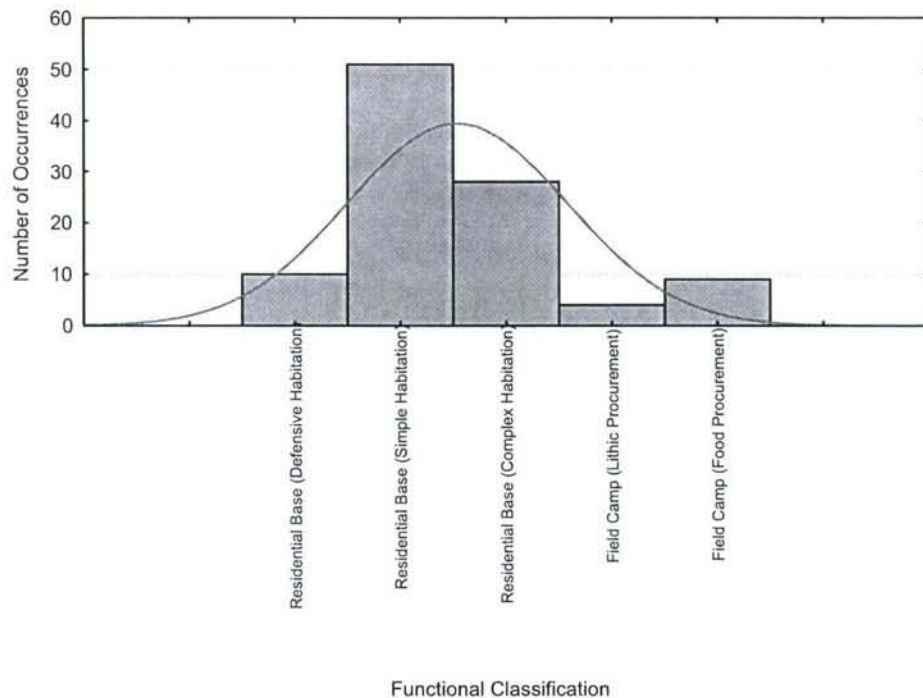


Figure 1.19: Histogram of site functional classification.

Histograms alone have provided a hint as to the key elements for architectural feature placement – proximity to critical resources like food and water. Broad general statements have been made regarding the project data, but the first step to identifying changing patterns in human land use is to set the data in time. Unfortunately, project prehistoric temporal information is relatively limited and most of the project sites are of unknown temporal affiliation. Nevertheless, the project data was arranged using frequency scatterplots to place it temporally, and to determine whether the placement of habitations features has changed within the Late Prehistoric stage.

Figure 1.20 was used to investigate the relationship between debitage/chipped tools ratios and the Late Prehistoric temporal periods. In every case, more debitage pieces were found than tools and there appears to be little change through time. Chipped tool/ground stone relationships were compared in the same way, but more meaningful data was obtained (Figure 1.21). A higher proportion of chipped tools key hunting activities and more ground stone items point to vegetal material processing. Many of the sites, from all time periods, show evidence for significant vegetal food preparation, but especially those sites of unknown chronological affiliation. Known Diversification period sites show less reliance on plants, as do sites from the Developmental period.

Considering the earlier discussion regarding biface/core ratios and their ability to key sedentary or mobile populations, the Diversification period apparently evidences a higher degree of residential mobility when ratios are compared chronologically (Figure 1.22). If a 1:1 relationship indicates equal reliance on curated and expedient technologies, Developmental period populations relied heavily on both, while several unknown age sites relied almost

exclusively on expedient technologies and likely had lower degrees of residential mobility. Mixed Developmental/Diversification period sites exhibit much higher degrees of mobility and suggest that many may actually date to the latter time period.

Figure 1.23 was generated by cross-tabulating geophysical setting by temporal range. Sites from all time periods were found near the canyons; this shows a selection preference based on the abundance of resources found there. More Diversification period sites are found near the canyons than the preceding Developmental period, though not many more. Related data was obtained from Figure 1.24, with canyon settings dominating local landforms. A key point is to be made here. If prominent points and areas of high terrain key defensible locations, then conflict began in the Developmental period and it is not a diagnostic for the Diversification period (Apishapa phase) as Withers (1954) has claimed. Data from Figure 1.25 supports this proposition as well.

There are other potential Developmental defensive sites from outside the PCMS. Wiseman (1975, 2002) recorded the southernmost site with Plains Woodland-like features at Sitio Creston (LA4939). Steamboat Island Fort (Campbell 1969:223) contains "slab enclosures and stone barrier walls" that date from AD 800 and 1000. Darrien's Fort (LA48871) in extreme northern New Mexico is a defensive site with 100 ft cliffs on its sides and 3 ft high barrier walls where the landform might be accessed. It dates to AD 940, placing it later in the Developmental period (Winter 1988:36).

When site aspect data is compared, several distinct modes are apparent (Figure 1.26). The unknown age prehistoric sites cover all potential aspects. To a certain degree, so do the Diversification period sites, though two modes are clear: 1-50 ° (north/northeast) and 170-218 ° (south). Developmental period sites exhibit three modes, and these only overlap slightly with those of the Diversification period. One large mode shows that most Developmental period sites were oriented to the east between 35-130°. A second mode clusters around 195° and the third mode between 240-325°. What exactly do these modes mean? Perhaps, they key group mobility and season of occupation, as certain exploitable plant species would only grow during the summer or fall and the modes happen to reflect times of more intense area occupation. All things being equal, southern exposures can key winter occupations and those to the north, summer occupation. These hypotheses will never be proven using surface collected data alone, but clearly seasonal occupation can be inferred with some degree of reliability.

As was shown in Figure 1.8, distance to water is a highly significant factor for site selection. When this variable is analyzed through time (Figure 1.27), sites from known chronological context cluster between 1 and 500 m from permanent water sources. Diversification period sites are generally a little closer to water and this may be related to domesticated plant growth. Several of the Developmental period sites are a great distance from water and this may be related to differing site function, like the seasonal storage of food items or the use of a structure as a hunting blind rather than for habitation.

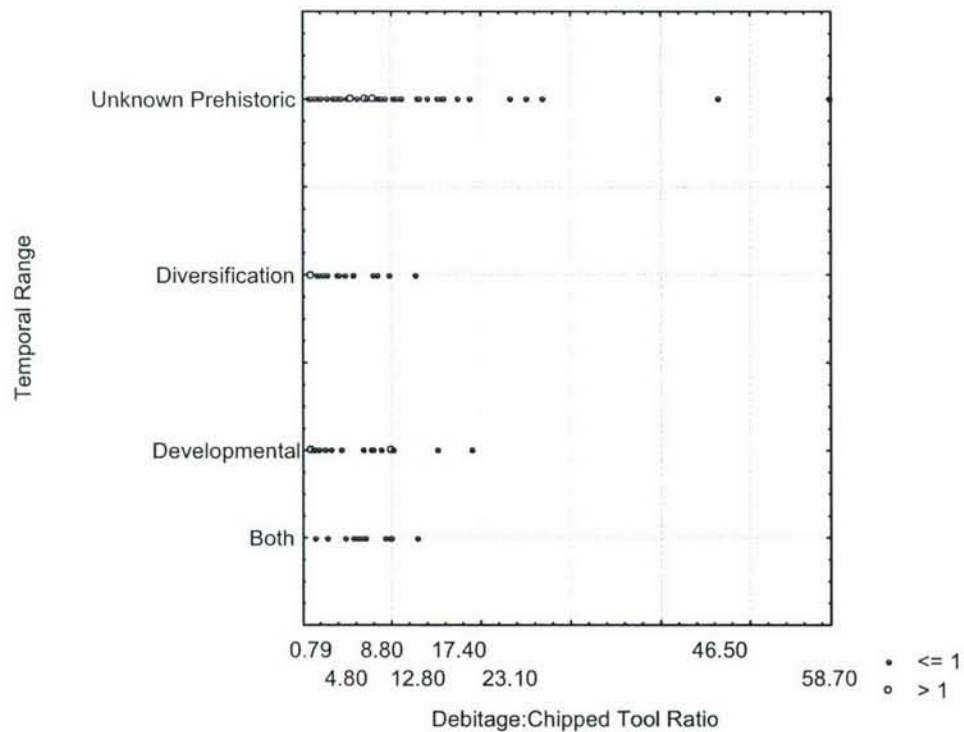


Figure 1.20: Frequency scatterplot of debitage/chipped tool ratio by temporal range.

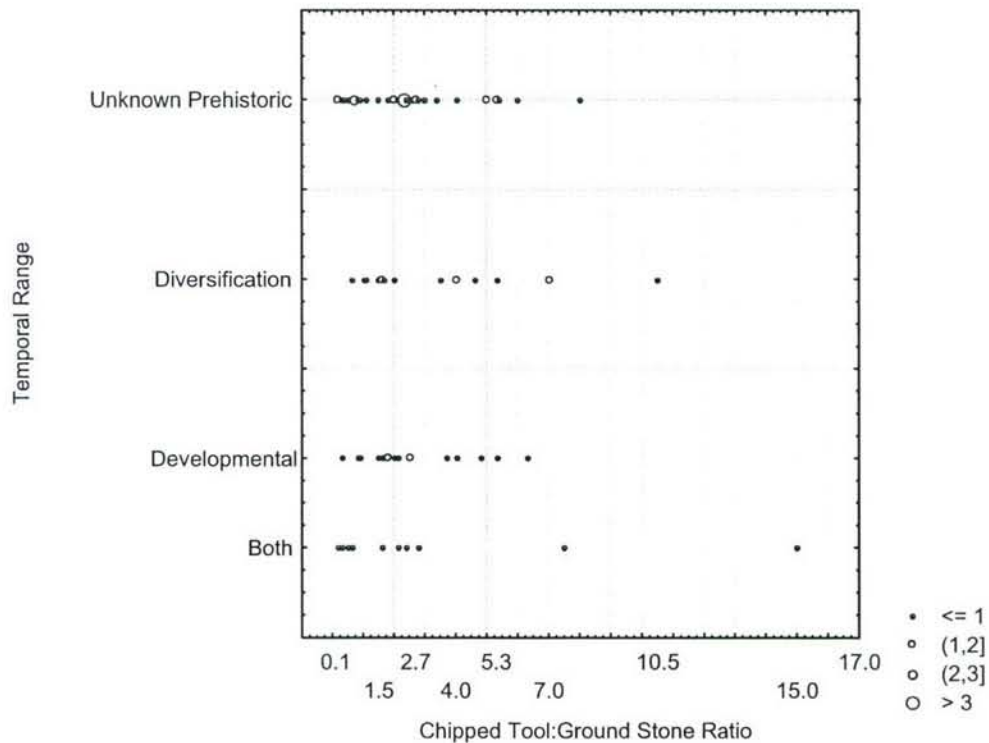


Figure 1.21: Frequency scatterplot showing chipped tool/ground stone ratio by temporal range.

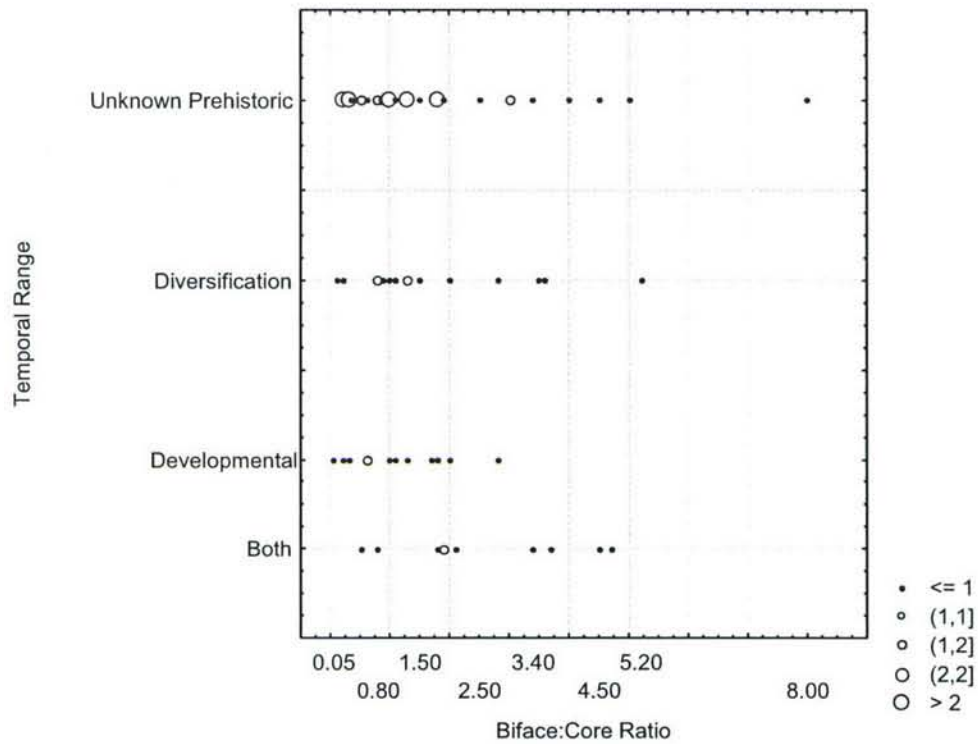


Figure 1.22: Frequency scatterplot of biface/core ratio by temporal range.

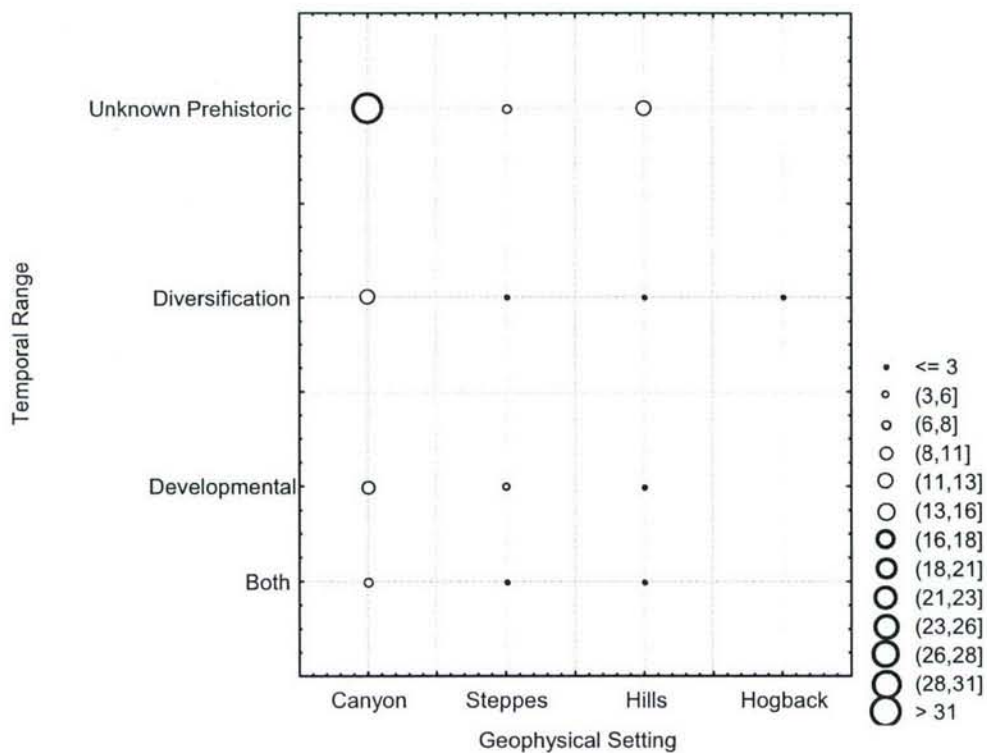


Figure 1.23: Frequency scatterplot of site geophysical setting by temporal range.

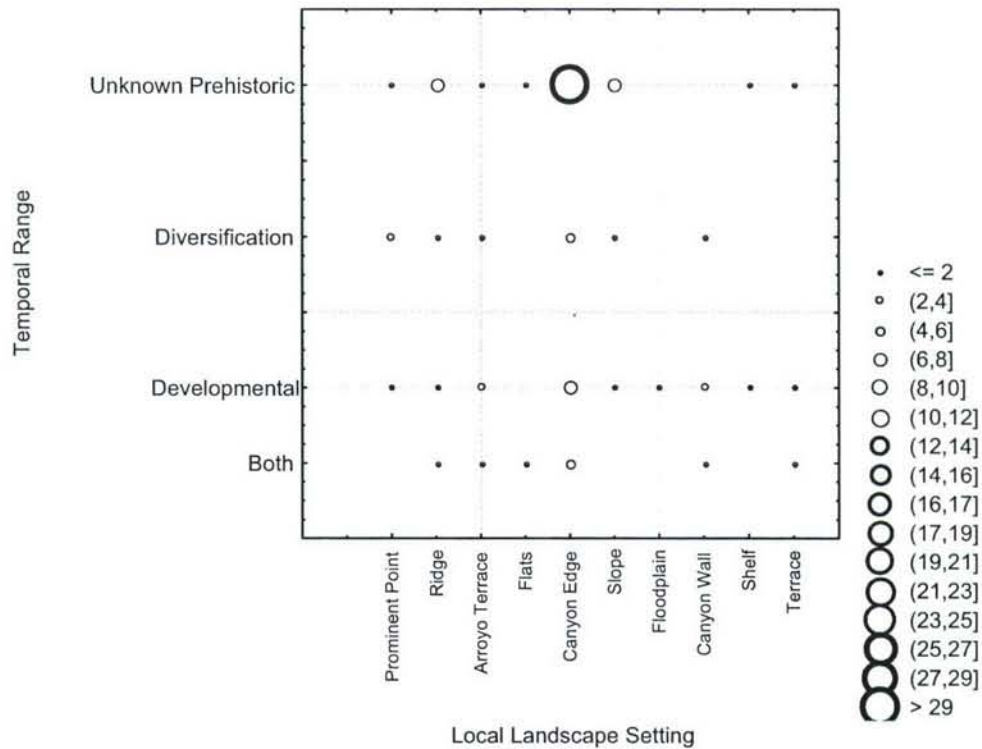


Figure 1.24: Frequency scatterplot of local landscape setting by temporal range.

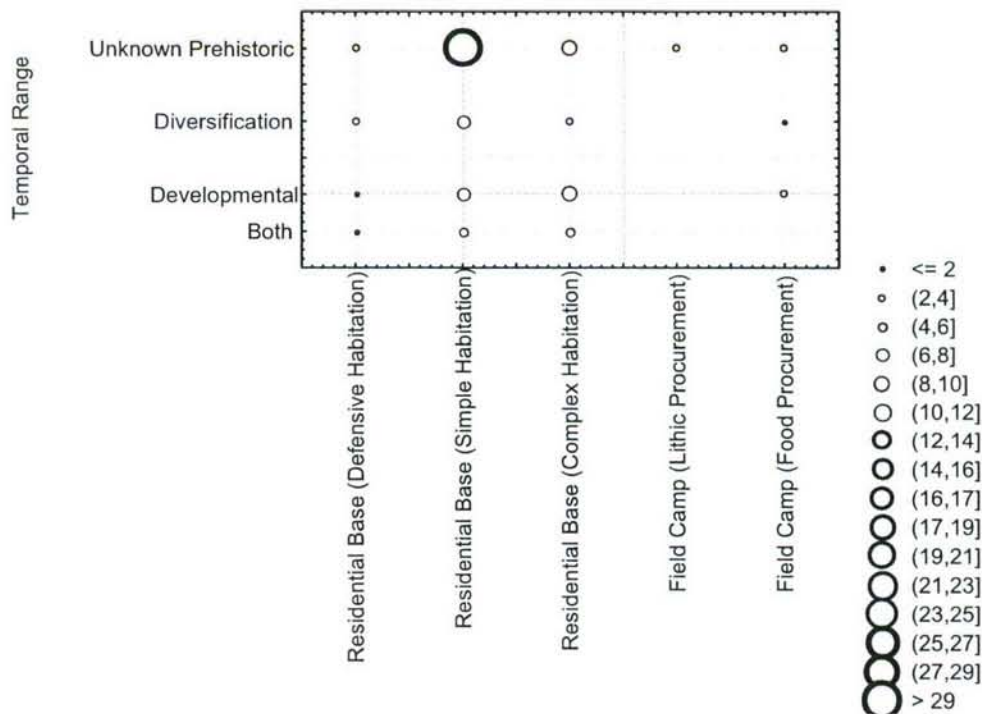


Figure 1.25: Frequency scatterplot of site function classification by temporal range.

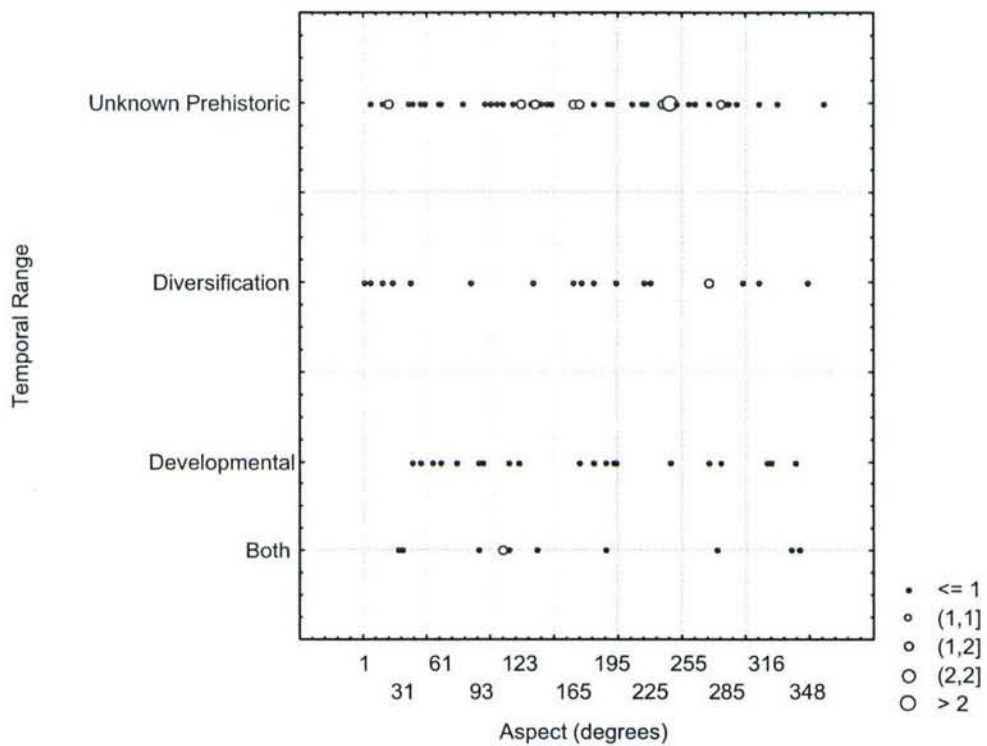


Figure 1.26: Frequency scatterplot of site aspect by temporal range.

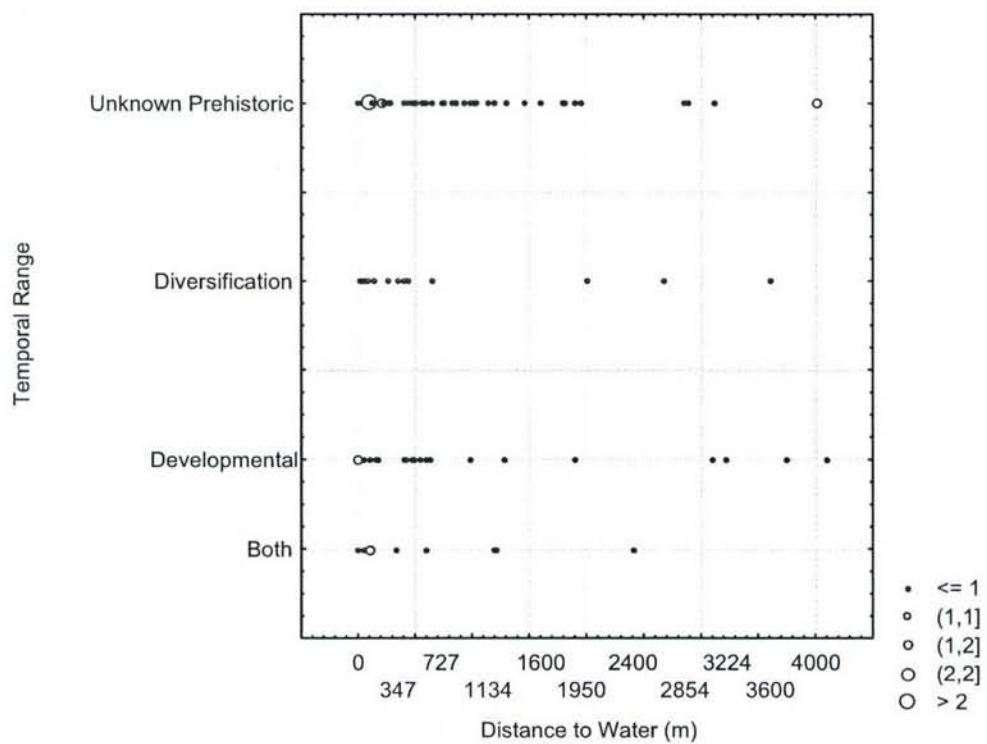


Figure 1.27: Frequency scatterplot of distance to water by temporal range.

The high correlation of sites to canyon areas is shown in Figure 1.28, where plant community is cross-tabulated against temporal range. Diversification period sites occupy more plant communities than those of the Developmental period and this is likely related in some way to local mobility; perhaps task groups were sent out from base camp areas.

According to Gunnerson (1989), architectural units of the Diversification period are small isolated dwellings. Figure 1.29 provides conflicting data, though most Diversification units were isolated in their construction. Isolated units are quite common in the Developmental period as well, so they are more likely a Plains lifeway diagnostic than a temporal or cultural diagnostic. Abutment structures and rockshelters with internal architectural units were identified during the Developmental, but there are generally fewer architectural features per site on Developmental period sites than those of the Diversification period (Figure 1.30). Generally, sites of both periods have less than five architectural units and the appearance of two to three per site is common.

For any given activity more than one factor played a significant role in site location. Temporally, the project data has shown that a variety of resources were being utilized and site placement may not always be related to the resources being utilized. In an attempt to further elucidate Late Prehistoric economic focus, the following frequency scatterplots cross-tabulate geophysical setting or plant community by several of the project variables.

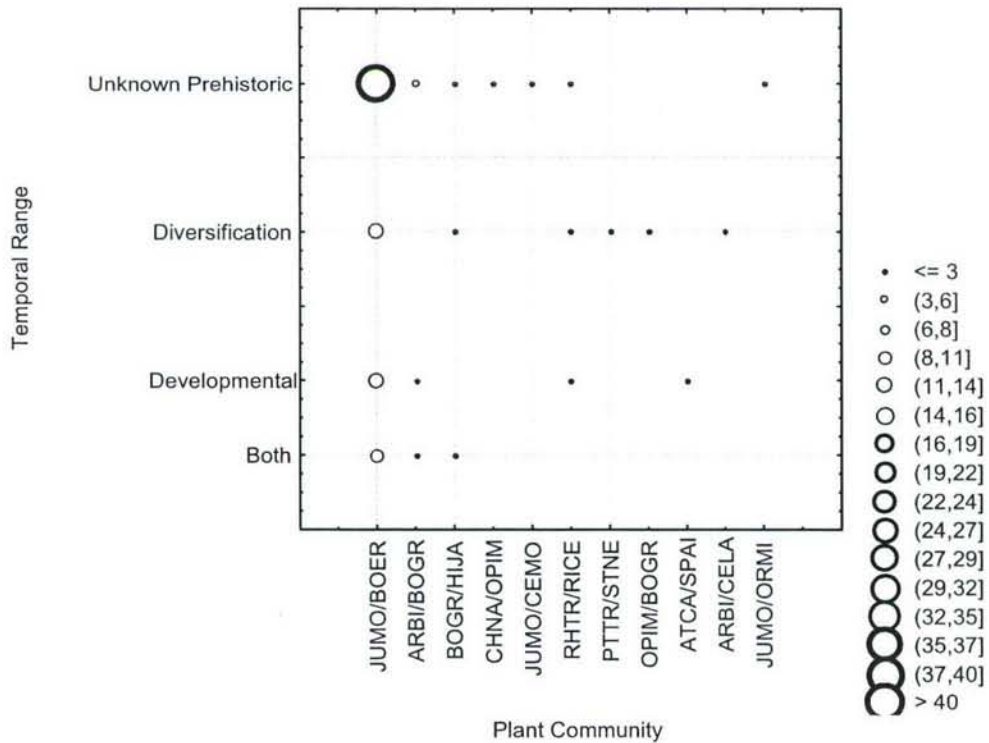


Figure 1.28: Frequency scatterplot of plant community by temporal range.

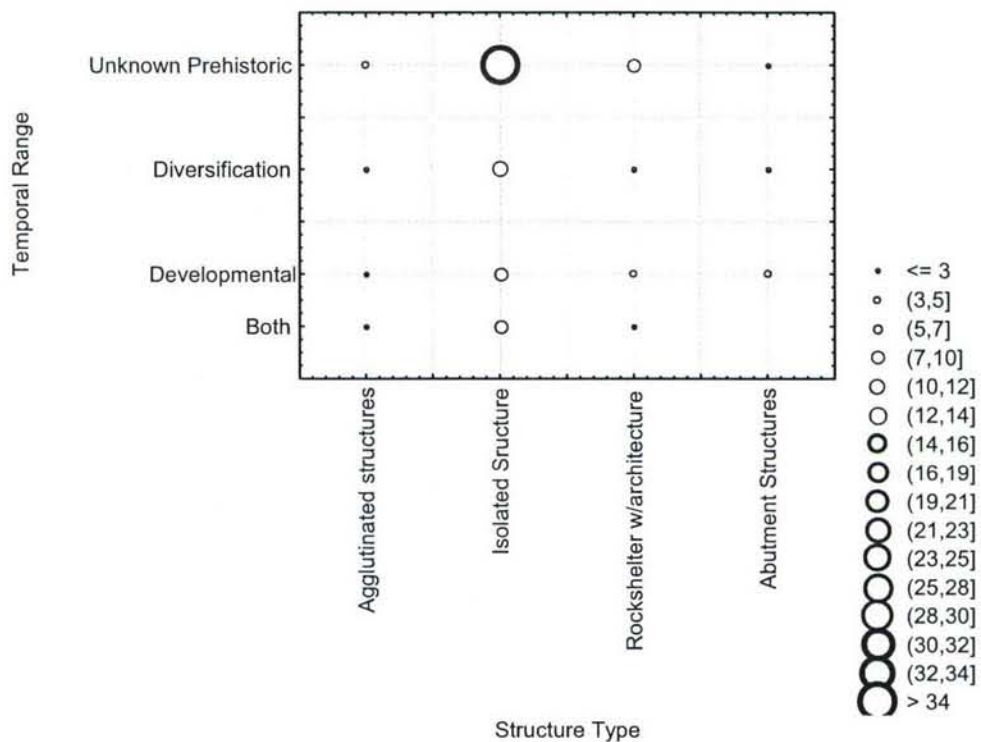


Figure 1.29: Frequency scatterplot of structure type by temporal range.

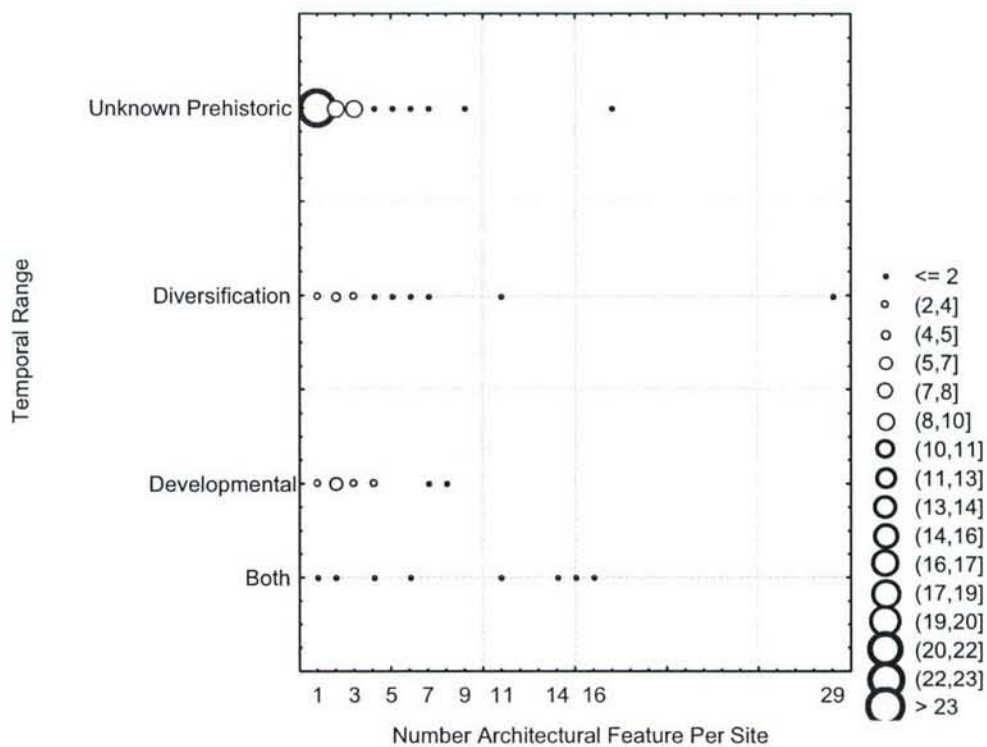


Figure 1.30: Frequency scatterplot of number of architectural features per site by temporal range.

In the steppes of the PCMS, architectural sites generally show a higher ratio of chipped tools to debitage and suggest that food procurement pursuits were a dominant focus (Figure 1.31). Much higher ratios of debitage to flake tools were observed in canyon and hill settings, where good tool stone outcrops in abundance. Figure 1.32 shows a mixed bag of foodstuffs were procured and processed. In steppe settings, hunting and gathering pursuits were nearly equal, and in canyon, hill, and Hogback sites, hunting appears to be the dominant economic focus.

Biface/core ratios confirm a reliance on hunting (Figure 1.33), but support the idea that low residential mobility groups often occupied habitation sites in the canyons and hills. Higher biface/core ratios suggest more mobile people using a variety of geographical settings on a short-term basis.

Figure 1.34 was generated by tabulating site aspect by geophysical setting to support seasonal/functional assumptions. In canyon settings, southern exposures are common. This likely reflects the more intense occupation of canyon areas, but perhaps the canyons were places that prehistoric populations constructed longer-term residential sites during the cold winter months. In steppe areas, two distinct modes were identified: 71-103° (east) and 265-338° (west). Rarely were steppe sites oriented to the south so winter habitation cannot be inferred. Clearly, architectural features in the steppes are related to another function like food procurement. Sites 5LA9188 and 5LA 9450 are two of these sites; they were found on low wooded terraces with good views into the grassy flats where ungulates would have grazed. A distinct mode between 1-60° was identified for hill architecture sites and is likely related to resource procurement pursuits.

Sites in defensible positions were often found in canyon settings, though some were identified in the Black Hills and above Stage Canyon (Figure 1.35). Canyon settings also contained most of the isolated structures and village sites. Though not on pointed projections, most of the isolated architectural features are found within 50 m of the edge and many have a line-of-sight relationship to each other like those shown in Figure 1.36.

Architectural sites where foodstuffs were procured and processed were most often found in the JUMO/BOER plant community (Figures 1.37 and 1.38). Again, this is the community found near the canyon, so this is not surprising. Plant communities away from the canyons have high biface/core ratios indicative of a hunting function.

DISCUSSION

Archaeological features are objects produced by people who physically arrange natural materials into a functional form. Resource availability plays a major role in determining what materials will be used to make a structure, and it also influences where they will be placed in the landscape and what function they perform. Any functional form will exhibit behaviorally relevant performance characteristics. The following section discusses the four integral performance characteristics and how they relate to the data presented in the preceding pages.

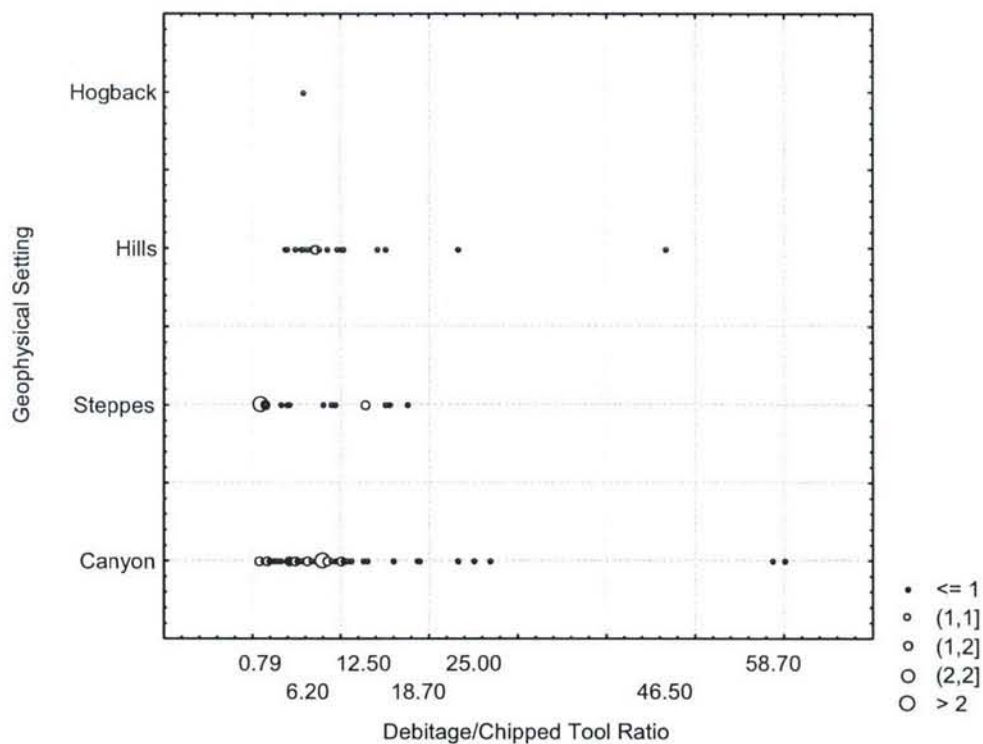


Figure 1.31: Frequency scatterplot ofdebitage/chipped tool ratio by geophysical setting.

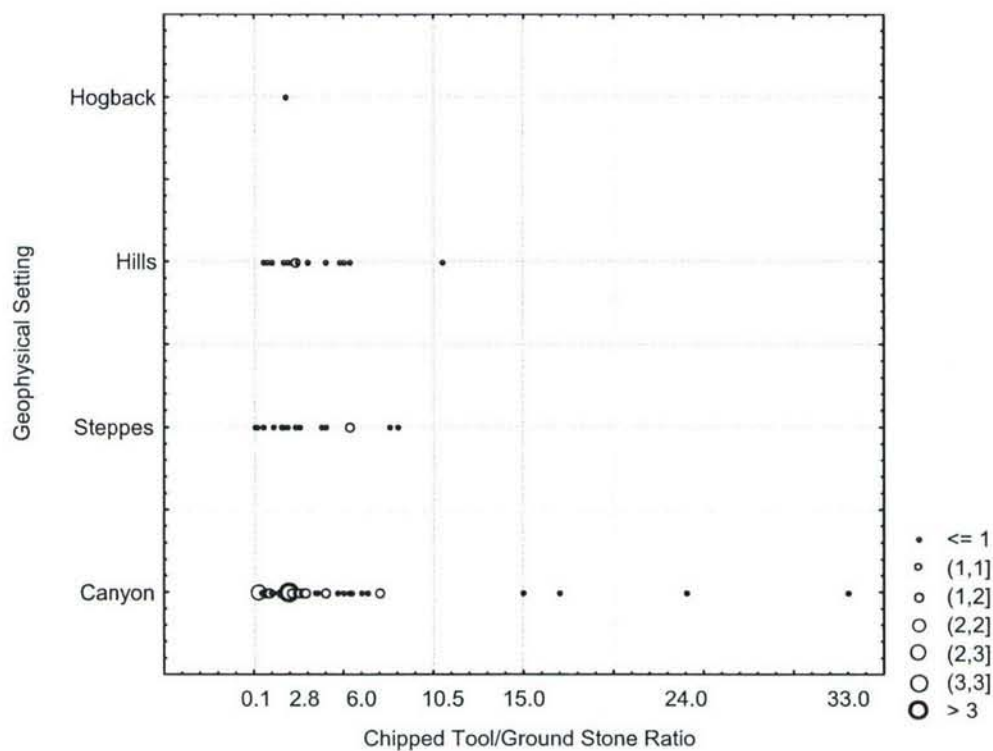


Figure 1.32: Frequency scatterplot ofchipped tool/ground stone ratio by geophysical setting.

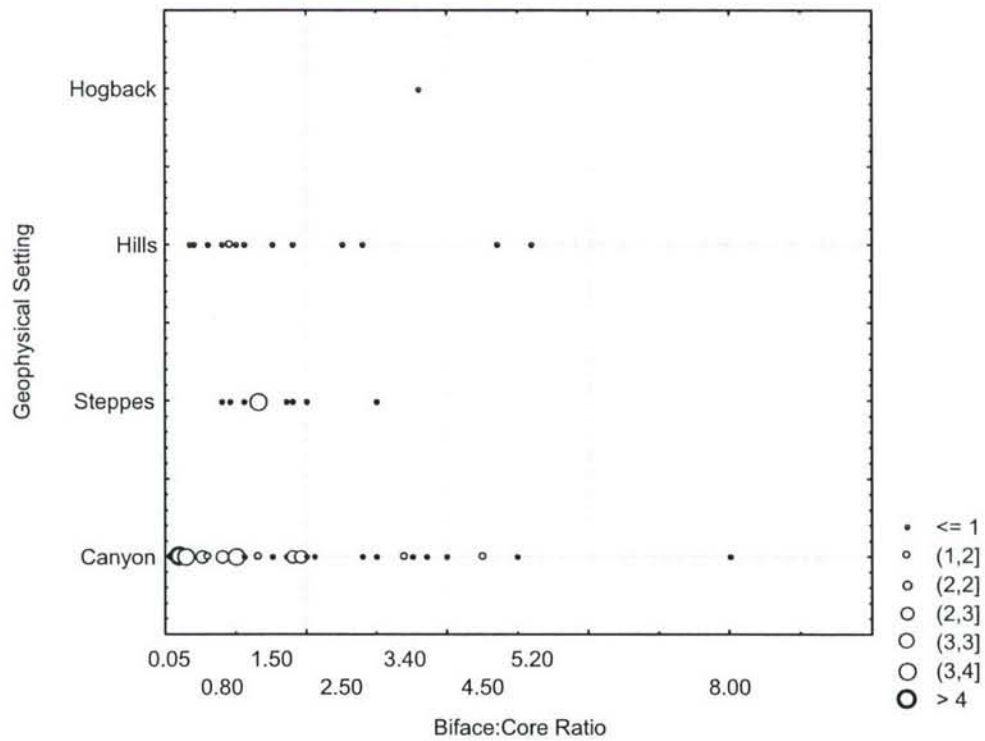


Figure 1.33: Frequency scatterplot of biface/core ratio by geophysical setting.

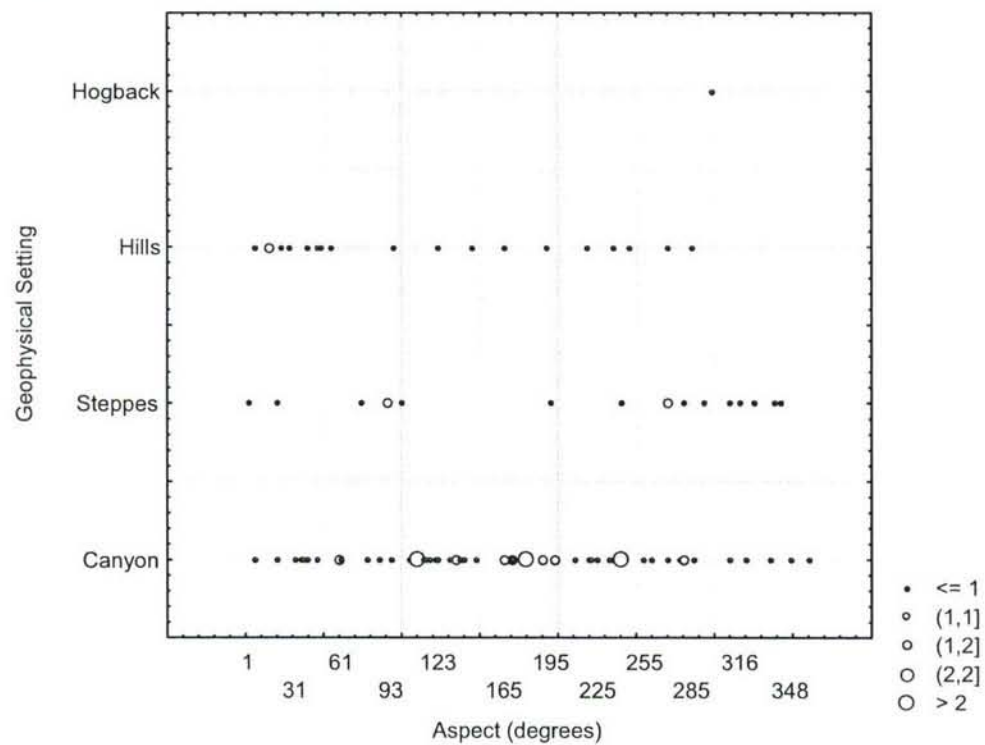


Figure 1.34: Frequency scatterplot of site aspect by geophysical setting.

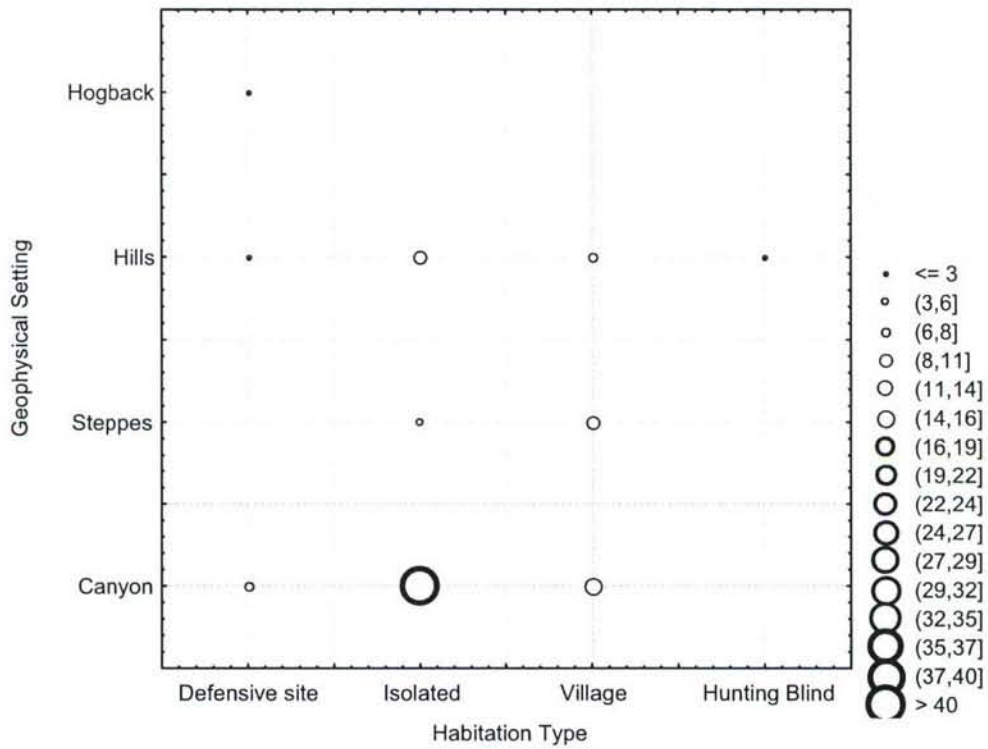


Figure 1.35: Frequency scatterplot of habitation type by geophysical setting.

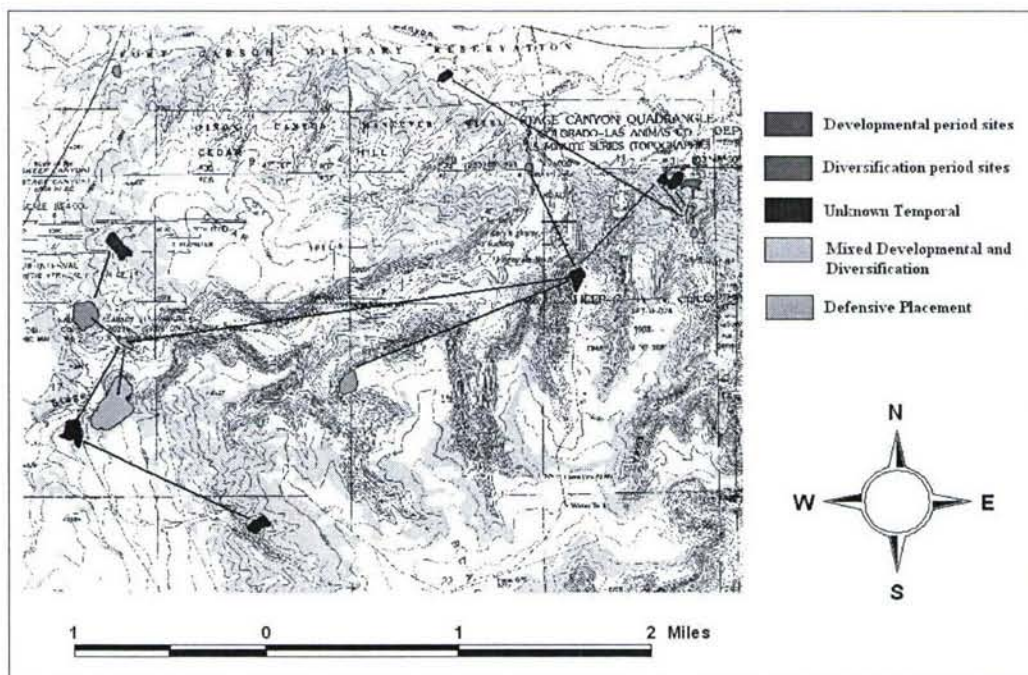


Figure 1.36: Line-of-sight relationship of Late Prehistoric architectural sites near Stage Canyon.

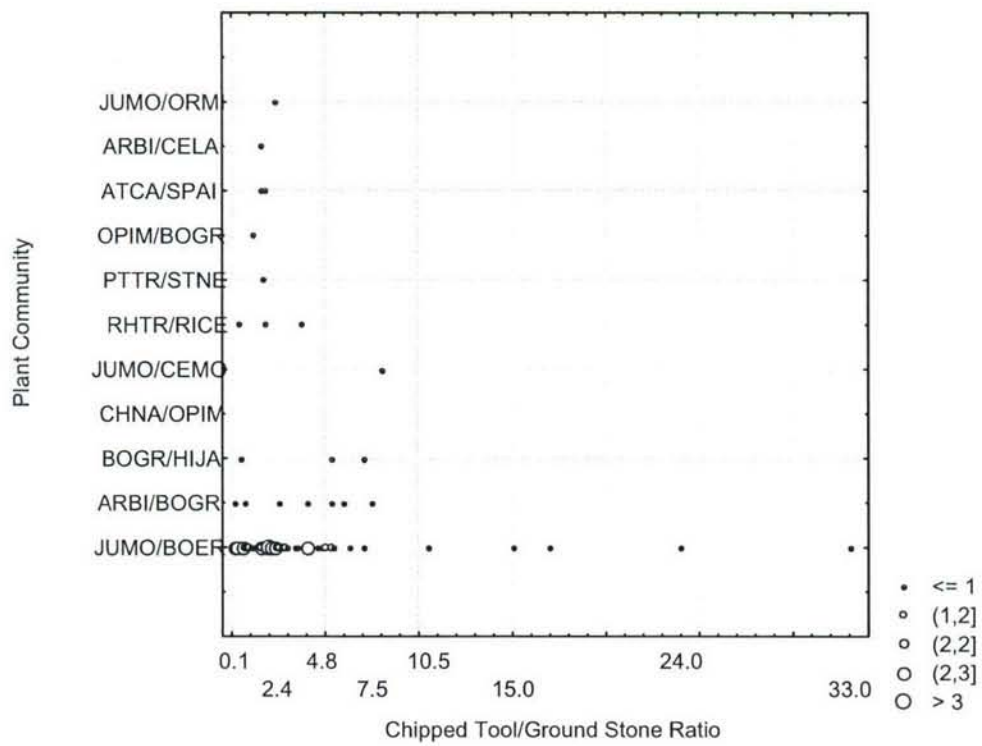


Figure 1.37: Frequency scatterplot of chipped tool/ground stone ratio by plant community.

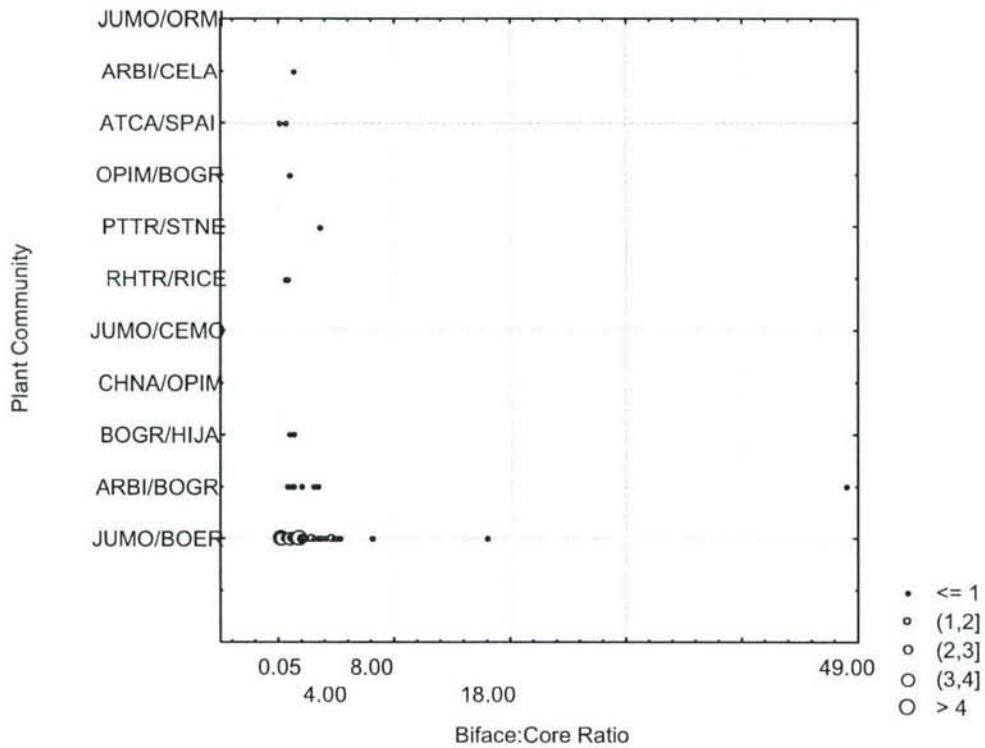


Figure 1.38: Frequency scatterplot of biface/core ratio by plant community.

On the surface, acoustic performance characteristics seem to have little relevance to the current project. The majority of the architectural features were found in open-air settings (n=59, 58%), though rockshelters with architecture were relatively common (n=43, 42%). Rockshelters are known to resonate or amplify sound, and because of this many prehistoric cultures regard caves or alcoves as sacred. Similarly, an acoustical influence (shamanistic) on both the context and placement of rock art has been demonstrated in Upper Paleolithic sites of Europe, as well as in North America (Waller 1993). Open-air sites near canyons have been found to have amplified sound levels, and given the fact that so many PCMS architectural sites have been found in close proximity to each other and the canyons (Figures 1.3, 1.4, 1.23, 1.241.36), acoustic performance characteristics are at least a minor factor in site selection. With evidence suggesting prehistoric warfare during the Developmental and Diversification periods of the Late Prehistoric stage, perhaps acoustic performance characteristics were highly desirable as echoes would have made a defensive force seem larger to a raiding group. Conversely, the amplification of sound could betray a group location as well.

Sensory deliberations are almost impossible to tease from the archaeological record as they relate to taste, smell, sight, and touch. Only sight will be addressed here, though touch may be of some relevance on rock art sites with architecture. Shamanistic or religious practices do have sensory connections regarding structure placement, but based on the limited project data this research topic cannot be addressed.

On a large scale, architectural visual performance characteristics relate to viewshed. Structures in these cases would be placed next to a cliff when line-of-sight observation was necessary for communication. Conversely, prehistoric peoples would want their houses to blend in with the landscape to hide from prehistoric raiders or large herds of animals that they would like to exploit. Regarding the latter, four of the project sites fit this description – 5LA9020, 5LA9044, 5LA9188, and 5LA9450 (Figure 1.39).

As noted above, the canyons tops of the PCMS are echo rich locations, but they are also areas where a line-of-sight relationship can be found (Figure 1.36). In the area of Stage Canyon, though sites are of mixed temporal affiliation, most of the architectural sites have a line-of-sight connection to defensible landforms. Especially noteworthy is the apparent communication relationship of the one that spans the entire length of Stage Canyon. Extreme line-of-sight relationships are not unique to the PCMS. Bement and Carmichael (2003:49) note line-of-sight relationships of up to 6.8 m for Black Mesa sites in the panhandle of Oklahoma.

To further explore line-of-site relationships, many of the project sites were personally visited in an attempt establish visual connections. Figure 1.40 shows that isolated structure sites often had line-of-sight relationships with between 2 and 6 sites (measured to 1 km away). Village sites had line-of-sight relationships with up to eight sites, but typically the number of sites clustered between 1 and 5. Defensive locations were often some distance from other architectural sites, but that is because pointed projections and easily defensible locations are not to be found everywhere in the canyons. A noteworthy exception to this is the line-of-sight relationship between the two Diversification period sites shown in Figure 1.14. From the map,

the many curves in the canyon appear to obscure the line-of-sight between the two, but upon inspecting the canyon, both sites can be easily seen, and an echo carries across the entire 1.6 km distance between them.

It should be noted that several of the architectural sites along the legal PCMS boundary showed no line-of-sight relationship with other sites, but this is because their associated sites are likely located off of the property or in the canyon bottoms where archaeological inspection has yet to occur. A case in point would be 5LA330 (Sorenson) at the northeast boundary. Though it has few associations with sites to the north or west (PCMS lands), many Developmental and Diversification period sites are found along the Purgatoire River on the Comanche National Grasslands (Reed and Horn 1995).

In order to model the function of the project sites, a category not discussed by Schiffer (1987), functional performance characteristics was added to the analysis. While it is difficult to clearly identify site function, a relationship of actions can be used to infer probable site function. From the primary data in Figures 1.19 and 1.26, and the supplemental information in figures 1.28 to 1.33 and 1.35 to 1.42, it is clear that the project sites function primarily as simple or complex residential bases, defensive bases, or field camps associated with lithic and food procurement.

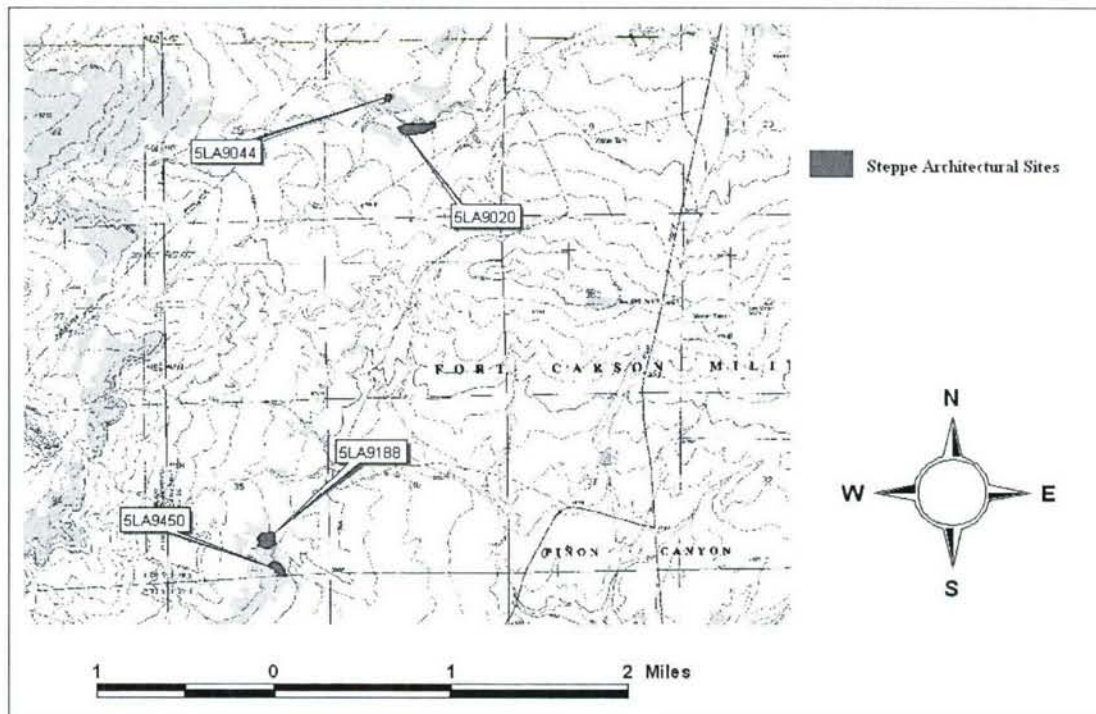


Figure 1.39: Map showing four of the steppe architectural sites.

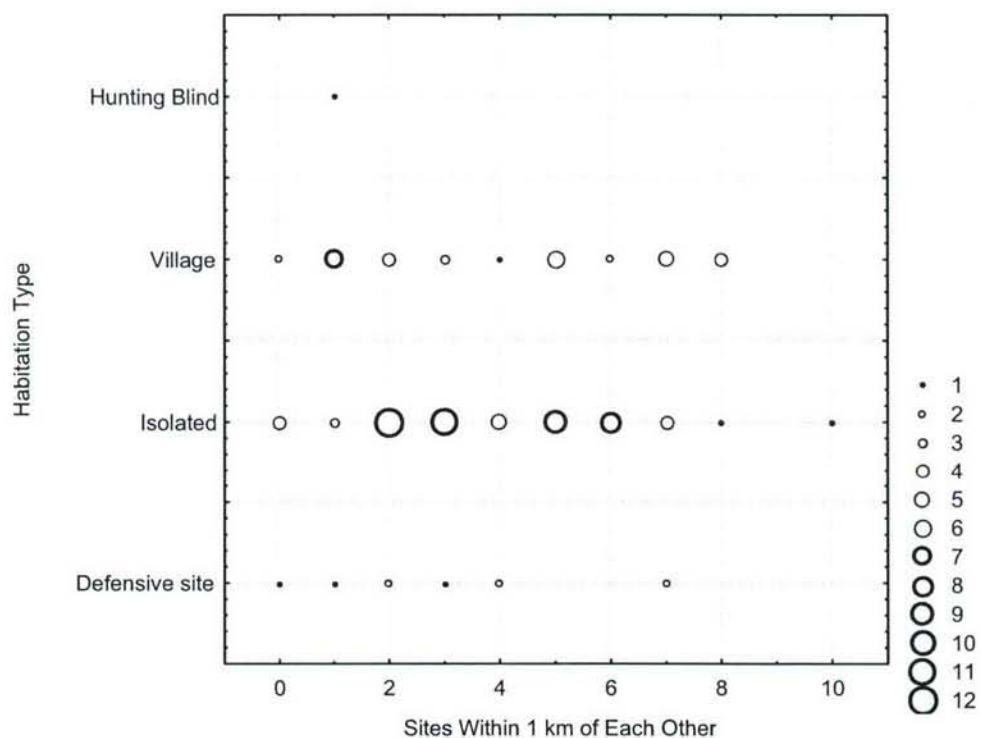


Figure 1.40: Frequency scatterplot of habitation type by architectural sites within 1 km.

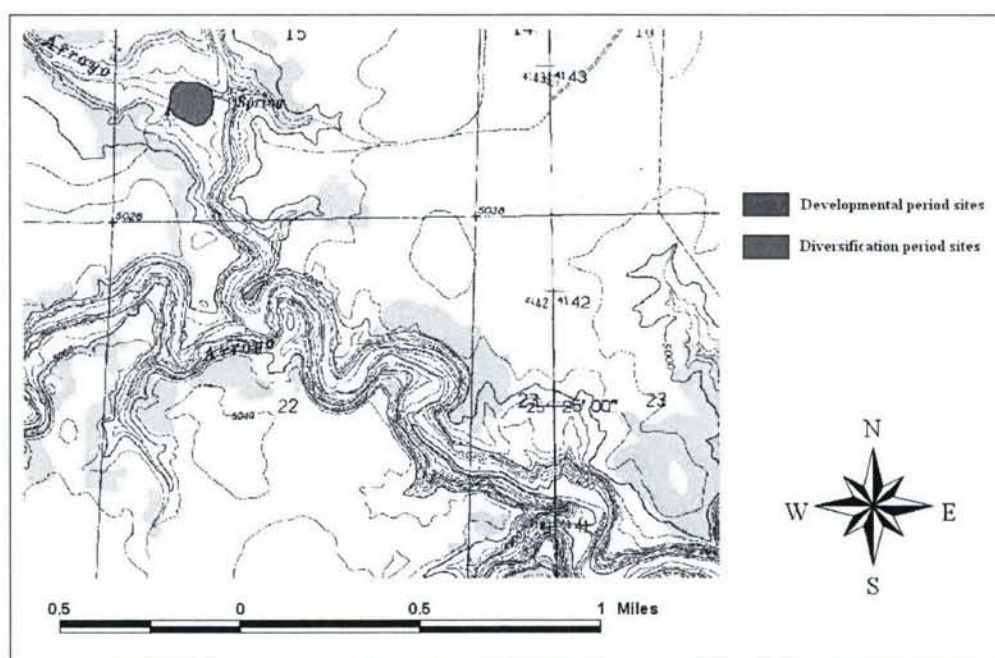


Figure 1.41: Map of Developmental and Diversification sites in the Taylor Canyon area.

CONCLUSIONS

Because of the limited funding associated with cultural resource management projects, archaeologists need to find ways to maximize their field efforts while maintaining federal and state compliance. Fieldwork on the PCMS is primarily large-scale survey projects with the occasional evaluative testing project. The overall objective of the work is to identify prehistoric and historic properties, evaluate their National Register of Historic Places eligibility, and to provide appropriate management recommendations to ensure their protection from adverse impacts.

For PCMS archaeologists, the majority of the cultural materials they encounter are on the modern ground surface. Many purely academic researchers view surface materials as tainted, arguing that both cultural and natural formation processes make data somewhat biased, and thus, they tend to concentrate their efforts on “intact” and stratified buried sites. I believe that buried sites and the prehistoric occupation surfaces within them, can be just as much, if not more, “mixed,” and that spatial data recovery can easily occur without the extreme cost associated with excavation. This project caters to the academic researcher as it takes into account the various site formation processes. As a final point, archaeologists have to make use of any data that can be obtained; if one only has surface data to work with, they must factor out potential biases by utilizing inferential statistics.

The goal of this research was to determine if the Late Prehistoric architectural features of the PCMS could be modeled despite their surface context. Results show that they can indeed be modeled using chronological, geographical, technological, and functional variables, but the post-abandonment mixing of time and cultural diagnostic materials keep the conclusions of a general nature. Because the canyon areas are those most ravaged by natural and cultural impacts, the project variables were bolstered by a performance characteristic framework; it allowed other mechanisms for site placement to be addressed. It has been shown that various acoustical sensory, visual, and physical performance characteristics can be patterned to a limited degree, but they are primarily related to the geographic placement of sites upon the landscape.

Chronologically, the data in Appendix A and Figure 1.2 is not that impressive, however, when the dated sites are plotted into a GIS program, patterning becomes apparent. Developmental period sites are found where abundant resources are clustered, but Diversification period sites are found where fewer critical resources, like food and water, can be obtained. In addition, population densities, based loosely on the size of site boundary, look like they decline during the Diversification period.

The assignment of architectural sites to occupation periods allowed for spatial analysis using GIS software. This was done to determine if site placement had changed through time. Figures 1.36, 1.39, 1.41 and 1.42 show that some interesting, though limited, information was collected. First, the size of Developmental period sites seems much larger in relation to those of the Diversification period. The former are almost always found near permanent water sources

and other critical resources, the latter in locations where views can be had and at least some degree of seclusion could be achieved.

Late prehistoric age sites seem to fit well into the processual model and patterns relating to geographical variables have started to emerge. Regarding local site setting, most (over 55%) of the project sites were found in the canyon areas, which includes those on ridges (12%) and prominent points (7%). The larger-scale variable of geophysical setting also highlights the selection preference for canyon settings with 64% of the total. As has been reiterated many times previously, the canyon areas are closest to water sources, outcroppings of tool stone (for bedrock metates and to manufacture portable items), and architectural building materials. The presence of steppe and hill sites suggests that resources are not always the primary consideration for site placement, however.

Most of the project sites were found at elevations between 4,900 and 5,100 ft; these are the canyon areas of the PCMS. Elevation is really not a significant factor regarding site placement and it is biased because most of the past PCMS survey has occurred at the canyon/steppe boundary where mechanized maneuvers occur. Some project sites were found in the hills between 5,100 and 5,500 ft, and Late Prehistoric age architectural sites have been identified outside of the PCMS and along the Purgatoire River at elevations down to 4,320 ft (Reed and Horn 1995).

Though the variable of slope has been used on other projects with some success, it seems to be a minor factor when the project sites are considered. Perhaps the difference in the data relates to the fact that many PCMS sites are very large and exhibit multiple and diverse slope readings within their boundaries. It seems many of the project structures were indeed placed on relatively level ground, but to make this a valid variable, slope readings will need to be taken at every architectural feature, a daunting task as it would take literally months to accomplish.

Aspect seems to be one of the most telling project variables and may indicate year-round Late Prehistoric habitation of the PCMS. Most of the project sites exhibited southern exposures – preferred for cold weather habitation. Northern exposures suggest significant summer habitation as well, but it is the high frequency of northeast and northwest trending sites that are noteworthy. These likely relate to the seasonal exploitation of particular food stuffs and suggest the Late Prehistoric inhabitants of the PCMS maintained a fairly high degree of residential mobility.

Technological variables allowed additional statements regarding residential mobility and site function, but they are not that good a predictor of site placement except when lithic procurement or heavy foodstuff grinding were the primary activities. The dominant material type variable shows high percentages of quartzite; this material is found along the canyon edges and in the eastern hills of the PCMS. Expedient and curated technologies were identified within the lithic assemblages and, overall, biface/core ratios fall within the predicted pattern for Plains Village sites (Parry and Kelly 1987:290-291).

When all of the project variables are considered, it seems they are interrelated to a high degree. This is not unique to the PCMS. Regarding “least cost” strategies along the Cimarron

Valley of northern New Mexico, Adrienne Anderson (1975:8) noted, "...for any given site activity more than one factor played a role in its location; that is, the major resource being utilized was not the only factor considered by the aboriginal occupants." In her model, Anderson found that resources significant to site selection were ecological community, landform, ground cover, type of nearest water supply and type of exposure. Insignificant to site selection were availability of lithic materials, frequency of food resources, availability of fuel, protection from elements, and protection from enemies.

Discounting her significant variables, our data are clearly at odds. Perhaps, this is related to site type. Her project covers the gambit of site types including lithic and food procurement locations, caches, stations, field camps, and residential sites. Most of my sites are residential – simple and complex habitations, though defensive sites and probable field camps were also identified.

Regarding the sites on pointed projections and other raised landforms, defense seems to be the most plausible explanation for the features, rather than environmental variables. These areas are locations where acoustic and visual performance characteristics dominate, but why defensive sites, especially in both the Developmental and Diversification periods? Possible explanations include: (1) intergroup rivalry over critical territory, (2) seasonal fluctuations of critical resources, (3) depletion of farmlands and game herds, (4) internal and external sociopolitical pressures, and (5) appearance of new groups and populations (Winter 1988:77).

Explanations 1 through 3 would be directly related to the absence of a good water supply. Near the end of the Developmental period the already xeric climate (McDonald 1992; Schuldenrein et al. 1985) became even more dry (Scott-Cummings and Moutoux 2001:262). Late in the Diversification period another drought has been suggested (Baeris and Bryson 1965:216; Bryson et al. 1970; Schiavitti et al. 2001:237; Wendorf 1960:62). Droughts would have led to increased population pressure and human responses would include (among other things) expanding territory size, the exploitation of different resources, or the raiding of resources.

Regarding the fourth and fifth explanations, the Diversification peoples of southeastern Colorado (Apishapa) disappeared around AD 1450. Creation myths and other lines of evidence suggest they became Caddoan (Hughes 1974; Gunnerson 1989:13) and that they were pushed out of the area by Athabaskans (; Haskell 1978; Kingsbury and Gabel 1983). A rock art panel along the Purgatoire River bearing Rio Grande rock art tradition elements (Figure 1.43) suggests Puebloan peoples are a candidate.

Though not sophisticated by current GIS standards, this project model can predict defensive sites and complex sites with a high degree of accuracy. Unfortunately, the range of variability of Late Prehistoric architecture is still unknown because all of the PCMS landholdings are in "upland settings" in the Purgatoire River system. Reed and Horn (1995) found many large residential bases in the canyon bottoms and to further study these could either buttress the current model or discount it completely. Though surface assemblages can produce a wealth of data, supplementary excavations will be necessary to validate some of the conclusions presented here.

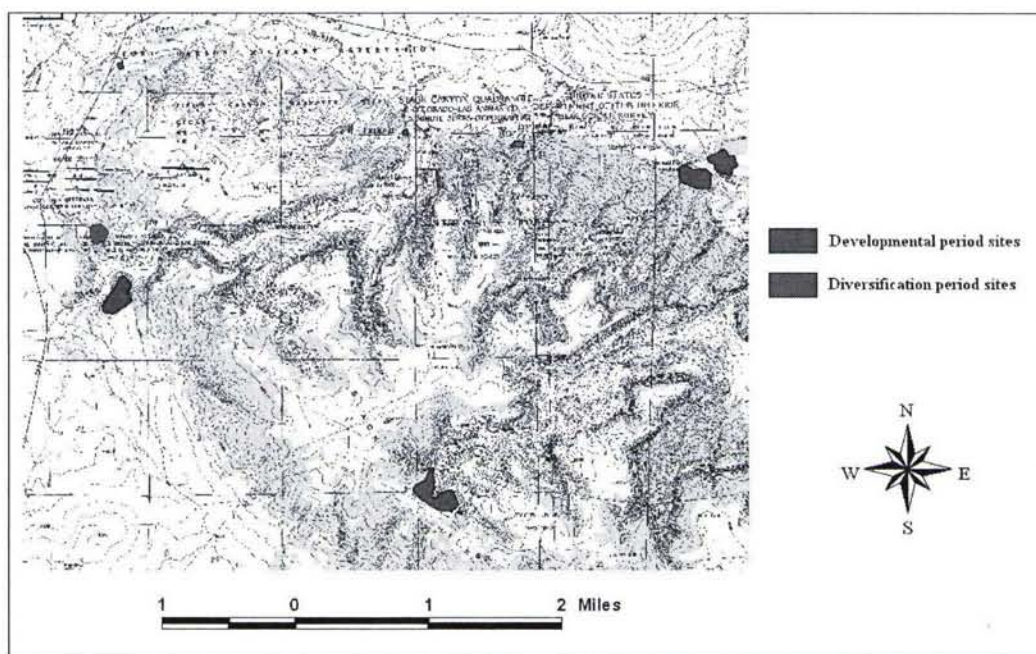


Figure 1.42: Map of Developmental and Diversification period sites near Stage Canyon.



Figure 1.43: Photograph of Rio Grande rock art along the Purgatoire River.

BIBLIOGRAPHY

Anderson, A. B.

1975 "Least Cost" Strategy and Limited Activity Site Location, Upper Dry Cimarron River Valley, Northeastern New Mexico. Unpublished Ph. D. dissertation, University of Colorado, Boulder.

Baerreis, D. A. and R. A. Bryson

1965 Historical Climatology of the Southern Plains: A Preliminary Statement. *Bulletin of the Oklahoma Anthropological Society* 13:69-75.

Baugh, T. G. and J. Ericson (editors)

1994 *Prehistoric Exchange Systems in North America*. Plenum Press, New York.

Bell, R. E.

1985 *Guide to the Identification of Certain American Indian Projectile Points*. Special Bulletin 2, Oklahoma Anthropological Society.

Bement, L. C. and C. R. Carmichael

2003 *From Top to Bottom: Pedestrian Survey of the Black Mesa Region, Cimarron County, Oklahoma*. The University of Oklahoma. Copies available from Oklahoma Archaeological Survey, Archaeological Resource Survey Report No. 48. Norman.

Binford, L. R.

1962 Archaeology as Anthropology. *American Antiquity* 28:217-225.

1977 Forty-Seven Trips: A Case Study in the Character of Archeological Formation Processes. In *Stone Tools as Cultural Markers: Change, Evolution, and Complexity*, edited by R. V. S. Wright, pp. 23-36. Australian Institute of Aboriginal Studies, Canberra.

1980 Willow Smoke and Dog's Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1):4-20.

Brooks, R. L.

1987 *The Arthur Site: Settlement and Subsistence Structure at a Washita River Phase Village*. Oklahoma Archaeological Survey, Studies in Oklahoma's Past, No. 15.

Bryson, R. A., D. A. Barreis and W. M. Wendland

1970 The Character of Late-Glacial Climatic Changes. In *Pleistocene and Recent Environments of the Central Great Plains*, edited by W. J. Dort and J. K. Jones, pp. 53-74. Department of Geology, University of Kansas Special Publication 3. University Press of Kansas, Lawrence.

- Campbell, R. G.
 1969 *Prehistoric Panhandle Culture on the Chaquaqua Plateau, Southeast Colorado*. Ph.D. dissertation, Department of Anthropology, University of Colorado, Boulder.
 1976 *The Panhandle Aspect of the Chaquaqua Plateau*. Texas Tech Graduate Studies No. 11. Lubbock, Texas.
- Chomko, S. A. and S. L. DeVore
 1990 *Sorenson Prehistoric Fortifications (Sites 5LA330 and 5LA331): an Apishapa Village on the Purgatoire River*. Interagency Archeological Services Rocky Mountain Regional Office National Park Service, Denver, Colo.
- Chomko, S. A., S. L. DeVore and L. L. Loendorf
 1990 Apishapa Phase Research at the Pinon Canyon Maneuver Site, Southeastern Colorado. Paper presented at the 48th Plains Conference, Oklahoma City, Oklahoma.
- Eighmy, J. L.
 1984 *Colorado Plains Prehistoric Context*. Office of Archaeology and Historic Preservation, Colorado Historical Society, Denver.
- Feiler, E.
 1994 *A 6000-Year Old Vegetation Record from West Carrizo Canyon, Southeastern Colorado*. Unpublished Master's Thesis, Northern Arizona University, Flagstaff, Arizona.
- Gardner, A. D., M. Stevens, L. Pasacreta and G. Hadden
 2005 The Apishapa and the use of Cheno-ams and Maize: the Results of Excavations along the Purgatoire River, in Southeastern Colorado. Paper presented at the 63rd Annual Plains Conference, Edmonton, Alberta, Canada.
- Gulley, C. C.
 2000 *A Reanalysis of Dismal River archaeology and Ceramic Typology*. Unpublished Master's Thesis, University of Colorado.
- Gunnerson, J. H.
 1989 *Apishapa Canyon Archaeology: Excavations at the Cramer, Snake Blakeslee, and Nearby Sites*. Reprints in Anthropology. Vol. 41. J&L Reprints, Lincoln.
- Haskell, J. L.
 1987 *Southern Athapaskan Migration: A.D. 200-1750*. Navajo Community College Press, Tsale.
- Hughes, J. T.
 1974 *Prehistory of Caddoan Speaking Tribes*. Garland Press, New York.

- Jochim, M. A.
1976 *Hunter-Gatherer Subsistence and Settlement: a Predictive Model*. Academic Press, New York.
- Judge, W. J.
1973 *Paleoindian Occupation of the central Rio Grande Valley in New Mexico*. [1st] ed. University of New Mexico Press, Albuquerque,.
- Kalasz, S. M.
1989 Prehistoric Architectural Remains. In *Temporal Assessment of Diagnostic Materials from the Pinon Canyon Maneuver Site*, edited by C. Lintz and J. L. Anderson, pp. 86-110. Memoir No. 4. Colorado Archaeological Society.
- Kingsbury, L. A. and L. H. Gabel
1983 Eastern Apache Campsites in Southeastern Colorado: A Hypothesis. *Plains Anthropologist* 28(102, Pt.2):319-325.
- Kohler, T. A. and S. C. Parker
1985 Predictive Models for Archaeological Resource Location. In *Advances in Archaeological Methods and Theory*, edited by M. B. Schiffer, pp. 397-452. vol. 9. Academic Press, New York.
- Kvamme, K. L.
1984 Models of Prehistoric Site Location Near Pinon Canyon, Colorado. In *Papers of the Philmont Conference on the Archaeology of Northeastern New Mexico*, edited by C. J. Condie, pp. 347-370. vol. 6. Proceedings of the New Mexico Archaeological Council, Albuquerque.
- Lintz, C. R.
1984 The Plains Villagers: Antelope Creek. In *The Prehistory of Oklahoma*, edited by R. E. Bell, pp. 325-346. Academic Press, Orlando.
- Loendorf, L. L. and D. D. Kuehn
1991 *1989 Rock Art Research, Pinon Canyon Maneuver Site, Southeastern Colorado*. Contribution No. 258. Department of Anthropology. University of North Dakota, Grand Forks.
- Longacre, W. A.
1970 *Archaeology as Anthropology: A Case Study*. Anthropological Papers of the University of Arizona No. 17, Tucson.
- McDonald, R. A.
1992 *5000 Years at Crow's Roost in Eastern Colorado*. Unpublished Master's thesis, Department of Anthropology, Colorado State University, Fort Collins.

- Owens, M. and L. Loendorf
2004 *Archaeological Sites Inventory of the Training Area 10 and 12 Portions on the Pinon Canyon Maneuver Site, Las Animas County, Colorado*. Fort Carson Cultural Resource Management Series, Contribution No. 10. Department of Sociology and Anthropology, New Mexico State University, Las Cruces. Submitted to the Directorate of Environmental Compliance and Management, Department of the Army, Fort Carson, Colorado.
- Parry, W. J. and R. L. Kelly
1987 Expedient Core Technology and Sedentism. In *The Organization of Core Technology*, edited by J. K. Johnson and C. A. Morrow, pp. 285-304. Westview Press, Boulder.
- Piper, C., E. Lynch, B. Newman and L. L. Loendorf
2006 *Unlocking the Past: Archaeological Sites Inventory of Training Areas B and C of the Pinon Canyon Maneuver site, Las Animas County, Colorado*. Prepared for the Directorate of Environmental Compliance and Management, Department of the army, Fort Carson, Colorado by the Department of Sociology and Anthropology, New Mexico State University.
- Reed, A. D. and J. C. Horn
1995 *Cultural Resource Inventory of a Portion of the Picketwire Canyonlands, Comanche National Grassland, Las Animas and Otero Counties, Colorado*. Alpine Archaeological Consultants, Inc. Ms. on file with the Colorado Historical Society, Denver. Submitted to USDA Forest Service, Pike-San Isabel National forest and Cimarron and Comanche National Grasslands, Pueblo, Colorado.
- Renaud, E. B.
1931 *Archaeological Survey of Eastern Colorado: First Report*. University of Denver, Denver.

1932 *Archaeological Survey of Eastern Colorado: First Report*. University of Denver, Denver.

1942 *Archaeological Series, Second paper, Indian Stone enclosures of Colorado and New Mexico*. University of Denver, Denver.
- Saunders, R. S.
1983 *The Carrizozo Creek Bridge site: A Plains Woodland Site on the Oklahoma/New Mexico Border*. Oklahoma Department of Transportation Papers in Highway Archaeology 7.
- Schiavitti, V.
2003 *Archaeological Investigations from 1998 at Six Sites on the Pinon Canyon Maneuver Site, Las Animas County, Colorado*. Fort Carson Cultural Resource Management Series, Contribution No. 12. Department of Sociology and Anthropology,

New Mexico State University, Las Cruces. Submitted to the Directorate of Environmental Compliance and Management, Department of the Army, Fort Carson, Colorado.

Schiavitti, V., L. Loendorf and E. Hill

2001 *Archaeological Investigations at Eleven Sites of Welsh Canyon in the Pinon Canyon Maneuver Site, Las Animas County, Colorado*. Fort Carson Cultural Resources Management Series Contribution No. 8. Department of Sociology and Anthropology, New Mexico State University, Las Cruces. Submitted to the Midwest Archaeological Center, National Park Service, Lincoln.

Schiffer, M. B.

1972 Archaeological Context and Systematic Context. *American Antiquity* 37:156-165.

1979 The Place of Lithic Use-Wear Studies in Behavioral Archaeology. In *Lithic Use-Wear Analysis*, edited by B. Hayden, pp. 15-27. Academic Press, New York.

1987 *Formation processes of the Archaeological Record*. 1st ed. University of New Mexico Press, Albuquerque.

Schiffer, M. B. and J. M. Skibo

1997 The Explanation of Artifact Variability. *American Antiquity* 62(1):27-50.

Schuldenrein, J. D., H. E. Helgren, H. E. Jacson and A. Pitty

1985 *Geomorphological and Geoarchaeological Investigations at the U.S. Army Fort Carson-Pinon Canyon Maneuver Site, Las Animas County, Colorado*. Gilbert/Commonwealth. Submitted to the National Park Service, Rocky Mountain Regional Office, Denver.

Scott Cummings, L. and T. E. Moutoux

2001 Pollen Analysis at Three Archaeological Sites (5LA6568, 5LA6592, and 5LA6595) in the Pinon Canyon Maneuver Site, Southeastern Colorado. In *Archaeological Investigations at Eleven Sites of Welsh Canyon in the Pinon Canyon Maneuver Site, Las Animas County, Colorado*, edited by V. Schiavitti, L. L. Loendorf and E. Hill, pp. 246-271. Department of Sociology and Anthropology, New Mexico State University, Las Cruces.

Scott Cummings, L. and R. A. Varney

2003 *Pollen Analysis of Three Manos Recovered in a Human Burial, and A Hearth From the Picketwire Site, 5LA5838, Southeastern Colorado*. Paleo Research Institute Technical Reports 02-98 and 03-39. Submitted to Western Wyoming Community College, Rock Springs, Wyoming.

Secoy, F. R.

1953 *Changing Military Patterns on the Great Plains*. Monographs of the American Ethnological Society XXI.

- Shaw, R. B., S. L. Anderson, K. A. Schultz and V. E. Diersing
1989 *Plant Communities, Ecological Checklist, and Species List for the U.S. Army Pinon Canyon Maneuver Site, Colorado*. Science Series No. 37. Department of Range Science, Colorado State University. Submitted to the U.S. Army Corp of Engineers, Engineering and Housing Support Center.
- Stiger, M.
2001 *Hunter-gatherer Archaeology of the Colorado High Country*. University Press of Colorado, Boulder, Colo.
- Van Ness, M. A.
1985 Flotation Analysis from a Hearth at 5BA320 in Southeastern Colorado. In *Archaeological Investigations in Southeastern Colorado*, edited by M. Nowak and C. A. Jones, pp. 107-116. Colorado Publications in Archaeology No. 8. Department of Anthropology, Colorado College, Colorado Springs.
- Waller, S. J.
1993 Sound and Rock Art. *Nature* 363:501.
- Wendorf, F.
1960 The Archaeology of Northeastern New Mexico. *El Palacio* 67(2):55-65.
- Wilcox, D. R.
1974 A Strategy for Perceiving Social Groups in Puebloan Sites. *Fieldiana: Anthropology* 65:120-174.
- Winter, J.
1988 *Stone Circles, Ancient Forts, and Other Antiquities of the Dry Cimarron Valley: A Study of the Cimarron Seco Indians*. New Mexico Historic Preservation Program, Historic Preservation Division.
- Wiseman, R. N.
1975 Sitio Creston (LA4939), a Stone Enclosure Site Near Las Vegas, New Mexico. *Plains Anthropologist* 20(68):81-104.

2002 Letter Report Regarding Sitio Creston (LA4939) Radiocarbon Dates, Museum of New Mexico, Office of Archaeological Studies.
- Withers, A. M.
1954 Reports of archaeological Fieldwork in Colorado, Wyoming, New Mexico, Arizona, and Utah in 1952 and 1953: University of Denver archaeological Fieldwork. *Southwestern Lore* 19(4):1-3.

Zier, C. J. and S. M. Kalasz

1999 *Colorado Prehistory: A Context for the Arkansas River Basin*. Prehistory of Colorado. Colorado Council of Professional Archeologists, Denver, CO.

Zier, C. J., M. W. Painter and K. P. Schweigert

1997 *Cultural Resource Management Plan for Fort Carson Military Reservation, Colorado*. Centennial Archaeology, Fort Collins, Colo.

APPENDIX A

Site	Chronology	Age Indicator
5LA330	Boundary of Developmental and Diversification periods	Radiocarbon and Cation Ratio Dates; Scallorn projectiles
5LA2234	Developmental and Diversification period	Scallorn and Washita projectiles
5LA2238	Developmental and Diversification period	Scallorn and Washita projectiles
5LA2606	Diversification period	Washita projectiles
5LA3189	Developmental period	Radiocarbon Date
5LA3387	Diversification period	Washita projectiles
5LA3397	Developmental period	Scallorn projectiles
5LA3491	Developmental period	Radiocarbon Date; Scallorn projectiles
5LA3503	Developmental period	Scallorn projectiles Point styles from Paleoindian through Scallorn
5LA4751	Multiple Components	Scallorn projectiles
5LA5243	Developmental period	Radiocarbon Date; Scallorn projectiles
5LA5249	Developmental period	Radiocarbon Date; Scallorn projectiles
5LA5305	Boundary of Developmental and Diversification periods	Radiocarbon Date; Scallorn projectiles
5LA5320	Diversification period	Radiocarbon Date; Fresno projectiles
5LA5326	Developmental period	Scallorn projectiles
5LA5383	Developmental and Diversification period	Obsidian Hydration and Radiocarbon Date; Washita projectiles
5LA5385	Diversification period	Radiocarbon Date; Fresno and Washita projectiles
5LA5402	Diversification period	Radiocarbon Date; Scallorn and Washita projectiles
5LA5403	Developmental period	Radiocarbon Date
5LA5421	Developmental period	Scallorn and Fresno projectiles
5LA5503	Developmental period	Radiocarbon Date; Scallorn projectiles Radiocarbon Date; Fresno and Washita projectiles
5LA5554	Diversification period	
5LA5622	Developmental and Diversification period	Scallorn and Washita projectiles
5LA5672	Developmental period	Scallorn projectiles
5LA5728	Diversification period	Washita projectiles
5LA5838	Boundary of Developmental and Diversification periods	Radiocarbon Date
5LA6028	Developmental period	Radiocarbon Date; Scallorn projectiles
5LA6107	Developmental and Diversification period	Radiocarbon Dates; Washita projectiles
5LA6493	Diversification period	Washita projectiles
5LA6568	Diversification period	Radiocarbon Dates
5LA7421	Developmental period	Radiocarbon Date
5LA7548	Developmental period	Radiocarbon Dates
5LA8620	Developmental period	Scallorn projectiles
5LA8622	Developmental period	Scallorn projectiles
5LA9020	Diversification period	Washita projectiles; Ceramics
5LA9283	Diversification period	Washita projectiles
5LA9370	Diversification period	Washita projectiles
5LA9450	Developmental period	Scallorn projectiles

5LA9472	Developmental and Diversification period	Scallorn and Washita projectiles
5LA9474	Developmental period	Scallorn projectiles
5LA9611	Developmental period	Scallorn projectiles
5LA9698	Developmental and Diversification period	Scallorn and Washita projectiles
5LA9703	Diversification period	Washita projectiles
5LA9781	Developmental and Diversification period	Scallorn and Washita projectiles
5LA9811	Developmental period	Scallorn projectiles
5LA10000	Diversification period	Washita projectiles
5LA10060	Diversification period	Washita projectiles
5LA10100	Developmental and Diversification period	Scallorn and Washita projectiles