Moccasin Confluence: Occupation and Settlement in the Lower Fredericksburg Basin of the Edwards Plateau

by
Joel Gunn and Anne C. Kerr

Center for Archaeological Research
The University of Texas at San Antonio
Special Report, No.14
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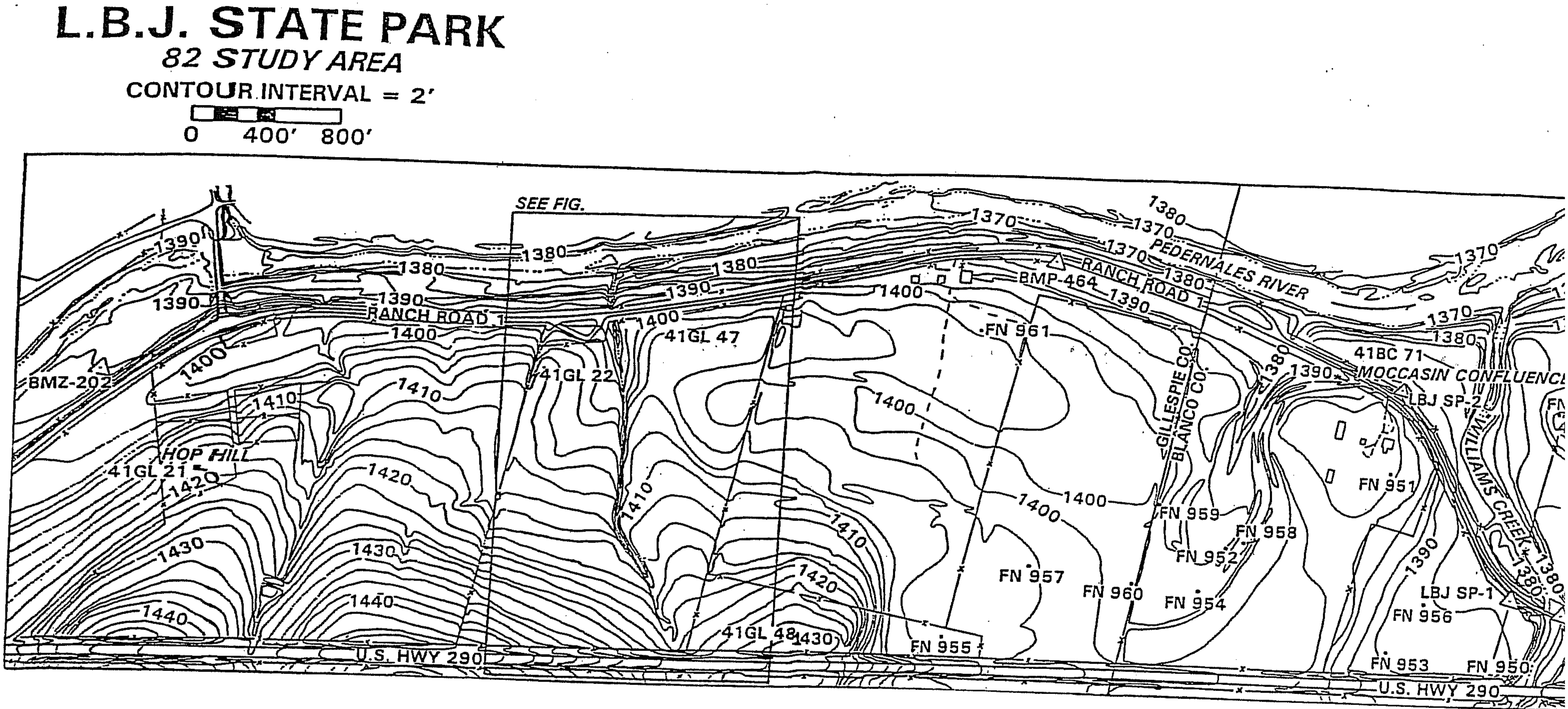

Figure 2.01. Eastern Half of LBJ State Historical Park with Sites and Tests Marked.

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The following information is provided in accordance with the General Rules of Practice and Procedure, Chapter 41.11 (Investigative Reports), Texas Antiquities Committee:

1. Type of investigation: archaeological investigation of Hop Hill site (41 GL 21);

2. Project name: LBJ Project;

3. County: Gillespie County, Texas;

4. Principal Investigator: Joel Gunn;

5. Name and location of sponsoring agency: Texas Parks and Wildlife Department;

6. Texas Antiquities Committee Permit Nos. 175, 310, and 418;

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ABSTRACT AND MANAGEMENT SUMMARY

During the summer of 1982 the eastern half of Lyndon B. Johnson State Historical Park was surveyed and sites tested. The work was sponsored by the Texas Parks and Wildlife Department and performed by Center for Archaeological Research and the Division of Behavioral and Cultural Sciences, The University of Texas at San Antonio. The Principal Investigator was Joel D. Gunn. The field work was conducted by the field course in archaeology from the University of Texas at San Antonio. Members (listed in the Acknowledgments section) of the Anthropology Laboratory class assisted the Principal Investigator with laboratory analysis.

Most of the sites were shallow or deflated and of limited information value except for their location in the overall settlement pattern. Excavation of 41 GL 21, Hop Hill (Gunn and Mahula 1977a), was completed. An old stream channel was found in the bedrock under the site. It was filled with occupation debris from the Late Archaic. The site may have been used as an overlook to an adjacent ford in the Pedernales River.

At the confluence of the Pedernales River and Williams Creek (Moccasin Confluence) at the east end of the park a very important site was found. Moccasin Confluence consists of two segments divided by Williams Creek. The west segment (41 BC 71) is a deeply stratified alluvial site with a Holocene sequence. Whether the sequence is continuous through the Holocene remains to be determined. The levels are extremely thick in the Middle and Early Holocene. The location, at three sources of varying sediments, indicates that the site could be a very sensitive geological barometer of Holocene climate, a hypothesis that seems to have merit based on analysis of sediment grain size composition and IPF analysis of sediment chemistry. The site is very rich in chronological diagnostics and is of great potential for studying environmental and cultural process in the Edwards Plateau region. Analysis of artifact wear patterns, points, flake size and frequencies, and mollusks indicates the site was inhabited over long periods of time, sometimes with a fair amount of intensity. Nomads apparently visited the site at the beginning of each cultural period and eventually settled there until their culture was disrupted. The site is recommended for nomination to the National Register of Historic Places.

The site (41 BC 63) on the east bank of Williams Creek outside the park, considered to be the eastern segment of Moccasin Confluence, was tested enough to show that it has a dense burned rock midden. It is assumed to represent a shift of occupation locus to the east side of the creek during the Middle Archaic.

Management Summary

The following management recommendations are supported by the investigations reported in chapter 2. Recommendations for National Register of Historic Places

(NRHP) and State Archaeological Landmark (SAL) status are tabulated for ready reference in Table 0.01. If stock tanks are constructed which impact the subsurface close to any of the known archeological sites or in the vicinity of any of the main drainages, testing may be warranted.

TABLE 0.01. RECOMMENDATION SUMMARY

Site	SAL Designation	NRHP Eligibility
41 GL 21	Eligible	Eligible
41 GL 22a	Not Eligible	Not Eligible
41 GL 22b	Not Eligible	Not Eligible
41 GL 22c	Not Eligible	Not Eligible
41 GL 22d	Eligible	Eligible
41 GL 47	Not Eligible	Not Eligible
41 GL 48	Not Eligible	Not Eligible
41 BC 63	Further Testing	Further Testing
41 BC 71	Eligible	Eligible

Sites 41 BC 71 and 41 BC 63 appear to be complementary aspects of the same site. The occupation periods appear to provide different emphases and both are therefore required to construct a complete prehistory of the park. They should be designated as State Archaeological Landmarks and are recommended eligible for the National Register of Historical Places.

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ACKNOWLEDGMENTS

The successful outcome of a project of the scale and interdisciplinary nature of the LBJ Park Project owes much to numerous people who graciously gave of their time, energy, and expertise. We wish to thank these individuals for their contributions to this undertaking.

Harold Woods of the Parks Department was very gracious in making park facilities, such as the swimming pool, available to the survey team. Henry and Anne Fox of San Antonio made the accommodations of the Fox Ranch available to the crew.

The project was greatly facilitated through the efforts of employees of The University of Texas at San Antonio administration and the Center for Archaeological Research, notably, Mary Lou Ellis. Anne Kerr and Ann Young typed the manuscript, and Sharon Quirk was the editor. Several persons, including Eileen Johnson, and Vance Holliday read and commented on the manuscript. Thomas R. Hester, Elton Prewitt, and Thomas C. Kelly identified the points.

The project staff, especially Eric C. Gibson, David O. Brown, and Anne C. Kerr made major contributions to the research design, as their contributions bear evidence, and to the final form of the report.

Finally, there is special recognition and appreciation due to the members of the field school and laboratory analysis class for the devotion and enthusiasm which they showed through long hours of work. Their unceasing interest in archaeological research was inspiring.

Field School Participants	Laboratory Class Participants
Anne C. Kerr	Anne C. Kerr
Joseph H. Labadie	Joseph H. Labadie
Christina Rosas	Jewell Price
Frances Meskill	Frances Meskill
Darrell Sims	Darrell Sims
Frank La Rocca	Frank La Rocca
John Probst	John Probst
Marlene Syverson	Marlene Syverson
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30 November 1996

CHAPTER 1—INTRODUCTION (Gunn)

During the summers of 1976, 1978, and 1982, survey, testing, and excavation were performed in and around Lyndon B. Johnson (LBJ) State Historical Park. The park is located on the south bank of the Pedernales River, a tributary of the Colorado River, on the border between Gillespie and Blanco Counties (Figure 1.01). Additional map details are in Chapter 12. The activities were conducted under the sponsorship of Texas Parks and Wildlife Department and The University of Texas at San Antonio. The principal investigator was Joel D. Gunn, and the projects were administered by the Center for Archaeological Research, The University of Texas at San Antonio (CAR-UTSA, Dr. Thomas R. Hester, Director). The work was executed under the terms of Texas Antiquities Permits, Numbers 175, 310, and 418.

Previous work in the park area had focused on Hop Hill (41 GL 21), a prehistoric quarry, workshop, and habitation site located on a bluff above the Pedernales River and facing across a natural ford of the river from the Lyndon B. Johnson ranch house. Investigation into the Hop Hill locality and its environs were reported by Gunn and Mahula (1977a). The 1978 season included an archaeological survey of an 134-km^2 along the south side of the river surrounding the park, definition of strata in the vicinity of the primary midden at Hop Hill, excavation of a few occupation levels under those reported in the 1977 publication, and of primary interest, the excavation of a test pit into a buried gully head under the occupation floors that produced a human mastoid process. The objectives of the 1982 season were to determine the nature of the deposits under the midden at Hop Hill and explore the park east of Hop Hill by survey and testing to determine the nature of the archaeological remains in that area.

The chapters of this report are arranged, first, to overview the progress and results of the survey and testing, and then to give detailed reports that support the conclusions presented in the overview. Chapter 2 discusses the 1982 survey in the park. Testing operations are reported in a general manner in Chapters 3 and 4. Chapters 5, and the following chapters, research the details of the test and excavation results, and Chapter 12 develops a settlement pattern model for the subregion.

The general problem orientation of the research is set in the context of a broad research program that involves the issue of culture change in southcentral United States. The general outlines of a model for culture and climate change were first reported by Gunn (1977a), and have since been elaborated upon in Gunn (1979a, 1979b, 1991, 1992, 1996), Gunn and Adams (1981), Gunn and Brown (1982), and Gunn and Kerr (1984). In essence, the model suggests that the extreme climatic instability of central Texas (for documentation see Gunn 1982a, 1982b, 1989) creates a zone of climate/culture dependency between the woodlands of the Southeast and the Basin and Range province of the Southwest. Within this zone there should be an usual abundance of data for archaeologists to define the timing and causal character of climate and culture change.

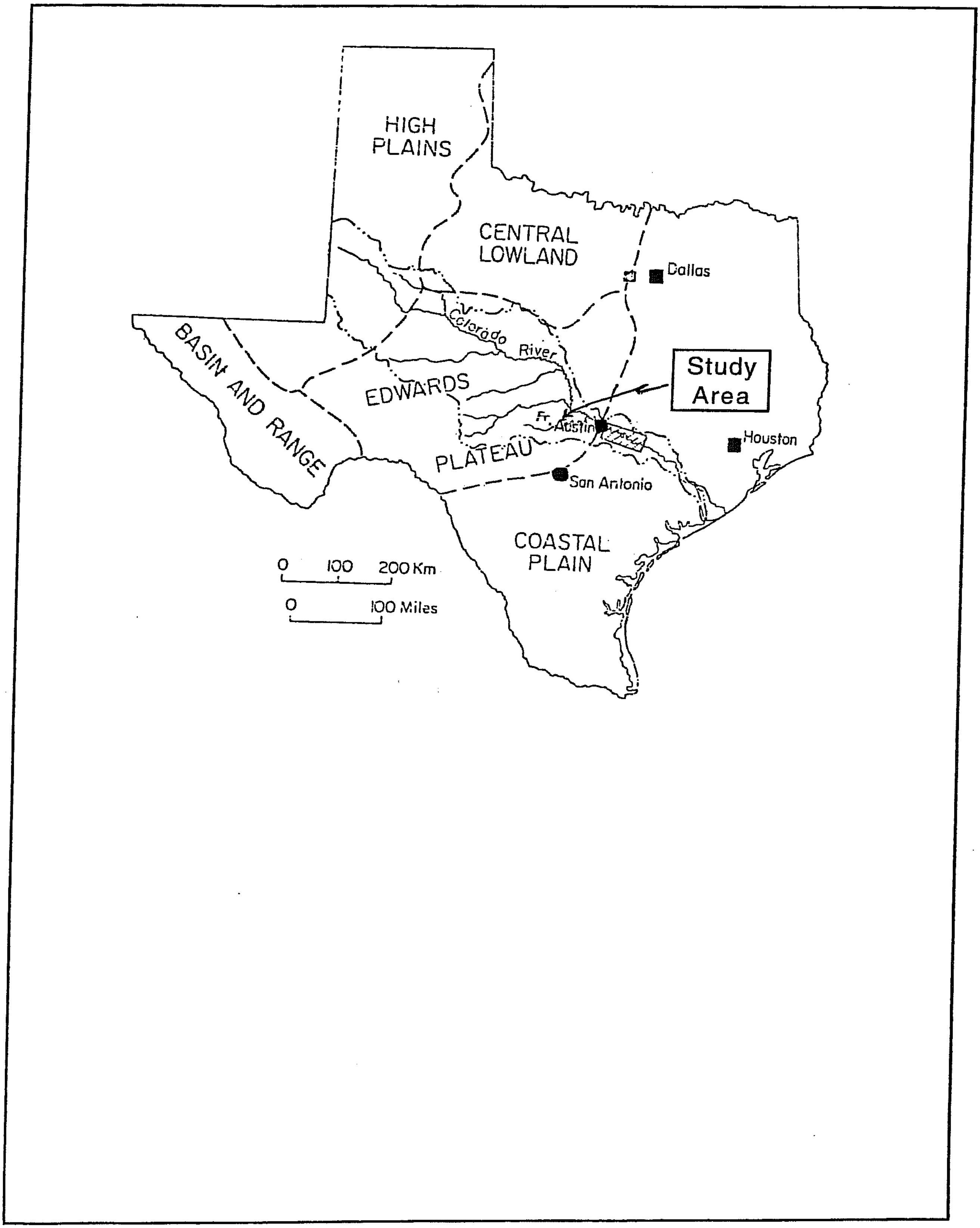

Figure 1.01. Project Area Location.

Evidence suggests that prehistoric culture in central Texas never became more complex than possibly semisedentary collectors and hunters (Weir 1976). Presumably regions to the east and west that gave rise to more complex cultures did so because of a relatively dependable environment, whether it be woodland or desert. Cultures in the dependency zone varied substantially with climate. It is further suggested, based on Weir's (1976) analysis of the character of cultures at various times in central Texas, that culture in central Texas may be influenced from the east or west depending on prevailing climate. The issue of prehistoric climatic stability or instability is and perhaps always will be a matter of controversy. However, those who support Holocene climate stability for central Texas do so on the basis of pollen analyses (Bryant 1977). It is becoming increasingly clear that pollen analysis, unless conducted under extremely well-controlled, ideal conditions, does not yield a high resolution vegetational chronology necessary to infer climatic changes within the Holocene. The degree of control necessary is illustrated in Bernabo (1981), in which periods of hundreds of years or less were pinpointed as to their relative temperatures. Related chronologies such as the rock fall chronology at Arenosa Rock Shelter in west Texas (Patton and Dibble 1982), the Colorado River alluvial chronology in central Texas (Baker and Penteado-Orellana 1977), and the Pomme de Terre River in Missouri (Brackenridge 1980) clearly show that the ecotonal region between the eastern woodlands and the desert west was not climatically stable during the late Quaternary. The evidence for these and many other studies is reviewed in Gunn (1982a).

Another issue of even greater concern is the co-evolutionary character of biota, including pollen bearing species, and human organization. There is ample evidence that humans have interacted with the vegetation for tens of thousands if not millions of years (see Balée 1989, 1993, see Gunn 1994 for documentation). Balée, in particular provides illuminating examples of so-called anthropogenic forests. Texas grasslands could just as well be anthropogenic. Thus, pollen analysis, especially since it convey a subregional rather than local signal, is registering human and plant interaction as much as plant and climate interaction. Though themselves not free of human influence, physical phenomena such as rock fall are in greater part indicators of climate, or the climate can be registered as a function of astronomical and geophysical conditions as is done in this study (see chapter 3).

The specific problem orientation of the 1982 field season in LBJ State Historic Park was to test two ideas that are relevant to the problem of culture and climate change. The first is a high resolution chronology for prehistoric central Texas published by Prewitt (1981). Prewitt's chronology (Figure 1.02) is based on cultural subsistence traits and diagnostics; time periods range from 150-1500 years long with a mean of 639 years for 13 periods. Since climatic episodes appear to range in hundreds of years (high resolution) rather than thousands of years (low resolution, see low resolution chronology in the side box in this paragraph), which is characteristic of previously published chronologies, the Prewitt chronology poses an interesting opportunity to investigate the relationships between proposed cultural and climatic chronologies.

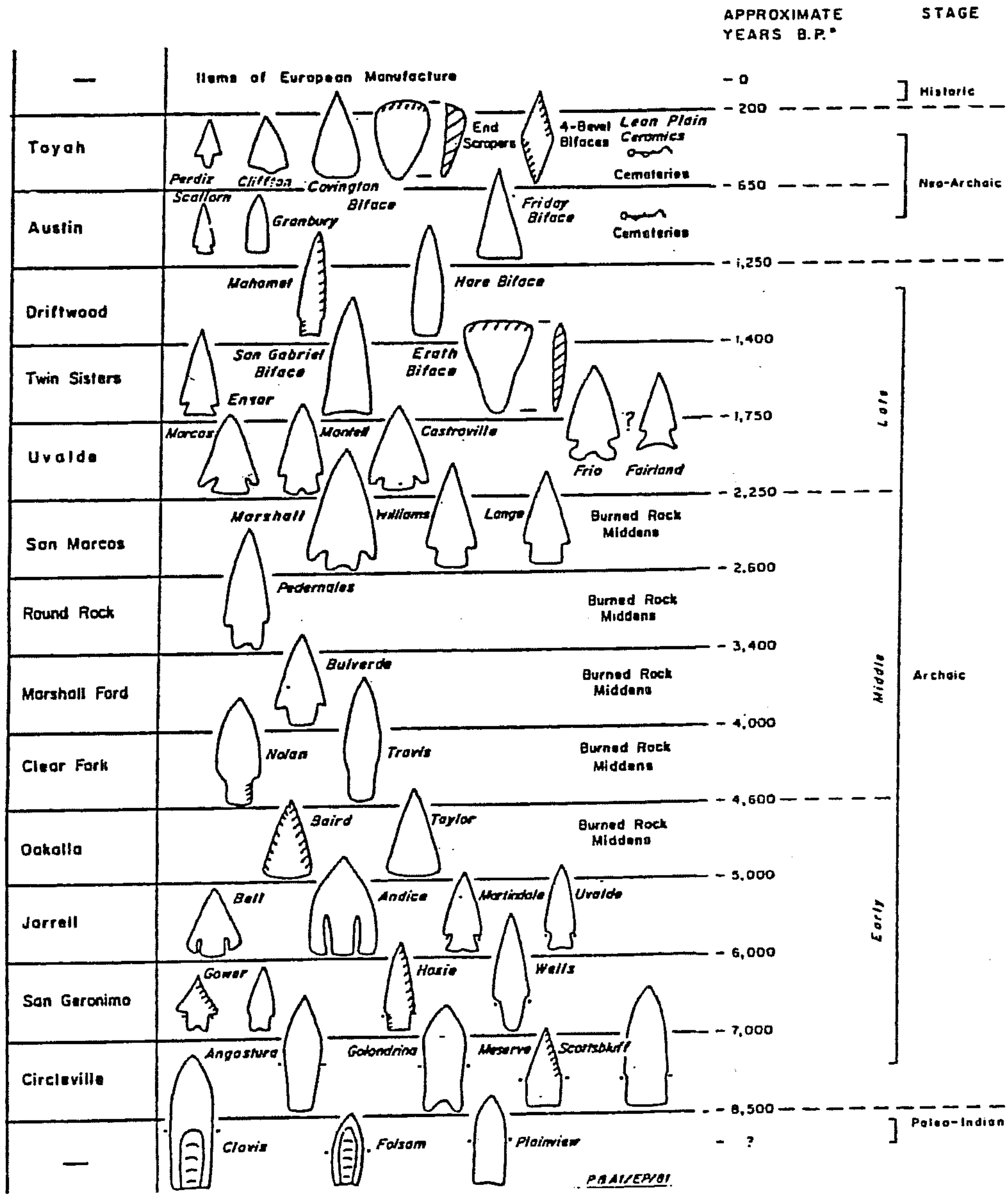

Figure 1.02. Point Chronology (calibrated dates, Prewitt 1981).

The second development that contributes to the model for testing in this project is the publication of a substantial amount of information on Holocene and Late Pleistocene global volcanic activity. Bryson and Goodman (1980) and Simkin et. al. (1981) have published on global volcanics. Analysis of 20th century weather data by Gunn (1981) shows that Gulf Coastal Plain climate is highly susceptible to the affects of volcanic dust (aerosols) in the upper atmosphere. The data on global volcanism, then, can be converted into a 100-year resolution climatic chronology for central Texas by means of a global-to-local transformation function.

Figure 1.03 is an estimated global average temperature curve for the last 8,000 years of the Holocene. Since annual temperatures in Texas are directly correlated with global temperatures, a function can be devised to convert global average temperature into Texas temperature on an approximately decade to century scale (Gunn 1979b). Moisture appears to be inversely correlated to temperature. These functions can be used to generate a climatic chronology for the middle and late Holocene of central Texas. The curve is generated by a two-influence model (Gunn et al. 1995). Its overarching character is controlled by a calculation of the October precession of the Earth's rotation and orbit. Kukla (1975) first suggested that the October precession is an important component of global climatic change. The model was first developed for Central Texas (Gunn 1979b) and the Gulf Coastal Plain (Gunn 1981), and later elaborated to other Texas subregions (Gunn 1988, 1989, 1992). The oscillations imposed on the overarching curve are generated from global volcano frequencies (Bryson and Goodman 1980). Though work remains to be done on solar emissions variations, they are also an important component of global average temperatures (Gunn 1991, 1996), and as modeled by Landscheidt (1987) probably are reflected to some degree in the volcanic chronology. When combined, the curves give an estimate of the combined effects of tilt of the earth's rotation and the reflective properties of the atmosphere as controlled by volcanoes. This curve and its more complex subsequent developments have been used successfully to estimate moisture in the Yucatan Peninsula (Gunn et al. 1995) of Mexico and Burgundy, France (Gunn and Crumley 1991).

The issue of interpretation of this model into a climatic chronology is discussed in detail in Gunn (1983a), but for now can be viewed as a relatively simple process of assigning moist intervals to periods of high volcanic activity and dry periods to times of low volcanic activity. The overall input from the sun as modulated by this process must also be accounted for. For a discussion of combined solar and volcanic effects on climate see Schneider and Mass (1975) and Gunn (1991).

In regional perspective, the LBJ project is central to a set of problems that encompass west Texas, northeastern Mexico, central Texas, east Texas, and western Louisiana. In the United States, the ecotonal area encompassed by this space can best be characterized as the Southcentral area, as opposed to the Southwest and the Southeast. It is an area with various regional problems that is generally characterized by the ecological disposition of instability.

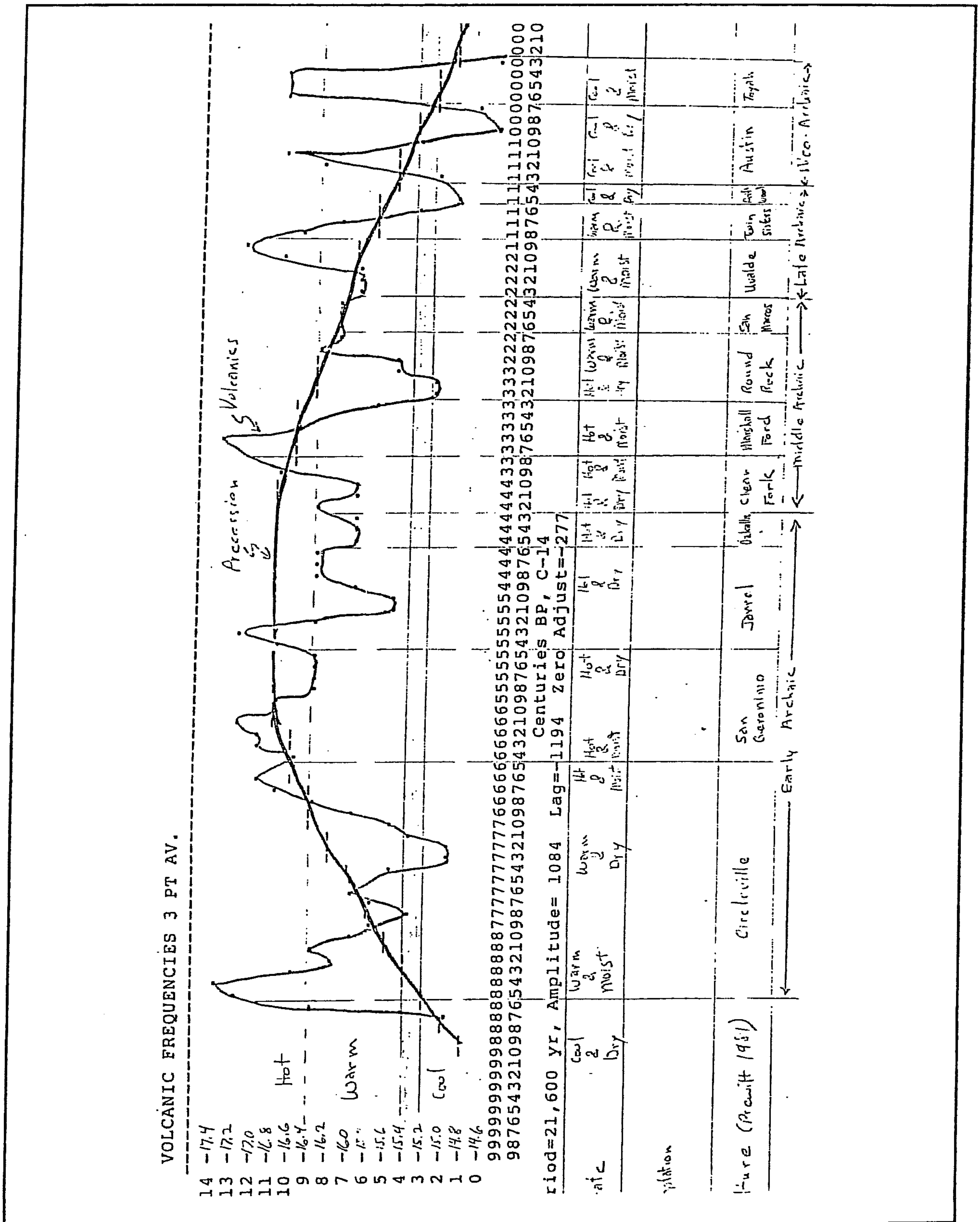

Figure 1.03. Global Temperature Chronology.

CHAPTER 2—SURVEY OF THE EASTERN HALF OF LBJ STATE HISTORICAL PARK, JUNE 1982 (Gibson, Gunn)

INTRODUCTION

The reconnaissance and testing investigations conducted in the LBJ State Historical Park during 1982 are presented in five sections. First and second, the field research methods and research orientations are described. Third, artifact categories and terms are defined (derived from Crabtree 1972; Gunn and Mahula 1977a, Gibson 1981:18-19). Fourth, the sites and their associated artifacts are described. Fifth, the conclusions based on these findings are presented as a proposed settlement pattern.

Archaeological sites can be considered as the location of one or more prehistoric activity areas. Activity areas are spatially restricted zones within which a specific task or tasks were performed (hunting, camping, cooking, tool manufacturing and/or replacement, hide-working, etc.). Sites and their associated activity areas are generally characterized by waste products, a scatter of tools, and/or raw materials (Flannery 1976:34). If activity areas are separated into spatially discrete clusters, but the clusters are related by technological remains, temporal diagnostics and the like, then the site is referred to as a locality; i.e., it contains subsites.

As discussed in Gunn and Mahula (1977a), existing within the park are many different kinds of potential sites. They are defined by different conditions of soil formation, sediment deposition, depth, and protection from erosion. The first group of sites are those with significant sediment deposition at the time, or since the occupation of the site, whether deposition is ongoing or has ceased. The second group of sites are those with no significant deposition during or since the time of human habitation, or where the sediments have eroded away (Pettigrew 1979).

The first of these two basic site types has vertical structure; vertical differences between artifacts or features at the same horizontal location which have temporal significance. At such sites the vertical structure, as well as the horizontal structure, below the surface can only be studied by standard excavation methods. The second of the two site types (those with no deposition) has no true vertical structure even though some cultural debris may be buried. At such a site vertical displacement of specimens is not caused by soil deposition but by soil disturbance processes. Burrowing rodents and tree roots are likely examples (Pettigrew 1979). When artifacts are recovered at these sites by excavation, only horizontal patterning is discovered, since there is no vertical structure (Gibson 1981). A more efficient method of investigation for such sites is mapping surface distributions and numerical analysis of the resulting data (Gunn and White 1977; Gunn 1982c).

Field research methods for the LBJ project were selected according to the conditions found at each site as classified above. The primary objective was to obtain as much data on vertical and horizontal site structure as possible in order to evaluate archaeological potential. Also, it was deemed important to obtain as large a sample of diagnostic artifacts as possible to evaluate the relationship between Prewitt's (1981) high resolution chronology for central Texas, and the sites of the LBJ State Historical Park which must be taken, for now, to represent the archaeological sequence of the Fredericksburg Basin. Plans were, of course, constrained by the amount of money and time available to the project.

THE CONCEPTUAL PERSPECTIVE MADE EXPLICIT

The study of archaeological sites addresses the material remains of a cultural system. When analyzing and interpreting such archaeological data, implicit assumptions should be made explicit. These explicit assumptions that follow are an extension of those offered by Fitzhugh (1972), Gunn and Mahula (1977a), and Gibson (1981).

1. In broadest perspective, humans are part of an ecosystem. They are limited in part by the environment and their ability to alter that environment to supply their needs (Fitzhugh 1972). Thus, human culture can be analyzed as a subsystem of the ecosystem which is the chief means of survival for humans (Gibson 1981) and is in part determined by the environment. As such, the study of culture is part of the larger perspective of ecological studies. In this context, cultural events and processes can be independently verified by examination of contemporary conditions in the ecosystem.

2. The authors of this chapter consider culture to be an adaptive system which articulates with the environment through a complex set of patterned relationships. These relationships are presumed to be reflected in a settlement pattern and are therefore detectable by survey, provided enough information is collected on each site to define the nature of its function relative to the overall pattern. This articulation is manifested in two contexts--social and physiographic (Fitzhugh 1972:7). Archaeologists would like to define patterns in both aspects of the system. However, the bulk of the preserved evidence is of a physiographic nature (Fitzhugh 1972).

3. As do many archaeologists, we assume that the most accessible and vivid relationship between a culture and its environment is expressed in its economic and technological adaptations which are partially preserved in material cultural remains. We further assume that ecological behavior is goal directed (e.g., focused on economic exploitation) and is a major part of a society's adaptation. In this sense, we are in accord with what Harris (1979) defines as the techno-environmental adaptation of a society. Yet, as must always be emphasized, particularly in archaeology, that technology is only part of the whole cultural system (Fitzhugh 1972).

4. Another important archaeological assumption is that technological and economic behavior, observed ethnographically and experimentally, and the material remains produced by this behavior in similar environmental milieus, may represent similar prehistoric behavior as evidenced in the archaeological record. As is implied in assumption 3, an assemblage of artifacts indicates various activities that have occurred at a particular place at a particular time (Fitzhugh 1972). However, these activities are only partially preserved and as Gunn and Mahula (1977a:6) have observed in an analogy between archaeological sites and information systems channels; "Whatever information is encoded and survives the channel of time, is destroyed in an instant by archaeological excavation. The resolution of the archaeologists' techniques has been and still probably does consist of inadequate mechanisms to decode the delicate pulses--taps of an ancient persons's hand."

Many of the above assumptions have been expressed in a detailed model for hunter-gatherer cultural systems (Binford 1980). This study of central Texas prehistoric hunter-gatherer settlement uses Binford's model as a descriptive and analytical framework. A brief review of the characteristics of Binfords' model provides a departure point for presenting the results of the 1982 reconnaissance.

Binford (1980:10) defined hunter-gatherer subsistence and settlement into two basic types, "foragers" and "collectors," and expressed these types in terms of a model. The following discussion addressed the problem of which type best characterizes the prehistoric residents in the general park area at various times.

In discussing foragers, Binford (1980:5) writes, "One distinctive characteristic of a foraging strategy is that the foragers typically do not store foods, but gather food daily. They range out of camp gathering food on an 'encounter' basis and return to their residential bases each afternoon or evening." By contrast, "collectors" are hunters who supply themselves with specific resources through specially organized task groups (Binford 1980:10). Binford's alternative hypotheses are presented in Tables 1 and 2, in terms of their respective components. If the techno-environmental adaptation was of the forager mode, the two types of sites, residential base and location (Table 1), would be expected in the study area (Binford 1980:9; Gibson 1981:29).

The forager mode is similar to the "Restricted Wandering Community Model" developed by Beardsley et al. (1956). In addition to the two types of sites described above, if the hunter-gatherer groups were of the "collector" mode, one would expect the three types of sites, field camp, station, and cache (Table 2) with their associated criteria for identification (Binford 1980:10- 12).

TABLE 2.01. COMPONENTS OF BINFORD'S FORAGER MODE FOR HUNTER-GATHERERS

Site Types	Definition	Archaeological I.D. Criteria
Residential Base	Center of subsistence activities where most processing, manufacturing, and maintenance activities take place. Short term in forager mode. Longer term in collector mode.	Features, consisting of hearths, lithic workshops, ground stone tools for plant processing, mixture of diverse floral and faunal remains. Depth of deposit would be minimal due to brief occupation.
Location	Where extractive activities are exclusively conducted, low-bulk procurement. Very brief usage.	Difficult to identify due to brief occupation and low bulk extraction, possibly some modified floral materials and remains (Binford 1980:9). No hearths or evidence of long term occupation would be present.

TABLE 2.02. COMPONENTS OF BINFORD'S COLLECTOR MODE FOR HUNTER-GATHERERS

Site Types	Definition	Archaeological I.D. Criteria
Field Camp	Temporary occupational center for a task group which maintains itself while away from the residential base. Field camps may be expected to be further differentiated by specialized tools and the nature of the target resources, thus caribou hunting camps, fishing camps, etc.	Small discrete scatter of cultural debris, fire-cracked rock from hearth, flakes from tool maintenance, and abundance of one kind of fauna. Lost or discarded specialized tools.
Station	Where special-purpose task groups are localized in information gathering, i.e., game movement may be ambush locations or hunting stands	Minimal to low cultural debris and faunal remains, etc., if associated nearby with a field camp I.D. of station may be facilitated.
Cache	Common components of a logistical strategy, i.e., successful procurement of resources by relatively large groups generally means large bulk. This bulk must be transported to consumers, temporary storage is required. Such field storage facilities may be constructed to deal specifically with the bulk obtained.	Evidence of large bulk processing large amounts of split bone, discarded tools, butchering marks on the bones, storage features, pits, racks, platforms, etc., (evidence of postholes).

The collector mode is similar to the "Central Based Wandering Community Model" (Beardsley et al. 1956). Within each site category, one can expect further variability that may relate to the seasonal availability and character of the resources being exploited by logistically organized task groups. Another source of intrasite variability is that all of the functions may not necessarily be independently located. As Binford (1980:12) points out, "In some situations one might be able to use the field camp as an observation point, in others, it may equally serve as a hunting stand. Many other combinations can be imagined. The point is simple: the greater the number of possible combinations, the greater the range of intersite variability we may expect." This is an important point for consideration; evidence of contemporaneous, extensive, intersite variability indicates the collector cultural system.

The applicability of Binford's model has been tested in south Texas (Gibson 1981), and it was found to be useful, particularly as a site classification and explanatory model for settlement patterns. Because of its usefulness in that specific test case, and because of the lack of settlement pattern models for central Texas (see Skinner 1981 for an exception), Binford's model is employed as the primary analytical and descriptive perspective for the 1982 investigations. The overreaching conceptual framework described in this section provides the basis for the interpretations present in the following section.

RESEARCH OBJECTIVES AND METHODS

Previous archaeological work in LBJ State Historical Park focused on Hop Hill (41 GL 21) which was excavated during the 1976 and 1978 field seasons. All that was known of the other sites in the park area was the information recorded by Texas Parks and Wildlife Department archaeologist, D. J. Ing in his site forms (on file at Texas Archeological Research Laboratory [TARL]). Thus, of concern in 1982 was to recover more data regarding the nature of the surface and subsurface components at the following sites: 41 GL 22, 41 GL 47, 41 GL 48, 41 BC 63, and 41 BC 71 (see Figure 2.01). For each of these sites a more refined understanding of the following criteria was sought: (1) site size; (2) vertical displacement; (3) intensity of occupation; (4) physiographic setting; (5) site-specific ecology; and (6) chronological placement. These criteria were sought through the procedural and sampling designs summarized in Table 2.03.

TABLE 2.03. RECONNAISSANCE/TESTING PROCEDURES FOR 1982 FIELD SEASON

Site Number	Areal Coverage in Reconnaissance	Shovel Tests	1-m2 Units
41 GL 21	100%	no	6
41 GL 22	100%	yes	3
41 GL 47	100%	yes	2
41 GL 48	100%	no	0
41 BC 63	100%	yes	0
41 GL 47	100%	yes	6

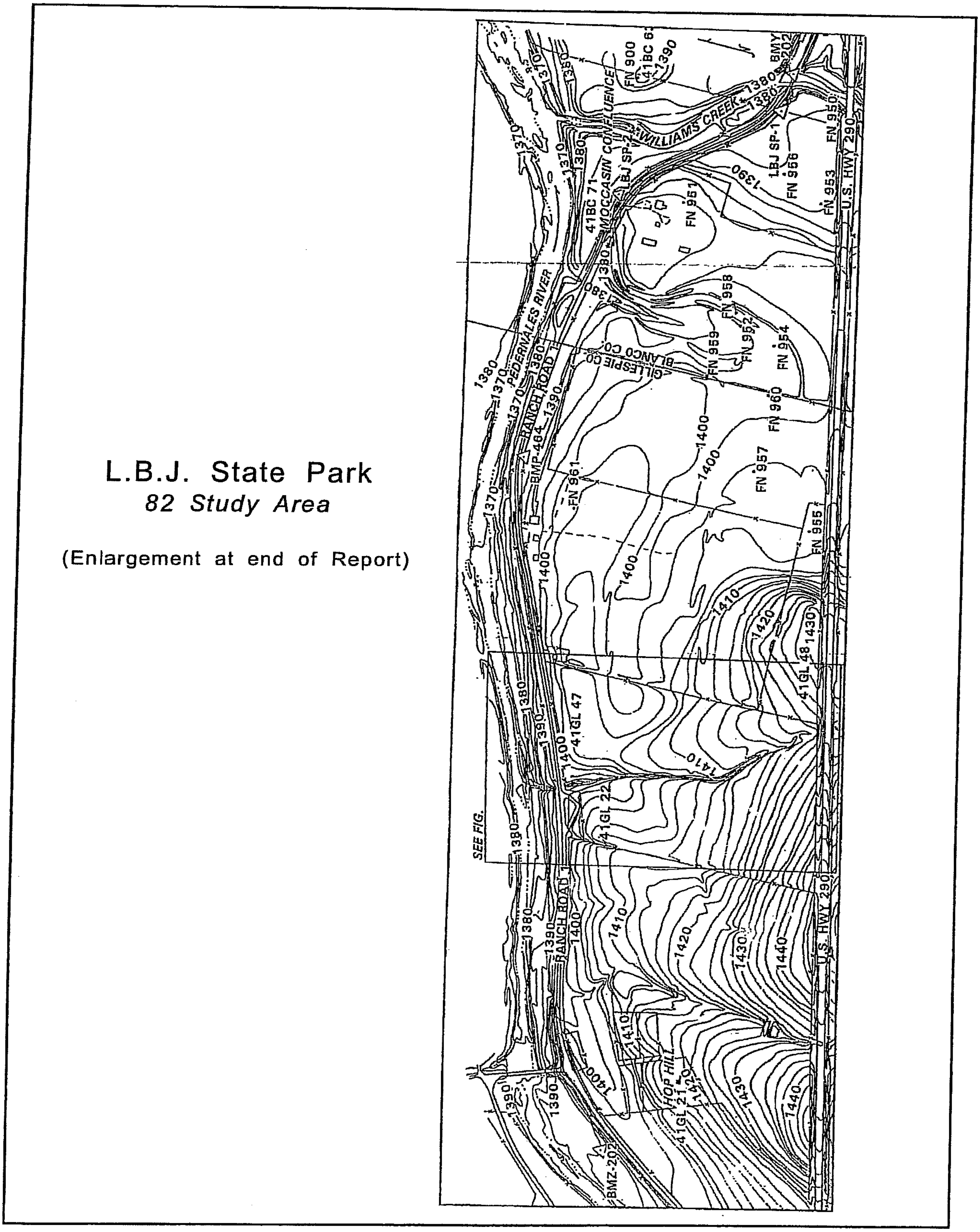

Figure 2.01. Eastern Half of LBJ State Historical Park with Sites and Tests Marked.

Sites that appeared to bear information relevant to any of the above criteria were to be evaluated relative to prospective park development plans. These included a grazing lease for the eastern fields of the park, and possible plowing relative to grazing. Concerning Hop Hill (41 GL 21), the impact of a camping area was to be assessed and mitigated. A recommendation relative to these matters appears at the end of each site description and in the abstract and management summary at the beginning of the report.

RECONNAISSANCE METHODS

A systematic archaeological reconnaissance was conducted at all of the known park sites. At sites 41 GL 22 and 41 GL 47 a ten person field team conducted the survey by using the skirmish-line transect technique. At sites 41 GL 48 and 41 BC 71 a four-person team was used, and at site 41 BC 63 a two-person team completed the reconnaissance. At all of the sites, each person walked north to south transects, spaced at 10 m intervals. As the team slowly walked over an area, a color-coded flagging system (pin flags) was used to mark the locations of cultural debris and arbitrary shovel tests. A red flag denoted a diagnostic artifact, and a yellow flag was placed wherever lithic debitage, burned rocks, or other cultural remains were located. A blue flag marked the location of shovel tests to be excavated upon completion of the transects. At site 41 GL 22, shovel tests were arbitrarily located every 30 m along the uneroded terrace parallel to the draw. Additional locations for shovel tests at 41 GL 22 were selected based upon intensity of surface materials and likelihood of undisturbed buried deposits. The latter selection procedure was used for shovel testing at sites 41 GL 47, 41 BC 63, and 41 BC 71. No shovel testing was conducted at 41 GL 48 because the entire site was deflated and eroded down to bedrock.

The shovel tests had an average depth of 80 cm (although some were as shallow as 60 cm and as deep as 1.3 m). The tests range from 35-40 cm in diameter, and were circular in shape. All of the excavated soil was sifted through 1/4-inch mesh screen.

All of the sites were documented on standard site survey formats and shovel test forms (see Appendix D). Photographs were also taken at each site. All diagnostic artifacts were collected. In this study, diagnostic artifacts were considered to be man-made objects that are evidence of specific aboriginal functions or activities (such as a scraper or mano), and often indicate chronological or cultural-historical affinities (such as points or pottery fragments).

The concluding reconnaissance activities focused on the open fields between sites 41 GL 22 and 41 BC 71, referred to here as the Schuman Field. The fields were tested by a dozen randomly located shovel tests. The azimuth and distance to each test was drawn from a table of random numbers. The locations are shown in Figure 2.01. As Table 2.04 shows, with the exception of Shovel Test FN 951, no sites were located in the field. FN 951 is near the Schuman house and is considered part of 41 BC 71.

TABLE 2.04. SHOVEL TESTING IN THE SCHUMAN FIELD

Shovel Test FN	Depth (cm)	Artifacts Recovered	Recommendations
950	70	nothing	no excavation
951	47	5 flakes, 6 chips, 1 point	1 x 1m unit, near house
952	5	nothing	no excavation
953	60	1 tabular chert fragment,	1 x 1m unit
954	30	nothing	no excavation
955	30	nothing	no excavation
956	43	nothing	no excavation
957	17	1 chip	no excavation
958	3	nothing	no excavation
959	80	nothing	no excavation
960	50	nothing	no excavation
961	56	nothing	no excavation

ARTIFACT TERMINOLOGY

The following terminology was used in describing artifacts found during the survey and testing.

Bifaces: Bifaces are tools that have had flake removals from both surfaces and also along at least one edge of the implement. In this chapter, bifaces are separated into thin and thick categories. A more detailed analysis is reported in chapter 8. In some cases, thin bifaces were probably used as cutting tools or knives, and thick bifaces may have had other uses (such as chopping or cutting). Some bifaces may have also been "preforms," which are bifaces that were intended for further modification into knives or projectile points.

Cores: Cores are pieces of siliceous stone or other raw materials that have at least one surface from which flakes have been removed.

Cortex: A stone's weathered and/or carbonaceous surface.

Flake: A piece of stone that has been removed from a core by the application of force against the core's platform. In this report, flakes are considered only to be the result of human flint knapping activities. Diagnostic attributes of a flake are: a striking platform, ripples, fissures, and a bulb of percussion (see chapter 9).

Primary Cortex Flake: A flake characterized by a cortex outer surface.

Secondary Cortex Flake: A flake characterized by some portion of cortex remaining on the outer surface.

Interior Flake: A flake lacking cortex, usually the most common flake form found at a site. Interior flakes are flint knapping debitage produced from a core, another flake, or a tool that has had all cortex detached by previous flake removals.

Mano: a mano is usually a small (hand-sized), rounded nodule of stone exhibiting evidence of use as a grinding stone (smoothing, polish, striations) on one or more flattened surfaces.

Hammerstones: Hammerstones are usually round or rounded nodules of stone that show evidence of battering (small craters, abrasions, etc.) on one or more ends.

Points: Usually points are thin bifaces that may have been use on the end of a projectile such as an arrow, atlatl dart, or spear. Some of these specimens may also have functioned as knives or cutting tools.

Scrapers: Formal tools that show either unifacial or bifacial modification. They usually have steep edge angles. Wear patterns often appear along edges in the form of damage and/or polish.

Unifaces: Unifaces are tools that have been modified on only one surface and one edge. Edge modification resulted from intentional retouch and/or use. The uniface category applies to any non-formal unifacially worked tool.

SITE DESCRIPTIONS

In this section, the sites studied during the course of the 1982 field season are described. Each site is introduced by a summary of data gathered by D. J. Ing in 1974 and R. Ralph in 1977. Ing and Ralph conducted evaluations for the Texas Parks and Wildlife Department (notes on file at TARL). The new information provided by our 1982 investigations presents an interesting case study in how surface visibility and subsurface testing can influence perceptions of a site to a significant degree.

41 GL 21 (Hop Hill)

Previous Research: The Hop Hill site was originally excavated in 1976 and reported by Gunn and Mahula (1977a). During that excavation a large area of the surface midden was examined and extensive surface collections were made. In 1978 the midden was further investigated and a draw discovered with 2 m of deposits in it. In 1982 the buried draw, probably a relic spring was excavated. Six square meters were excavated to the bottom of the draw. The results of the later two visits are reported in Chapters 4, 8, 10 of this work. The contents of the draw were dominated by Castroville and Ensor points suggesting the draw was used as a discard area during the Twin Sisters and Uvalde phases. The sediments were dark and included ash. The draw is presumed to have been a trash discard area.

Recommendation: Part of the utilization plan for LBJ State Historical Park is use of the area of the Hop Hill site as a camping area. Given that the midden has been extensively sampled both by surface collection and excavation, and that the draw has been excavated and sampled, it seems likely that the cumulative excavations at the site have adequately characterized the horizontal and vertical contents of the site. The only remaining deposits in the site that might be given attention are those of the draw. Since they have been vertically sampled, they are adequately treated given the apparent trash accumulation character of the deposits. Horizontal patterning of artifacts is unlikely since the narrow draw could not have been used as a living surface. It might possess some value in terms of preservation for future research when additional research questions for the park area have been devised. Given the protected context of the deposits in the ravine, they will be preserved by the normal grassing of camping areas characteristic of the park. It is therefore recommended that the camping facility be allowed to proceed. As a site with intact deposits, 41 GL 21 should retain its National Register of Historic Places status and it warrants SAL listing.

41 GL 22 (Dead Goat Draw)

Previous Research: Ing described this site as a lithic quarry located along the sides of the draw in Figure 2.01. He noted that the western margins had been badly disturbed by plowing, and that the eastern side was fairly intact but eroded.

Comments: The 1982 investigations, which consisted of intensive reconnaissance and extensive subsurface testing, demonstrated that 41 GL 22, instead of being one large site was, in fact, four small sites, or a site locality (designated here as 41 GL 22a, 41 GL 22b, 41 GL 22c, 41 GL 22d). Frequencies of artifacts collected from the surface are shown in Table 2.05. Shovel tests are plotted in Figure 2.02. Table 2.06 shows the frequencies of artifacts found in shovel tests.

TABLE 2.05. SURFACE COLLECTED ARTIFACTS FROM 41 GL 22 SUBSITES AND LOCALITY

	Platformed Flakes	Chips	Large Bifaces	Uni-faces	Cores	Hammer stones	Burnt Rock	Biface Chopper	Core Tool	Mano
41 GL 22a	0	0	2	0	0	0	0	0	0	0
41 GL 22b	1	0	0	0	3	0	0	0	0	0
41 GL 22c	1	0	1	0	0	0	0	0	1	0
41 GL 22d*	0	0	8	1	3	2	7	2	1	0
Locality	6	0	6	0	6	0	1	2	0	0
41 GL 47	1	0	1	0	2	1	0	0	0	1

Additional Surface Scatters:

FN 100 50 m NE of 41 GL 22b, tested cobbles, flakes, core frag. In roadbed.
FN 102 50 m SE of 41 GL 22b, tested cobbles, chinks, flakes, chips.
FN 128 100 m N of 41 GL 22b, by road, chunks, core fragments, flakes.

*Field Selected Items

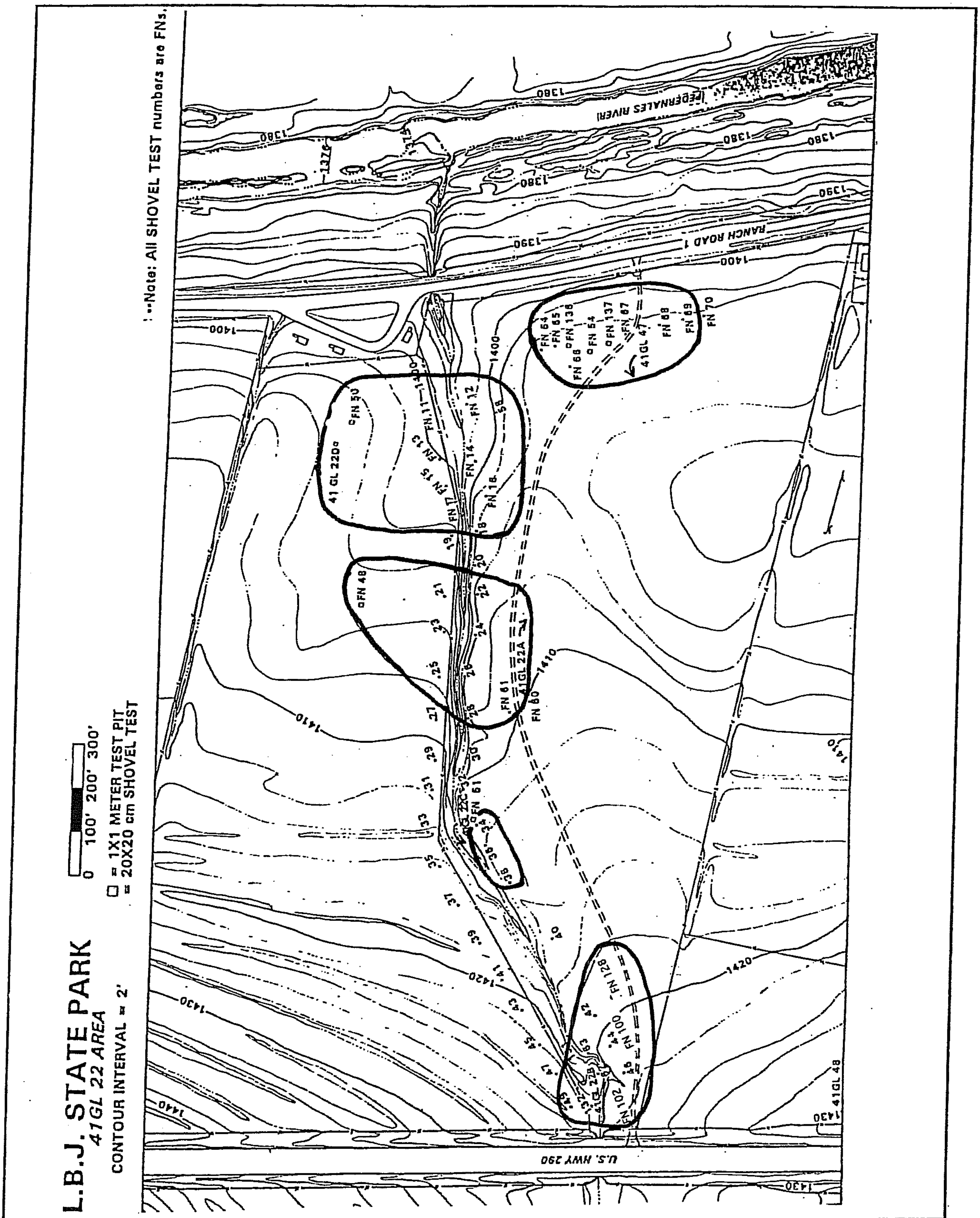

Figure 2.02. Site 41GL22a-d, 41GL47, and 41GL48, Shovel Tests, and Test Pits.

TABLE 2.06. SHOVEL TESTS WITH ARTIFACTS AT 41 GL 22 AND 41 GL 47

FN	Totals	Platform-	Chips	Other
41 GL 22				
11	3	0	0	1 side scraper, 1 altered flake, 1 bone
14	1	0	1	
16	1	1	0	
21	1	0	0	modified cobble
24	1	0	1	
25	2	0	0	cobbles
28	2	0	0	small cobbles
34	1	0	0	notched stone
36	1	0	1	
38	1	0	1	
41	4	1	0	2 trimmed cobbles, 1 large cobble
44	1	0	1	
56	5	5	0	
57	1	0	1	
58	1	0	1	
59	5	5	0	
63	1	0	1	
131	1	1	0	
132	4	0	4	
Total	37	13	12	
41 GL 47				
64	1	0	1	
67	17	15	0	1 burned rock, 1 mussel shell
69	1	0	1	
133	1	0	1	
134	3	3	0	
135				combined with Test Pit 136, Level 166-1
170	0	8	0	
Total	23	26	3	

41 GL 22a

Map Name: 7.5 USGS "Hye Texas"

Map Coordinates: Zone 14 Easting 538780; Northing 3345310.

Environmental Location: The site is on an upland floodplain of a dry creek channel (Figure 2.02). Vegetation on the site consists of an open grassy field with clumps of live oak and cedar intermixed. Other plants observed in the site area include prickly pear, yucca, and sotol. Perhaps the nearest source of water at the time of occupation was the creek bed which is less than 100 m to the west. Chert nodules are eroding from the slope. The soil in the site area is predominantly reddish and clayey with some depth, underlain by chert gravels.

Dimensions: Site 41 GL 22a is about 90 m north-south and 120 m east-west along an unimproved road. The boundaries were defined by positive shovel tests and surface collection.

Description: The artifact assemblage consists of two large bifaces that may have been preforms. No burned rock was present.

Interpretation of the Site Type: This site may have been used as a quarry and initial flint knapping location where naturally occurring chert nodules were extracted and primary modification performed. The low bulk of materials suggests the site was occupied briefly. No hearths or evidence of long-term occupation is present.

Activities of Fieldworkers: Site was surveyed and mapped. Eleven shovel tests were excavated. Four proved positive (FNs 21, 24, 25, 28, see Table 2.06). The site boundaries were defined by surface collection. A test pit (FN 48, Table 2.07) also provided artifacts.

Probable Cultural Association: Unknown; no diagnostic artifacts were recovered.

Condition: Heavily eroded.

Recommendations: No further work is necessary.

41 GL 22b

Map Name: 7.5 USGS "Hye Texas"

Map Coordinates: Zone 14 Easting 538880; Northing 3345030.

Environmental Location: Site 41 GL 22b is also located on the upland floodplain of a dry creek channel (the same channel as 41 GL 22a). Vegetation in the site area consists of open grassy fields, interspersed with clumps of live oak, cedar, hackberry, elm, and huisache. Ground cover is primarily bear grass and grama with scattered prickly pear and yucca plants. Lithic outcrops of river cobbles are present in the adjacent creek bed (see Figure 2.02). The soils exposed in the creek bed and shovel tests are blackish clayey loam for a depth of nearly one meter below surface underlain by reddish clay.

Dimensions: The site extends approximately 100 m (north to south) and is 70 m (east to west) as determined by positive shovel tests and surface collection.

Description: A small thin scatter of artifacts was observed on the site surface consisting of one exhausted core, two core fragments, and one large macro flake. One long flake and a few chips were found in the shovel tests. No fire-burned rock was seen in the site vicinity. Some artifacts were also found along the nearby unimproved road (FNs 100, 102, and 128).

Interpretation of the Site Type: Like 41 GL 22a, this site was used as a flint knapping location. The few flakes suggest this was a location where only a few cobbles were tested. The low frequency of artifacts indicates that this site was only occupied briefly, probably even less than 41 GL 22a.

Activities of Fieldworkers: The site was surveyed and mapped. Ten shovel tests were excavated. Shovel tests 44, 63, 131, and 132 were positive (see Table 2.06); only flakes were recovered. The site boundaries were defined by the positive shovel tests and surface collection.

Probable Cultural Association: Unknown, no diagnostic artifacts were recovered.

Condition: Heavily eroded and deflated.

Recommendations: No further work is necessary.

41 GL 22c

Map Name: 7.5' USGS "Hye Texas"

Map Coordinates: Zone 14 Easting 538780; Northing 3345210.

Environmental Location: Site 41 GL 22c is located on what appears to be an erosion resistant landform (see Figure 2.02). It is at this point that the creek bed starts to migrate to the east. The site is located immediately adjacent to the creek bed. The surface vegetation is comprised of open grassy fields with clumps of live oak and cedar. Ground cover consists primarily of bear grass and grama. Lithic sources are primarily rounded river cobbles present in the dry creek channel. Soil is entirely a blackish (7.5 YR 3/2) clayey loam as far down as our subsurface test penetrated (ca. 1 m below surface).

Dimensions: The site is approximately 70 m north south by 30 m east-west based on positive shovel tests (FNs 34, 36, 38; see Table 2.06).

Description: In the creek channel adjacent to the site, one large biface, one secondary cortex flake, and one edge altered core were found. In a test pit (1- x 1-m, FN 51) six interior flakes and two cores were recovered. No fire- burned rocks were recovered.

Interpretation of the Site Type: As in the cases of 41 GL 22a and 41 GL 22b, 41 GL 22c appears to be a flint knapping location. Additionally, as in the cases of the previous two sites, 41 GL 22c seems to have been occupied very briefly.

Activities of Fieldworkers: The site was surveyed and mapped. Two shovel tests and a 1- x 1-m test unit were excavated to a depth of 82 cm.

Probable Cultural Association: Unknown; no diagnostic artifacts were recovered.

Condition: Slightly eroded.

Recommendations: No further work necessary.

41 GL 22d

Map Name: 7.5' USGS "Hye Texas"

Map Coordinates: Zone 14 Easting 538670; Northing 3345520.

Environmental Location: Site 41 GL 22d is situated on the third terrace above the floodplain of the Pedernales River. The surface vegetation is an open, grassy field composed primarily of beargrass and grama. At an adjacent picnic area (which probably is constructed over a portion of 41 GL 22d), are clumps of live oak. The nearest lithic sources are rounded river cobbles eroding from the slope above the creek bed. Soils are variable--in the center of the site human occupation has resulted in the accumulation of a midden 30 to 40 cm thick. However, the overall underlying soil matrix consists primarily of brownish (7.5YR 3/2) clay loam.

Dimensions: The site area extends at least 70 m north to south and approximately 80 m wide east to west based on positive shovel tests (FNs 11, 14, 16, 58, see Figure 2.02) and test pits.

Description: A large number of artifacts of all types were scattered on the surface (see Table 2.05). Shovel testing and the excavation of two 1- x 1-m unit showed that the site has 40 cm of depth (Table 2.07). A high amount of fire- burned and cracked rock was seen on the surface and also in the 1- x 1-m test pits.

TABLE 2.07. SITE 41 GL 22c and d, 1 X 1 METER TEST PITS

FN Level	Depth (cm)	Flakes	Chips	Altere Flakes	Bone	Burned Rock	Aquati Shell	Cores Fragments	Points etc.
41 GL 22c, Test Pit 48									
150	0-10	13	87	0	0	P	0		7
151	10-20	4	7	0	0	P	0		0
-	20-30	0	2	0	0	P	0		0
Total		17	96	0	0		0		7
41 GL 22d, Test Pit 51									
159-165	0-82	6	0	0	0	A	0		2
41 GL 22d, Test Pit 50									
152-1+2	0-10	50	95	3	0	P	0		2 Darl
153	10-20	43	20	4	0	P	0		0 Hearth
154	20-30	5	26	0	0	P	0		0
155	30-40	0	1	0	0	P	0		0
-	40-80*	0	0	0	0	A	0		0
Total		98	142	7	0		0		2

*One quadrant only; A = absent, P = present

Interpretation of the Site Type: Site 41 GL 22d was a residential base camp either of long-term occupation and/or of repeated usage. The quantity of cultural materials observed and collected substantiates this interpretation.

Activities of Fieldworkers: The site was surveyed and mapped. Nine shovel tests, four of which were positive (FNs 11,14, 16, 58, see Figure 2.02) and two 1- x 1-m units (FNs 50 and 51, see Table 2.07) were excavated. Two-hundred fifty-seven artifacts were recovered.

Probable Cultural Association: A Darl projectile point from the upper 10-cm level of Test Pit 50 date the site to the Late Archaic.

Condition: On the margins of the slope, a great deal of slope wash erosion has occurred. This process, combined with plowing of the field in the recent past, has scattered artifacts over 200 m to the south of the site and approximately 100 m to the east.

Recommendations: Should the site area be planned for development the test should be expanded to determine if there is any horizontal integrity to the subsurface levels. A 4- x 4-m excavation on top of the rise would likely be sufficient.

41 GL 47 (Rabbit Run Site)

Map Name: 7.5' USGS "Hye Texas"

Map Coordinates: Zone 14 Easting 538800; Northing 3345640.

Previous Research: In his 1975 site survey, Ing described 41 GL 47 as a buried midden that was under a red clay plow zone. He observed that the midden deposit consisted of a dark gray sandy matrix, that possibly had been burned (notes on file at TARL).

Comments: The 1982 field research consisted of intensive reconnaissance and subsurface testing at this site. The results of our investigations demonstrated the following: (1) the site was much smaller than previously thought (see below); (2) the midden was deflated, plowed, and intermixed with the underlying red clay; and (3) a large amount of cultural debris was eroding from the western side of the site.

Environmental Location: Like 41 GL 22d, site 41 GL 47 is situated on the third terrace above the floodplain of the Pedernales River. The surface is vegetated in open, grassy fields with clumps of interspersed oak and cedar. The nearest lithic sources are in tabular slabs from the eroded western slope of the site and are also abundant in the dry creek channel. Soils along the slope are thin, red clays. The slope is predominantly limestone bedrock. Near the site summit, along the terrace, soils are humic, brownish loamy clay mixed with the red clays, probably as a result of intensive plowing in the recent past.

Dimensions: The site approximately 120 m long (east to west) and 50 m wide (north to south).

TABLE 2.08. SITE 41 GL 47, 1 X 1 METER TEST PITS

FN Level	Depth (cm)	Flakes	Chips	Altere Flakes	Bone	Burned Rock	Aquati Shell	Core Fragments	Points & Tools
Test Pit 136									
166-1	0-8	41	83	1	0	P	0	11	0
167-2	8-15	19	24	0	0	P	0	0	0
Total		60	107	1	0		0	11	0
Test Pit 54									
168-1	0-8	101	138	4	0	P	0	1	0
169-2	8-15	14	12	0	0	P	0	1	1
Total		115	150	4	0		0	2	1
Test Pit 137									
137-1	0-6	45	64	0	0	P	0	0	2
137-2	6-12	4	9	0	0	P	0	0	0
Total		49	73	0	0		0	0	2

P = present

Description: As mentioned above, a large amount of cultural debris (primarily debitage, cores, and broken tools) is eroding from the site surface (particularly along the western margins of the site). One mano was collected from the surface, and several hundred lithic artifacts came from the shovel tests and the three one by one meter units. All of our data indicate that the most intensive usage of the site was located along the west half.

Interpretation of the Site Type: Like 41 GL 22d, site 41 GL 47 was a residential base camp where a variety of activities occurred. This site, too, may have witnessed long-term occupations and/or may have been reoccupied numerous times.

Activities of Fieldworkers: The site was surveyed intensively, mapped, and tested. Ten shovel tests to ca. 45 cm below the surface were excavated seven of which proved positive (FNs 64, 67, 69, 70, 133, 134, 135, see Figure 2.02), and three 1x1 meter test pits (FNs 54, 136, 137) were completed to an average depth of 15 cm below surface (Table 2.08, see Figure 2.02). Site boundaries are based on positive shovel tests.

Probable Cultural Association: Not known; no diagnostic artifacts were found.

Condition: Except for occasional flakes, the material from the site is in a thin sandy surface sediment about 8 cm thick. The loose surface level seems to be deflated and probably suffered plow displacement in recent times. As such, the artifacts should be considered a surface collection.

Recommendations: No further work is recommended.

41 GL 48 (Dead Cow Hill)

Map Name: 7.5' USGS "Hye Texas"

Map Coordinates: Zone 14 Easting 539060; Northing 3345100.

Previous Research: In 1975, Ing described this site as a small quarry, located on a rocky chert and limestone outcrop. This landform is, in fact, a limestone ridge.

Environmental Location: The vegetation consists primarily of dense cedar, thorny brush, and mesquite. The nearest lithic sources are on the site surface and are abundant in nodular form. Soils are a red, gravelly clay and are very thin and weathered.

Dimensions: Site 41 GL 48 is approximately 200 m long (east to west) and 100 m wide (north to south). It was probably wider prior to the construction of U.S. Highway 290, which removed an unknown portion of its southern extent.

Description: Ing's description of 41 GL 48 as a quarry site is correct. It probably served as a prolific source of chert raw material through all of the cultural historical periods. However, there is no evidence of any long-term occupation at the site (burned rock or middens). Most of the nodules seen on the surface had been tested.

Interpretation of the Site Type: Site 41 GL 48 is a flint knapping location of repeated, but brief, usage.

Activities of Fieldworkers: The site was intensively surveyed and mapped.

Probable Cultural Association: Unknown; no diagnostic artifacts were found.

Condition: Site 41 GL 58 has been deflated to bedrock by extensive sheetwash erosion.

Recommendations: No further work is necessary.

41 BC 63 (Hye Site)

Map Name: 7.5' USGS "Hye Texas"

Map Coordinates: Zone 14 Easting 540360; Northing 3345850.

Previous Research: In 1977, Ralph described this site as a midden located along the eastern first terrace of Williams Creek at its confluence with the Pedernales River.

Comments: A burned rock midden was confirmed at 41 BC 63 during the course of our 1982 field investigations.

Environmental Location: Site 41 BC 63 is located on the uppermost eastern terrace of Williams Creek near its confluence with the Pedernales River. The surface is heavily vegetated in tall beargrass and bermuda grass. Several very large oaks are located in the site vicinity. Soil is a dark blackish loam with unknown, but considerable, depth (in excess of 45 cm).

Dimensions: The site size could not be determined because of heavy ground cover. In 1977, Ralph estimated the north-south extent to be 140 m but was unsure of the east-west extent (notes on file at TARL). Only a small portion of the presumed east-west extent of the site is on park property.

Description: The shovel test excavated in the burned rock midden produced approximately 73 lithic pieces of all types and a very dense concentration of burned rocks (Table 2.09).

Interpretation of the Site Type: These 1982 data, combined with Ralph's 1977 information, suggest that this site functioned as a residential base camp. Evidence suggests it may have had fairly long-term occupation (burned rock midden accumulation).

Activities of Fieldworkers: The site was surveyed, mapped, and one shovel test was excavated.

TABLE 2.09. SHOVEL TEST AT 41 BC 63

Shovel Test FN 900
Depth: 45 cm
30 platformed flakes
53 chips
quartz bearing calcareous sandstone
one possible point tip fragment, crazed
one altered flake, large
one lateral fragment, biface
one burned pecan shell fragment

Probable Cultural Association: The distinctive burned rock midden indicates a Middle Archaic association.

Condition: The burned rock midden is probably the only portion of the site that has not been plowed; undisturbed components could exist below the plow zone.

Recommendations: In the event the site is developed the test area should be expanded to determine if there is any horizontal integrity to the subsurface levels. It should be nominated for the National Register of Historic Places as a part of the 41 BC 63-71 complex of sites. As will be shown in later sections, activity during the Middle Archaic at 41 BC 71 is marked by an unexpected reduction. It seems likely that this reduction of activity at 41 BC 71 was a product of shift of emphasis to 41 BC 63.

41 BC 71 (Moccasin Confluence)

Map Name: 7.5' USGS "Hye Texas"

Map Coordinates: Zone 14; Geographic Center = Easting 540130; Northing 3345820; SW = Easting 540170, Northing 3345900; NW = Easting 540030, Northing 3345860; NE = Easting 540170, Northing 3345900; SE = Easting 540270, Northing 3345520.

Previous Research: Ralph, in 1977, named 41 BC 71 "Schuman House Site," however, it was renamed during the course of our 1982 field work. Also, Ralph described the site as a prehistoric midden, quarry, and chipping station.

Comments: Our research showed 41 BC 71 to be a multicomponent, residential base camp that was occupied from Paleoindian times to the Late Prehistoric period. Site 41 BC 71 received a great deal of our energy and effort in 1982 and is described in detail in chapter 3 and various technical chapters. Only the salient characteristics of the site are summarized here. Without question, 41 BC 71 is one of the most important sites yet tested in central Texas.

Environmental Location: Site 41 BC 71 is located where the floodplains of Williams Creek and the Pedernales River meet. Thus, it is situated on a wide, nearly level, terrace. Site vegetation consists primarily of grama, beargrass, and assorted weeds. Along the left bank of Williams Creek is a grove of some very large oaks, elms, hackberry, and pecans. Also, large oaks grow on the northern margins of the site near the Pedernales River. Soils consist of a deep sandy clay loam that extends to a depth in excess of two meters. The nearest source of lithic raw material occurs as stream and river cobbles on the lower banks of Williams Creek and the Pedernales River. There is an outcrop of limestone in the orchard to the southeast of the Schuman house that appears to have been a lithic resource. Also, upland lithic resources described above were probably utilized as well.

Dimensions: Site 41 BC 71 covers over four square hectares, extends approximately 400 m (north to south), and is approximately 150 m wide (east to west).

Description: The site has many components. The best represented periods are Late Paleoindian, Early, Middle and Late Archaic. Shovel tests (Table 2.10) in the eastern area of the site obtained hundreds of chert flakes and tools, as well as five points (Bell, Marcos, Nolan, Castroville, and an unknown type). A sizable midden with burned rock is located in the north central area of the site and seems to date to Middle and Late Archaic times. Subsurface testing revealed extensive occupation floors (chapter 11), and associated faunal materials, aquatic shells, and burned rock. The only evidence for the Late Prehistoric occupation was from a possible Scallorn stem recovered from a shovel test. No further Late Prehistoric evidence was uncovered in the extensive testing of the site. Therefore, Late Prehistoric occupation is considered ephemeral for the time being, and is not discussed in the subsequent technical chapters.

Interpretation of the Site Type: From the Early Archaic until at least the early Late Archaic, site 41 BC 71 functioned as a large scale, long-term residential base camp.

Activities of Fieldworkers: The site was intensively surveyed, mapped, and tested. Thirty-four deep shovel tests and six 1- x 1-m test units were excavated (see subsequent chapters of this report).

Probable Cultural Association: All periods from Plainview-Angostura (Late Paleoindian) through Ensor (Late Archaic) are positively identified at 41 BC 71. Others are suggested. Local informants report that Lyndon Johnson's grandfather use the location to coral cattle before driving them to the Kansas railheads.

Condition: A local informant told us that this site, north of Ranch Road 1 has never been plowed. Thus, 41 BC 71 could be considered a pristine prehistoric site.

TABLE 2.10. SHOVEL TESTS AT MOCCASIN CONFLUENCE (41 BC 71)

Shovel Test FN	Depth	Platformed Flakes	Chips	Altered Flakes	Bone*	Burnt Rock*	Core Frags.	Additional Comments**
200	124	69	87	0	P	P	0	possible *Scallorn* stem
201	34	4	4	0				
202	37	48	73	2	P	P	0	point base, *Darl, Lange, Bulverde?*
				0	A	A	0	
203	32	11	14	1	A	P	0	
204	28	5	6	0	A	P	0	
205	70	27	46	0	A	P	0	ironware sherds, glass sherd, cut square nail/ late 1900's
206	30	14	21	0	A	P	1	small piece mussel shell
207	100	108	249	0	P	P	0	FN235 beveled knife/ FN243 EP, mussel shell, small point frag., Poss. *Bulverde* frag. (crazed)
208	75	131	202	3	P	P	2	gouge (unifacial, one side nibbled),Bf. point tip, Bf. knife
209	75	0	2		A	P	0	
210	68	7	6		A	P	0	poss. mano frag.
211	75	23	56		A	A	0	1 frag. glass
212	75	2	2		A	A	0	2 glass bits
213	80	74	141	3	A	P	3	1 crazed point tip, FN232 *Marshall (Pedernales?)*, shell bits, point tip (burned)
214	90	29	63	4	A	P	0	FN231 basal point frag., FN233 *Bell*, charcoal
215	80	37	80	2	P	P	2	mussel shell, 2 tip frag.
216	87	43	201	4	P	P	0	FN234 *Nolan*
217	78	63	125	0	A	P	0	Bf. lateral frag., basal frag. Bf.
218	73	1	1	0	A	P	0	
219	80	0	0	0	A	A	0	
220	85	0	0	0	A	A	0	
221	70	0	0	0	A	A	0	charcoal
222	100	0	0	0	A	A	0	
223	70	11	10	0	A	P	1	charcoal, worm cast?, FN238 Bf. basal frag.
224	80	0	0	0	A	A	0	
225	73	37	46	0	A	A	1	1 small scraper
226	80	0	0	0	A	A		
227	80	26	56	0	A	P	0	FN242 oval Bf. (preform?) tip gone, glass bit
228	85	0	0	0				
229	89	20	28	0	A	P	0	
230	100	69	60	1	A	P	1	FN237 *Castroville* or *Marshall*, FN239 large teardrop Bf.
626	123	43	54	0	A	P	2	Bf. side scraper, barbed wire, poss. barb from a *Bell* point
962	106	38	81	0	A	P	0	red reflector frag., burnt quartz-bearing sandstone.
963	57	0	0	0	P	A	0	

* P=present; A=absent
** Bf.=biface

Recommendations: The site contains deeply stratified, intact deposits with great variety and numbers of artifacts. The artifacts date from Paleoindian to modern times. The site is endangered by development upstream that will increase flooding in the Pedernales River, already a problem since the 1950s. We recommend large-scale block excavations be conducted at this site in anticipation of its eventual destruction. The site should be nominated to the National Register of Historic Places and warrants designation as a SAL.

SUMMARY OF RECONNAISSANCE AND SUBSURFACE TESTING DATA

The major interpretations obtained from the reconnaissance and testing operations of the 1982 field season are presented below. Principal activities performed at the site and primary function of sites are emphasized.

Sites 41 GL 22a, 41 GL 22b, and 41 GL 22c, with low amounts of occupational debris, were used briefly by people of unknown cultural- historical association. All of these sites functioned as briefly occupied, flint knapping locations.

The evidence from 41 GL 48 suggests it was repeatedly used as a flint resource location. Unfortunately, diagnostic artifacts were not found, and therefore the cultural-historical associations of the site is unknown.

Five residential base camps were found. Most significant of these is 41 BC 71, a multicomponent, stratified site, dating from the Paleoindian to Late Archaic period, and possibly even Late Prehistoric. Hop Hill (41 GL 21) was shown to be an intensively inhabited (semipermanent?) base camp dating to the Late Archaic Uvalde and Twin Sisters phases. Site 41 GL 22d was shown to be a less intensively occupied site dating probably to the Late Archaic as well. However, one Darl point does not necessarily mean this was the only time it was occupied. The other two residential base camps, 41 GL 47 and 41 BC 63, could not be firmly dated to a specific period, since no diagnostic artifacts were recovered. Site 41 GL 47 shows no evidence of intensive use comparable to 41 GL 21 or 41 BC 63-71. Site 41 BC 63 appears from one shovel test to be a very deep and dense burned rock midden in the classic sense. It can be assumed to date to the Middle Archaic since such middens are normally taken to be diagnostic of that period (Weir 1976; Prewitt 1981).

Further mention should be made of isolated artifacts recorded during the reconnaissance. Some artifacts (usually nondiagnostic unifaces and bifaces) were frequently found singly, mostly in the uplands, without any other associated cultural debris, and often several hundred meters from the nearest archaeological site. These artifacts may be indicators of specific prehistoric activities or, what Binford (1980:9) calls a "location," more commonly called an isolated find. Perhaps some plant extractive and associated expeditious tool making and discarding activities occurred prehistorically where these artifacts were found.

Furthermore, we should add a cautionary note in our assessment of the prehistoric settlement patterns represented in the study area. There is a high potential that certain site functions could be "masked" to the archaeologist's observations, particularly at the large residential base camps. As stated earlier in this section, in some situations sites may serve different functions or combinations of functions. Within a seasonal exploitation cycle, a site that was a fishing camp in the summer could be a residential base camp in the autumn. If these different seasonal functions did occur prehistorically in the site area (and in all likelihood they did), they would be difficult to distinguish, owing to their sequential deposition. Thus, the only methods whereby such distinctions can be discerned at residential base camps like Hop Hill and Moccasin Confluence is through microstratigraphic excavation techniques (see chapter 3 of this report). However, owing to the enormous size of Moccasin Confluence (over four hectares), and the limited preliminary test excavation we completed, most of the differential, discrete, seasonal site functions are still unknown. These phenomena await future meticulous microstratigraphic excavations.

CONCLUSIONS, OBSERVATIONS, AND PROPOSITIONS

The size of the site samples obtained from the reconnaissance and testing procedures is small, but certain observations (O) and testable propositions (P) can be made concerning the prehistoric settlement patterns. These are presented as follows:

O1 In terms of site proximity, sites 41 GL 21, 41 GL 22a, 41 GL 22b, 41 GL 22c, 41 GL 22d, 41 GL 47, and 41 GL 48 form one cluster. Sites 41 BC 63 and 41 BC 71 form another cluster.

O2 The Gillespie County sites, based on the evidence from Hop Hill, date primarily to the Late Archaic period with a trace of a Middle Archaic occupation at 41 GL 21.

P1 We propose that this site complex represents a nearly semisedentary settlement system functional during the Castroville-Ensor occupations of the Late Archaic period. Possibly this proposition can be tested in the following manner:

1. An examination of lithic raw material frequencies at the Gillespie County sites could or could not show similar outcrop utilization.

2. A study of the lithic technology represented at the Gillespie County sites should ascertain whether an integrated information system was shared by the prehistoric occupants of these sites in terms of lithic manufacturing behavior (see Weir 1976).

3. Paleoclimatological data and paleoenvironmental reconstructions could possibly shed light on why, judging by relative artifact deviation, this settlement

system was narrow-ranging and nearly semisedentary. Narrow range implies a rich environment that supports a population locally. The Middle and Late Archaic artifact frequencies, therefore, imply a rich environment. The shift of emphasis to Hop Hill in the Late Archaic suggests a shift in resource base. Its elevated location near the locally well-known Johnson Ranch ford of the Pedernales River probably implies large, migratory game. Castroville points are frequently associated with bison (Dillehay 1974:183). Weir (1976) thinks the Middle Archaic was deer-acorn oriented. The nature of concordant climatic shifts will be discussed in chapter 5.

O3 Site 41 BC 71 shows evidence of repeated and intensive occupations during the Early Archaic (Bulverde, Bell, etc.).

O4 Site 41 BC 71 is located at the confluence of the Pedernales River and a major tributary.

O5 Site 41 BC 63 has a location similar to 41 BC 71.

P2 The Blanco County Early Archaic Components at 41 BC 71 (and possibly at 41 BC 63, though this is problematic at present) show evidence of a riverine adaptive focus that may be the result of the Altithermal that occurred at this time (Middle Holocene).

P3 The Middle Archaic occupations at 41 BC 71 should show as a result of faunal-floral analysis an adaptive shift (still riverine, but more terrestrially oriented) and are probably part of the same narrow-ranging settlement pattern described above.

P4 Again paleoclimatological data may provide independent verification of the above propositions.

O6 Given that Hop Hill and the Moccasin Confluence are large, long-term residential base camps, the respective locations need to be analyzed to determine the faunal-floral and lithic resources that attracted differential occupation. This could be a complex problem because it would involve not only reconstructing the prehistoric environment as it differs from the present-day conditions, but also reconstructing the two environments under two different prehistoric conditions.

O7 Flotation analysis should also be designed to provide seasonality of occupation at 41 BC 71 and Hop Hill.

MANAGEMENT SUMMARY

A management summary for LBJ State Historic Park archaeological sites developed from the above reported investigations appears in the Abstract and Management Summary section at the beginning of this report.

CHAPTER 3—MOCCASIN CONFLUENCE OVERVIEW—A LATE QUATERNARY SITE IN THE LOWER FREDERICKSBURG BASIN OF THE EDWARDS PLATEAU (Gunn)

Moccasin Confluence was tested during the 1982 season under the terms of Texas Antiquities Permit Number 310. The site was found to contain, as far as can be determined to date, a continuous sequence of sedimentary and cultural deposits from the latter part of the Pleistocene and through the Holocene virtually to the present. Concentrated residential occupation occurred during the Early and Late Archaic. Historically, it is also very interesting. It is located at the confluence of the Pedernales River and Williams Creek. According to a local informant the area was used by President Johnson's grandfather to pen cattle before driving them to Kansas to be sold at the railheads.

Geomorphologically the site is constituted of a slack water deposit at the mouth of Williams Creek and a nearby sandy knoll (Figure 3.01) across Ranch Road 1. Slack water deposits are formed when, during a flood, tributary water looses its rate of water flow as it enters the floodplain at its mouth. As the stream enters the floodplain the flatter terrain slows the rate of flow and heavier sediments settle. This accounts for the relatively high topography at the mouth of Williams Creek relative to the Pedernales floodplain, and for the preservation of the archaeological remains. Camps used by prehistoric peoples were frequently covered over by the predominantly silt-sized sediments before harm could come to them. Silt-sized particles of sediment settle out of water in about 15 seconds which gives a perspective on the relatively greater speed of the water in the uplands above the confluence.

The sandy knoll south of Ranch Road 1 is composed of coarser sediments. It appears to be an erosional remnant of an older sand body. The sand may be from an underlying, resistant sandstone, or it may have been brought in by the Pedernales River and blown out of the river bed during dry, windy seasons. Resolution of the problem of both the knoll and the confluence awaits further sediment analysis and geomorphological testing at depth.

Surface indications of the presence of a site in the confluence consisted of an area of unusually verdant grass near Test Pit 4 and a few burned rocks on the surface. A systematic program of deep shovel testing (Figure 3.01) revealed an abundance of lithic and burned rock materials within a meter of the surface. Two of the shovel tests, 213 and 214, provided five diagnostic points. Furthermore, field analysis of the points showed that the shovel tests up stream along Williams Creek contained, on the average, older points such as Bell. The tests closer to the Pedernales River usually produced younger points, generally of the Late Archaic. A shallow depression across the confluence north of Test Pit 4 suggested an old channel of the river passed nearby. The midden associated with Test Pit 4 may have been on the bank of the river.

Since the confluence may have been migrating northward, Test Pits 1 and 4 were placed to test the possibility that habitation migrated with the confluence. Detailed analysis of the lithics in the two test pits showed such a trend (see chapter 6). Test Pit 2, which was also located near two highly productive shovel tests, was occupied during the Paleoindian period and was accorded a relatively constant amount of occupation activity through the Holocene. Test Pit 4 analysis, on the other hand, showed a continuous increase in camp interest that peaked precipitously in the Late Archaic.

Test Pit 6 was located on the sandy knoll, in the front yard of the Schuman House. Diagnostics were limited to the Middle and Late Archaic. Occupation was most intense during the Middle Archaic. A rather interesting idea suggests itself: if the Middle Archaic was in part moist, as is suggested by the climatic chronology (see Figures 1.03 and 5.06), the elevated and well-drained knoll may have been a much favored place to camp with respect to the lower ground next to the stream. When corrected for sedimentation rates (see chapter 6) both test pits on the confluence show a drop in occupation activity during the Middle Archaic.

The Middle Archaic in central Texas is generally characterized by intensive occupation. Site 41 BC 63 across Williams Creek to the east was shovel tested. The test revealed a dense and thick burned rock midden typical of the Middle Archaic. While the locus of occupation may have been migrating to the knoll, it also seems likely that interest shifted across the creek, apparently for other reason judging by apparent site function, e.g., a burned rock midden. This may be because the east side of the creek was more proximate to raw materials, especially limestone outcrops. Any future research should investigate this prospect.

Diagnostics suggest that the break between Middle and Late Archaic in Test Pit 6 was between levels 9 and 10 (Figure 3.02). However, a detailed analysis of flake morphology showed a distinct break in flake width between levels 8 and 9 (see chapter 9). There is reason to think that the flake morphology indicator is as good a marker of the change between the two periods as diagnostics since there are so few points and many flakes. With regard to function, a change from narrow to wide flakes is also suggestive. Several indications were found that the Middle Archaic was a biface-oriented technology while the Late Archaic was a core flake oriented technology. The distinctive narrowing of flakes from Middle to Late Archaic reasonably indicates a change from broad bifacing flakes to narrow core flakes or perhaps even resharpening flakes. Weir (1976:116) notes that the Rondroele Phase and bifacing by implication, has an east Texas origin. There is also some sentiment that core flaking is Plains related. Gunn (1982d) suggests that the root of the preferences lies in a perspective on the applications of the two technologies. Bifacing lends itself to the manufacture of large, sturdy stone tools. These large, sturdy tools are amenable to both sedentary life and woodland technology. Nomads

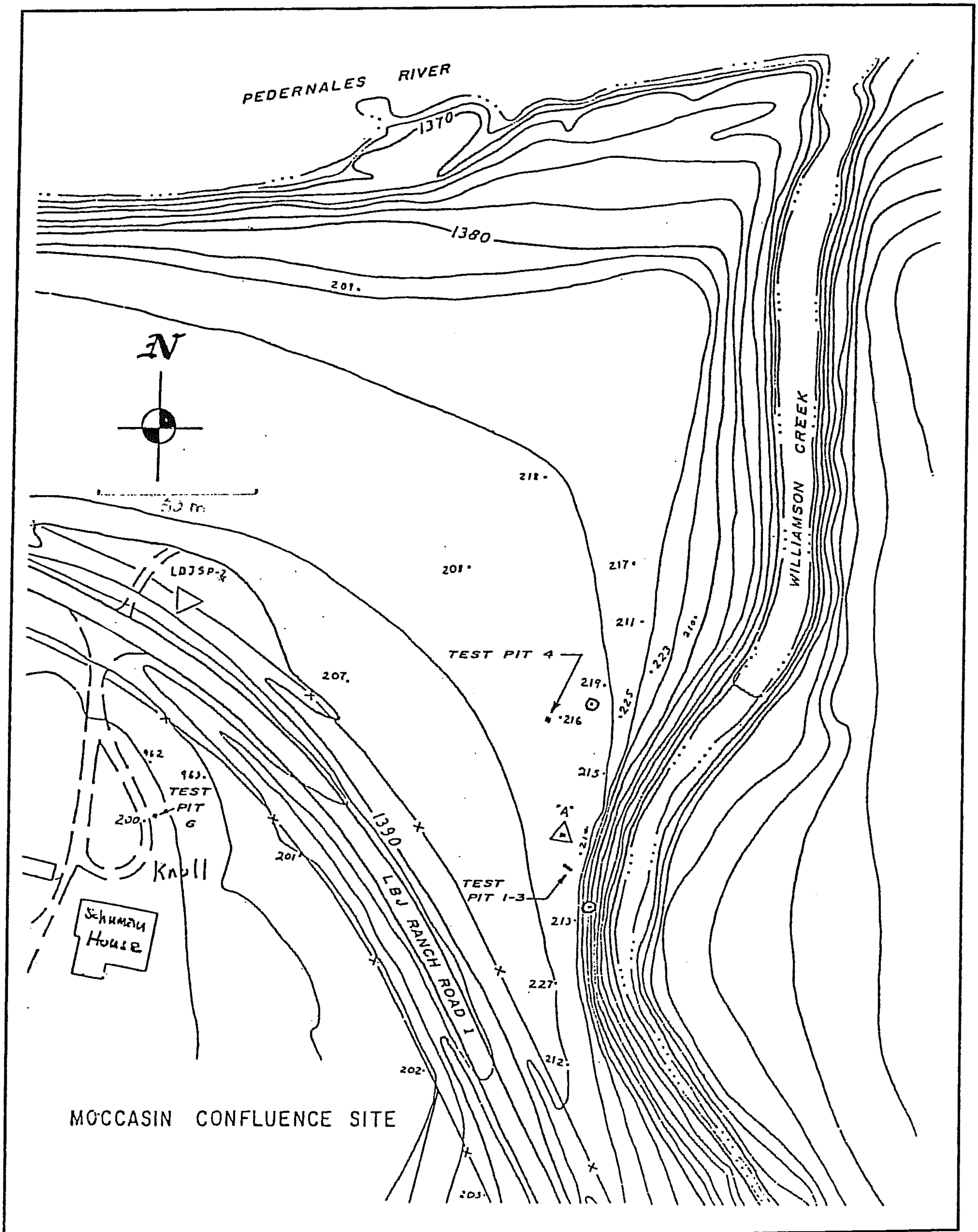

Figure 3.01. Shovel Tests and Test Pits at Moccasin Confluence.

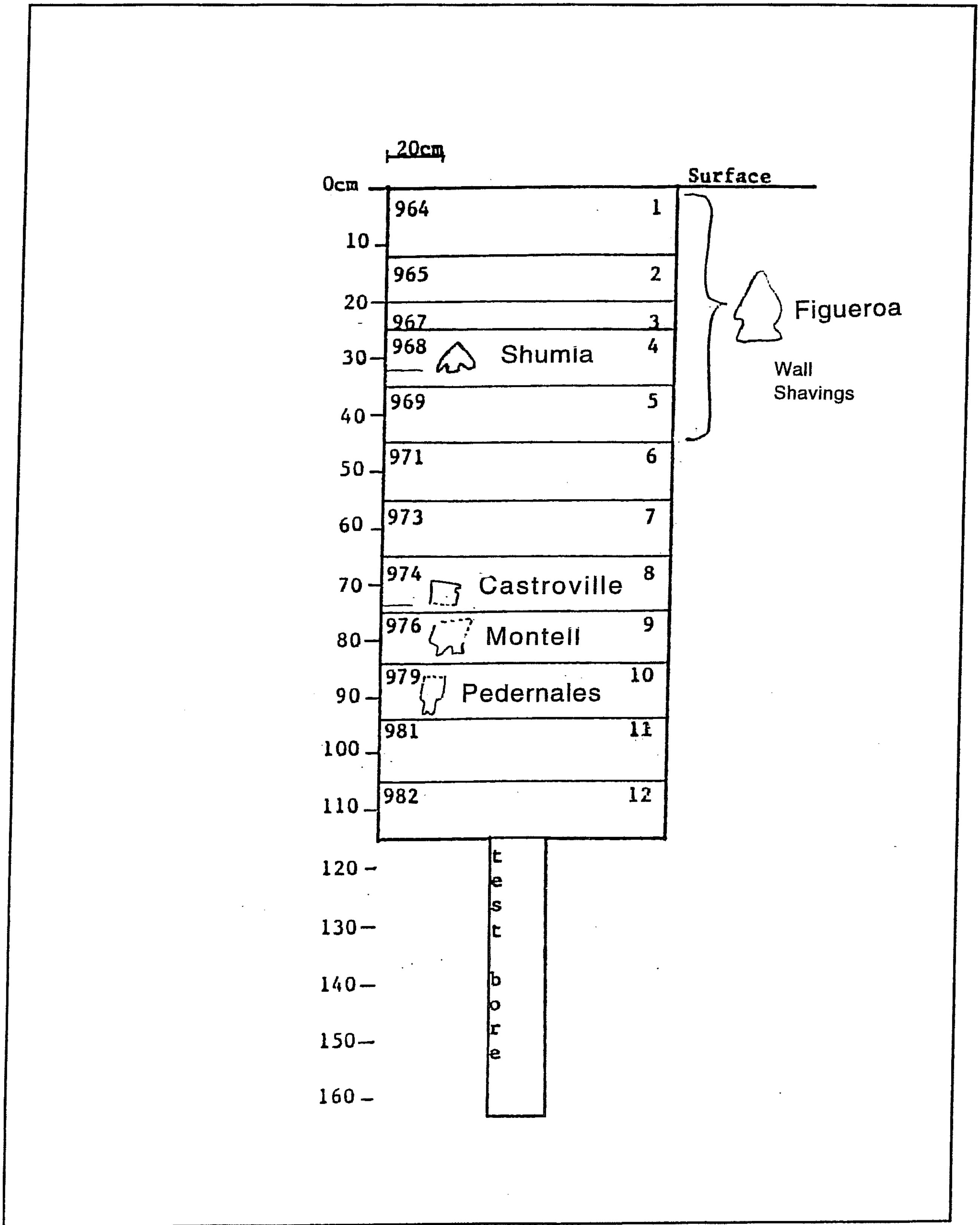

Figure 3.02. Diagnostic Sequence in Test Pit 6: Dates are BP-C14, identifications by E. Prewitt.

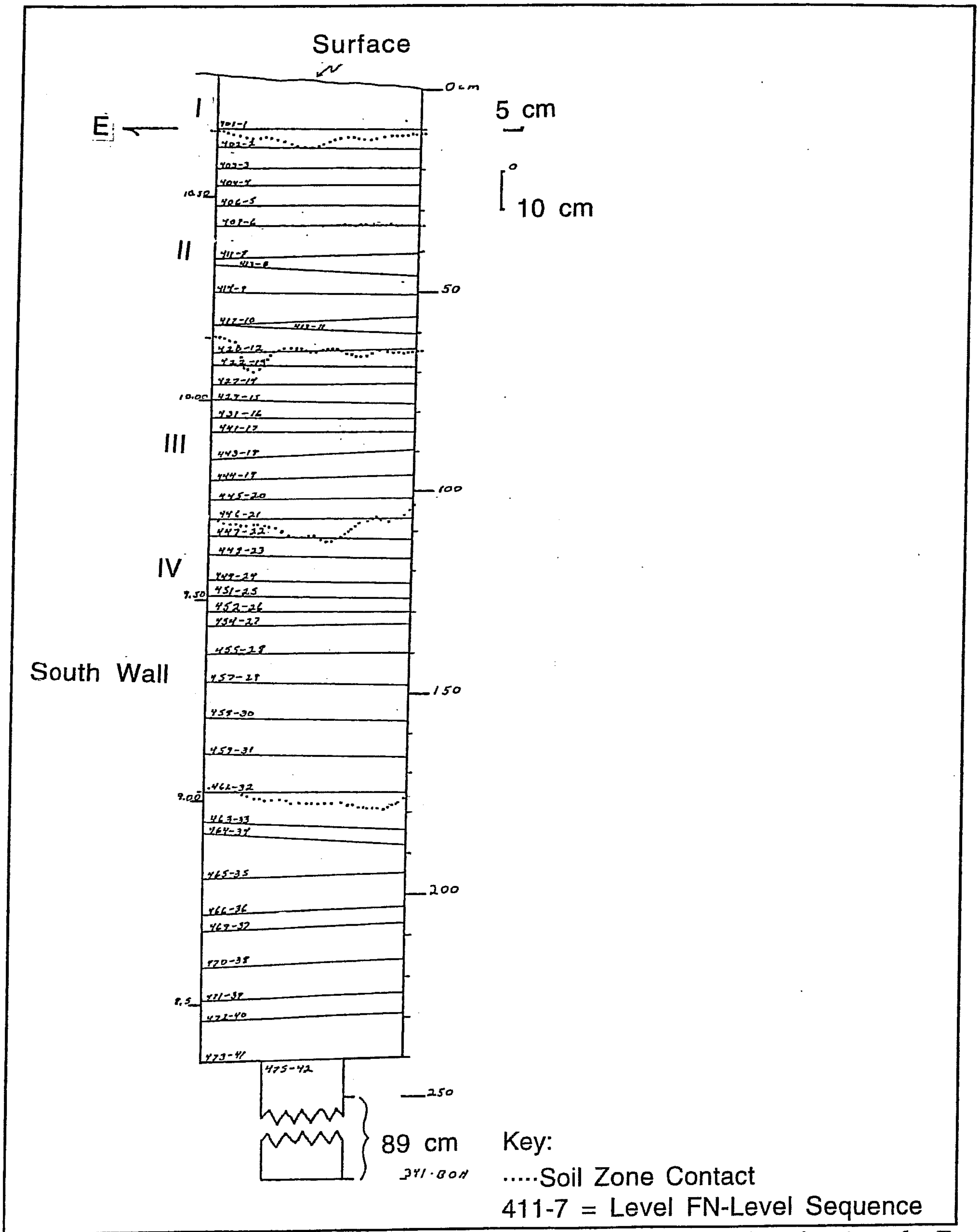

Figure 3.03. Diagnostic Sequence in Test Pit 4: Dates are BP-C14, identifications by E. Prewitt.

do not carry large tools about with them, while sedentary dwellers can keep them around the hut. Woodland tool kits are used on tough, woody plant species to convert them into usable products such as house frames, canoes, etc.

By contrast, core technology and the similar but more refined blade technology is amenable to nomadic lifeways. Small tools that represent efficient use of material and effective dispatch of tasks are handily made by core/blade technology. Nomads, who are forced, at least in part, to carry their lithic raw material with them, would prefer an efficient technology with respect to the core bulk-to-edge ratio produced. Sheets and Muto (1972) have demonstrated the relative efficiency of core and blade technology. Binford (1978) and Goodyear (1979) have outlined the complexities of nomadic logistics that require efficient use of materials.

The alternation between core and biface technology demonstrated at Moccasin Confluence can be taken to mean that alternating Plains and Woodland influences held sway at the site. Coordination of the climatic chronology and the proposed sources of these technologies is suggestive. Final resolution of the problem will come with future work on the environment at the site. Such efforts should bring additional support to both the climatic and climate/culture hypotheses by confirming the presence of Plains-like and Woodland-like climates during the postulated technological intervals.

Test Pit 4 is located on the highest point in the confluence proper. Deposition seems to stop in the Late Archaic. This suggests that the river and the creek were no longer flooding to a level capable of continuing deposition. Note for contrast that deposition continued at the lower Test Pits 1-3. This probably suggests a lowering of the Pedernales River floodplain during the later part of the Holocene and more rainfall distributed more evenly over the year. Such a rainfall pattern would result in more vegetation, less sediment yield, and less overbank flooding.

The rock midden is clearly most concentrated in the Test Pit 4 area. It was apparently near the Pedernales River channel, a popular place to camp during the Late Archaic in particular. The deposits are quite thick during the Early Archaic and the Paleoindian periods (see chapter 4). This indicates relatively sparse vegetation in the uplands and high sediment yields (Schumm 1965). Model Holocene climatic change for the coastal plain (Gunn 1981) indicates that the hot and dry climate of the Middle Holocene would have been accompanied by torrential summer rainfall produced as a by-product of tropical storms. Such summer floods would very likely account for the thickness of the Early Archaic deposits. Such deposits are characteristic of south-central and southeastern rivers during the Middle Holocene (see Gunn 1982a for sources).

Test Pit 2 was the most intensively analyzed unit of the test excavations. Flake morphology was studied for all levels in the same fashion as Test Pit 6. Flake use-wear, mollusks, sediments, etc., were also studied intensively. Test Pit 2 was selected for close study because it appears to have the longest chronology of any test pit (see chapter 4). Deposition continues after the Late Archaic because of its low elevation. Also, a Paleoindian biface fragment was found far under the Plainview/Angostura horizon. It may well be Clovis related since the fragment is clearly not Folsom.

Much of the flake morphology and use-wear analysis suggests a situation opposite of that at Test Pit 6. Bifacing and core flake relationships are in many cases inverted. Also, the frequencies of use-wear types are often inconsistent. Two hypotheses are suggested as explanations for the inversions. First, the inversions may represent differing functions within the same societies. Manufacturing was more frequent by the creek and use more frequent on the knoll. Perhaps some thought should be given to division of labor. A second prospect is that the differences were generated by alternating visits from eastward or westward based groups. On first examination this may seem like a Deus Ex Machina approach to explaining the assemblage. However, there is plenty of evidence, both prehistoric (Dillehay 1974) and historic (Gunn and Frkuska 1982) to show that the comings and goings of bison to the southern plains were intermittent, and probably controlled by the annual average winter temperatures and length of growing season. Various historical sources show that Coastal Plains bands hunted in the Edwards Plateau in fall and winter (Campbell 1975). If so, annual fluctuations in winters alone could serve as an adequate explanation for the introduction of Plains elements into the assemblage. As will become quite clear in the Hop Hill discussion, bison hunters played a role in the deposition of Moccasin Confluence, and bison bone fragments were found in the Test Pit 1-3 sequence. Likewise, white-tailed deer bone is present in the deposits and could be an indicator of more easterly oriented hunters, since deer are browsers and, unlike bison, are able to survive in woodland environments. A distinctive shift in deer-bison ratios was found by Bryson and Baerreis (1968:291; Figure 3.04) on the prairie forest ecotone further north.

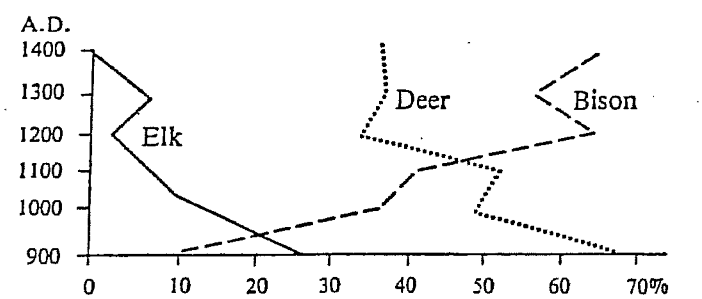

Figure 3.04. Dear-Bison Bone Ratios in the Mill Creek Culture of Iowa.

Moccasin Confluence is without a doubt one of the best sites in the Southcentral area for the study of long-term culture change. It is a large site and deserves a substantial excavation effort to determine both horizontal and vertical changes through time. It should be nominated to the National Register of Historic Places and preserved as a vital element in the history and future of central Texas and warrants designation as a SAL.

CHAPTER 4—HOP HILL OVERVIEW—A LATE ARCHAIC OCCUPATION (Gunn)

The Hop Hill locality (Gunn and Mahula 1977a) was surveyed and excavated during the 1976, 1978, and 1982 seasons. The last two seasons were sanctioned by Texas Antiquities Permit Number 175. Diagnostics (Figure 4.01) from the surface indicate that it was visited from Early Archaic to Neo-Archaic times (Kelly 1977). Its primary interest to prehistoric populations seems to have been the flint nodules that outcrop below the site on slopes facing the Pedernales River. Some occupation floors were defined in a small midden explored during the 1976 and 1978 field seasons. However, no reasonable definition of the time and consequence of the occupations was possible until the 1982 excavations. The direction the 1982 excavations took was keyed by the discovery in 1978 of an area not underlain by caliche as was the rest of the occupation area. A small test on the last day of the 1978 excavation produced a mastoid process of human skull and a meter of deposits descending into the bedrock under the site. In 1982 a 6-m2 area was opened down into the deposits (see chapters 8 and 10 for analysis of lithics). A full two meters of deposits were found in what appears to have been an old ravine, perhaps the head of an extinct spring. The upper two horizons are clearly marked by Ensor and Castroville point types of the Twin Sisters and Uvalde phases of the Late Archaic (Prewitt 1981). The zone below the Uvalde phase is judged to be San Marcos, the last phase of the Middle Archaic, by stratigraphic position; no diagnostics were present.

The accumulation of debris in the ravine and the use-wear patterns on flakes suggest the following scenario. During the San Marcos phase, Hop Hill was used as a lithic procurement area as it had been for millennia. The edge damage patterns found on the lithics in the suggested San Marcos phase shows that the flakes were not used for tools and supports an inference of lithic manufacturing at the site (see chapter 10). More human bones associated with the mastoid process were fragmentary and may be the remains of a bundle burial interred during the San Marcos phase or shortly thereafter. The burial was shallow, being primarily covered with a flat stone (Appendix B). In the Late Archaic, deposition increases substantially in the ravine as does the frequency of lithic debris. Along with the increase in overall lithic debris is a modest amount of detectable use of flakes as tools.

The deposition rate and the frequency of flakes used as tools peak in the Twin Sisters phase. Most of the debris show signs of burning. The percentage of flakes used as tools was slightly higher. After the Late Archaic the ravine was filled. There is no reason, however, to suspect from the surface deposits that occupation continued with the former intensity. The relative thinness of the surface deposits suggest that the ravine was used as a natural trash pit or a gratis cooking pit.

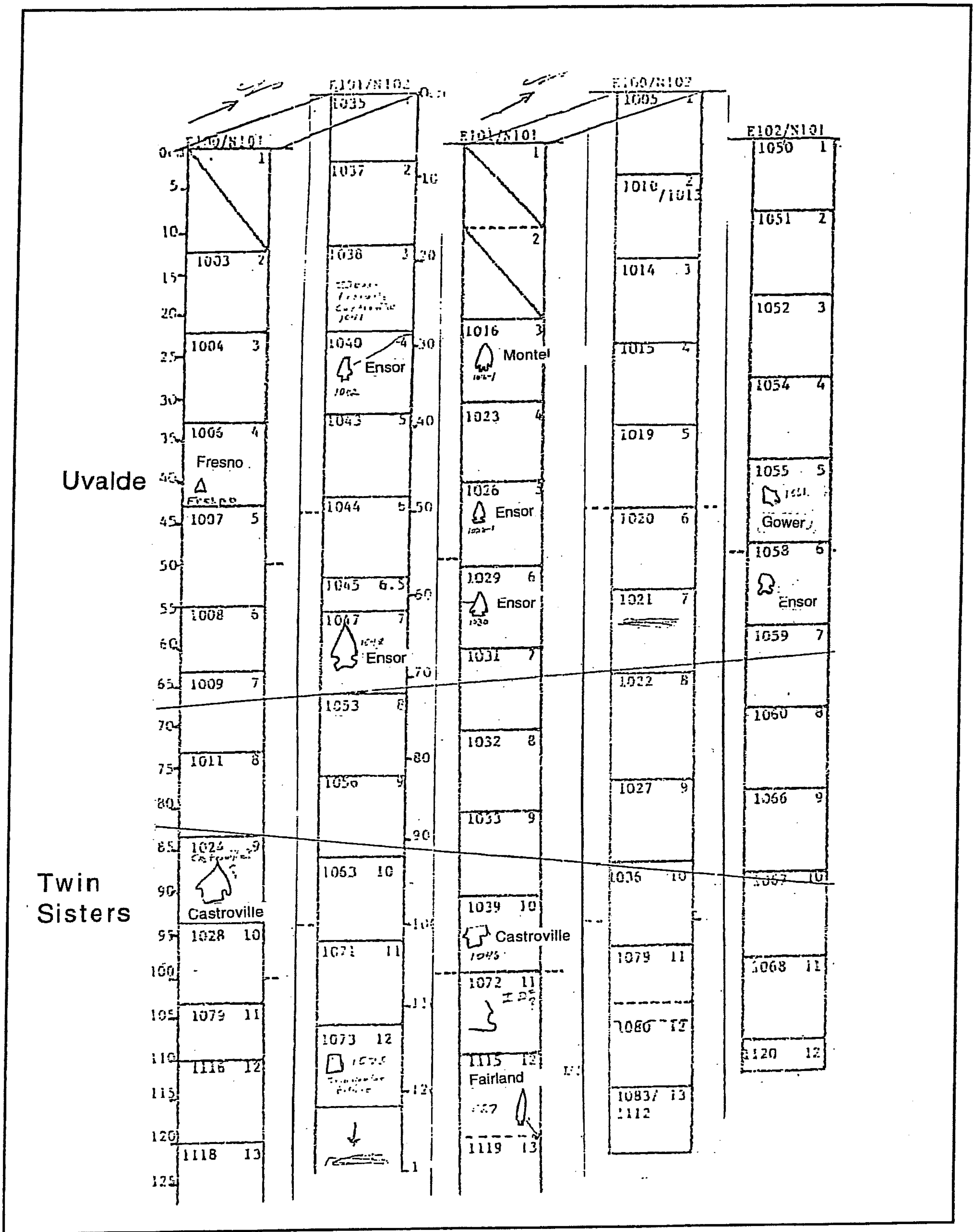

Figure 4.01. Diagnostic Sequence at Hop Hill.

Two insights into the Hop Hill occupation are worthy of special note. First, the peak of occupation occurred at the same time, both at Hop Hill and at Test Pit 4 in Moccasin Confluence. Both are associated with modest middens of burned rock, and not classic burned rock middens of the Middle Archaic. Whatever the Late Archaic inhabitants were doing could have been done equally well in either microhabitat. Castroville points have been associated at several locations with bison procurement (Dillehay 1974). A logical explanation for the activity at Hop Hill is that the inhabitants were watching for bison crossing the ford of the Pedernales River below the location of the present day Johnson Ranch house. It is likely that the middens with rock represent subsidiary activities performed while watching for bison, or perhaps the cooking of bison meat. The lower occupation midden at Hop Hill contained flat rocks too large to be appropriate for boiling stones (Gunn and Mahula, 1977a). They could, however, have been used to heat an oven-like affair such as was used by the western Indians to prepare roots and steam meat.

The concept of the vectored seasonal round, i.e., that a seasonal round would be engineered to pass as many resources simultaneously as possible, suggests the vast utility of Hop Hill to the bison hunters, but not to nonherd oriented cultures. The site has a lithic resource area, an overlook, and a natural cooking convenience. Thus the two meters of debris as opposed to the few centimeters left by previous visitors.

Given that the midden and the trash pit have been sampled at Hop Hill, it seems unlikely that any further excavation at Hop Hill is necessary given the research goals of this project. The ravine can be traced down the hill toward the Pedernales River by a line of trees. It undoubtedly contains more trash in the same vertical sequence as excavated during the 1982 season. Further excavation would only duplicate information already obtained. For future potential the ravine should be preserved, capped or grassed. The rest of the site has no remaining archaeological value. A resume of the Hop Hill findings and recommendations appear in Chapter 2.

CHAPTER 5—PHYSICAL AND LATE QUATERNARY ENVIRONMENT OF LBJ PARK (Brown, Gunn, LaRocca, Sims)

INTRODUCTION

The sections of this chapter survey the geology, geomorphology, soils, sediment column, and molluscan sequence in the eastern half of the Lyndon B. Johnson State Historical Park. Special techniques are used to analyze the sediments and snail sequence in an effort to infer climate at the site over its history.

GEOLOGY (Brown)

A hundred million years ago the LBJ State Historical Park area lay buried in mud, part of a shallow sea that extended northward as far as Colorado. As the waters receded, the mud, heavily laden with microscopic shelled creatures, hardened into rock, and the rock was uplifted above sea level. Almost from the moment of its emergence from the waters of the last great Cretaceous sea, erosion began to shape the landforms we see today in the LBJ State Historical Park.

Since it is far from the main twisted and shattered central core of the Balcones Fault Zone, the bedrock geology of the park presents a relatively simple picture. At the base of the Cretaceous marine deposits are the ancient rocks of the Llano Uplift.. These uplifted, faulted, and metamorphosed sedimentary and igneous rocks from the Precambrian and Paleozoic eras crop out across a broad area of central Texas to the north of the park, an area often termed the Central Mineral Region. Parts of this ancient uplifted area stood as islands above the sea at times during the Cretaceous.

Within the park area, however, these strata exert little influence on the actual geology other than serving as a platform for later deposition. They are exposed primarily where erosion has cut deeply through the Cretaceous sediments. The most easily observed exposure is along the channel of the Pedernales River where the river flows through both coarse and fine grained dolomite. This rocky channel is mapped as the San Saba member of the Wilberns Formation (Barnes 1964, 1965) and includes small areas of calcite and limestone as well as dolomite. Most of this is non-fossiliferous and generally noncherty.

Aside from small areas of the San Saba exposed along subsidiary drainages and a few areas of other Wilberns Formation limestones (Morgan Creek member and Point Peak member, Barnes 1964, 1965) mapped near the upstream end of the park, only one other Llano uplift formation is exposed in the vicinity of the park. This is the lower Ordovician (and thus slightly more recent than the Late Cambrian Wilberns)

Threadgill member of the Tanyard Formation which directly overlies the San Saba mentioned above. Two small outcrops occur south of Highway 290 along Williams Creek. One, bisected directly by the creek, may be of some prehistoric significance because it is noted as slightly cherty (Barnes 1964).

As the earliest Cretaceous sea rolled inland it left thick coarse-grained shoreline deposits, later buried in mud by the advancing waters. These deposits, which vary in texture from boulders to clay, are generally sorted and slightly indurated sand overlying a more strongly cemented basal conglomerate.

Designated the Hensell Member of the Travis Peak Formation, this sediment underlies a large portion of the park. It is of considerable historic economic importance as it is more readily cultivable than the surrounding limestone soils (Barnes 1964; Campbell 1962) and made the middle reaches of the Pedernales River more attractive to early settlers than the other deeply incised limestone valleys and narrow alluvium along other hill country streams. A reported dense growth of broadleaf oak that was not cultivated (Cuyler 1931) suggests that this sandy strip may have had considerable significance to the aboriginal inhabitants of the area as well.

Overlying the Hensell sand at the southern margins of the park is the Glen Rose limestone formation. It is the marine equivalent of the Hensell sand and essentially a contemporaneous deposition. This thick deposit of limestone (including beds of dolomite, clay, and silt) extends half a dozen miles south of the river where its characteristic stair step topography and shallow soils support only sparse vegetation.

South of the Glen Rose Formation, capping the low hills that form the divide between the Pedernales and Blanco Rivers is a Cretaceous formation of considerable aboriginal significance, the Edwards Limestone (Barnes 1981). The formation, represented by the Fort Terret Member, contains large quantities of high quality chert and was heavily utilized by prehistoric peoples wherever it outcropped.

GEOMORPHOLOGY AND PEDOLOGY

Despite the age of most of the deposits in the river valley, their modern configuration is due primarily to more recent geomorphic events. Erosion has stripped the ancient sediments again and again, and alluvial deposition has filled the center of the valleys. Although the modern alluvial deposits along the Pedernales River are relatively narrow, there are indications that ancient alluvial deposits were once more extensive. Patches of high terrace gravels are mapped well above the modern alluvial terraces of the river (Barnes 1964). In the Pedernales River, Concho River, and other upper Colorado River Valleys, Blum and colleagues (Blum and Velastro 1989; Blum et al. 1994) have examined and dated alluvial sediment sequences. The have found the landscape evolution on the Edwards Plateau of the Late Pleistocene and Holocene to be one of gradual degradation and removal of once thick uplands soils. High effective moisture in the Pleistocene gave way to Holocene cyclical droughts. The droughts reduced the vegetation and once thick soils were reduced to bedrock.

The most extensive remaining alluvial deposits in the park area are along the banks of Williams Creek at the eastern edge of the park. It is the combination of these alluvial deposits from Williams Creek with those of the Pedernales River that have shaped the depositional history at Moccasin Confluence. One of the keys to the understanding of this depositional history is the soils observable at the site.

An examination of the soils at Moccasin Confluence shows them to be clearly alluvial (Figure 5.01). The Soil Conservation Service (Dittemore and Allison 1979) has mapped the soil in this area as Oakalla silty clay loam, a deep, well drained soil formed in alluvium along major creeks. In fact, their typical profile description of the Oakalla series soil is apparently taken from the alluvial terrace immediately across the creek from Moccasin Confluence, and agrees closely with the field description given below. The field soil profile description of the soils in the main excavation units at 41 BC 71 is given below. All colors given were recorded on dry soil.

SOIL PROFILE OF TEST PITS 1, 2, & 3: (Map see Figure 3.01)

<u>Soil Horizon A1, 0-18 cm</u>. Very dark grayish brown (10YR 3.5/2) silty (clay?) loam; very strong coarse subangular blocky structure; very compact, friable, sticky when moist; many medium and fine roots, very few land snails, very few small limestone fragments (1-3 cm); some worm casts; insect burrows are fairly common; lower boundary smooth, abrupt.

This horizon thickens noticeably toward the creek, exhibiting a less pronounced creekward slope on its upper surface than that shown by the soil horizon below. The abrupt nature of the break between this zone and the one below may indicate a depositional break, perhaps a relatively recent one. It is possible that this horizon represents a single catastrophic flooding event.

<u>Soil Horizon Ab2, 18-41 cm</u>. Very dark grayish brown (10YR 3/2) silty clay loam; moderate to strong fine granular with weak to moderate coarse subangular blocky structure; very compact, friable; moderate amount of small roots; some land snails; few, very small (<4 cm) chert stream gravels; few tiny limestone fragments; abundant worm casts; lower boundary smooth, gradual.

Whatever the depositional origin of the horizon above, this zone is apparently an older A horizon that has been buried beneath it. A number of vertical cracks extend downward from the upper horizon through this zone. The lower boundary of this horizon is marked by a very clear cultural zone that extends downward into the next soil horizon. The thickness of this horizon is variable, almost pinching out near the creek.

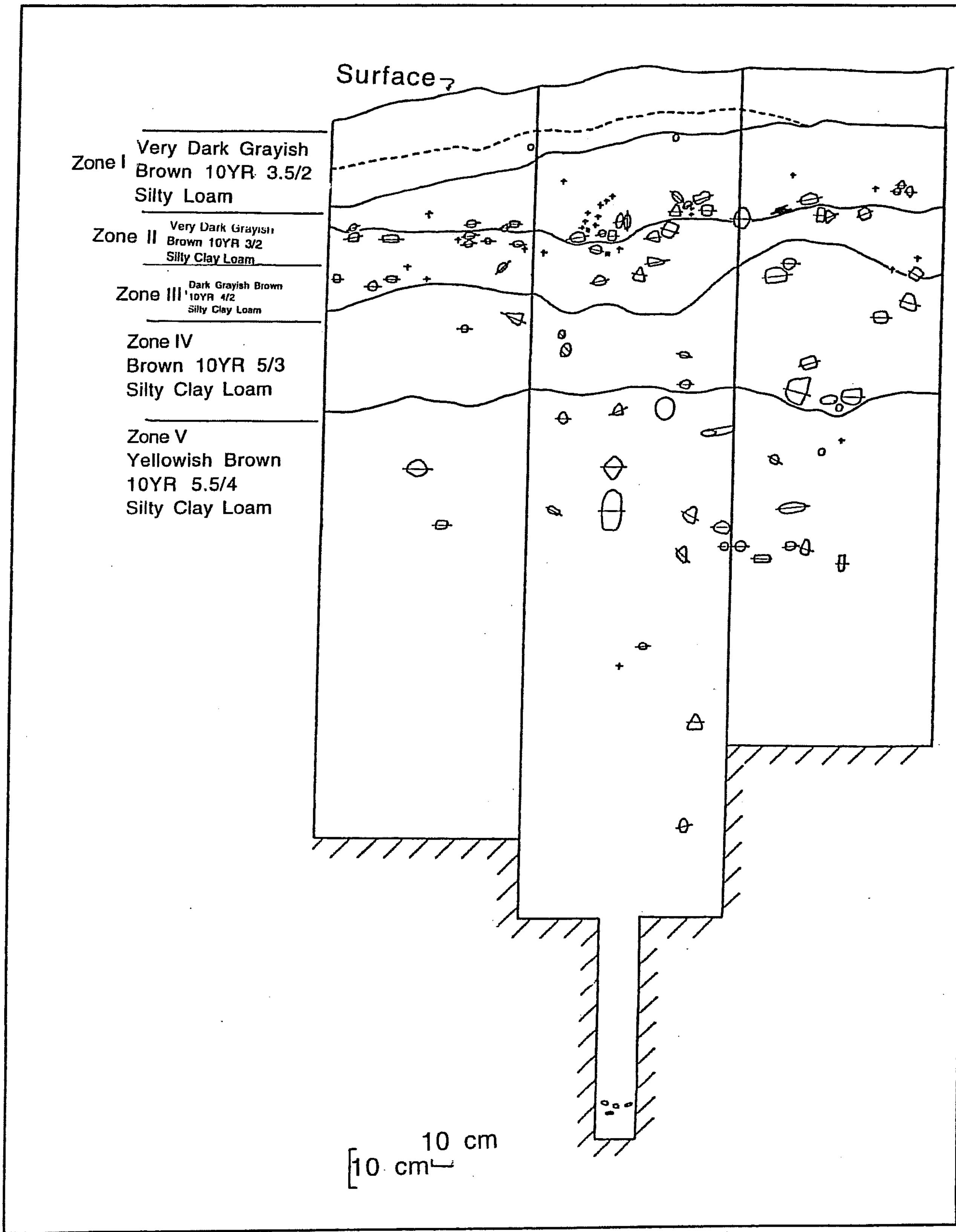

Figure 5.01. Soil Profile for Test Pits 1, 2, and 3 at Moccasin Confluence.

Soil Horizon A3, 41-52 cm. Dark grayish brown (10YR 4/2) silty clay loam; strong fine granular with moderate to strong medium subangular blocky structure; moderate number of fine roots; moderate amount of land snails; abundant worm casts; some small alluvial pebbles; some vertical cracks extending downward from the horizon above; some carbonate accumulation on the ped faces and in cracks; lower boundary smooth, gradual.

This zone underlies the most visible cultural horizon in the profile.

Soil Horizon B, 52-80 cm. Brown (10YR 5/3) silty clay loam; strong fine granular structure; moderate number of fine roots; moderate amount of land snails; some worm casts; few limestone pebbles; many carbonate threads on ped faces; few vertical cracks continue downward through this horizon from above; lower boundary smooth, gradual to diffuse.

This horizon generally parallels the one above, thickening slightly creekward. This horizon is clearly part of the same solum as the two lowest A horizons above (Ab2 and A3). There are no apparent depositional discontinuities in the soil profile below these horizons, suggesting a relatively stable depositional environment during this time (i.e., no major cycles of truncation and redeposition).

Soil Horizon C, 80-135 cm. Yellowish brown (10YR 5.5/4) silty clay loam (with high silt/low sand at the top of the zone and increasing sand toward the bottom); weak medium to coarse subangular blocky structure; only slightly compact; slightly friable; few roots, land snails, limestone pebbles, worm casts; marked decrease in carbonates; vertical cracks observed above do not continue downward into this level.

TEST PIT 4 PROFILE (Map see Figure 3.01)

Soil Horizon A1, 0-15 cm. Dark grayish brown (10YR 3.5/2) silty loam; strong medium to coarse subangular blocky structure; many medium and fine roots; some worm casts; some large limestone cobbles and some very small (1-10 mm) limestone pebbles; a few small alluvial chert gravels (1-10 mm); lower boundary smooth, clear.

Although some cultural material is found in this horizon (which may actually be an Ap horizon), the bottom of this horizon marks the beginning of the actual midden zone.

Soil Horizon A2, 15-35 cm. Dark gray (10YR 4/1.5) silty clay loam; strong fine granular with moderate to strong coarse subangular blocky structure; many fine roots; some worm casts; lower portion of horizon marked by zone of increased carbonates; lower boundary wavy, gradual.

The upper portion of this zone (above the carbonates) is marked by a layer of culturally derived burned limestone rocks, apparently part of a burned rock midden.

Soil Horizon C1, 35-63 cm. Light yellowish brown (10YR 5.5/4) silty clay loam; moderate coarse subangular blocky structure; moderate amount of fine roots; some land snails and worm casts; small limestone fragments; some carbonates through upper half of zone; some vertical cracking; numerous rodent disturbances marked by darker soil from above; lower boundary smooth, gradual.

This horizon appears to have a greater clay content than that of the horizon above which probably has just barely enough to classify as clay loam; it is not clear whether this increased clay is the result of argillic translocation or differences in depositional energy.

Soil Horizon C2, 85-110 cm. Reddish yellow (10YR 6/6) silty clay loam; moderate coarse subangular blocky structure; some land snail fragments; very few carbonates; some rodent disturbances.

This horizon has more silt and perhaps less clay than the zone above, and, except for color, strongly resembles the C horizon of Test Pits 1,2, and 3.

DISCUSSION

The history of alluvial deposition at Moccasin Confluence is a complex one, primarily because of the interaction between the two drainages at the confluence. The classic alluvial terrace depositional sequence of coarse basal sediments grading upward through finer sediments is upset here by the differing characteristics of the two drainage systems. Although Williams Creek does flow for a short distance through the Hensell sand, it is likely that the major contributor of sand to the terrace is the Pedernales River itself. It flows through nothing but sand, sandstone, and very hard limestone for a number of miles above the site. The modern alluvial deposits near the banks of the river are almost pure sand.

Conversely, while the Pedernales River has quite enough energy during floods to transport silts and finer particles the requisite distance, it is likely that Williams Creek, and the fine-grained sediments that make up the majority of its drainage basin, contribute the smaller sized sand particles to the terrace. The deposition of fine sediments from Williams Creek is exaggerated by the effect of the stronger flow of the Pedernales River acting to back up the flow of the creek, increasing deposition.

In addition to the simple changes in patterns of deposition through time, it is likely that the river itself was closer to the site at times in the past. This is supported by the presence of a shallow linear depression just north of the site. This depression, which runs approximately parallel to the modern course of the Pedernales River, may be an old, filled-in channel of the river. If this is so, the original inhabitants of the area would have been at the immediate confluence rather than 100 m up from it as is the case today.

A related and quite interesting feature of the depositional history of the confluence site is the apparent presence of two terraces, or a single terrace and modern floodplain sequence. The higher and older terrace, which contains the site, lies 5-7 m above the elevation of the modern river and is separated from the lower terrace by a low, gradual (but nonetheless distinct) scarp running parallel to the modern course of the river. The lower terrace, at 3-5 m above the river, is apparently matched by another at the same elevation across the river to the north.

The old channel of the river is located on the upper terrace some 50 m south of the scarp. There are observable changes in the density of cultural material within and north of the depression. This suggests that the site was occupied primarily when the old channel was active, at least as an oxbow lake or seasonally wet slough. The relatively shallow depression on the top of the Archaic midden in the northern portion of the site also suggests that an active terrace formation related to this old channel ceased no later than the end of the main midden occupation there.

If it is assumed that the final upper terrace deposits are coterminous with the latest dated occupation at the site, terrace formation may have ceased at some time during the Uvalde phase of the central Texas Archaic period dated to between 2250 and 1750 B.P. (Prewitt 1981). Assuming some consistencies in deposition within the Colorado River basin, the termination of terrace formation here would correlate well with that of the third terrace level (previously termed the Riverview, or Fish Hatchery terrace) identified by Baker and Penteado-Orellana (1977) on the Colorado River near Austin. The final channel phase associated with this terrace (phase 4) is suggested to have ended around 2000 B.P. (Baker and Penteado-Orellana 1977:412). The height of this Pedernales terrace at 5-7 m above the river also agrees reasonably well with the height of 6-10 m given for the Fish Hatchery terrace by Baker and Penteado-Orellana.

Further attempts at correlation between these rather widely separated depositional units formed perhaps under quite different depositional environments would be premature. On the other hand, a carefully designed geomorphic and sedimentological study could provide useful comparative data not only for the immediate site area but for the region as a whole. Any further work at the site should consider the inclusion of such a study.

ANALYSIS OF TEST PIT 2 SEDIMENTS (Gunn, Sims, La Rocca)

A numerical analysis was undertaken of the particle size distributions at Moccasin Confluence. Samples were taken from the soil zones described above. It was expected that both regional and site specific environments would be reflected in the character of the depositional sequence.

As discussed above, Test Pits 1, 2, and 3 revealed five distinct soil zones. At the close of the field season eight sediment samples were collected by horizon, from the south wall of the excavation unit (see Figure 5.02). At least one sample was taken per zone, with several being removed from the thickest strata. This is very broad sampling compared to the depth of the site. It was intended to characterize the sediments in a general fashion. The results must, therefore, be taken as tentative and very general. The results suggest that a restudy at higher resolution would be very helpful in describing the Holocene environment of the study area.

Six-hundred gram samples were removed from each collection bag. Each sample was then placed in water for approximately 30 minutes, in order to disaggregate the sediments. Disaggregation was encouraged by frequent stirring, and then organic material was skimmed off with a 1/16-inch screen.

Separation of the sediments into grain sizes was accomplished through the use of standard geologic sieves sizes in Table 5.01. This table illustrates the three grain sizes and the type of sediment for each sieve size. The No. 12 sieve catches the very coarse sand grains and material larger than 1.7 mm in diameter; the No. 35 sieve separates the coarse sand, and the No. 100 sieve retains the medium and larger fine sands, i.e., particles greater than 0.15 mm in diameter. The remaining sediments, those not caught in the sieving process, were stirred vigorously and allowed to settle for 16 minutes. After the water was siphoned off, the particles in suspension were very fine silts and clays, while the settled material consisted of larger silt particles (Table 5.02).

All samples were dried completely in an oven set at 225°F. Each of the samples was then weighed to 0.01 g. To determine the weight of the very fine silts and clays the weights of the heavier fractions were summed, and the remainder was taken to be the silt and/or clay weight, plus any error in the procedure.

The data collected were the weights of each fraction for each sample. The fractions were: Very Coarse Sand, Coarse Sand, Fine Sand, Silt, Clays and Fine Silts, and Flotation Material. In the analysis to follow, a Time element was estimated by coding the excavation level number most representative of each sample.

A principal components analysis (Nie et al. 1975:479) was used to expose the sedimentary processes active at the site (Table 5.03). Three components had eigenvalues greater than 1.0, and accounted for 85% of the variance in the samples. Communality, with one exception, ranged above 86%. The one exception was the flotation material with only 42% of the variance accounted for. The lack of data for the flotation variable in the Zone V sample may be the reason for this anomalous result.

A preliminary examination of the components suggests that they can be assigned to essentially geomorphic and climatic causes. Sedimentary Process I pertains to the elevation of the sediments. Sedimentary Processes II and III seem to relate to climate and vegetation.

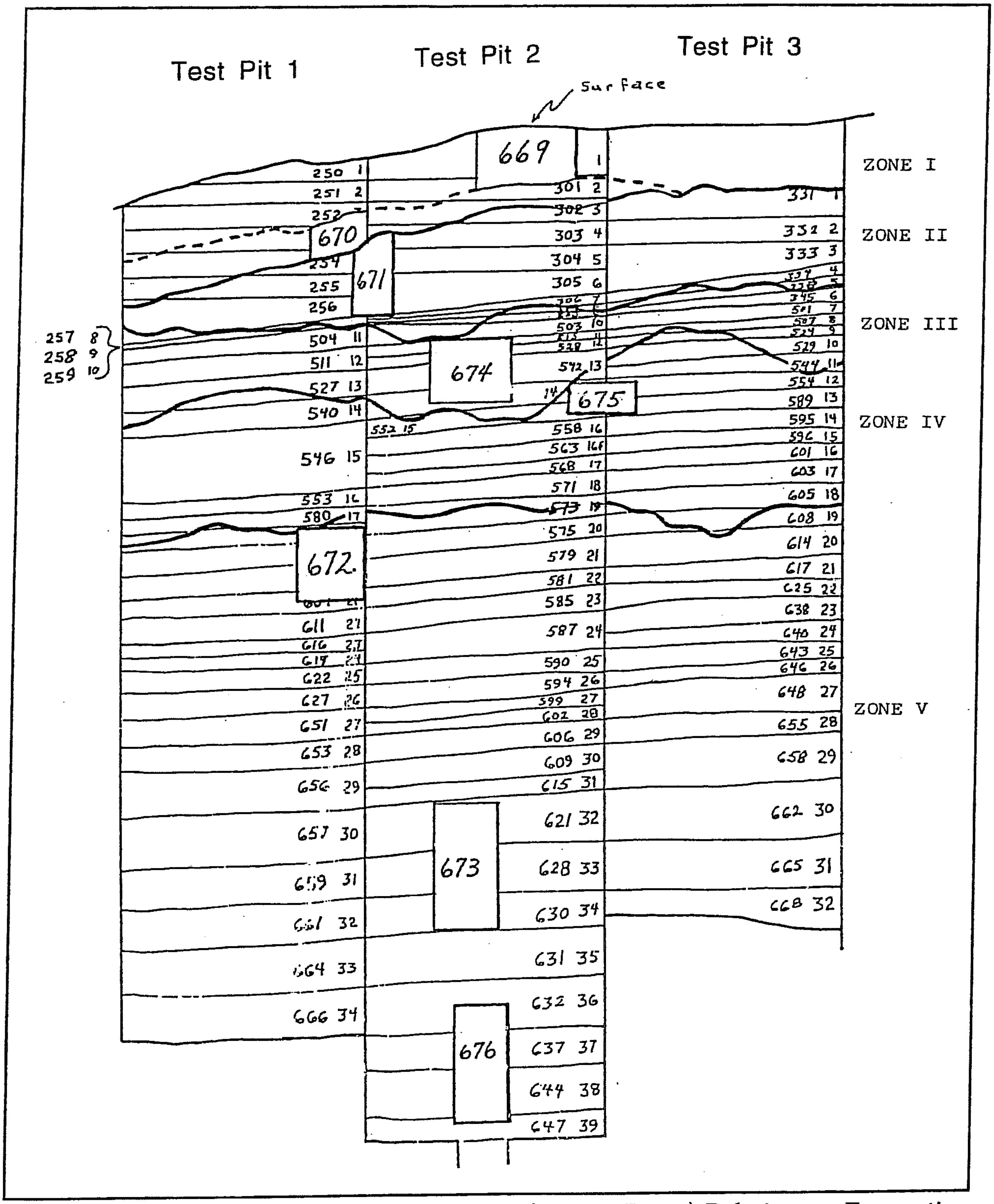

Figure 5.02. Locations of Sediment Samples (FNs in Boxes) Relative to Excavation Levels (Level FNs and Sequence Numbers).

TABLE 5.01. SIEVE SIZES USED IN THE MOCCASIN CONFLUENCE ANALYSIS

Type	Size (mm)	American Standard Sieve Size	
		Sieve Size (mm)	Mesh No.
Gravel:			
Boulder	≥ 256.00		
Cobble	64.00		
Pebble	4.00		
Granule	2.00		
Sand:		1.70	12
Very Coarse	1.00		
Coarse	.50	.50	35
Medium	.25		
Fine	.125	.15	100
Very Fine	.063		
Silt:			
Coarse	.031		
Medium	.022		
Fine	.013		
Very Fine	.0039		
Clay	< .0039		

Source: Tickell 1965

TABLE 5.02. PARTICLE SIZE SETTLING TIMES

Particle Size (mm)	Withdrawal Depth (cm)	Time Hours	Minutes	Seconds	Grain Type
0.062	20			58	Very Fine Sand
0.044	20		1	56	
0.031	10		1	56	Coarse Silt
0.022	10		3	52	Medium Silt
0.015	10		7	42	
0.011	10		15	0	Fine Silt
0.008	10		31	0	
0.006	10	1	1	0	
0.0039	10	2	3	0	Clay
0.003	10	4	5	0	
0.0019	10	8	10	0	
0.0014	10	16	21	0	
0.0009	10	32	42	0	

Source: Shackley (1975)

TABLE 5.03. UNROTATED PRINCIPAL COMPONENTS LOADINGS FOR PARTICLE SIZE ANALYSIS

Variable	Sedimentary Process I High Bank	Sedimentary Process II Humidity	Sedimentary Process III Aridity	Communality
Time	-0.49	-0.75	0.24	0.86
Flotation Material	0.56	-0.23	-0.23	0.42
Very Coarse Sand	-0.4	0.57	0.67	0.93
Coarse Sand	-0.89	-0.29	-0.29	0.96
Fine Sand	-0.39	0.78	-0.38	0.90
Silt	0.92	-0.04	0.39	1.00
Fine Silt and Clay	0.89	0.08	-0.28	0.88
Variance	0.47	0.24	0.15	0.85

Important loading > 0.40

Geomorphic Process

Sedimentary Process I (SED I), accounts for 47% of the variance, and exhibits a negative loading between all sand sizes, and the Silts and Clays. Since Time (level) correlated with sands, there is downward coarsening of the sediments. It will be referred to as the "High Bank" process. This means that as the sediment piles higher, more energy is required to lift suspended sediments onto the bank. We would expect to see a progression of finer sediments as the bank grows higher in relation to the normal river level. This expectation is fulfilled in Sedimentary Process I.

An additional force shaping the High Bank process is channel movement. Sediments deposited at the confluence have pushed the main course of the Pedernales River northward, while moving Williams Creek to the east. As Brown noted above, archaeological surface features, as well as occupation frequencies (see Kerr, chapter 6) seem to support a bed shift. The high negative loading of Sands compared to Silts and Clays suggests that the depositional environment was changing through time in logical concert with channel shift. The sample from the lowest strata contained 127 g of Coarse Sand, more than all the other samples combined. Apparently during this earliest period the Pedernales River was very close to the site. As the channel moved away, fine sediments were more frequently deposited by overbank flooding.

Climatic Processes

With the basic geomorphic process of High Banking factored out, it is likely that the remaining two components are products of subtler biotic and climatic processes. Schumm (1965) has described principles of climatological, hydrological, and vegetational interaction and the sedimentary processes they produce. The effectiveness of these principles was tested and found to be workable on the Colorado River by Baker and Penteado-Orellana (1977). And since the Pedernales River is a tributary of the Colorado River, these principles may again be applicable.

Long-term climate on the Gulf Coastal Plain seems to be controlled by two principles to judge by analysis of modern climatic data (Gunn 1981, 1989; Gunn and Prewitt 1985). The first principle (P1), is that as the average temperature of the Northern Hemisphere increases, rainfall shifts from small amounts in the winter, through larger amounts in the spring and fall to very large amounts in the summer. The spring rains are most beneficial to vegetation while torrential summer rainfall is destructive. Also, winter precipitation is less than fully advantageous. Summer rainfall appears to be associated with arid climate, spring rains with humid climate, and winter precipitation with steppic climate.

The second principle (P2) is that as the average temperature of the Northern Hemisphere approaches 15-16°C. an optimal balance develops between evaporation off the Gulf of Mexico, cloud cover, evapotranspiration, and Arctic frontal activity to produce a Moisture Optimum. This condition is associated with a year-round, warm, moist climate. In the following discussion, we will attempt to determine if the sedimentary processes can reasonably be assigned to one or the other of these principles.

Sedimentary Process II (SED II, Figure 5.03) accounts for 23.7% of the variance in the samples. Very Coarse and Fine Sands correlated negatively with Time (see Table 5.03). Two processes can be suggested to account for coordinated behavior of sediments as different as Very Coarse Sand and Fine Sand. First, the increase of Fine Sand in the upper levels is probably indicative of increasing eolian deposition. The grain size of Fine Sand falls in the average transportable grain size for windblown materials. If the Fine Sands were the product of alluviation from the Pedernales River, there would be an increase in the amount of Silts and possibly Clays, but this is not the case.

	- <-------------------------------------	-------------------------------------	-------------------------------------> +
Climate	Year around Humidity	Intermediate Hum/Arid	Year around Aridity
Sediment	small quantities: Very Coarse Sand Fine Sand		large quantities: Very Coarse Sand Fine Sand
Dominant Process	Probably Alluvial Implied		Colluvial &/or Eolian

Figure 5.03. Sediments, Processes, and Implied Climate for Humidity/ Sedimentary Process II.

The increase in the amount of Very Coarse Sand indicates a second process in relation to the depositional environment. The Very Coarse Sands in the upper part of the section are so high it is unlikely they were deposited by the river. However, the Very Coarse Sands on the knoll to the south of the confluence are accessible. There are deep colluvial deposits of these sands at the base of the slope below the knoll. This, also, suggests that the sands were deposited colluvially from the knoll.

Increased eolianation with sparse vegetation cover implies a xeric climate that would have facilitated the movement of the Very Coarse Sands downslope. In particular, periods of episodic rainfall would have encouraged colluvial movement of the sands. Once again, the lack of correlated Silt and Clay suggests that deposition was not from the Pedernales River, but from the up slope area to the south.

We will assume for now that Sedimentary Process II represents the essential contrast between arid climate at one end (+) and humid climate at the other (-) (see Figure 5.03). It is an index of P2, the Moisture Optimum principle. This Arid-Humid continuum should correlate with other similar indicators, a topic that will be addressed in the next section of this chapter.

Sedimentary Process III (SED III, Figure 5.04), accounts for 14.7% of the variance. It was the only non-Time-related component. Very Coarse Sands and Silts correlated negatively against Fine Sands (see Table 5.03). The Silts can be taken to represent flooding. Heavy rains upstream would both increase the bed load and send the river over its banks. Once over the banks, the loss in velocity would result in deposition. Brown's discussion above suggests that the Silts would have been deposited from Williams Creek, while the Coarse Sand could have been brought in by the Pedernales River. However, sudden summer rains tend to be associated with arid climate and, by inference, sparse vegetation on the Coastal Plain (Gunn 1981). It is equally likely that the Coarse Sand was deposited as the result of slopewash from the sandy knoll to the south, as discussed previously.

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Climate	Aridity without floods, cool summers?	Aridity with summer floods
Sediment	Fine Sand	Very Coarse Sand Silt
Process	Eolian	Colluvial Flooding

Figure 5.04. Sediments, Processes, and Implied Climate for Aridity SED III.

The negative relationship of Very Coarse Sand and Silt to Fine Sand implies eolian activity without colluviation, indicating cool and dry climate (see Figure 5.04). The complementary relationships in Sedimentary Process III fit P1 very well. When average temperatures of the Northern Hemisphere rise above the Moisture Optimum, general aridity with summer flooding becomes the mean climate. These conditions would most resemble a warm steppe or desert. With movement of sediments during summer rains, which are in part related to the uplift of the Balcones Escarpment (Gunn and Prewitt 1985), the regime resembles the standard Basin and Range pattern of the Southwest.

The aridity without floods, which complements the above, probably represents the lowering of Northern Hemisphere temperatures below the Moisture Optimum. Reduced temperatures of sea water in the Gulf of Mexico reduce the amount of moisture. Rainfall is primarily off the Pacific in winter and not in great quantities. The more energetic atmospheric movements of cooler global climate stir the dust of the attendant cool steppe. The climate is probably that observed by Spanish Colonial period explorers and missionaries in Southcentral United States during the Little Ice Age (Gunn and Frkuska 1982).

To summarize, then, there appear to be three underlying processes that governed deposition of sediments at Moccasin Confluence. The first is High Banking, Sedimentary Process I, which is a natural result of increased depth of the sediment pile and is of little interest to this study except insofar as it is desirable to factor it out of the climatically related processes that it masks. The second process (Sedimentary Process II, Humidity) is associated with the amount of Very Coarse and Fine Sand accumulated by colluvial and eolian forces. It probably is an index of the Moisture Optimum.

The third process (Sedimentary Process III, Aridity) contrasts the movements of Silts and Very Coarse Sands to Fine Sands. Where there was one kind of Humidity, there are two kinds of Aridity, which would be expected from the model. Very dry summers associated with high temperatures and with torrential rainfall would increase the amount of colluvial (Very Coarse Sands) and flood deposits (Silts), and produce a coordinated movement of Very Coarse Sand and Silts. This most likely represents Altithermal and Altithermal-like climates.

The polar opposite of the Altithermal is the cool steppe with only eolian movement of Fine Sands. It can be expected to be associated with lower average temperatures, Little Ice Age-like climates. Dry and cold climates are known to produce eolian deposits from river beds (Saucier 1981) during the winter, and this may be applicable here.

Future research at Moccasin Confluence should include a high resolution examination of the sediment column. The interaction of the processes discussed above should correlate with projected climatic chronology discussed in chapter 1.

SEDIMENTS, GASTROPODS, AND ENVIRONMENT (Nash, Gunn)

Once it was determined that certain components of the sediments reflected climatic variability, these data were integrated with molluscan data (Table 5.04) from the excavation levels to further define the environment of Moccasin Confluence. The hypothesis that guided this effort was as follows: the frequency and size of specific snail species is expected to correlate with the particle size of the sediments and lithic materials that they are associated. Analysis of this mix of sedimentary, human, and biotic measures would provide insights into the climatic conditions contributing to the development of the depositional sequence.

Three species of gastropods were identified. They were the *Helicina orbiculata* tropica, *Polygyra texasiana texasiana*, and *Rabdotus* sp. The gastropods collected from Test Pit 2 were weighed and counted by level (see Table 5.04).

The preferred environment of the *Rabdotus* sp. is arid or semiarid areas such as Northern Mexico and the Southwestern United States (Fullington and Pratt 1974:14). In living specimens, three species of *Rabdotus* are identified. *R. dealbatus* inhabits riparian woodlands. *R. mooreaus* is found in prairie habitats. *R. alternatus* are relatively abundant in mesquite chaparral and is found less often in a prairie type of habitat. They tend to prefer living in bushes and related forms of vegetation where they cling to the bark. During the winter, all species hibernate a few inches below the soil surface. In this study no attempt was made to separate the species, and there is some doubt as to whether they can be separated in non living specimens (R. Neck, personal communication). A strategy for analysis of *Rabdotus* sp. will be discussed later.

TABLE 5.04. GASTROPOD ORIGINAL DATA

LEVEL	FRAG WT	RAB NO	RAB WT	POLY NO	POLY WT	HEL NO	HEL WT
1	.11	2	.95	1	.11	1	.11
2	.11	0	.00	3	.30	2	.20
3	.06	3	1.20	2	.20	2	.15
4	.44	1	.07	0	.00	6	.30
5	.10	0	.00	0	.00	3	.30
6	1.15	0	.00	0	.00	5	.70
7	9.90	0	.00	22	2.56	37	7.10
8	1.40	2	1.77	5	.40	9	1.30
9	.22	1	1.10	7	.60	19	3.30
10	44.74	8	3.89	63	6.19	185	29.80
11	.65	5	4.60	2	.19	6	1.00
12	4.80	17	1.63	112	8.90	121	20.62
13	10.70	32	26.70	363	28.20	447	73.24
14	13.26	23	20.20	235	21.88	290	48.60
15	8.33	14	12.60	118	10.36	143	23.80
16	17.30	25	26.32	181	15.70	210	35.14
16.5	12.92	27	27.62	139	12.11	136	24.58
17	16.69	32	41.57	170	14.57	167	29.90
18	25.39	41	45.00	209	19.05	180	32.55
19	30.61	17	17.07	107	9.70	106	18.18
20	30.61	23	27.49	133	12.30	84	15.55
21	13.20	21	16.24	61	5.66	57	9.89
22	26.52	20	16.88	120	10.92	65	11.46
23	7.34	1	2.24	18	2.43	20	3.94
24	12.45	9	7.96	37	3.52	17	3.53
25	28.28	32	45.04	52	4.56	24	4.00
26	1.31	3	3.64	2	.17	4	.75
27	0.00	1	.31	1	.11	0	.00
28	10.28	28	44.64	20	1.92	0	.00
29	.80	0	.00	20	1.80	4	.60
30	2.76	0	.00	8	.88	8	2.80
31	.00	4	8.96	0	.00	0	.00
32	14.00	16	15.80	136	10.16	0	.00
33	7.60	20	4.40	160	11.72	24	4.52
34	11.60	4	1.88	124	8.88	0	.00
35	9.68	12	1.28	276	18.92	44	6.76
36	20.00	8	2.80	64	4.44	4	.88
37	3.40	0	.00	8	.56	32	4.12
38	4.96	8	5.48	24	1.56	52	8.00
39	1.16	8	6.04	0	.00	12	2.04

Polygyra, by contrast, is found in prairie-forest ecotones, but not in deep woodlands or open prairie. They are primarily characterized as snails of humid country by Pilsbry (1940), and tend to live under dead wood, leaves or stones, and only come out at night or during rain. As with all snails they adapt to drought by sealing their apertures to prevent water loss (Cheatum and Fullington 1973). Survival in a given area depends on drought being shorter than the period individuals can survive in this dormant state.

Helicina is a species that ranges over most of the state of Texas, with the exception of far west Texas. Weeds and grasses in pasture lands, as well as protected woodland regions, are its preferred habitat. In the Dallas region *Helicina* has been observed ascending hackberry and elm trees (Cheatum and Fullington 1973), and, as with *Polygyra*, it possesses a certain amount of ability to survive short term drought.

Land gastropods have been used in the past to provide general environmental information. It has, however, been difficult to obtain precise climatic information from snail data due to nonspecific identification and probably their drought resistance. Sealing off their aperture to preserve internal moisture, they suspend growth and reproduction and become dormant.

We tried several ideas to see if reasonable climatic sequences could be obtained from the snails. In all experiments we assume that snails are a part of a multicausal system and that frequencies, weights, etc., must have non relevant patterns controlled out or partialled before climatic responses will become apparent. For example, the climatic component in snail frequencies cannot be observed until the effects of human occupation frequency have been numerically controlled; humans and snails apparently live in a positive feedback relationship.

We first tested the hypothesis that, if the snail species have preferred habitats, then the ratios between species should vary in accordance with changes in vegetation, that are governed by climate. *Rabdotus* is presumed to be more frequent in a drier climate, and *Polygyra* and *Helicina* more frequent in moister environments.

Second, we tested the idea that the size of snails responds in a general way to climate. Longer dry seasons or generally drier conditions would overtax the snail's drought-resisting capabilities, or simply reduce the amount of time for growth during the lifetime of snails. The net result, whatever the intervening causal factors, would be smaller average size in the population. R. Neck advises that this strategy is more applicable with *Polygyra* and *Helicina*, which have determinate growth, and is in theory less applicable to *Rabdotus* in which size analysis is complicated by indeterminate growth. The *Rabdotus* indicator is further complicated by the multiple unidentifiable species problem mentioned above. In this preliminary experiment we proceeded with the simple size/climate assumption with the understanding that during future research it would be desirable to tailor recovery and analysis methods to this design. This would include recovery of micro and small snails and attempts to speciate the *Rabdotus* population.

The second hypothesis, that of snail size, seemed to be most productive with this data set. This may be in part due to the fact that the snails were collected from 1/8-inch dry screens, and the largest specimens would have been those often recovered. Wet screening with 1/16-inch screens would, without a doubt, yield a better collection capable of sustaining a more sophisticated analysis. Because of the method by which they were collected, the sample represented the upper end of the size range for Moccasin Confluence snails, and this may account for the better results obtained from the simple size hypothesis.

The principal components analysis that was calculated using the weight of snails appears in Table 5.05. The average snail size seemed to yield a reasonable analysis according to what is known about snail habitat preference. The correlated behavior of *Polygyra* and *Helicina* was as expected since they are reported to prefer moister conditions. The fact that *Rabdotus* are on another component indicates that it varies independently of *Polygyra-Helicina* rather than in a complementary fashion, which would be the case if they were on the same component but negatively correlated. Thus, the presence of small or large *Rabdotus* does not predict the size of the other two species. This complicated set of relationships may account for some of the frustration of previous attempts to use snail data as indicators of climate.

TABLE 5.05. AVERAGE SNAIL SIZE PER EXCAVATION LEVEL: UNROTATED PRINCIPAL COMPONENTS ANALYSIS

	SNAI	SNAII	Communality
Level	-.27	.61*	.44
Rabdotus Av.	-.05	.83*	.84
Polygyra Av.	.78*	.32	.58
Helicina Av.	.77*	-.05	.59
Variance	.32	.29	.61

* indicates an important loading.
SNAI - Rabdotus and Level
SNAII - Polygyra and Helicina

ANALYSIS OF SNAILS AND SEDIMENTS (Gunn)

Since we are assuming that both snails and the sediments are related to the cultural and environmental system, analyzed together they should provide independent and mutual verification of environmental changes. To accomplish this the component scores (Nie et al. 1975:479) from the analysis of sediments—High-Bank (SED I), Humidity (SED II), Aridity (SED III), and the analysis of snails—*Rabdotus* and Level (SNAI), and *Polygyra* and *Helicina* (SNAII)—were joined into the same data set. Also, the lithic debris weights discussed in chapter 6 were included in the analysis as an indicator of the occupation intensity. This controls for any effect of humans on snail frequencies.

ENVI Human/Humidity. Component ENVI (Table 5.06) indicates a tendency for human occupation to increase with humid conditions. *Polygyra-Helicina* (SNAI) show no favorable response to humidity, and *Rabdotus*-Level (SNAII) have a strong negative response. The modest loading of the Aridity factor (SED III) indicates that occupation of Moccasin Confluence during periods of warm steppic or desert climate has something in common with periods of extreme humidity. Perhaps human activity increases near the stream as the uplands become more desiccated, or there is a real increase in population during arid intervals. A negative loading with *Rabdotus*-Level (SNAII) indicates that the pattern is late. Knowing which species of *Rabdotus* are present would be extremely helpful for the interpretation of this pattern. Presence of a prairie or riparian habitat would determine the model. As it is, it remains ambiguous.

TABLE 5.06. SEDIMENTS, SNAILS, AND LITHIC DEBRIS (UNROTATED PRINCIPAL COMPONENTS ANALYSIS)

	ENVI	ENVII	ENVIII	Communality
SED I High-Bank	.01	.32	.94*	.98
SED II Humidity	.86*	.23	.04	.79
SED III Aridity	.42*	-.76*	.18	.79
SNAI *Polygyra-Helicina*	.20	.77*	.01	.63
SNAII *Rabdotus*-Level	-82*	.48*	-.09	.91
Lithic Debris	.73*	.50*	-.27	.86
Variance	.36	.30	.17	.83

* indicates an important loading

ENVII Human/Cool Aridity. Component ENVII shares the variance in lithic debris with ENVI; note important loadings on both components. This indicates that there were two independent human responses to differing climates rather than one in which they withdrew in the face of adverse climate. Both snail components (SNAI and SNAII) show increases in the size of snails associated with human occupation. The component has a negative relationship to the Aridity factor (SED III). This means that it pertains to human occupation during periods of cool steppe rather than hot steppe or desert. It is probably associated with Late Holocene bison hunters. There is a related spectacular increase in occupation debris at both Moccasin Confluence and Hop Hill during the early Late Archaic (see chapters 3 and 4).

Component ENVIII relates only to the High Bank (SED I) phenomenon and is not relevant to our concern here.

HOLOCENE CLIMATE AND CULTURE CHANGE

In the next few paragraphs we will attempt to relate the climatic sequence generated by this analysis to the central Texas archaeological sequence. For the sake of simplicity in comparing the components with the archaeological periods, ENVI will be referred to as the "Humidity" factor. It will be taken as an indicator of year-round humidity (positive) and aridity (negative). ENVII will be called the "Aridity" factor and indicates the type of seasonal drought. Its positive pole is winter drought with torrential summer rainfall. Its negative pole is summer drought associated with cooler climate.

The component scores for the Humidity and Aridity factors are plotted over the projection of climate discussed in the introductory chapter (Figure 5.05). Since no radiometric dates are yet available from Moccasin Confluence, the temporal correlation of the two chronologies is based on dates and diagnostics used by Prewitt (1981). While there seems to be a convincing coherence through the section between dates and diagnostics, the correlations have to be regarded with caution until independent confirmation of the dating is available. To achieve the correlation, period boundaries were established, and levels were apportioned increments between boundaries according to their relative thicknesses. This procedure assumes stable deposition rates during periods. The correlations are particularly tenuous at the bottom of the section since we have no way of knowing the date of the initial occupation of the site. An assumption was made that the Clovis-age occupation began at about 12,000 B.P. Levi Rockshelter (Alexander 1963) indicates that this date may be late.

In overall perspective it is interesting that the Humidity and Aridity factors cross at 4600 B.P. (see Figure 5.05). Around 4500 B.P. is a frequently mentioned date in prehistory that generally has to do with the beginning of the Late Holocene round of cultural activity. For instance, the old central Texas Archaic chronology began at about 4500 B.P. In most regions of the Southeast, the Late Archaic, explosively populated with intensive collectors who laid the groundwork for later sedentary developments, began during the third millennium B.C. This crossing in the graph suggests fundamental change in climatic conditions, a moistening of the environment and a shift away from Middle Holocene winter droughts.

Correlated the way they are, the samples collected during the 1982 field season span from about 5000-1500 B.P. with an 800-year break between 2900 and 2100 B.P. The Humidity factor during this period shows a moistening trend to the 3000-2000 B.P. period, followed by a sharp drop in moisture during the Late Archaic. Since the Late Archaic represents a stagnation and retraction of the Middle Archaic pattern, the cultural and climatic chronologies seem to correlate logically. Also, the Late Holocene moist period defined by Baker and Penteado-Orellana (1977) and referred to by Gunn and Prewitt (1985) as the "Colorado Subpluvial," corresponds to the period of moisture defined by the Humidity factor. The three lines of evidence make a compelling case for a moist Middle Archaic and a changed Late Archaic.

They also fall during a period of stable and moderate volcanic activity and moderate global average temperatures, an 800-year period from about 2800 B.P. to 2100 B.P. During this time the climate model projects climatic conditions as being in the Moisture Optimum, a fourth independent line of evidence supporting the condition.

The Late Archaic is marked by a precipitous shift toward aridity on the Humidity factor. It is also notable for an extreme shift toward cool steppic climate on the Aridity factor. Dillehay (1974:183) documents the presence of bison in Texas during this period, as does the faunal material from Moccasin Confluence. This is the period of maximum occupation at Hop Hill, which is suggested in this report to be an overlook to bison fording the Pedernales River below the Johnson ranch house. Confluence.

Again, several lines of independent evidence support such a climatic regime. The climatic projection suggests that the cause is a period of substantially increased volcanic activity.

A comparison of sediment-snail responses at 3800 and 1900 B.P. indicates that responses to volcanicity were more radical during the period after the Moisture Optimum than before it.

The Humidity factor is consistently at or below the mean in the Early and Middle Holocene. In sample 6 the trend in Humidity is downward from the San Gabriel Subpluvial to the San Antonio dry interval. The Aridity factor is toward the warm steppe and/or desert end of the continuum which is as it should be. The response is not of the magnitude as that at 1800 B.P. The sampling may have obscured some of the magnitude. The problem of the Early to Middle Holocene transition deserves further research at higher resolution (Gunn 1996).

The relative aridity of central Texas during the Clovis period is of interest. A model based on reactions of the climate in the Southern Plains and central Texas to the Chichon volcanic eruption of 1982 predicts that central Texas would have been dried and the Southern Plains moistened by the highly volcanic Clovis period (Gunn 1983b, 1992). The Clovis period on the Plains is already known to be moist according to Wendorf (1975) and Bryant and Shafer (1977). This evidence can be taken as partial confirmation of the central Texas aspect of the problem.

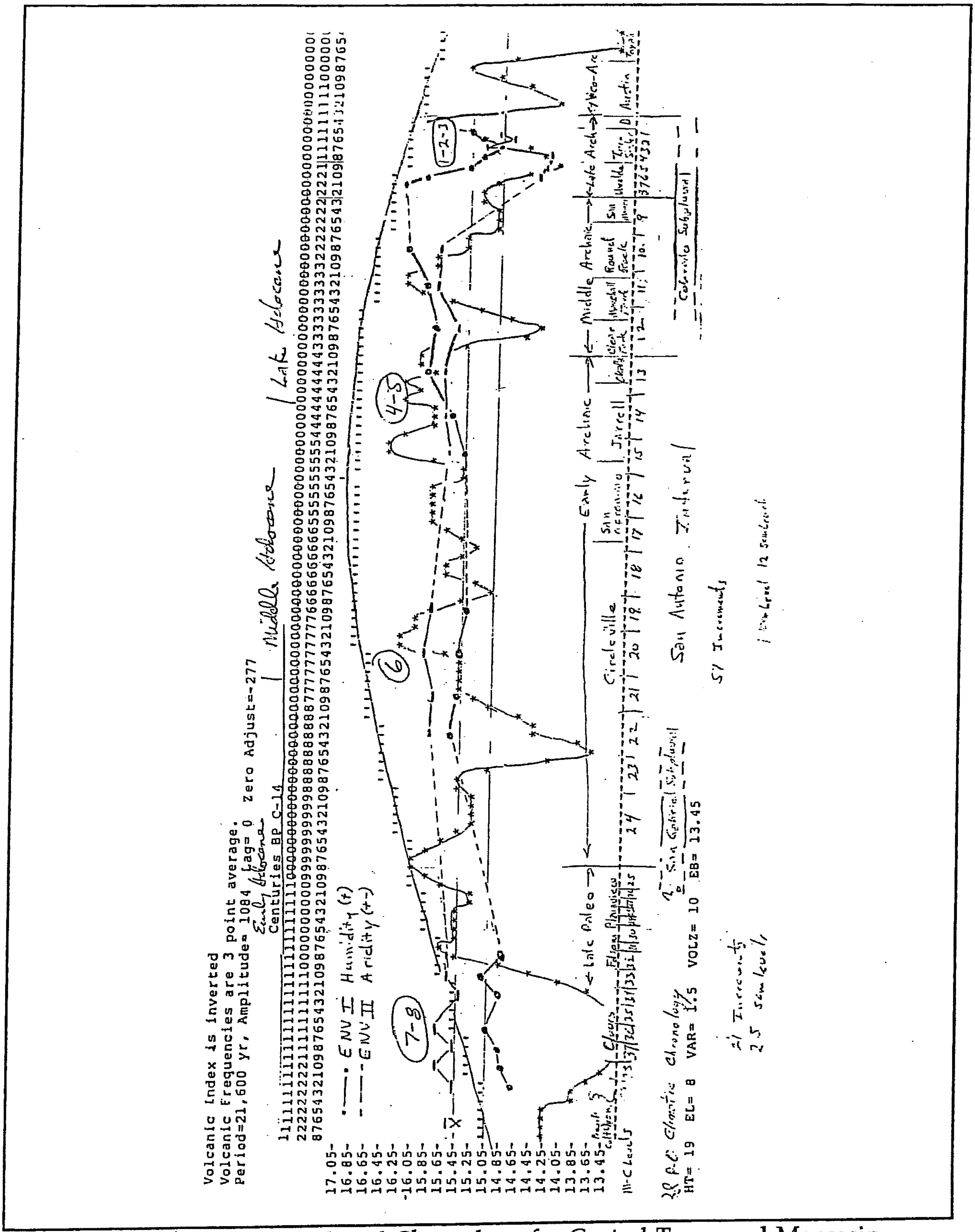

Figure 5.05. Climate and Cultural Chronology for Central Texas and Moccasin

CONCLUSIONS

The Moccasin Confluence site is a deeply stratified site in the Edwards Plateau that has substantial geomorphological and climatic significance for the study of culture and climate change in the Late Quaternary. The study of sediments and snails through use of numerical analysis shows that, once non relevant factors are controlled out of the data, logical and convincing trajectories of climatic change can be drawn. The climatic trajectory indicates that centered about 4500 B.P. is a period of pivotal change from Early-Middle Holocene climate to Late Holocene climate. The samples that have been analyzed to date, coarse as they are, indicated a much more precipitous climatic pattern change in the Late Holocene, especially as pertains to global volcanicity. Such a pattern implies an equally precipitous pattern of cultural changes.

CHAPTER 6—CHRONOLOGICAL DEMOGRAPHY: VERTICAL CONCENTRATIONS OF LITHIC DEBRIS FROM MOCCASIN CONFLUENCE (Kerr)

It required many millennia for successive human occupations to create the Moccasin Confluence site (41 BC 71). It is equally likely that it will take several reoccupations by archaeologists to gather sufficient data to understand all of the cultural processes that formed the site. The effort began with the 1982 test excavations. The present task is to evaluate what was recovered before proceeding with more excavations. This study involved the calculation of the vertical concentrations of lithic debris from three 1- x 1- m test pits. The test pits were located in order to examine various salient features of the site as is explained in chapters 2 and 3.

Once the vertical concentrations of lithic debris were determined for the three test pits under study, a comparison between pits was made to locate areas of occupation intensity. This analysis presupposes that lithic debris concentrations can be used as indicators of horizontal and vertical occupation intensity. We were interested to see if the camp locus changed through time and, if so, whether the change resulted from random movements or purposeful shifting. This was to be done by comparing chronologically equivalent modes on test pit histograms representing vertical debris frequencies. Modes showing similar relative frequencies of debris would indicate random camping at the site; uncorrelated modes would denote a purposeful shift. The trend across test pits with the highest concentrations would indicate the horizontal direction of the shift.

The random and/or systematic shift hypothesis was suggested by shovel tests conducted just prior to the excavation of the 1-m^2 test pits. Artifactual materials from the shovel tests indicated that older artifacts were coming from the southern (upstream along Williams Creek, Figure 3.01) portion of the site, and later materials were appearing further north. Furthermore, the geomorphologist (Brown) indicated that the channel of the Pedernales River shifted to the north as sediments deposited by Williams Creek accumulated at its confluence with the Pedernales River. The implication drawn from this was that the focus of occupation should have shifted northward with time. It was hoped that the analysis and interpretation of the concentrations of lithic debris would lend support to these tentative observations.

METHOD

The three test pits that were studied are designated by the numbers 6, 4, and 2 (see Figure 3.01). Test Pit 2 is located the closest to Williams Creek on the west bank and has the lowest surface elevation of the three units. Test Pit 4 is 47 m northwest of

Test Pit 2 and has a surface elevation 46 cm higher than Test Pit 2. Test Pit 6 has the highest surface elevation, being 3.6 m above Test Pit 2, and is farthest from the creek, 109 m west southwest of Test Pit 2.

"Lithic debris" for this study was defined as a platformed flake or chip weighing under 30 g individually. The debris from each excavation level was weighed as a unit. Then, since the excavation levels were not of equal thickness, the debris weight was divided by the level thickness, producing a grams-per-centimeter index. These indices were plotted as histograms to facilitate comparison (Figure 6.01 and Tables 6.01-6.03).

After the vertical frequency indices were plotted as histograms, a tentative chronology was assigned to each test pit sequence using associated diagnostic point types, which were graciously identified by Elton Prewitt. Prewitt's (1981:75-76) central Texas chronology was used to attribute the chronological periods of Paleoindian, Early, Middle, and Late Archaic to the various levels in the test units.

One problem became immediately apparent. The frequencies of diagnostics were not sufficient to produce the desired precise and refined chronology. This obscured the comparison of debris concentrations in the three test pits. The intended precise correlations of modes on the histograms were not possible, so the comparisons had to be interpreted in a more generalized manner.

DATA

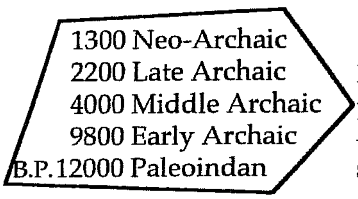

Figure 6.01 is a plot of the vertical lithic debris frequency indices for each test pit. Test Pit 6 has a high debris index in level 10. The presence of a Pedernales point designated this level as Middle Archaic. The succeeding level 9 has a slightly higher frequency and is marked as early in the Late Archaic by a Montell. The debris index drops with level 8, which contained a Castroville, another Late Archaic point. The next three levels remain at the same moderate index level. Level 4, containing a Shumla, begins an upsurge of activity that peaks in level 3. Levels 2 and 1, near the surface, show a rapid decline in debris frequency. Test Pit 6 is in the front yard of a house, and so the upper two levels may have been disturbed.

Test Pit 4 has a low intensity but fairly constant debris index during the Paleoindian period which ends with level 32 where a Plainview was recovered. Level 39 with no flakes or chips is exceptional. Level 30 is notably high in debris. The trend through the Early Archaic is one of an oscillating, but constant, rise in the debris frequency index. It reaches a peak in level 9, which contained a Taylor triangular point, an Early Archaic indicator.

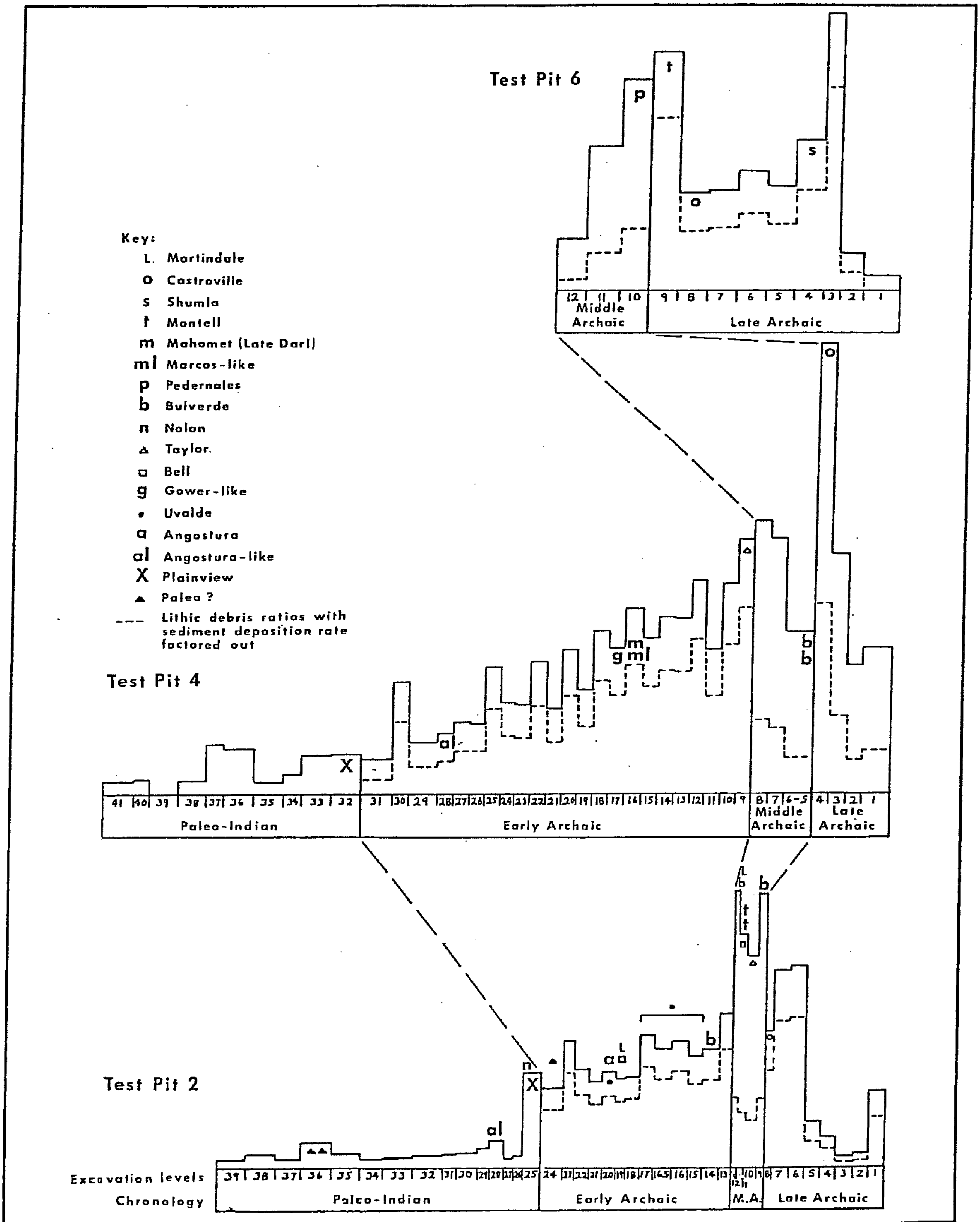

Figure 6.01. Moccasin Confluence Vertical Frequency Indices of Lithic Debris.

A problem was encountered in determining the chronology in this test pit. The presence of later materials mixed with the early materials, particularly those located in levels 14-16, was troublesome. The field notes suggested bioturbation as a probable cause. The field notes have several descriptions of rodent burrows and specifically mention level 14. Microstratigraphic excavation, with the separation of burrow material, would be necessary to determine if the mixing is original to the point types involved or a product of some other sedimentary process such as deflation.

The Middle Archaic in Test Pit 4 is indicated by the presence of two Bulverde points in level 5. The debris from levels 5 and 6 was inadvertently mixed at some point and is represented as an average. There was a consistently high debris frequency in the Middle Archaic. In Level 4 there is a very high debris concentration, the highest at the site. This level contained a Castroville, placing it early in the Late Archaic. This is also the period of most intensive occupation at Hop Hill (chapter 4).

Test Pit 2, like Test Pit 4, has low debris indices for the Paleoindian period. This period extends to level 25 where there is an increase in frequency. Level 25 contained a Plainview point. During the Early Archaic, debris frequencies are considerably higher than the Paleoindian concentrations. Variation through the Early Archaic levels are not substantial. Overall there is a slight increase in debris as in Test Pit 4.

TABLE 6.01. VERTICAL CONCENTRATIONS OF LITHIC DEBRIS IN TEST PIT 6

Periods	Levels	Weight (g)	Level Thickness (cm)	Ratio* (g/cm)	Ratio (g/yr)
	1	0.8	12	0.06	0.002
	2	14.0	8	1.75	0.07
	3	169.9	5	33.98	1.27
Late	4	134.2	10	13.42	0.50
Archaic	5	79.7	10	7.97	0.30
	6	96.5	10	9.65	0.36
	7	73.9	10	7.39	0.28
	8	73.1	10	7.31	0.27
	9	236.1	9	26.23	0.98
Middle	10	215.4	10	21.54	0.28
Archaic	11	135.8	11	12.34	0.16
	12	29.4	10	2.94	0.04

* indicates ratio calculated with deposition rate factored out

TABLE 6.02. VERTICAL CONCENTRATIONS OF LITHIC DEBRIS IN TEST PIT 4

Periods	Levels	Weight (g)	Level Thickness (cm)	Ratio (g/cm)	Ratio* (g/yr)
Late Archaic	1	153.2	10	15.32	0.17
	2	62.9	5	12.58	0.14
	3	163.1	5	32.62	0.36
	4	530.0	5	106.00	1.18
Middle Archaic	5	178.0	10	17.80	0.15
	6	-	-	-	-
	7	178.7	5	35.74	0.30
	8	201.9	5	40.38	0.34
Early Archaic	9	177.8	5	35.56	1.14
	10	131.6	5	26.32	0.84
	11	75.4	5	15.08	0.48
	12	135.2	5	27.04	0.87
	13	99.7	5	19.94	0.64
	14	100.8	5	20.16	0.65
	15	83.7	5	16.74	0.54
	16	107.8	5	21.56	0.69
	17	76.5	5	15.30	0.49
	18	90.4	5	18.08	0.58
	19	48.4	5	9.68	0.31
	20	76.2	5	15.24	0.49
	21	35.5	5	7.10	0.23
	22	67.4	5	13.48	0.43
	23	38.9	5	7.78	0.25
	24	40.0	5	8.00	0.26
	25	63.3	5	12.66	0.41
	26	28.1	5	5.62	0.18
	27	28.7	5	5.74	0.18
	28	22.6	5	4.52	0.14
	29	36.9	10	3.69	0.12
	30	52.9	5	10.58	0.34
	31	19.1	10	1.91	0.06
Paleo-Indian	32	24.9	10	2.49	
	33	23.9	10	2.39	
	34	3.4	5	0.68	
	35	1.1	10	0.11	
	36	32.1	10	3.21	
	37	17.9	5	3.58	
	38	1.2	10	0.12	
	39	0.0	10	0.00	
	40	0.9	5	0.18	
	41	0.9	10	0.09	

* indicates ratio calculated with deposition rate factored out

TABLE 6.03. VERTICAL CONCENTRATIONS OF LITHIC DEBRIS IN TEST PIT 2

Periods	Levels	Weight (g)	Level Thickness (cm)	Ratio (g/cm)	Ratio* (g/yr)
	1	67.4	5.0	13.48	0.23
	2	7.4	5.0	1.48	0.03
	3	4.8	5.0	0.96	0.02
Late	4	22.7	5.0	4.54	0.08
Archaic	5	35.5	5.0	7.10	0.12
	6	249.0	5.0	49.80	0.84
	7	239.9	5.0	47.98	0.81
	8	85.6	3.0	28.53	0.48
	9	161.5	2.0	80.87	0.33
Middle	10	231.3	4.4	52.56	0.21
Archaic	11	135.0	2.2	61.36	0.25
	12	81.2	1.0	81.2	0.33
	13	156.3	4.6	33.97	0.61
	14	139.0	5.8	23.96	0.43
	15	96.3	4.4	21.88	0.40
	16	139.9	5.4	25.90	0.47
	16.5	143.6	6.0	23.93	0.43
Early	17	116.7	4.25	27.45	0.50
Archaic	18	77.0	4.4	17.50	0.32
	19	53.7	3.2	16.78	0.30
	20	83.6	4.6	18.17	0.33
	21	71.9	4.6	15.63	0.28
	22	104.8	5.6	18.71	0.34
	23	103.6	4.0	25.90	0.47
	24	103.1	7.2	14.31	0.26
	25	112.5	6.2	18.14	
	26	3.9	3.0	1.30	
	27	1.9	2.5	0.76	
	28	19.5	5.25	3.71	
	29	8.2	3.75	2.18	
	30	11.1	7.2	1.54	
	31	5.2	4.4	1.18	
Paleo-	32	11.4	9.8	1.16	
Indian	33	8.5	10.0	0.85	
	34	1.8	7.4	0.24	
	35	15.5	9.2	1.68	
	36	36.2	10.0	3.62	
	37	1.4	8.6	0.16	
	38	14.6	9.8	1.48	
	39	3.9	10.0	0.39	

* indicates ratio calculated with deposition rate factored out

The Middle Archaic in Test Pit 2 is not clearly indicated by the presence of characteristic point types. However, Test Pits 1 and 3, located immediately adjacent to Test Pit 2 on the east and west, did contain Bulverde points. (Note: Points in Test Pits 1 and 3 are indicated by symbols placed above the histogram, those for Test Pit 2 within the histogram.) The highest debris frequencies for Test Pit 2 occur in the levels designated as Middle Archaic. These levels also contained a midden of rocks which, according to Prewitt (1981:80), is a characteristic feature of Archaic sites.

The Late Archaic in Test Pit 2 begins with level 8. There was a Castroville point present in this level. Debris concentration drops relatively low in level 5. Succeeding levels contained no diagnostics, so there is no clear upper bound on the chronology at this test pit or the others for that matter.

After the lithic debris concentrations were determined in the preceding manner, it seemed possible that differing rates of sediment deposition through time could contribute to the appearance of high or low concentrations. In essence, a low sediment deposition rate, coupled with repeated incidental accumulations of lithic debris, would lead to seemingly high debris concentrations within excavation levels. As a test, an average sediment deposition rate of years-per-centimeter was calculated for the Early, Middle, and Late Archaic for Test Pits 2, 4, and 6. These sediment deposition rates were factored out of the debris frequency indices. The pattern within periods did not change. However, a different picture of lithic debris concentration (which are indicated as small dashed lines on the histograms in Figure 6.01) emerged between periods. Provided the time spans were properly estimated, the Middle Archaic may actually have a much lower debris frequency relative to the Early and Late Archaic. The phenomenon suggested by the low adjusted Middle Archaic frequencies will be discussed below.

INDICATIONS AND DISCUSSION

Resolution of the problem of whether camp loci were randomly or purposely shifting seems to be resolvable in favor of a purposeful northward shift. Test Pit 2 to the south shows a sudden increase in popularity during Late Paleoindian times. After that, interest in the area remains relatively constant until the latter part of the Late Archaic after which it is largely ignored. Test Pit 4 to the north, and closer to the Pedernales River, shows a sustained increase of attention that culminates with spectacularly high, early Late Archaic frequencies. That the two test units represent two points within one camp area that was repeatedly occupied through time is supported by the fact that the same point types, including Plainview, Angostura, Taylor, Bulverde, and Castroville, occur in both places. The shift, then, probably concerned the changing location of activity areas within the camp from one occupation to the next rather than total relocation of the camp. Test pits further north of Test Pit 4 are needed to determine if the trend continues into later phases.

The Test Pit 6 area seems to be occupied for the first time in the Middle Archaic. The implication is that the camp area may have been expanded outward from the confluence suggesting a larger group was occupying the site. However, such an interpretation needs to be applied cautiously. There is little to support the assumption that the Test Pit 6 area was occupied concurrently with the Test Pits 4 and 2 area during the Middle Archaic. Test Pits 4 and 2 contain Bulverde points and no Pedernales points, and Test Pit 6 contains only one Pedernales point. This suggests that the elevated Test Pit 6 area was occupied at a slightly later time under possibly different conditions than Test Pits 4 and 2.

Also, Test Pit 6 concentrations may not be reflective of actual occupation intensity because the peculiar geomorphic situation, deposition on a knoll, coupled with the sandier sediments, suggest that the area may have been subject to wind (eolian) deposition, thereby disturbing the lithic debris concentration. Precise temporal control of both the upper and lower bounds of the test pit chronology are lacking, so deposition rates could not be calculated with assurance.

Further information to be considered concerning the location of main Middle Archaic occupation comes from a survey and shovel test across Williams Creek on the east side. There was definite evidence of a deep rock midden indicating that the east bank may have been the main locus of Middle Archaic occupation. This implies that the west bank lithic debris concentrations for the Middle Archaic may not reflect actual intensity of occupation at the confluence as a whole. Prewitt (1981) and Weir (1976) indicate that the Middle Archaic was a time of dense population in central Texas. Prewitt (1981:80) cites lithic debris concentrations associated with rock middens as the identifying feature of the Middle Archaic phase in central Texas. Weir (1976:131) hypothesizes the Middle Archaic as a time of increased population with many small groups reoccupying sites more frequently for longer stays. This suggests that high frequencies of Middle Archaic lithic debris should be present. Either the 41 BC 71 sequence, when corrected for deposition rates, is extra ordinary for central Texas or the other side of the creek was more attractive.

The difficulties encountered during this use of lithic debris concentrations as an occupation intensity indicator prompted many thoughts on the processes by which concentrations were accumulated. All of them have a bearing on interpretation. Accumulation of lithic debris involves several variables including duration of stay, population size, frequency of return to the site, site function, and the nature of the particular tool assemblage. All of these variables would have operated in a systemic fashion. Environmental factors would have affected the relationship, and they would have been changing through time.

Further considerations have to be given to what happens to lithic debris accumulations after the site was abandoned (long before the archaeologists arrive to count them). Erosion by wind and rain has an affect. Rodents can rearrange the debris. A low sediment deposition rate inflates concentrations of lithic debris and therefore needs to be taken into account. All of this makes reliance on lithic debris concentrations alone as an indicator of occupation intensity an imprecise analytical tool. Lithic debris concentrations in concert with frequencies of tools, site boundaries, and as many other clues as it is possible are necessary to indicate intensity of occupation at a particular site during a particular time.

CHAPTER 7—POINT CHRONOLOGY AND SYSTEMATICS (Gunn, Craig)

INTRODUCTION

The art of point analysis has progressed through the efforts of several analysts in the last decade. Thanks to the enduring interest in points, their analysis has come under scrutiny from various perspectives so that such efforts boast a growing body of literature and the status of a subdiscipline. A review of this literature can be followed by reference to Gunn and Prewitt (1975) and Benfer and Benfer (1981). Through a series of studies, ideas about measurement and analysis of points have been refined. In this study we suggest what appears to be a method of measurement and analysis that meets objections raised in previous studies as well as facilitates the study of points from the perspective of a theory of point function. Some of the subsystems of point morphology are time dependent in the LBJ State Historical Park collection.

Until recently most of the efforts to analyze points were essentially atheoretical. The peculiar problems and complexities of point morphology attracted interest in themselves. Little thought, however, was given to the functional implications of those morphologies. In Gunn (1982e) the senior author undertook the development of a theory of point function which is based on physical laws of levers. Such a perspective allows the researcher to examine points as an interacting system of morphological attributes that respond to cultural and environmental preconditions.

In the work cited, it was noted, for example, that in both Texas and Louisiana there are sequences of points that suggest a gradual adaptation of points, changing from dart to arrow weapon systems. The first step in that adaptation was to simply make dart points smaller. This, however, narrowed the penetration swath of points, presumably reducing their effect on game. This was corrected in the second stage of adaptation by exaggerating the barbs on the arrow points. In Texas, this sequence is represented by the Darl-Scallorn-Perdiz sequence; in Louisiana by the Gary-Small Gary- Catahoula sequence. In each case the adjustments are made by rearranging the proportions of the points to match the needs of the manufacturer and the peculiarities of the weapon system. The blade was shortened relative to the width, the stem was shortened relative to the blade, etc.

METHODOLOGY

Specific measurements of base width, blade length, neck width, etc., assume to a certain extent, that the analyst knows the morphological subsystems of point shapes and shape-related function. In this study we attempted to objectively define morphological subsystems (MSS) by numerical analysis. A method of measurement using polar coordinated radii was developed. Measurements made by this method presents a principal components analysis with a continuous array of data on the shape of the points. The principal components analysis then determines the MSS as statistically independent trends in the data. Nie et al. (1975) discuss the principal components method.

The best measurement method was selected by a set of experiments. Three different methods were evaluated by measuring the 39 relatively complete points from stratified contexts in LBJ State Historical Park. The first was the series of measurements used by Gunn (1982e, Figure 7.01a). The second was a set of 14 polar coordinate radii along which measurements were taken to the edges of the points (Figure 7.01b). Both of these produced analyses that in large part ignored the barbs. The final approach was to outline the point on a polar coordinate grid as is illustrated in Figure 7.01c.

This method, which we will refer to as the polar coordinate grid technique, records only half of the point. In other words, it assumes the point is symmetrical. This is a reasonable assumption, given the basically symmetrical nature of points, and it is often helpful since one or the other barbs of a point is frequently broken and has to be reconstructed. Each point was centered on the grid with the horizontal radii marking the blade- haft interface (on Ray 4). The blade-haft interface is the highest point on the tool that shows modification for hafting. In the instances of lanceolates, we follow Kelly (1977) and assume that the haft is no further up the point than the side with the shortest edge grinding.

The rays in the upper left quadrant are spaced at 30° to measure the length of the blade (1), the convexity or concavity of the blade (2,3), and the width of the blade (4). Rays 5-18 are arranged in three fans. They are closer together at the blade-haft interface to emphasize notches, barbs, etc. The locations of the radii are determined by Fibonacci's Series (Borissavlievitch 1958), a geometric series that has found wide applications in esthetics, architecture, etc., and works in this case to concentrate measurements in the turn of the notch. The series used was 5°, 8°, 13°, 21°, 34°, 55°, and 89°. The location of each ray is determined by the sum of the previous two.

Figures 18a-c illustrate the use of the rays to measure points of various styles. The most extended use of the three fans of rays is demonstrated in Figure 18a, the case of the basally notched point. The first fan of rays, 5-8 measure the distances to the outside edge of the barb. The second fan of rays, 9-12, measures the inside of the barb, or outside of the notch. The third, 13-17, measures the stem or inside of the notch. Ray 18 measures the length of the haft.

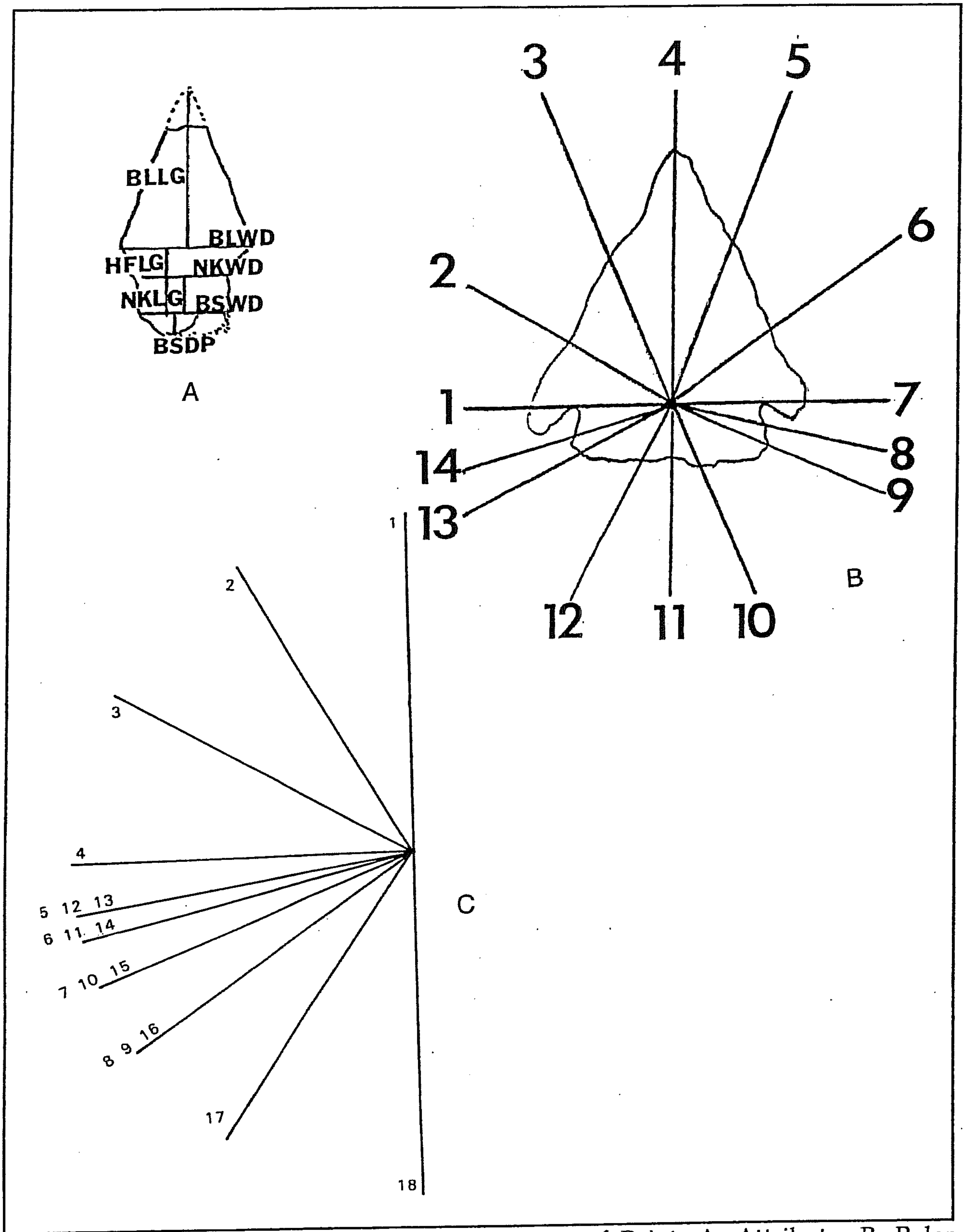

Figure 7.01. Approaches Taken to Measurement of Point; A. Attribute, B. Polar Coordinate, C. Polar Fan.

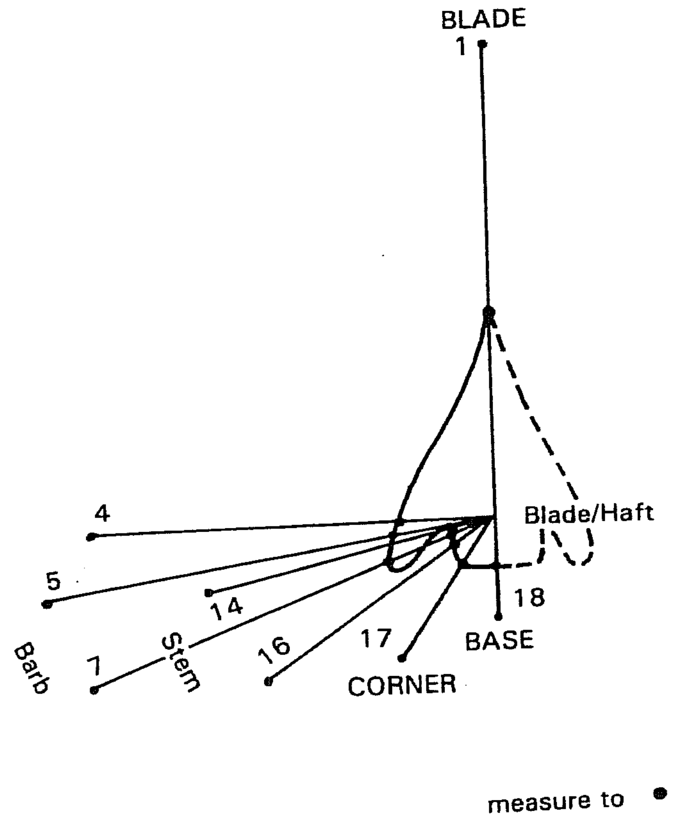

Figure 7.02. Methods of Measuring Three Types of Points with the Polar Fan; A. Basil Notch, B. Corner Notch, C. Lanceolate.

The cases illustrated by Figure 18b-c are less complex in form. In those instances in which the rays cross an inside and outside edge, they function as they did with the basally notched point. Where there is no inside and outside, they assume the same values.

Benfer and Benfer (1981), as well as other investigators who have used the Gunn and Prewitt (1975) system of measurement, noted in their criticisms that angle measurements were difficult to replicate. Also, Benfer and Benfer (ibid.) felt that the angle measurements used in the original system were not completely appropriate. The polar coordinate grid system both dispenses with angles and involves only one judgement, the location of the blade-haft interface. As such it is as heuristic as a system of measurements can be expected to be.

ANALYSIS

Table 7.01 lists the 39 points along with their provenience, type, and presumed period; data appear in Appendix C. Twenty additional points too fragmentary for the analysis were recovered from Hop Hill and Moccasin Confluence during the 1978 and 1982 seasons. To find the systemic interactions of various aspects of point morphology for the LBJ State Historical Park collection, the polar grid data, along with thickness at the blade-haft interface, were processed through a principal components analysis. Each component from this analysis represents an independent process or morphological subsystem (MSS) of the total point morphology system represented by and sampled by the 39 points.

In practice it was not desirable to analyze all 18 rays. With this particular sample, measurements were frequently similar for the whole sample, particularly in adjacent rays. This redundancy or replication of information violates the assumption that measurements are independent of each other, and too much redundancy distorts the analysis. Of the pairs of rays with correlations above 0.80, one was removed. The best pattern of rays to use for analysis of this sample seems to be the list of variables in Table 7.02, the unrotated principal components matrix for the data. Ray 1 characterizes the length of the blade. Rays 5 and 7 measure the outside aspect of the barb, while Rays 14 and 16 indicate the width dimensions of the stem. Note, by reference to Figure 7.02c, that Rays 5 and 7 are not measured on the same radii as Rays 14 and 16. Rays 17 and 18 measure the stem length. Using this combination of rays guaranteed that, even in the case of a lanceolate, no two measurements are at the same location on the edge of the point. This combination of rays seems to eliminate most of the excess redundancy and is adequate for this particular collection. Other combinations of rays may be better for other collections. Each point collection must be subjected to the process of running all 18 radii and eliminating one of each set with a correlation greater than 0.80.

TABLE 7.01. POINTS RECOVERED IN PLACE FROM LBJ STATE HISTORICAL PARK

Sequence	FN	Stage*	Type	Site	Season
1	88	LA	FRIO	41 GL 21	1982
2	232		MARSHALL	41 BC 71	1982
3	233		BELL	41 BC 71	1982
4	234		NOLAN	41 BC 71	1982
5	344	LA	BULVERDE	41 BC 71	1982
6	405	LA	CASTROVILLE	41 BC 71	1982
7	407	MA	BULVERDE	41 BC 71	1982
8	408	MA	BULVERDE	41 BC 71	1982
9	433	EA	MARCOS	41 BC 71	1982
10	442	EA		41 BC 71	1982
11	471	LA	FRIO	41 BC 71	1982
12	486	LA	PEDERNALES	41 BC 71	1982
13	508	MA	MONTELL	41 BC 71	1982
14	510	MA	TAYLOR	41 BC 71	1982
15	513	MA	MONTELL	41 BC 71	1982
16	514	MA	MARTINDALE	41 BC 71	1982
17	517	MA	BULVERDE	41 BC 71	1982
18	522	MA	BELL	41 BC 71	1982
19	537	LA	CASTROVILLE	41 BC 71	1982
20	555	EA	BULVERDE	41 BC 71	1982
21	559	EA		41 BC 71	1982
22	564	EA	GOWER	41 BC 71	1982
23	576	EA	UVALDE	41 BC 71	1982
24	583	EA	MARTINDALE	41 BC 71	1982
25	584	EA	BULVERDE	41 BC 71	1982
26	591	EA		41 BC 71	1982
27	608	LA	ENSOR	41 GL 21	1982
28	623	PI	NOLAN	41 BC 71	1982
29	654	PI	ANGOSTURA	41 BC 71	1982
30	970	LA	SHUMLA	41 BC 71	1982
31	972	LA	FIGUEROA	41 BC 71	1982
32	1007	LA	FRESNO	41 GL 21	1978
33	1016	LA	MONTELL	41 GL 21	1978
34	1030	LA	ENSOR	41 GL 21	1978
35	1042	LA	ENSOR	41 GL 21	1978
36	1048	LA	ENSOR	41 GL 21	1978
37	1081	LA	CASTROVILLE	41 GL 21	1978
38	1127	LA	FAIRLAND	41 GL 21	1978
39	1243	LA	WELLS	41 BC 71	1982

* LA=Late Archaic, MA=Middle Archaic, EA=Early Archaic, PI=Paleo-Indian

TABLE 7.02. MORPHOLOGICAL SUBSYSTEMS (MSS): UNROTATED PRINCIPAL COMPONENTS MATRIX FOR POINTS IN THE LBJ STATE HISTORICAL PARK COLLECTION

	MSS I	MSS II	MSS III	MSS IV	MSS V	Communality	Point Charteristics
Ray 1	.4	-.6	.5	.2	.2	.85	Blade
Ray 5	.8	.0	.1	-.4	.2	.90	Barb
Ray 7	.8	-.1	-.0	-.5	-.1	.90	
Ray 14	.7	-.0	-.5	.4	.3	.93	Stem
Ray 16	.7	-.3	-.3	.5	-.4	.93	Width
Ray 17	.4	.7	.2	-.0	-.4	.89	Stem
Ray 18	.1	.9	-.2	.1	.3	.94	Length
B-H Thick	.2	.3	.8	.3	.1	.89	Thickness
Variance	.34	.22	.16	.11	.07	.90	

Morphological Subsystems

The following paragraphs discuss the characteristics and relationships between the morphological subsystems.

Morphological Subsystem I (MSS I). Except for the thickness and haft length ray (18), MSS I is a typical first principal component that captures size variance; all loadings are positive. With the effects of general size of artifacts removed to MSS I, the rest of the morphological subsystems can be assumed to pertain primarily to shape.

MSS I points with high deviation component scores have both wide stems and barbs (Figure 7.03A). Those points with low deviations component scores have both narrow stems and barbs. The points with scores near zero have other combinations of attributes, i.e., narrow stems and wide barbs, that will have high scores on other MSS pertaining to those trends.

As Table 7.03 indicates, MSS I has a statistically significant relationship to time. The positive beta (correlation) shows that points through time tended to become broader in the haft and lower blade. Such a broadening of the swath, the width of penetration (Gunn 1982e), probably reflects a growing use of points as projectiles rather than knives.

TABLE 7.03. REGRESSION OF MSS COMPONENT SCORES AGAINST CULTURAL PERIODS

MSS	beta	F-value	Probability
II	-.33	4.7	<.01
III	-.31	4.2	<.01
I	.25	2.6	<.05
V	-.16	1.1	>.05
IV	-.13	.8	>.05

Overall F-value = 2.66 (5 x 30 Degrees of Freedom), $p=<.05$, $R^2=.31$, Adjusted $R^2=.19$.

Morphological Subsystem II (MSS II). In MSS II there is a negative relationship between blade and stem length (see Table 7.02). As the blade lengthens, the stem becomes shorter and vise-versa.

The points with long stems and short blades had high positive deviation component scores (see Figure 7.03B). The points with short stems and long blades scored high negative deviations.

The systemic interaction of blade and stem has the strongest statistical relationship to cultural periods of any MSS (see Table 7.03). The negative beta indicates that through time stems become shorter and blades relatively longer. In the perspective of the leverage model, the shorter haft suggests less concern for lateral stress (Gunn 1982e). The longer blades may also suggest less resharpening. Both indicate a decreasing interest in using points as knives, lateral stress and resharpening being more characteristic of knives than projectiles. This correlates with an increased use of flakes as tools (chapter 10).

The analysis suggests that through time, points became specialized as projectile points and their function as knives decreased.

Morphological Subsystem III (MSS III). This subsystem contrasts blade length with the upper stem width (Ray 14). As the blade lengthens the upper stem narrows (see Figure 7.04C). As the blade shortens the upper stem widens. Through time there is a statistically significant tendency for blades to shorten and stems to widen (see Table 7.03).

The pattern is the well-recognized shift from a generalized lanceolate to a triangular pattern.

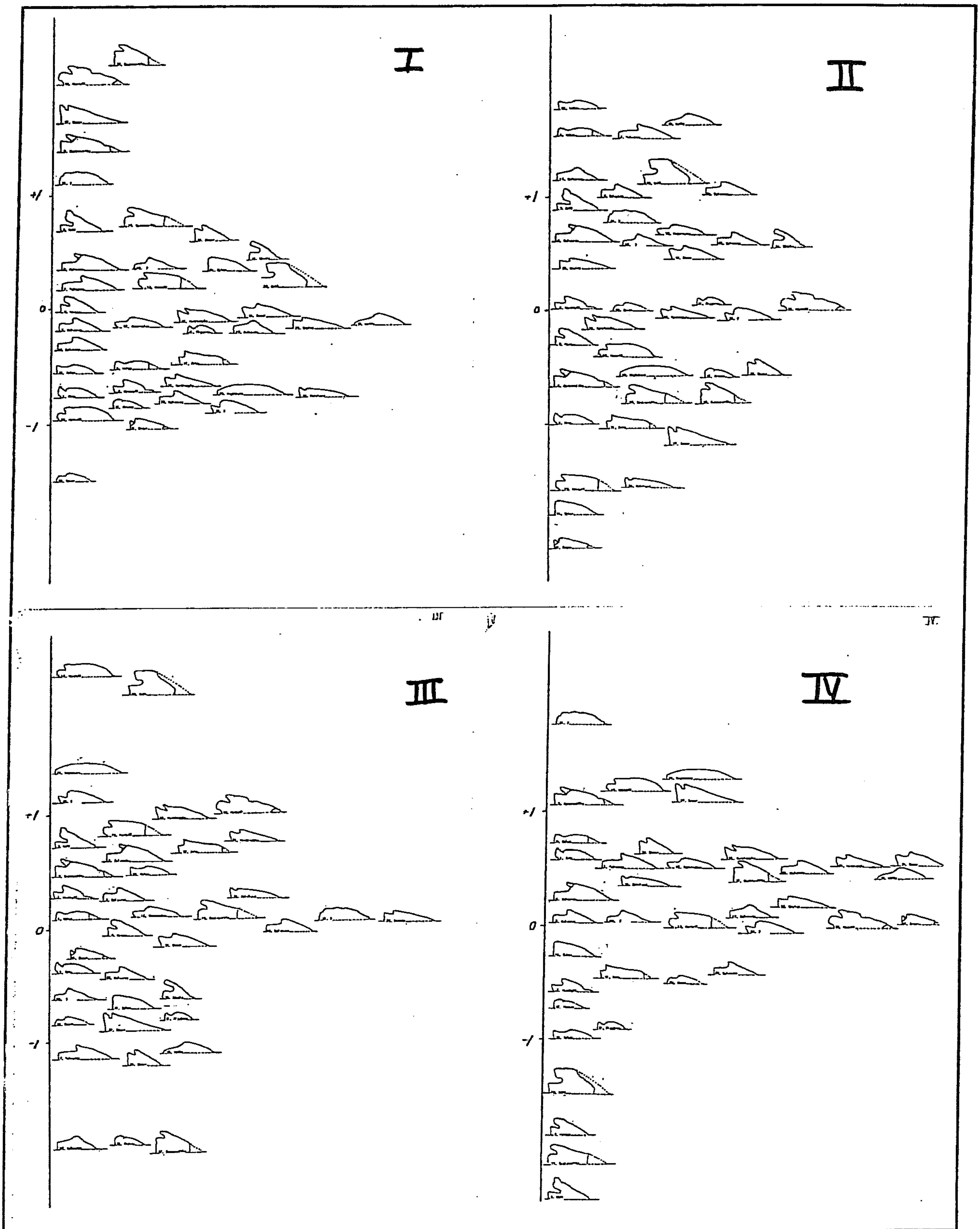

Figure 7.03. Single Dimension Component Score Plots for MSS I-IV (A-D).

Morphological Subsystem IV (MSS IV). As the stem widens the barb shortens. This interesting MSS shows a tendency for width of the stem to interchange with barbs (see Figure 7.03D). Wider points have shorter barbs, while narrower points have wider barbs.

There is no relationship with time (see Table 7.03), which indicates a universal or time-independent relationship or process. It may be either an inherent difference between lanceolates and notched triangles, or it may be that resharpening of barbs produces this phenomenon. Observe for example, the two forms of Gower illustrated by Prewitt (1981:76), one no doubt the result of sharpening the other. Such sharpening sequences are quite common in Late Paleoindian assemblages (Goodyear 1974:26; Guy and Gunn 1983; Gunn 1984).

Morphological Subsystem V (MSS V). This subsystem shows a negative relationship between Rays 16 and 17, and Ray 14. The pattern suggests extension of the lower corner and retraction of the notches and lower stem. Side and basal notching is under-represented in the LBJ collection which probably accounts for the minimal impact of the component on the total system; it only accounts for seven percent of the variance in the data set. It does, however, bear a modest relationship to time (see Table 7.03).

There is a tendency for a segment of the point population to extend the basal corner.

Of the four major MSS it is no doubt important that three are related to time (MSS I, II, and III, see Table 7.03), and therefore, to some sort of cultural and technological evolution in central Texas points. Since the sample is biased toward the Archaic, with only two usable points from Paleoindian levels, it appears that most of this evolution took place in the Archaic. In brief, this evolution consisted of the following trends:

1. Points became wider, both in the blade and the stem.

2. As stems shortened, blades became longer relative to them. This seems to document the transition sequence from lanceolate, to early stemmed, and later to notched triangles that analysts have been aware of for some time.

3. As stems widened, blades became relatively shorter, a process of triangularization of lanceolates.

These trends seem to reflect a specialization of points away from multipurpose knife-projectile lanceolates that were designed to resist lateral stress, toward specialized, wide-swathed projectiles.

A fourth pattern is the retracting of barbs as stems become proportionally wider. Since this pattern has no time trend, it is presumed for now to be the product of variation in the barbs due to manufacturing peculiarities or resharpening.

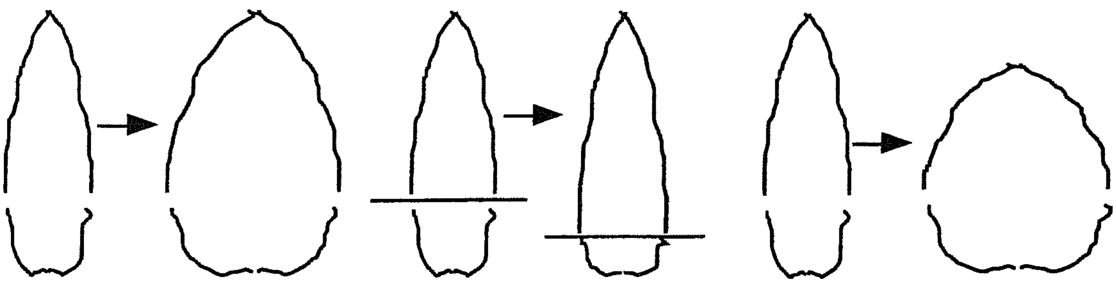

Figure 7.04. Three Tends in Point Morphology.

Component scores for the blade-stem (MSS III on horizontal axis) and barb-stem (MSS IV on vertical axis) are plotted in Figure 7.05. MSS III is one of the most time-dependent morphological subsystems (see Table 7.03). The plot demonstrates some of the strengths and weaknesses of ascribing chronological significance to morphological forms. Castroville points appear in clusters with Bell-Shumla, Martindale-Montell, or Ensor depending on their particular attributes. Ensors on the other hand, occupy a single quadrant of the plot, the upper left. The plot also shows that much of the barbing effect has to do with the contrast between basally notched pieces such as Bell and Shumla (bottom) and the various corner- and side-notched types (top). With notable exceptions, time trends are observable from old (on the right) to young (on the left).

Point Transition Matrix Analysis

It is safe to conclude from the above analysis that the points from LBJ State Historical Park have certain characteristics that can be used as time diagnostic markers, and, given a better sample, it would be possible to quantify those traits more securely. Given the minimal sample for such a long time range, the time transgressive nature of the traits can only be suggested as a statistically significant hypothesis. The next question is whether traditional typology effectively indicates time trends in the sample. Since typology is not inherently linear in structure a non-linear method must be used to test the typology's time-worthiness. Also, the size of the samples as compared to the number of years/strata is, again, a problem. A simple transition matrix, however, will serve to open the question to discussion.

Table 7.04 was constructed by noting all of the types of points found in LBJ State Historical Park along two sides of a square matrix. The order is taken from Prewitt (1981). In each case, where a point was found in a level, a mark was placed in the cell of the type of points occurring in the next level. Across the top the point types on the left are taken to be the older and the ones on the right the younger. If the

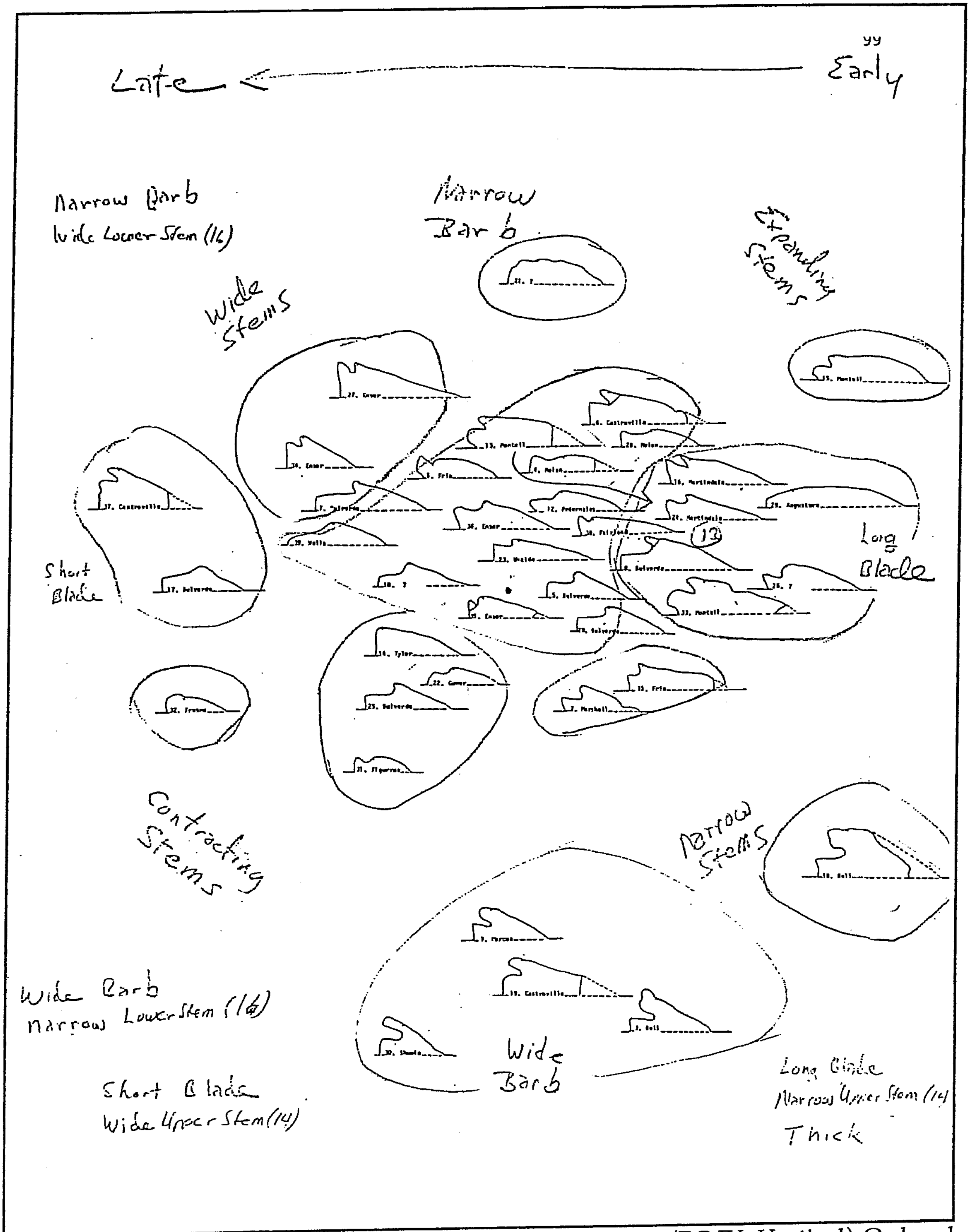

Figure 7.05. Blade-Stem (PC III, Horizontal) and Barb-Stem (PC IV, Vertical) Ordered on Component Scores.

points were properly ordered by chronology, and there was no mixing of points in strata, all of the scores would appear immediately above the diagonal (*) of the matrix. For example, all transition from Plainview to Angostura would appear in cell two of row one. Two such occurrences were observed. The one transition from Plainview to Uvalde is out of order, perhaps in this case because of too many sterile strata between the two. Whether it is due to mixing or insufficient sample, its location off the diagonal suggests a problem.

TABLE 7.04. TRANSITION MATRIX FOR POINT TYPES FOUND IN PLACE IN LBJ STATE HISTORIC PARK, FIRST ORDERING OF TYPES YIELDS 21%

	P	A	G	B	M	U	T	N	B	P	M	F	C	M	E	M	S
Plainview	*	2				1											
Angostura	1	*	1	1	1			1									
Gower			*		1									1			
Bell				*		1	1		1								
Martindale				1	*	1			1		2						
Uvalde				1	2	*			1								
Taylor							*		3				1				
Nolan		1			1			*									
Bulverde				1	1				1		2		1				
Pedernales										*	1						
Montell							2				*						
Fairland												*	2				
Castroville													*		8		1
Marcos							1							*			
Ensor											4				4		
Mahomet							1									*	
Shumla																	*

* Diagonal cells

In this matrix 21% of the transitions are on the diagonal, i.e., from one point type to itself or from that point type to its nearest younger type.

Rearranging some of the types as in Table 7.05 brings 38% of the transitions onto the diagonal. To archive this improved performance, Martindale and Uvalde were reversed in order, and Marcos was moved before Fairland and Castroville; to discover if this new ordering of types truly improves understanding of type sequences, it would require additional research into the reasons why researchers have ordered types as they have, and if there are any doubts as to these orderings. It is presumably a better arrangement, at least perhaps for the LBJ park collection; is it possible for there to be reversed type sequences from region to region? It is also a small collection and therefore the experiment can only be considered a first approximation. As the collection is increased in size and more transitions are added, the correct sequence will become more secure.

TABLE 7.05. REORDERED TRANSITION MATRIX: POINT TYPES FOUND IN PLACE IN LBJ STATE HISTORICAL PARK WITH TYPES REORDERED TO BRING THEM CLOSER TO THE DIAGONAL, 38% ON THE DIAGONAL

	P	A	G	B	U	M	T	N	B	P	M	M	F	C	E	M	S
Plainview	*	2			1												
Angostura	1	*	1	1		1		1									
Gower			*		1				1								
Bell				*	1		1		1								
Uvalde				1	*	2			1								
Martindale				1	1	*			1		2						
Taylor							*		3					1			
Nolan		1				1		*									
Bulverde				1		1			1		2		1				
Pedernales										*	1						
Montell							2				*						
Marcos							1					*					
Fairland													*	2			
Castroville														*	8		1
Ensor											4				4		
Mahomet							1									*	
Shumla																	*

* Diagonal cells

CONCLUSIONS

The long sequence of points recovered from sites at LBJ State Historical Park suggests that several characteristics of points may qualify as time diagnostics. It may be that when the size of the sample is enlarged, defining morphological subsystems that indicate with some accuracy the time when a point was made will be possible. The evolutionary progress of points through the periods of the Texas Archaic appears to have been driven by a desire to specialize points for hunting functions. Technological innovations that altered morphological subsystems include broadening the points and adapting them to bear more penetration stress and less lateral stress. Given the present sample and the stratigraphic relationships obtained from excavations, time transitions defined by Prewitt (1981) account for only 21% of the stratigraphic order in the assemblage. Slight rearrangement of the points in time increases the transitions accounted for to 38%. The unaccounted for 62% is apparently due to various causes, stratigraphic mixing, homologous types from different levels, gaps in the point type sequence from the park, and possible additional misarrangements in the order of the types. These various possibilities cannot be studied separately until more specimens have been recovered to eliminate gaps.

CHAPTER 8—TOOL MORPHOLOGY AND FUNCTION (Mock, Price, and Gunn)

INTRODUCTION (Gunn)

There has been a determined effort on the part of most archaeologists to distinguish between tool morphology and function, morphology being assumed, at least in part, to be a product of stylistic preferences, and function relating to the use of tools. Normally morphology, the shape of tools, is studied through more or less traditional ideas of typology and classification. Use, and the wear that results from it, are studied by macroscopic and microscopic methods, most of which have been developed since 1960.

In this chapter, both approaches are utilized to determine the stylistic and functional changes of tools at Moccasin Confluence and Hop Hill. Those stylistic and functional changes are then related to the central Texas chronology as proposed by Weir (1976) to show how the cultural changes relate to environmental conditions.

BACKGROUND AND HYPOTHESIS (Mock and Price)

The purpose of this chapter is to explore adaptive techniques and cultural changes evidenced in the chert tool assemblage of the prehistoric inhabitants of Moccasin Confluence (41 BC 71) and Hop Hill (41 GL 21).

Through analysis of the unifacial and bifacial tools recovered from the two sites, we hope to demonstrate how stylistic and functional changes relate to changing environmental adaptations during the central Texas Archaic. For this study the five phase division of the Edwards Plateau Aspect, proposed by Weir (1976:2), was followed.

According to Weir, the Archaic was characterized by large numbers of specialized stone implements, meeting the varied subsistence needs of Archaic peoples. Periodic environmental change influenced the subsistence related resources (Weir 1976:96). Each period reflects cultural adaptations to environmental changes, and we hope to find evidence of these oscillations in our analysis of the tool assemblage.

One of the variables that must be considered in the relationship between adaptation and environment is the location of the sites to be studied. The Edwards Plateau, with its diverse physiography, has been described as a distinct biotic province (Blair 1950:112). While the sites involved in this analysis are in the Balconian zone of the plateau (a more mesic environment evident on the eastern edge of the plateau), the central Texas area, in general, is a transition zone, or ecotone, between the mesic environments to the east, and the xeric environments to the west. As an ecotone this region exhibits characteristics of both environments.

Unpredictable physiography and climate probably contribute to the extreme variability within tool forms found in this region. The lack of standardization frequently causes problems in typology building and analysis. A problem often encountered is a lack of recognizable formal tools. Tools of convenience represent a minimum amount of energy expended in modification, but ordering them into morphological and functional categories requires an inordinate expenditure of energy on the part of the archaeologist.

In *A Review of Central Texas Archeology*, Suhm (1958:73) mentions limited tool varieties and highly variable tool types as one of the reasons for so many different interpretations of central Texas assemblages. Perhaps this lack of distinctive and recognizable tools types is due, in part, to the abundance of chert found in the region. For, as Sollberger (1969:232) has demonstrated in his replicative experiments, a newly struck, unmodified flake is often adequate for the job. A limited technology might also be expected from a mobile people who would have difficulty carrying a wealth of tools.

Ethnographic accounts of hunters and gatherers from the western desert of Australia (Hayden 1977:179) indicate a similar rarity of formal or retouched tools. If flint was nearby, a core flake was suitable for the job, and then discarded when the task was completed. Such comparative ethnographic accounts are useful because information on the indigenous central Texas people is lacking due to the invasion of Comanche and Apache groups, as well as the Spanish in historic times (Newcomb 1961). Stone tools are the main source of information concerning pre-existing subsistence patterns in central Texas because climatic and edaphic factors do not promote preservation of other cultural remains as they do in areas such as west Texas.

One aspect of the dependence upon stone tools as cultural indicators is the trajectory of the tools themselves. It is important to consider that such evidence of cultural activity was due to discarding, and may not represent all of the activities carried out at the site. Also to be considered is the possible development of an ecofact by bioturbation, wind and water erosion, or historic activities, such as root plowing. During the analysis, information can also become distorted due to remodification, recycling, or even multiple function.

Despite the theoretical handicaps, we hope to develop some information concerning the economic adaptations at these two sites, through the analysis of the stone tools in the assemblages.

Many current typologies of the central Texas region have been confusing or inconsistent because style and function were combined in the artifact descriptions, and ultimately the assemblage as a whole. In this analysis we attempt to research style and function as distinct aspects of tool manufacture and use. The first step, then, was to establish a typological model. According to Jelinek (1976:19), an artifact in its finished form embodies two distinct properties. The first, style, reflects choices made by the knapper from a number of possibilities. The study of style involved consideration of shape, size, different knapping abilities, materials used, or cultural preference.

The second property, function, is dependent on the intended task. Function was determined by an analysis of use-wear characteristics. All unifaces and bifaces, as well as fragments, were examined for wear-related edge damage. This approach has recently been posed as a fruitful technique for the study of previously and newly acquired lithic collections (Keeley 1980). The basic underlying assumption is that patterned evidence of "wear" indicates a "use" that is integral to the putative lifeway activities of prehistoric peoples.

UNIFACE DESCRIPTIONS: MOCCASIN CONFLUENCE

A uniface is defined as a tool that has been flaked or modified on one side only, and is created by the knapper according to a mental template. This definition originated in the classification of Upper Paleolithic tools and does not seem to apply to the majority of the unifacial tools in this assemblage. A mental template assumes an attempt on the part of the knapper to achieve a preconceived shape or form. The tools in this assemblage, however, appear to have been manufactured with a minimum expenditure of effort with the emphasis on an efficient working edge. Classification of these tools was determined by the classification system employed by Frkuska and Frkuska (1977:192-203) in which the artifact is divided into bit and haft ends, and categorized according to their dimensions. Brief comments follow some of the descriptions. Field numbers (FN) for tool categories and provenience appear in Table 8.01.

1.1 End Trimmed Unifaces, Small to Medium Haft/Small Bit (N=1)

This distinctive artifact (FN 645, Figure 8.01) has a broadly flared bit with concave and irregular nibbled edges. There is a lateral break in the haft end. It is manufactured from a dark, fine-grained chert and is possibly from the Paleoindian period. It is, in fact, at the next to the lowest level in the deepest test pit, Test Pit 2, level 38. The edge is marked by oblique flake scars and nibbling on the (arbitrarily determined) right corner. Polish was detected on both aspects, but primarily the outer surface. Its triangular shape suggests that it could have most likely been used for scraping or cutting activities.

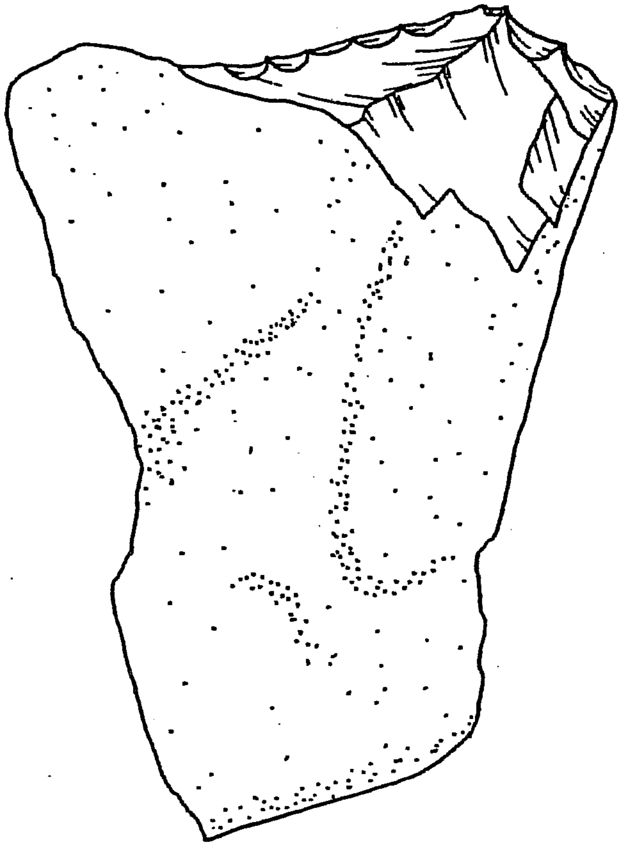

Figure 8.01. FN 645 Paleoindian Uniface from 41 BC 71 Test Pit 2, Level 38.

2.2 Unilaterally Trimmed Unifaces, Medium Haft/Medium Bit (N=1)

FN 588-2 (see Figure 8.02) is a subtriangular specimen made from a core flake. One slightly beveled lateral edge has step and hinge fractures. Sometimes referred to as a side scraper, this tool is believed to have been used in hide, bone, and wood scraping, or plant processing.

3.1 Unilaterally and End Trimmed Unifaces, Small Haft/Medium Bit (N=2)

Specimen FN 560 exhibits lateral and distal flaking. The lateral edge is low edged and shows evidence of nibbling as well as stepping. It is probably a multipurpose tool. FN 537 has three distinct notches beside the bulbar end and the left lateral upper corner exhibits very fine nibbling and stepping.

4.0 Bilaterally and End Trimmed Unifaces (N=7)

All of these specimens have been trimmed at the end opposite the platform of the flake and along both lateral edges. The shapes and sizes vary.

TABLE 8.01. TOOL CATEGORY, FN, AND PROVENIENCE LIST OF UNIFACIAL TOOLS FROM 41 BC 71 AND 41 GL 21

Category	FN	Level	Test Pit/Unit	Site
1.1	645	38	2	41 BC 71
2.2	588	-218	1	41 BC 71
3.1	560	16	2	41 BC 71
3.1	537	10	3	41 BC 71
4.1	454-2	27	4	41 BC 71
4.3	506	11	1	41 BC 71
4.3	434	16	4	41 BC 71
4.4	574	19	2	41 BC 71
4.4	511-2	12	1	41 BC 71
4.5	467	36	4	41 BC 71
4.5	966	3	6	41 BC 71
5.0	505	7	3	41 BC 71
6.0	451-2	25	4	41 BC 71
7.1	577	20	2	41 BC 71
8.0	553-3	16	1	41 BC 71
8.0	524-2	9	3	41 BC 71
8.0	543	10	3	41 BC 71
8.0	463-2	33	4	41 BC 71
8.0	532	11	2	41 BC 71
8.0	1118-2	13	E931; N970	41 GL 21
8.0	1040-4	4	E932; N971	41 GL 21
8.0	1037-2	2	E932; N971	41 GL 21

4.1 Bilaterally and End Trimmed, Small Haft/Small to Medium Bit (N=1)

Specimen FN 454-2 (Figure 8.02) is a core flake tool. Opposite the platform end are a series of irregular notches and one small finely flaked graving tip. This protrusion exhibits bright polish and was possibly used on flesh or bone. A low edged right lateral area shows oblique flake scars and was possibly used as a cutting edge.

4.3 Bilateral and End Trimmed Unifaces, Small Haft/Medium to Large Bit (N=2)

These crescent-shaped tools (Figure 8.03, FN 506, FN 434) with steeply beveled, concave edges and beaked points are quite distinctive. The concave edges exhibit relatively large step and hinge fractures; the convex edges are low angled and show microstep fractures. FN 506 is made from a fine gray chert and is a terminal end bit fragment. It is stratigraphically placed in the Early Archaic. FN 434 is complete except for the small missing tip. It is heat treated, slightly patinated, and also from the Early Archaic. These two specimens possibly functioned as composite tools, perhaps hafted and used for scraping activities. An intersite search of the tool assemblages revealed two similar tools. Jackson (1938:92) describes a dull, billed scraper, but fails to provide a drawing or photograph.

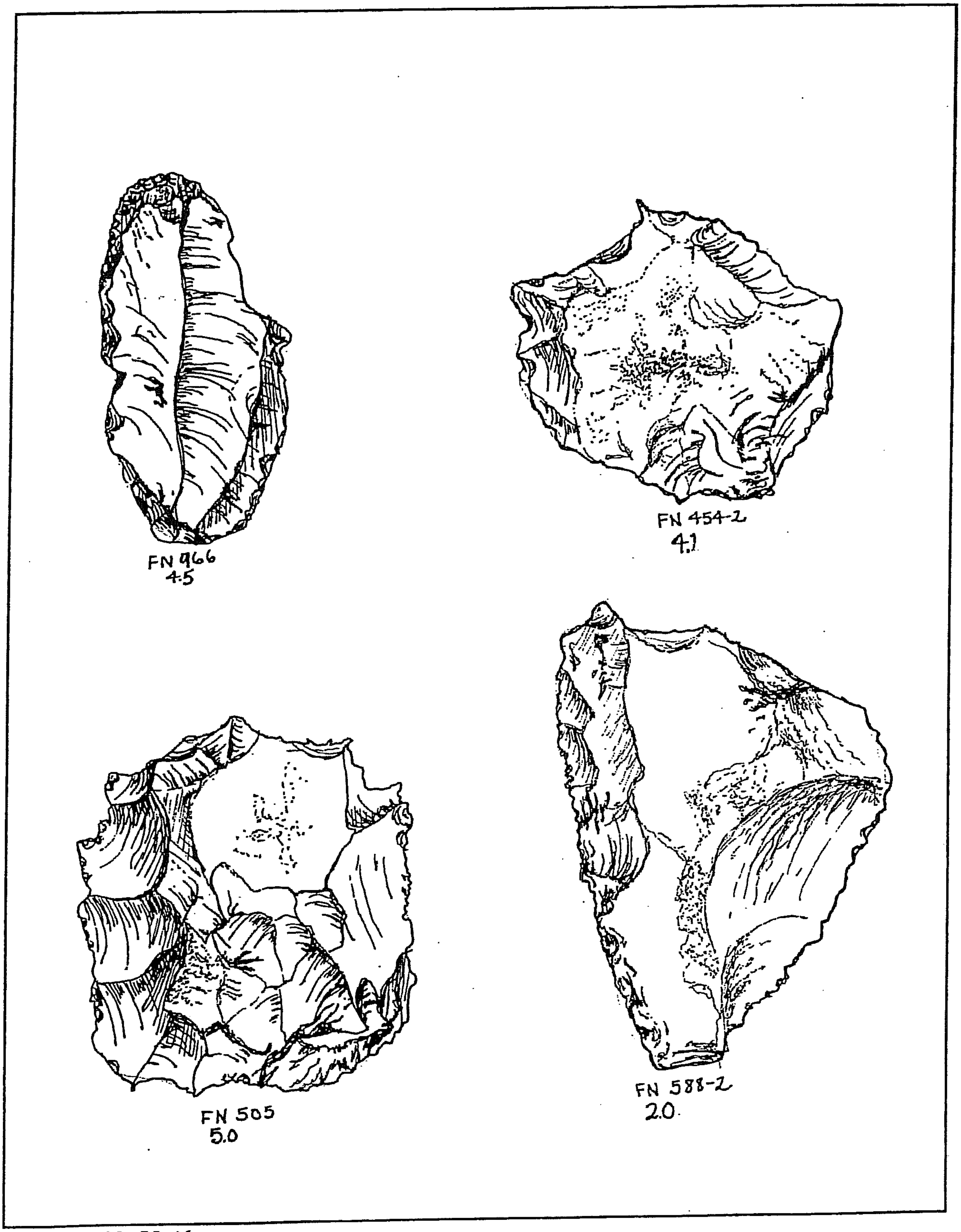

Figure 8.02. Unifaces.

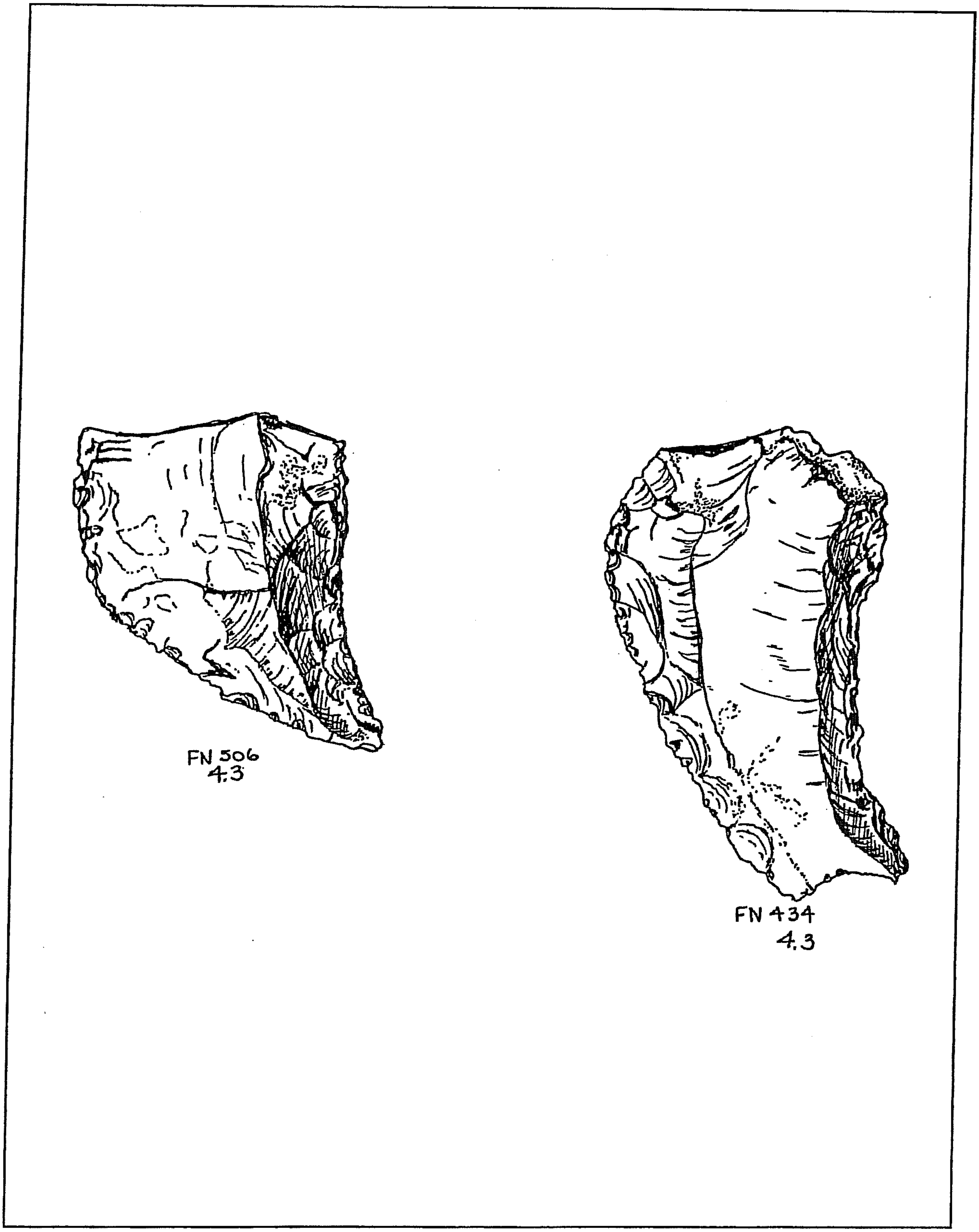

Figure 8.03. Bilaterally Trimmed Unifaces (Type 4.3).

4.4 Bilateral and End Trimmed Unifaces, Small Haft/Large Bit (N=2)

Specimen FN 574 is a modified flake with small beveled notches and nibbling along the right lateral edge. FN 511-2 (Figure 8.04) exhibits large hinge fracture scars along the steep left lateral edge. The preponderance of damage is found on the outer surface, indicating use as a scraper.

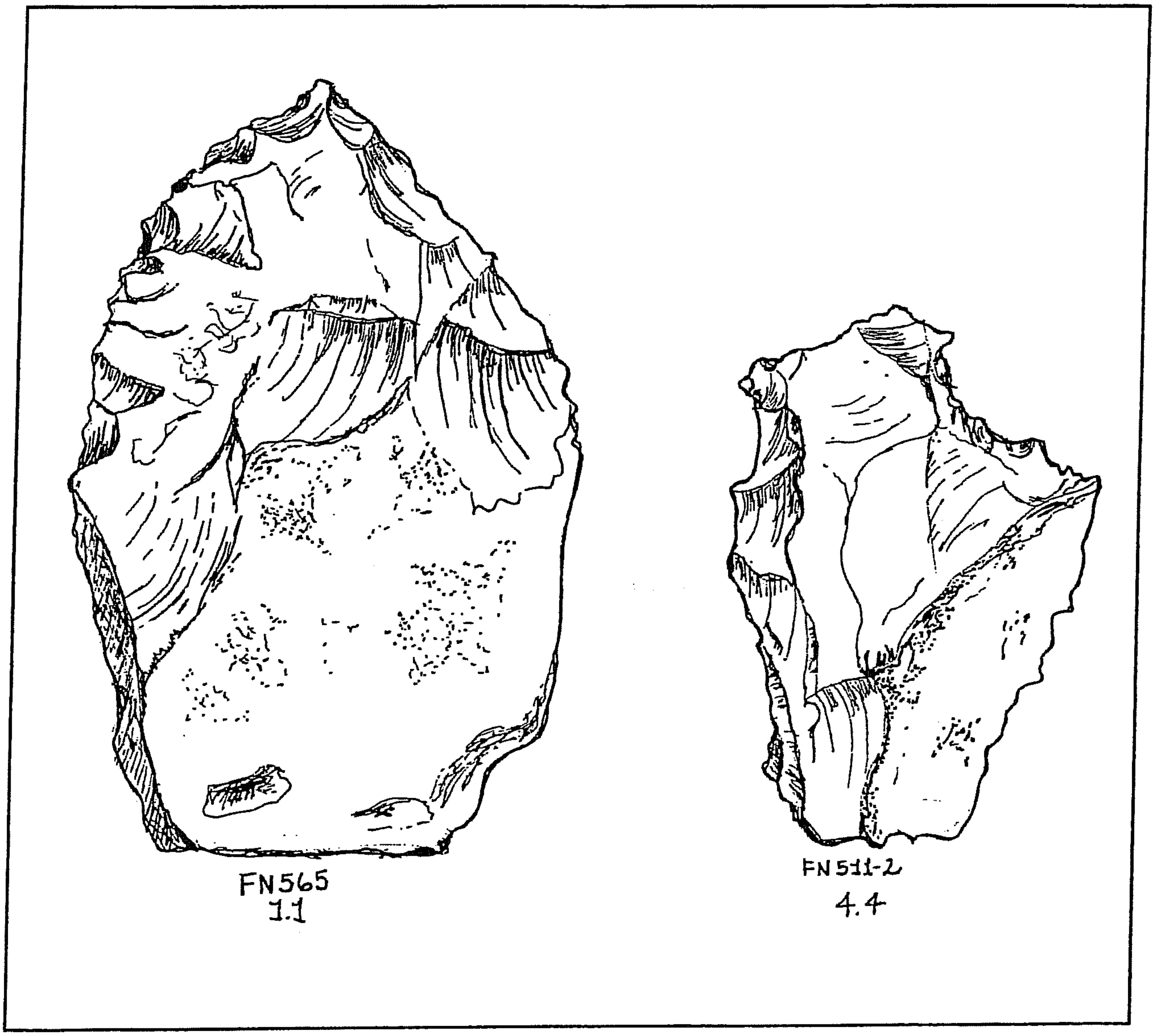

Figure 8.04. Bifaces.

4.5 Bilateral and End Trimmed Unifaces, Medium Haft/Medium to Large Bit (N=2)

FN 966 (see Figure 8.02) is an example of a more "formal" tool type. It is commonly referred to as a blade end scraper. However, small step fractures are apparent on both the terminal end and the left lateral edge, which exhibited both polish and nibbling on the 35° angle, strongly suggesting use on soft material. FN 467 shows heavy use on a lateral beveled edge opposite the platform.

5.0 Circular Trimmed Uniface (N=1)

This fine grained dark gray chert specimen, FN 505 (see Figure 8.02), has a plano-convex cross section and highly beveled edges between irregularly scalloped ridges. It exhibits polish on both aspects, and nibbling and microstep fractures on both ends. Keeley (1980:24-63) found scalloping and rounding to be a wear attribute associated with animal butchering activities.

6.0 Miscellaneous Trimmed Unifaces (N=1)

This small, stemmed flake, FN 451-2, exhibits polishing and nibbling on edges of various areas. It has a comparatively low edge-angle and was probably used for cutting soft material.

7.1 Notched Trimmed Unifaces, Small to Medium Haft and Small Bit (N=1)

Specimen FN 577 is a distinctively pointed tool with heavy step fractures, polishing and nibbling on the high-angled left lateral edge. Notched pieces have been found to be associated with woodworking.

8.0 Miscellaneous Incomplete Unifacial Fragments (N=5)

FN's 553-3, 463-2, and 524-2 are terminal, medial, and lateral flake fragments, respectively, and exhibit the traditional characteristics of end scrapers: high edge angle, polish, and nibbling concentrated on one aspect and tiny step fractures on the other. FN 543 is a platform end fragment with very little of the working edge remaining, but dulled at lateral points approximately opposite each other. It could have been hafted. FN 532 is a semicircular fragment with a peculiar jutting lateral area. It exhibits large step and hinge fractures on its rather dull edges. Of the three unifaces recovered from the Hop Hill site (41 GL 21), one, FN 1040-4, is a small, chunky proximal fragment with small step fractures ascending the outer aspect of both lateral edges. FN 1037-2 is complete and has a trimmed indentation on the platform end. Two projecting areas exhibit unifacial nibbling, indicating possible use as a scraper.

BIFACE DESCRIPTIONS: MOCCASIN CONFLUENCE

The biface collection was classified according to the Hop Hill criteria (Gunn and Ivey 1977), with only a few exceptions. Specimens are divided into groups according to proposed ideal forms or shapes determined by the steps a knapper takes to reach a predetermined tool type (Table 8.02). These ideal shapes are the square, the rectangle, and the triangle. Lithic material is assumed to be local unless otherwise noted.

TABLE 8.02. TOOL CATEGORY, FN, AND PROVENIENCE LIST OF BIFACIAL TOOLS FROM 41 BC 71 AND 41 GL 21

Category	FN	Level	Test Pit/Unit	Site
1.1	406-2	5	4	41 BC 71
1.1	565	16.5	2	41 BC 71
2.0	420-2	12	4	41 BC 71
4.0	246	6	2	41 BC 71
4.0	343	8	1	41 BC 71
4.0	667	39	2	41 BC 71
4.0	422-2	13	4	41 BC 71
4.0	445-2	20	4	41 BC 71
4.1	467-2	36	4	41 BC 71
5.1	618	21	3	41 BC 71
5.2	414-2	9	4	41 BC 71
5.2	447-2	12	4	41 BC 71
5.2	406-3	5	4	41 BC 71
5.2	597-3	19	1	41 BC 71
5.2	424	13	4	41 BC 71
5.2	445-3	20	4	41 BC 71
6.1	597-5	19	1	41 BC 71
6.5	512	12	1	41 BC 71
6.5	421	12	4	41 BC 71
6.5	415	9	4	41 BC 71
6.5	639	23	3	41 BC 71
6.5	523	11	2	41 BC 71
6.5	976-2	9	6	41 BC 71
6.5	426	14	4	41 BC 71
6.5	624	25	1	41 BC 71
6.5	423	13	4	41 BC 71
9.0	968-51	4	6	41 BC 71
10.1	563-3	16.5	2	41 BC 71
10.1	429-2	15	4	41 BC 71
10.1	404-3	4	4	41 BC 71
10.1	503-4	10	2	41 BC 71
10.1	571-2	18	2	41 BC 71
10.1	411-2	7	4	41 BC 71
10.1	597-4	19	1	41 BC 71
10.1	553-2	16	1	41 BC 71
10.1	641	24	3	41 BC 71
10.1	445-4	20	4	41 BC 71
10.1	533	12	2	41 BC 71
10.2	458-2	30	4	41 BC 71
10.2	542-3	13	2	41 BC 71
10.2	563-2	16.5	2	41 BC 71
10.2	257-2	18	1	41 BC 71
10.3	582	22	2	41 BC 71
10.3	500-3	9	2	41 BC 71
10.3	419-2	11	4	41 BC 71
10.3	410	6	4	41 BC 71
10.4	585-2	23	2	41 BC 71
10.4	306-2	7	2	41 BC 71
10.4	428	14	4	41 BC 71
10.4	568-2	17	1	41 BC 71
10.4	306-209	7	2	41 BC 71

Table 8.02 (Continued)

Category	FN	Level	Test Pit/Unit	Site
11.0	586	17	1	41 BC 71
11.0	549	15	1	41 BC 71
11.0	518	8	3	41 BC 71
11.0	979-2	10	6	41 BC 71
11.0	340	8	2	41 BC 71
11.0	605-2	18	3	41 BC 71
5.0	1037-4	2	E932; N971	41 GL 21
5.0	1016-2	3	E932; N970	41 GL 21
6.0	1058-1	6	E933; N970	41 GL 21
7.1	1060-1	8	E933; N970	41 GL 21
7.2	1072-4	11	E932; N970	41 GL 21
8.1	1052-2	3	E933; N970	41 GL 21
8.2	1043-2	5	E932; N971	41 GL 21
10.1	1035-2	1	E932; N971	41 GL 21
10.3	1007-3	5	E931; N970	41 GL 21
10.3	1031-2	7	E932; N970	41 GL 21
10.4	1037-3	2	E932; N971	41 GL 21
10.4	1037-5	2	E932; N971	41 GL 21
10.4	1074-1	2	E934; N970	41 GL 21
10.4	1038-2	3	E932; N971	41 GL 21
11.0	1069-2	1	E934; N970	41 GL 21
11.0	1026-2	5	E932; N970	41 GL 21

1.0 Pointed Bifaces (N=2)

The bifaces in this category are trimmed to a beaked or rounded bit and untrimmed on the cortexed haft end. They are manufactured from small core cobbles, and the shape is irregularly triangular.

1.1 Pointed Bifaces, Pick (N=2)

The bit edges of this type are parallel, merging to a rounded point. The irregular flaked edges have widely spaced serrations. FN 565 (Figure 8.04), a tabular biface exhibits nibbling on the left lateral edge and light scalar stepping on the right. FN 406-2 is heavily stepped on both aspects at the bit end. Chopping on a fairly hard surface is indicated.

2.0 End Biface (N=1)

This specimen, FN 420-2, was manufactured on a chert cobble. The base is narrow and has a cortex surface with the lateral edges expanding to a broad, crudely flaked bit. The edges are very sharp with no pattern of wear.

4.0 Rectangular Bifaces (N=5)

The members of this category are crudely flaked, irregular specimens that are greater than 1.5 cm in thickness. Four specimens have remnants of cortex, and one specimen with a concave base appears to have been a blank broken during manufacture.

4.1 Rectangular Biface, Small (N=1)

FN 467-2 is a small thin specimen of coarse grained material, exhibiting mostly steep fractures on the edge, except for one small area of nibbling and polish on the left proximal corner. It is possible that this is a remnant of an edge that was lost in subsequent reduction. It was recovered in level 36 of Test Pit 4 suggesting it might be from the Paleoindian period.

5.0 Round Bifaces (N=7)

These small bifaces are discoidal or subdiscoidal. All specimens exhibit crude, irregular flaking.

5.1 Round Biface, Thin (N=1)

The worked circumference of FN 518 is slightly beveled and irregularly notched. There is an area of cortex remaining on the slightly convex surface. Although the edge angle is relatively low (60R), there are indications of use on fairly hard surfaces. Nibbling is found on one of the bit corners, and scalar stepping is present on the edges bracketing the nibbling.

5.2 Round Bifaces, Thick (N=6)

All specimens are more than 1.5 cm in thickness, four specimens have cortex remnants, and one appears to have been heat treated. One specimen, FN 414-2, has a fairly low edge angle (50R) and exhibits a consistent pattern of polish and nibbling on all edges. FN 406-3 has the form of a flaked graver, i.e. a projecting pointed area, but there is no evidence of wear.

6.0 Oval Bifaces (N=10)

The bifaces in this category are oval to suboval. On some of the specimens the haft and bit ends are indistinguishable. The group exhibits wide diversity in shape and flaking.

6.1 Oval, Thick Biface (N=1)

FN 597-5 is postulated to be a dart point preform, rejected as a result of technological difficulties. It is more than 1.5 cm in thickness, and has one thinner lateral side, and exhibits nibbling along the edge of that side. It was probably used in cutting activities on semisoft material.

6.5 Oval, Thin Bifaces (N=9)

All specimens measure less than 1.5 cm in thickness and exhibit nibbling and small scalar stepping. One item, FN 426, has the characteristics of a point preform with a beveled lateral edge, and exhibits nibbling and minute step fractures on all edges. The largest, FN 423, has a form and thinness amenable to hafting, and the location of edge damage indicates that it may have been hafted. Four smaller bifaces are pointed, percussion flaked preforms with material flaws. The majority show evidence of use on a medium hard surface, i.e. scalar and nibbling. FN 976 has polish on its rather rounded tip.

9.0 Subtriangular Bifaces (N=1)

FN 968-51 has a very uniform shape and a rather crudely beveled proximal end. Since damage was detected only on the lateral edges and tip (mostly nibbling and polish) it was possibly hafted.

10.0 Miscellaneous Fragments (N=24)

These biface fragments cannot be sorted into projected forms. They vary a great deal in size and workmanship.

10.1 Miscellaneous Fragments, Tips (N=11)

These fragments range from 8 to 25 mm in thickness; edge angles range only up to 50R. The predominant observed wear characteristic is nibbling, although those with lower edge angles (30-35R) exhibited obvious areas of polish. One bifacial perforator tip, possibly made from a broken projectile point, is finely pressure flaked. Only one lateral edge shows step fractures, the other is only slightly marred, and the tip exhibits no polish. Because of these characteristics, FN 533 was probably broken during manufacture.

10.2 Miscellaneous Fragments, Medial (N=4)

Specimens range from 7 to 28 g; all four have edge angles of 50R or less and are characterized by the presence of polish and nibbling. All exhibit transverse or snap fractures.

10.3 Miscellaneous Fragments, Haft (N=4)

Three specimens have edge angles of approximately 50R and exhibit nibbling and polish concentrated on the lateral edges. FN 410 is a fire-reddened drill base, broken in the middle of the neck. The lateral edges, however, measure at 40R and consistently show polish, even along the proximal edge.

10.4 Miscellaneous Fragments (N=5)

The items in this group cannot be assigned to any of the above categories, but all are apparently what could be termed "lateral" fragments. They follow the previous pattern of low edge angle (60R or less), and polish and nibbling was observed.

11.0 Flake Core Tools (N=6)

Members of this category are large, thick core remnants with step and hinge fractures on the utilized edges, if any. They are commonly referred to as chopper tools, and are believed to have been used on hard contact surfaces. Some may simply be expended cores, however, since very few exhibit nibbling.

BIFACE DESCRIPTIONS: HOP HILL

There were 17 bifaces recovered from this site, subdivided into six categories. All are dated to the Late Archaic.

5.1 Round Bifaces, Thin (N=2)

These small bifaces, discoidal, or subdiscoidal in shape, exhibit crude irregular flaking. FN 1037-4 is of superior dark chert, with a suggested shoulder notch. Slight nibbling was noted on one lateral edge, and heavy scalar stepping on the haft edge. Damage is unifacial due to a transverse fracture. FN 1016-2 is pyramidal in extraplanar shape. Only stray flake scars mar its otherwise pristine edge.

6.0 Oval Biface (N=1)

The single example of this category is actually suboval. There is a cortex remnant on the lateral edges, along with polish and nibbling, but the damage is intermittently spaced along the edges. Perhaps the specimen was too thick in relation to its size for further reduction.

7.1 Ovoid Biface, Small Thinned (N=1)

FN 1060-1 is 9 mm thick, fire-reddened, and potlidded, which makes wear observation difficult. There is a cortex remnant and it appears to have been in the latter stages of reduction before discarding.

7.2 Ovoid Bifaces, Large, Thick (N=1)

FN 1072-4 exhibits one small area of scalar stepping on a protrusion at the distal end.

8.1 Triangular Biface, Small (N=1)

FN 1052-2 is 7 mm thick, finely flaked and resembles an arrow point preform of the Late Prehistoric period. It exhibits polish and nibbling along one lateral edge, and the edge angle is 50R, indicating use in cutting activities.

8.2 Triangular Biface, Large (N=1)

FN 1043-2 exhibits polish along one lateral edge. Due to its thinness (9 mm), it would be suitable for use in cutting activities, especially in semisoft material.

10.1 Miscellaneous Fragments, Tip (N=1)

FN 1035-2 appears to be a knife tip. It is beveled on both surfaces, with regularly serrated edges exhibiting mostly polish. Long beveled knives have been found in levels dated to the Late Prehistoric period at other sites, and are part of the Plains cultural tradition.

10.3 Miscellaneous Fragments, Haft (N=2)

Two of the fragments have low edge angles and exhibit polishing and nibbling. The other exhibits only nibbling.

10.4 Miscellaneous Fragments (N=4)

Three of these fragments are badly broken and are unclassifiable. FN 1038-2, however, is interesting because it has a badly damaged area, i.e. grossly rounded, but nibbled on this previously abraded edge.

11.0 Core Flake Tools (N=2)

Both of these tools were manufactured from chert cobbles. FN 1026-2 exhibits a broad utilized bit with extensive notching. FN 1064-2 has a narrow cortexed proximal end and a broad thick flaked bit with step and hinge fractures.

MORPHOLOGICAL INTERPRETATION (Mock)

The morphological studies performed on the flint tools from the Archaic levels at Moccasin Confluence indicate the following interpretations. Weir's (1976) studies of central Texas sites characterized the San Geronimo phase (8000-4500 B.P.) as a warm period, with a broad based exploitative pattern. During the Early Archaic a broad technological inventory would have been essential to support the varied subsistence activities. Test Pits 1, 2, and 3 bear this out. In the middle of the Early Archaic levels are clusters of bifaces, (Table 8.03) unifacial tools such as scrapers and gravers, and an unusual crescent-shaped composite tool (see Figure 8.03, FN 506). This diversity points to varied activities and a diverse economy.

Clusters of tools in the Early Archaic levels correspond to fluctuations in the lithic debris concentrations. This suggests episodic occupations by small groups as part of a nomadic subsistence pattern. Their activities probably varied in intensity with Middle Holocene climatic conditions as discussed in chapter 5.