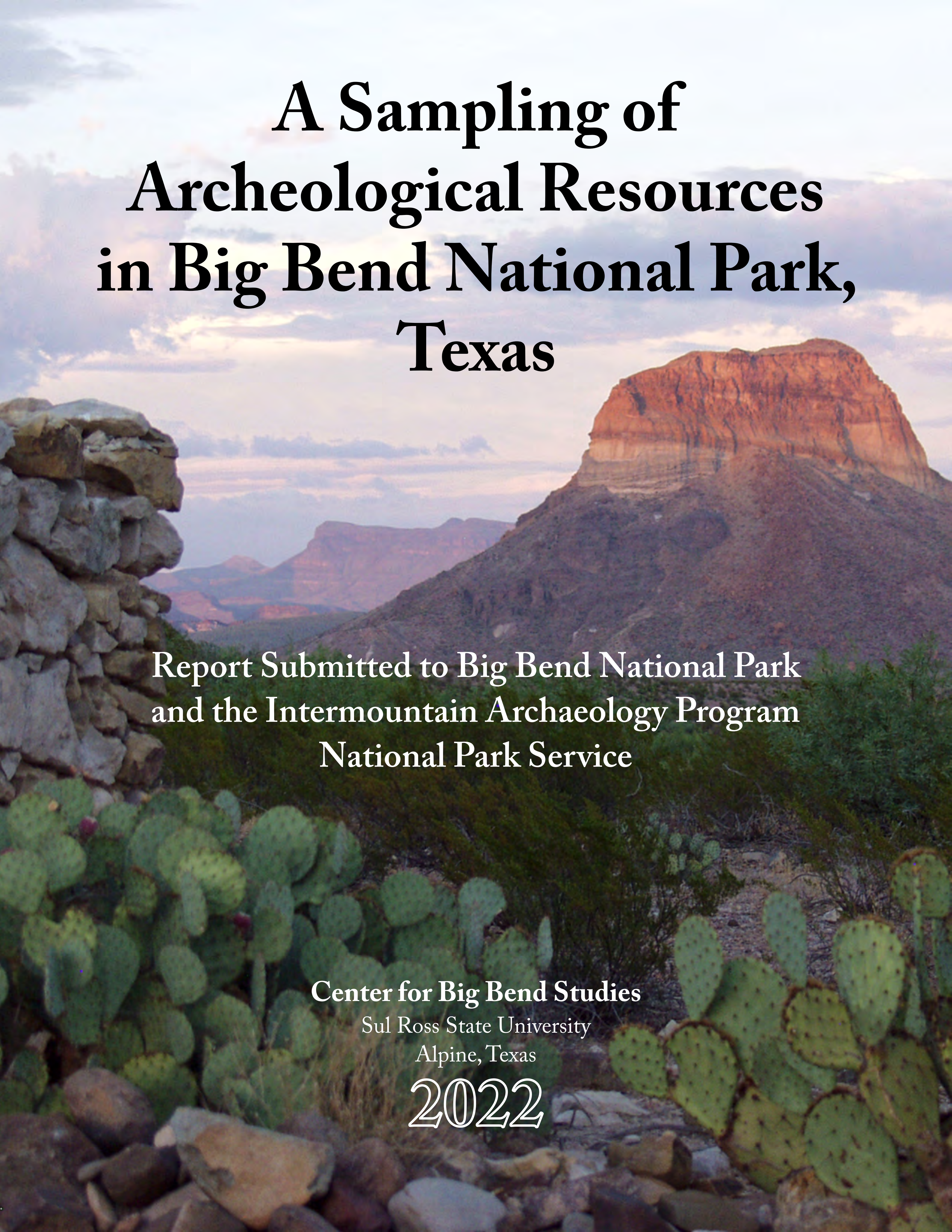

A Sampling of Archeological Resources in Big Bend National Park, Texas

Report Submitted to Big Bend National Park
and the Intermountain Archaeology Program
National Park Service

Center for Big Bend Studies
Sul Ross State University
Alpine, Texas

2022

Report Certification

I certify that the report entitled *A Sampling of Archeological Resources in Big Bend National Park*, produced by the Center for Big Bend Studies at Sul Ross State University in Alpine, Texas, has been reviewed against the criteria contained in 43 CFR 7.18(a)(1), and upon the recommendation of the National Park Service's Intermountain Archaeology Program has been classified as Available.[1]

ROBERT KRUMENAKER Digitally signed by ROBERT KRUMENAKER
Date: 2023.04.20 16:45:28 -05'00'

Superintendent, Big Bend National Park Date

[1]Making the report available to the public meets the criteria of 43 CFR 7.18(a)(1).

Intermountain Cultural Resources Management
Professional Paper No. 79

A Sampling of Archeological Resources in Big Bend National Park, Texas

By

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2022

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Acknowledgments

A great many people contributed to this project over the course of the nearly 10 years it took to complete. The project was originally conceived by then-State Archeologist Robert J. Mallouf to address the needs of both resource management within Big Bend National Park (BBNP) as well as regional archeological inquiry. The project proposal was submitted to the Southwest Division of the National Park Service in 1990 by Mallouf and William A. Cloud, both with the Office of the State Archeologist, and Thomas C. Alex, National Park Service archeologist for BBNP. Without their foresight and perseverance in seeking funding, this project never would have happened.

A very special thanks is extended to the heroic efforts of the more than 50 crew members that served over the course of the project. The 1995–1998 field crews, under the direction of Mallouf and field director William A. Cloud, consisted of crew chiefs Joseph Sanchez and Steven Kotter, and crew members Brandon Young, Frank Garcia, Anne Jung, Kelly Scott, Chris Howell, Patrick Hajovsky, Andrea Ohl, Rick Boretti, Mark Johnson, Doug Drake, Sandy Billingsley, Andrea Brand, Samuel Cason, Tim Gibbs, and Cory Barton. Thanks also to Curt and Helen Harrell who served as camp cooks for several sessions and to Dennis Treadaway and the late Charlie Fulcher who served as logistics coordinators.

The 2005–2010 field crews, under the direction of David W. Keller, consisted of crew chiefs Blake Cochran, Samuel Cason, and Bobby Gray and crew members Tim Gibbs, Jason Bush, Roger Boren, Warren Kinney, Richard Walter, Candace Covington, Sarah Loftus, Brian Dailey, John Moretti, Lisa Weingarten, Kate Baer, Wilbur Barrick, Todd Morrison, Leeland Jones, Amanda Murphy, Amie Meade, Kate Hill, Dawnella Petrey, Caleb Waters, Rachel Freer, Jesse Nowak, Ashley Baker, Logan Ralph, Steve Kennedy, David Hart, Katy Juckett, Chris Smith, Craig Cosby, and Aaron Thomas.

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There is no way to overstate the generosity and helpfulness of our field volunteers Dennis Treadaway, T.J. Treadaway, Linda Potter, Diane Couch, Michelle Huebner, Mary Alvarado-Cloud, Marty Estrada, Mike Shirey, Kirsten Lund, Lourene Barron, Jeannie Pruett, Andrea Ohl, and Benny and Gena Roberts. An especially hearty thanks is extended to Benny and Gena, our "volunteers extraordinaire," who donated far more than the sum of time, food, drinks, sweat, blood, and more than a few patches of skin lost during the course of the project. Their good-natured kindness always buoyed spirits when conditions were tough.

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I also wish to extend a heartfelt thanks to William A. Cloud and Susan Chisholm for the countless hours they spent meticulously editing this report—a thankless and tiring endeavor for which they deserve nothing less than a trophy. The report is a significantly better product for their perseverance and attention to detail.

In all, the project took up a significant chunk of many individuals' lives. During its course, lifelong friends were made, new romances were spawned (three of which resulted in marriage), and—following the project's completion—two crew member's deaths were endured. It is a project that has had a significant impact, not only on area archeology, but on the archeologists themselves.

Dedication

This report is dedicated to the memory of ***Blake Edward Cochran—***
friend, crew chief, madman.

Whose passion for the Big Bend and its archeology was boundless.

This report is also dedicated to the memory of ***Candace Ann Covington—***
friend, crew member, creosote queen.

Whose passion for the natural world inspired us all.

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Introduction

Big Bend National Park (BBNP) is located within the eastern Trans-Pecos in the far southwestern tip of Texas where the Rio Grande makes its large V-shaped bend. Encompassing 324,220 ha (801,163 ac), it is the 15th largest in the U.S. national park system. With mountain "islands," lowland shrub desert, and over 100 river miles of the Rio Grande, the park contains the best example of the Chihuahuan Desert ecoregion in the United States and is host to an extraordinary array of plants and animals, including many endemic and relict species (National Park Service 2009).

Figure 1.1. The Chisos Mountains at dawn with the Rio Grande in the foreground. Photo by D. Keller.

The park's outstanding vistas—rivaling those of other world-class southwestern U.S. national parks—are due primarily to the fantastic array of geological features (Figure 1.1). Because of arid conditions and scant vegetation, these geological features stand in bold relief as mesas, buttes, pinnacles, ridges, dikes, plugs, and volcanic domes. In total, over 500 million years of geological history are exhibited in the various formations visible within the park (Maxwell 1968).

In addition to its diverse physiography, the park is extremely remote; the nearest town having a population of over 500 is 145 km (90 mi) away. As far as it is from urban centers and major highways, the greater Big Bend region is largely free of industrialization and "retains more features of the Old West than perhaps any area of its size in the United States" (Maxwell et al. 1967:4). Its remoteness is made even more dramatic by its stark and overpowering geological grandeur.

The park's southern boundary is defined by 190 km (118 mi) of the Rio Grande that also comprises the international border with Mexico, bordering the states of Chihuahua and Coahuila. Adjacent to two protected areas in Mexico—Maderas del Carmen and Cañon de Santa Elena, the park is part of one of the largest transboundary protected areas in North America, together encompassing more than 810,000 ha (2 million acres) of classic Chihuahuan Desert (National Park Service 2009).

Established in 1944, BBNP was the 27th national park in the United States and the first in Texas. Originally designated as Texas Canyons State Park by the State of Texas in 1933, the name was soon changed to Big Bend State Park. Although Congress authorized the establishment of the national park as early as 1935, BBNP was not officially opened until June 12, 1944 (National Park Service 2009).

Averaging between 300,000 and 400,000 visitors per year, the park offers over 480 km (300 mi) of roads and 320 km (200 mi) of hiking trails as well as 219 front-country campsites and 116 backcountry campsites. In addition to hiking, camping, and backpacking, the stretch of the Rio Grande bordering the park includes more than 97 km (60 mi) of monumental canyons that draw hundreds of river runners annually. Boasting nearly 1,300 species of flora, 75 species of mammals, and more than 450 species of birds, the park's biological diversity ranks among the highest in the national park system. The park also offers the best night sky viewing in the continental United States. To administer and oversee park affairs and visitor services, the park has 103 permanent employees and 58 seasonal employees in addition to many volunteers and student interns (National Park Service 2009).

Within BBNP is evidence of nearly 12,000 years of human occupation from Paleoindian to historic times. As of 2021, a total of 2,755 sites have been recorded within the park boundaries and over 287,000 museum objects (including biological, geological, and paleontological specimens in addition to archeological materials) have been cataloged. There are four National Register of Historic Places (NRHP) districts within the park consisting of the Burro Mesa Archeological District, the Castolon Historic District, the Hot Springs Historic District, and the Mariscal Mining District. In addition, there are four NRHP sites within the park—the Homer Wilson Blue Creek Ranch, Rancho Estelle, Daniel's Farmhouse, and Luna's Jacal (National Park Service 2009).

The BBNP project's over-arching goals were to sample archeological resources within the park and to produce a predictive model of site occurrence. Spawned in 1990 by then-State Archeologist Robert J. Mallouf, the project took place over the course of almost 10 years. Nearly 25,000 ha (61,766 ac) of the park were intensively surveyed in this most remote and rugged part of the state. It was, consequently, one of the largest—if not the largest—survey of its kind in the state's history. Enduring extremes of triple-digit heat, blinding sunlight, dust storms, flash floods, rattlesnakes, scorpions, Africanized honeybees, cone-nosed beetles, and a vast array of wicked vegetation, crews were often pressed to the limits of endurance. Sometimes a little beyond.

Yet in spite of the often less-than-optimal working conditions, crew members conducted detailed recordings of hundreds of prehistoric and historic sites never-before documented. Tens of thousands of pages of paperwork, photographs, and proveniences later, this project could boast having made one of the largest archeological contributions (at least by volume) in the history of the region.

In addition to recording thousands of thermal features and artifacts commonly found across the region, the project also resulted in the discovery of feature types and artifacts previously unknown to science, including a new thermal feature type; a Middle Archaic dart point cache; a variety of zoomorphic, anthropomorphic, and abstract geometric petroforms; odd tool forms; and exotic ceramics, in addition to other artifacts representing occupations from Late Paleoindian to recent times. The range of site complexity was similarly broad—from sites as basic as a single hearth or artifact scatter to those containing prehistoric structures with contiguous room blocks, stratified buried occupations, or those whose features and artifacts span more than a square kilometer.

Project Description

This volume documents work conducted in BBNP by the Center for Big Bend Studies (CBBS) of Sul Ross State University under cooperative agreement with the National Park Service (NPS). It summarizes all findings and presents an analysis of prehistoric site data with reference to temporal affiliations, site size and distribution, site richness, and analyses of archeological content. The project began in 1995 with the creation of the research design and sampling strategy. Seventeen 10-day field sessions were conducted during the spring and fall seasons between 1995 and 1998, at which time the project funding was terminated and the project was shelved indefinitely. In fiscal year (FY) 2004, funding was reinstated and the project was revived under a partially revised research design and a streamlined methodology (see Chapter 5). Fieldwork resumed in the spring of 2005 and, following 34 additional field sessions, was completed in the spring of 2010.

Over the course of the BBNP project, including a total of 51 field sessions (490 field days), crews surveyed 24,996 ha (61,766 ac) in 58 survey blocks ranging in size from 16 ha (40 ac) to 3,076 ha (7,600 ac) each. A total of 1,566 sites were recorded including 1,462 new sites and 104 sites that had been previously recorded. In addition, a total of 2,365 artifacts were collected, over 17,000 photographs were taken, and over 32,000 proveniences were recorded.

Because the same methodology was utilized, the survey results from six small compliance (cultural resource management) projects conducted in the park by the CBBS were included in the GIS analysis as the basis for the predictive model. These CRM projects added a total of 44 sites and 1,117 ha (2,760 ac) to the project results for use with the GIS analysis. However, as these projects have been reported on individually, their results are not included in the present report (see Appendix 7).

It is significant that this project, which began more than 25 years ago, was conceived at a time very different from today, both with regard to the field of archeology and the interests of the NPS. The research design was not set up to test hypotheses or build a model of population dynamics. The goals were much more pragmatic. For the NPS—the managing entity, with primarily management-related concerns—the predictive model for prehistoric site occurrence would be a useful tool for planning purposes. In addition, the project would significantly increase the surveyed acreage and site inventory, bringing the park closer to compliance with Executive Order 11593 and the National Historic Preservation Act (see Appendix 17). Sites would be evaluated for inclusion in the National Register. Visitor interpretation services would be updated by providing better, more detailed information to the general public through booklets or popular publications.

In terms of the academic contributions, the project was expected to address a range of archeological questions, including the range of site, artifact, and feature types; unique archeological signatures; stone technology; inter-site relationships; subsistence patterns; and settlement patterns, among other goals. But while the project bears on all those things, it does not make systematic inroads into any one of them. Surveys such as this one offer a kind of "shotgun approach," driven partly by intuition, but with a very focused effort to accurately record what was observed. In this sense, the project harkens back to classic normative archeology—old school field archeology at its best, albeit with a few new gadgets and a few new tricks. But if the project seems elementary by modern standards, it is important to remember that the region is still in its infancy in terms of archeological research. The present project provides a significant foundation for future studies that will bring the region closer to the level of archeological understanding achieved in other parts of the state.

Report Organization

This report is organized topically. Chapter 2, Setting and Environment, details the environmental parameters of the present project—with a specific focus on the lowland, shrub-desert portion of the park, referred to in this report as the "basin zone." Chapter 3, History of Investigations, outlines the history of investigations within the greater Big Bend region with an emphasis on studies conducted within BBNP. Its unprecedented scope and level of detail make it the most comprehensive history of research in the park written to date. Chapter 4, Culture History, details the region's prehistoric and historic past, which includes significantly updated interpretations of the archeological record based on data recovered in recent years by the CBBS through the Trans-Pecos Archaeological Program (TAP). Chapter 5, Project Design, outlines the project's background and goals, including the original (1990) research proposal and 1998 research design as well as the 2008 research design revisions. This chapter also details the field and laboratory methodologies used during the project. Chapter 6, Survey Results, presents the project findings, beginning with a summary of results before offering a more focused examination of the prehistoric and historic materials in addition to isolates documented during the project. Chapter 7, Analysis of Survey Results, provides a descriptive statistical analysis of the prehistoric findings, consisting of temporal and spatial analyses as well as analysis of archeological site content. Chapter 8, Project Summary and Recommendations for Archeological Research, summarizes the project findings and offers suggestions for further research. The substantial appendices provide a range of data, including several lengthy tables containing site data, isolated occurrence data, National Register sites, cultural resource management projects, and results of special studies. Additional appendices contain the ceramic analysis, BBNP management issues, the report on predictive modeling, a report on the discovery of human remains, an overview of federal preservation mandates addressed by the current project, and a summary of the Lizard Hill Cache excavation.

Report Authorship

This report was written by a team of 15 people, without whom it could never have been completed. David W. Keller served as lead author and editor. He wrote the Introduction, Settings chapter, Project Design chapter, Historic Findings chapter, Isolates chapter, Summary and Recommendations chapter, and other various and sundry appendices and subsections. He also co-authored the Prehistoric Findings and Analysis chapters with Samuel S. Cason, who performed the bulk of the analyses and contributed to the suggestions for further research. Robert W. Gray analyzed the collected prehistoric artifacts and co-authored the Prehistoric Material Culture section in addition to photographing all the specimens. Richard W. Walter wrote most of the Culture History, including the Late Archaic, Protohistoric, and Historic periods. Roger D. Boren wrote both the Paleoindian and Early Archaic culture history sections and contributed to the Recommendations section. Andrea J. Ohl wrote the Middle Archaic culture history as well as the paleoenvironment section of the Settings chapter. Robert J. Mallouf wrote the lithic resources section in the Setting chapter and served as a consultant throughout the writing of the report. Thomas C. Alex wrote the 1982–present section of the History of Investigations chapter in addition to the corresponding table (Appendix 6), non-project radiocarbon data (Appendix 11), management considerations (Appendix 14), the report on the inadvertent discovery of human remains (Appendix 16), and made additional contributions throughout the report. William A. Cloud wrote the bulk of the History of Investigations, revised much of the Culture History, authored the Late Prehistoric culture history, co-authored the prehistoric material culture section, helped guide the writing of the report, and—in his capacity as director of the CBBS—also served as series editor.

In addition to these primary authors, Betty L. Alex wrote the section on the GIS predictive model (Appendix 15), created many of the critical GIS layers used in the report (environmental zonation, springs, infrastructure, etc.), provided much-needed assistance during the analysis, and offered editorial input on the Setting and Project Design chapters. David V. Hill performed the ceramics analysis and wrote the ceramic identification section (Appendix 13) with additions from David W. Keller. Dawnella Petrey and Ashley Baker aided in historic artifact identification and wrote a number of the sections on historic material culture (Chapter 6-III). Additional contributions were made in special study reports by Kathryn Puseman of PaleoResearch (Appendix 9), and macro-botanical consultant Phil Dering (Appendix 12). The report was designed and formatted by Letitia Wetterauer. James W. Kendrick served as chief reviewer at region for the National Park Service. The senior author would like to extend his deepest gratitude to everyone who contributed to this report, and for enduring the exhausting process of producing a document of this length and scope.

2

Setting and Environment

Big Bend National Park (BBNP) is a land of extremes. With a broad range of temperature, precipitation, and topography, the region is phenomenal in its variability, in addition to its remoteness and isolation. It also offers one of the most spectacular panoramas available in the national park system, primarily due to its geological and physiographic diversity. It is also ecologically distinct. Not only is the park considered a showpiece of classic Chihuahuan Desert flora and fauna, its biological diversity is unrivaled in the State of Texas and it boasts more resident and migratory bird species than any other U.S. national park.

The Basin Zone

The BBNP project was focused within a broad physiographic zone referred to here as the "Basin Zone" (as in Basin and Range). The Basin Zone refers to the low-elevation (ca. 1,800–3,600 ft above mean sea level [AMSL]) shrub-desert portion of the park that extends from the lower flanks of the Chisos Mountains and around various outlying isolated mountains, down to the Rio Grande, which flows across the southernmost, lowest, and hottest section of the park (Figure 2.1).


Figure 2.1 The Basin Zone from the South Rim of the Chisos Mountains. Photo by D. Keller.

Distinct from the higher elevation mountains within the park, the Basin Zone should not be confused with the Chisos Basin—a bowl-like valley nestled in the northwestern corner of the Chisos Mountains.

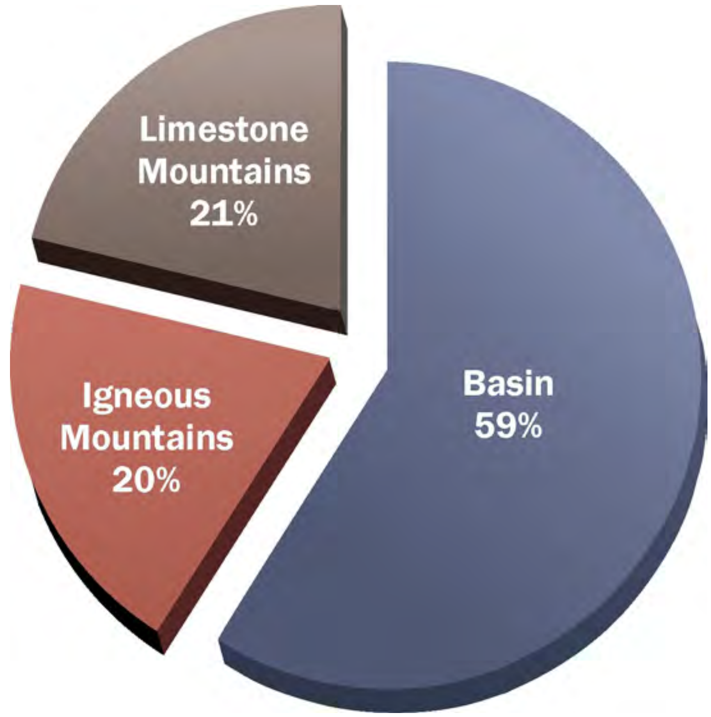

Figure 2.2. Environmental Zones in BBNP.

This zone was chosen for a variety of reasons. Making up some 59 percent of the park's total area (194,748 ha or 481,231 acres [ac]), the Basin Zone is the largest of the three main physiographic zones within the park (Figure 2.2). The other two zones, as identified for this project, are Igneous Mountains, which make up 20 percent of the park's total area (64,546 ha or 159,497 ac), and Limestone Mountains making up 21 percent (70,305 ha or 173,727 ac) (B. Alex 2011). Because of its greater size and accessibility, the Basin Zone receives the most visitor use and is the area most commonly impacted by National Park Service (NPS) undertakings such as road, trail, campsite, and other park infrastructure construction and maintenance. For similar reasons it also contains more cultural sites and higher site density than the other two zones. Sites located within this zone are also at greater risk of both natural and human-caused impacts. The limited vegetative cover, along with characteristically intense storm events, creates high rates of erosion due to both sheetwash and arroyo cutting. In addition, lowland sites are often more vulnerable to unauthorized collecting and vandalism due to their ease of access and relative high visibility. Consequently, it is this zone that is of most concern to the NPS in terms of resource management and the one that will benefit the most from a predictive model for site occurrence—one of the main products of this project.

This chapter provides a broad overview of the environmental setting of BBNP with a special focus on the Basin Zone, which makes up some 82 percent of the surveyed area. The remaining 18 percent of the surveyed area was split almost evenly across the Limestone Mountains and Igneous Mountains. This "extra" survey area outside the targeted zone was primarily the result of survey conducted during the early part of the project under the initial research design that called for sampling a portion of each zone (see Research Design in Chapter 5). Following the adoption of the revised research design, areas surveyed outside the Basin Zone resulted from overlap with other zones when sampling *ecotones* (where portions of two physiographic zones grade into one another).

Physiography

A boundary between two major physiographic provinces—the broadest of the physiographic divisions—occurs along the eastern edge of BBNP. The far eastern portion of BBNP is located within the Interior Plains physiographic province, whereas the western three-fourths of the park—including the present project area—is located within the Basin and Range physiographic province. Within this province, BBNP is considered the far eastern extension of the Mexican Highland Section that extends from Arizona eastward to the Trans-Pecos region of Texas. Characterized by northwest-trending mountain ranges separated by intervening basins, it is an extension of a geomorphic unit that reaches its maximum development in Mexico. Unlike most of the province, which is more basin than range, the Highland Section is distinguished by the near equal ratio of mountains to basins, as well as having more diverse geology and structure. Several graben-like troughs—known as the Rio Grande depression—further distinguish its eastern extent. In addition, drainage to the sea is greater than in other portions of the Basin and Range province (Natural Resource Conservation Service [NRCS] 2011; Thornbury 1965:498).

The diverse array of landforms within BBNP is the result of both geologic structure and the degree of resistance to erosion of specific rock units. The major structures across the park consist of folded mountains (anticlines), fault block mountains and mesas, dome mountains, broad dissected pediments, and alluvial plains, in addition to the steep-walled canyons through which the Rio Grande flows. Intrusive igneous outcrops consist of dikes, sills, tabular bodies, laccoliths, and bosslike masses. Horizontal strata are rare, contributing to the high degree of relief within the park. Elevations within the park range from 2,387 m (7,832 ft) AMSL on Emory Peak to 564 m (1,850 ft) at Rio Grande Village (Maxwell et al. 1967).

Physiographically, BBNP is dominated by a vast sunken block bounded on the east, south, and west by much higher limestone mountains faulted during the Laramide orogeny. Within this block rise the lofty Chisos Mountains, the centerpiece of the park—a Tertiary-aged mass built by igneous emplacements and extrusions. Nestled within the Chisos is a large open valley formed by water erosion known as the Chisos Basin. A narrow gorge cut into the Basin's western rim opens to a 23 m (75 ft) slickrock fall where a spring-fed trickle can become a raging waterfall during storm events. Masses of boulders, cobbles, and gravels—both colluvium and alluvium—skirt the mountain flanks, forming a debris apron around the entire igneous range. Other smaller mountains rise around the Chisos' periphery: Grapevine Hills, Paint Gap Hills, Croton Peak, Burro Mesa, and the Rattlesnake Mountains, among others. Along the expansive fan remnants and piedmont slopes surrounding the Chisos, the landscape grades from the mountain toeslope down to nearly level gravel-capped pediments. Often below these pediments are expanses of eroded sandstone or variegated badlands (Tuttle 1983).

Accounting for about 60 percent of the total park area, the Basin Zone is nearly synonymous with the sunken block with the exception of the higher mountains, notably the Chisos. Major landforms within the Basin Zone include pediments, alluvial fans, erosional remnants, badlands, alluvial flats, hills, and terraces[1] (B. Alex 2011).

Pediments, which developed during the middle to late Pleistocene, are broad erosion surfaces of low relief along the base of abrupt and receding mountains (Figure 2.3). They are underlain by bedrock mantled with a veneer of alluvium derived from the mountain masses. Tending to have an undulating or rolling surface, depth to bedrock is normally greater than 203 cm (80 in). Vegetation consists predominantly of medium and short grasses—notably chino grama and black grama—and woody shrubs—especially creosotebush, ocotillo, and lechuguilla. By far the most expansive of the basin landform categories, pediments account for around 29 percent of the total area within the Basin Zone (B. Alex 2011; NRCS 2011:236).

Alluvial fans extending out from the Chisos and other lesser mountains were formed during the much wetter Pleistocene and early Holocene periods (Figure 2.4). This material eroded from the mountains over

1. This breakdown is based on environmental zonation devised by BBNP Geographic Information Systems Specialist Betty Alex who used soil data and ecological site descriptions to subdivide the park into 25 discrete zones, 15 of which occur in the Basin Zone. For ease of discussion, the present breakdown is a simplification of her categories. It should be noted that subsequent sections, including the spatial analyses, utilize the full array of categories.

Figure 2.3 Pediment surface, looking northward towards the Chisos Mountains. Photo by D. Keller.

Figure 2.4 Alluvial fan flanking Nugent Mountain (eastern side of Chisos Mountains). Photo by K. Baer.

thousands of years and was deposited where the stream gradient decreases. Over long periods of time, fans were formed by lateral distribution of material on the surface. Characteristic vegetation includes chino grama, black grama, bush muhly, creosotebush, and ocotillo. Alluvial fans (including fan remnants) account for an additional 24 percent of the total area within the Basin Zone (B. Alex 2011; Natural Resources Conservation Service [NRCS] 2011:236).

Erosional remnants consist of eroded sandstone hills and mountains, creating areas of shallow to very shallow soils formed of residuum from weathered sandstone—notably the Cretaceous-aged Aguja Formation (Figure 2.5). Associated with knolls, ridges, cuestas, broad rolling uplands, and side slopes, the interbedded sandstone and shale parent material have been uplifted and tilted to form ridges. These areas are generally less vegetated and have lower diversity than those of higher elevation, with vegetation dominated by chino grama. Erosional remnants comprise around 11 percent of the total area within the Basin Zone (B. Alex 2011; NRCS 2011:130).

Badlands consist of deeply eroded, often colorful areas characterized by shallow soils derived from colluvium and clayey residuum weathered primarily from mudstone (Figure 2.6). Where lacking gravel to enhance infiltration, vegetation is sparse to nonexistent. Low-lying vegetated areas are often dominated by tobosa grass, purple prickly pear, and saltbush. These areas account for around 9 percent of the total area within the Basin Zone (B. Alex 2011; NRCS 2011:131).

Figure 2.5 Erosional remnant of the Cretaceous-age Aguja Formation. Photo by L. Weingarten.

Figure 2.6 Badlands of the Pen Formation near Dawson Creek. Photo by C. Covington.

Alluvial flats are broad, nearly level, or gently sloping areas composed of generally very deep soils that formed in loamy alluvial materials from both igneous and sedimentary sources (Figure 2.7). Highly susceptible to erosion, these flats are dominated by tobosa grass and other drought-tolerant bunchgrasses. These areas account for around 8 percent of the total area within the Basin Zone (B. Alex 2011; NRCS 2011:129).

Hills in the basin are areas consisting of shallow to very deep soils that formed in material weathered from igneous bedrock. These areas are dominated by drought-tolerant woody shrubs or short grasses, primarily creosotebush and chino grama. These areas account for another 8 percent of the total area within the Basin Zone (B. Alex 2011; NRCS 2011:124,127).

Stream terraces, erosional remnants of late Pleistocene to middle Holocene floodplains, occur along the lateral edges of modern drainages, but above the modern floodplain. These soils have been stable long enough to form cambic (weak mineral) horizons. Underlain by stratified sand, gravel, loamy, or clayey sediments, some terraces also contain buried paleosols. Stream terraces account for only about 4 percent of the area within the basin (B. Alex 2011; NRCS 2011:237). In addition to these seven landform types, but of much lesser spatial extent, are escarpments, arroyos, and floodplains that together account for the remaining 7 percent of the total area within the Basin Zone. Taken together, these 10 various landforms comprise about 82 percent of the total area surveyed during the present project (B. Alex 2011).

Figure 2.7 Alluvial flats with pedestaled mesquite trees west of Mariscal Mountain. Photo by B. Dailey.

Geology

BBNP offers a showcase of geological formations, many of which are completely exposed due to the scarcity of vegetation and, in most areas, a relatively thin mantle of soil. A wide variety of sedimentary, extrusive volcanic and intrusive igneous rocks (as well as minor exposures of metamorphic rocks) can be seen within the park, spanning the early Paleozoic Era to the present. The total thickness of exposed rocks is about 4,206 m (13,800 ft), of which the Paleozoic comprises some 427 m (1,400 ft), the Mesozoic 1,555 m (5,100 ft), and the Quaternary 2,377 m (7,800 ft). Broadly speaking, the limestones and other sedimentary units are mainly Cretaceous in age whereas the igneous rocks date to the Tertiary period. The major geological structures are related to Laramide tectonic activity in the late Mesozoic and early Cenozoic eras. Additional block faulting and mountain uplift along with igneous intrusions, volcanic eruptions, and extensive erosion and deposition occurred during the Tertiary period (Maxwell et al. 1967; Tuttle 1983).

The geologic history of BBNP is characterized by numerous, often repetitive, episodes of deposition, faulting, volcanism, and erosion that together have created the tortured, otherworldly landscape seen today. During the Paleozoic Era (542–251 million years ago [mya]) the region was part of the Ouachita Trough and was covered by a deep sea. For millions of years, sediment washed down from the dry land to the north and accumulated in the trough. During the late Paleozoic, these layered sediments were folded as the North American and South American plates collided, forming the Ouachita Mountains that extend from near Lajitas, Texas, northeastward into the State of Oklahoma. A limited exposure of these rocks can be seen at Persimmon Gap, in the extreme northern portion of the park (Henry 1998:18; International Commission on Stratigraphy [ICS] 2009; Tuttle 1983:405).

Early in the Mesozoic Era (250–65 mya) most of the Ouachita Mountains eroded away. The absence of rocks from the Triassic and Jurassic periods is probably a reflection of this erosional episode. Sedimentation resumed as warm, shallow seas covered the region to create thick limestone deposits, including those of the massive Santa Elena limestone that are 229–259 m (750–850 ft) thick. As these seas grew shallower, thin limestone and shale beds were deposited. Towards the end of the Mesozoic Era and the beginning of the Cenozoic Era (65 mya to the present), tectonic forces of the Laramide Orogeny compressed the earth's crust, creating the Rocky Mountains, including—at the far eastern edge of its influence—the Sierra del Carmen as well as San Vicente and Mariscal mountains (Henry 1998:24, 29, 32–53; ICS 2009).

During the Paleocene and Eocene epochs (ca. 65–35 million years ago), erosion of the Cretaceous rocks created sediments that accumulated approximately 914 m (3,000 ft) thick between folds and fault blocks that lie uncomformably over the older Cretaceous rocks. Towards the end of this erosional-depositional period, the first appearance of igneous rocks signifies the onset of volcanism. Beginning around 37 mya and continuing until about 24 mya, during the middle Tertiary period, volcanic activity was widespread across the region. The earlier extrusive events were responsible for depositing massive quantities of ash and lava, notably from the Sierra Quemada and Pine Canyon volcanoes. The Chisos and South Rim formations are made up of 914–1,524 m (3,000–5,000 ft) of massive lava flows, flow breccias, conglomerates, tuffaceous sandstones, mudstones, tuffaceous clays, and ash beds. Between eruptions, streams reworked and redeposited material that was subsequently buried by new volcanic deposits. Magma that cooled before breaking the surface formed laccoliths, sills, dikes, plugs, and small plutons that frequently intruded into earlier sediments and igneous deposits (MacLeod 2008:12-19, Tuttle 1983:407–408)

Near the end of volcanic activity, basin-and-range-style faulting began around 28 mya and persists to this day. The result has been a series of basins (grabens) and mountain ranges (horsts). It was also during this period that the entire central portion of the national park—between the Santiago Mountains to the east and Mesa de Anguila to the southwest—known as the sunken block, dropped down. For the last 10 million years, erosion has served as the prime geologic agent, carving out canyons and arroyos, uncovering volcanic intrusions, and redepositing sediment to form broad alluvial fans. As the sedimentary rock has weathered down, more resistant igneous intrusions have been uncovered to reveal mountains, pinnacles, mesas, and dikes. Although erosion is slower in the Chisos Mountains and the grasslands that surround them, the park continues to erode. This erosional environment has worked to expose archeological features and artifacts over thousands of years in the same way that it has uncovered geological deposits over millions of years (Henry 1998:55–63; MacLeod 2008:17; Tuttle 1983:408).

Twenty different geological formations occur in the Basin Zone portion of the surveyed area (out of a total of 28 formations found in the Basin Zone or 30 formations found across the entire park).[2] Of these, four formations occur most frequently within the survey blocks, together accounting for 70 percent of the surveyed area (Figure 2.8). Holocene-aged colluvium and fan deposits occurr most frequently, accounting for 21 percent of the surveyed area. The upper Cretaceous-aged Aguja Formation is next in frequency, outcropping

2. Because only a minor portion of non-basin areas were surveyed, limiting the discussion to this zone provides a more accurate representation of geological formations sampled. Discussions of soils in a subsequent section is similarly confined.

across 20 percent of the surveyed area. Pleistocene-aged alluvium and colluvium occur in 16 percent of the surveyed area, and Holocene-aged alluvium found on floodplains and terraces occurs in 13 percent of the surveyed area. The percentage of surveyed geological formations generally corresponded to their relative occurrence across the Basin Zone although Aguja Formation deposits tended to be overrepresented, and Chisos formation and Pleistocene-Miocene terrace deposits tended to be underrepresented (GIS files).

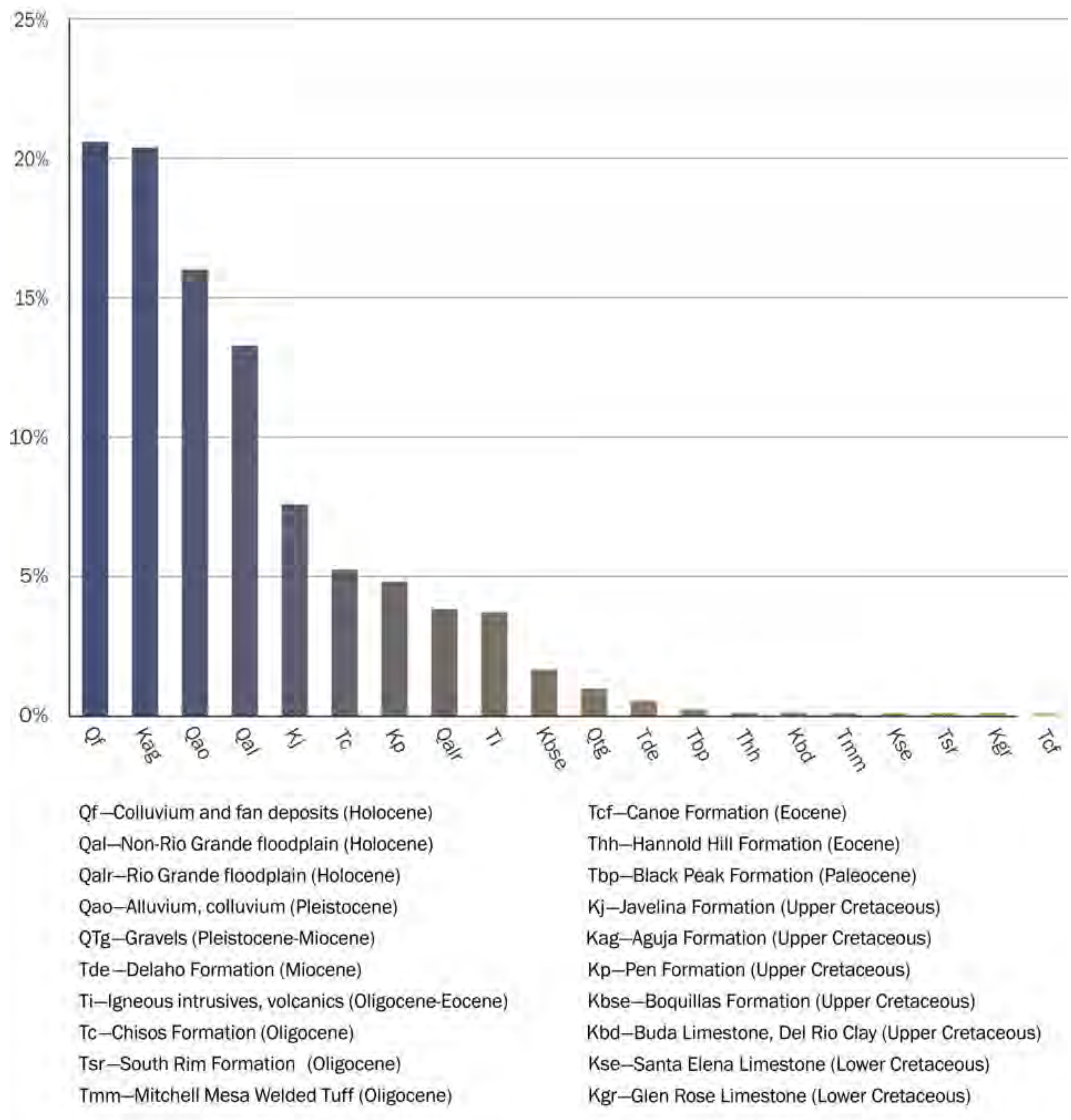

Figure 2.8 Distribution of geological formations within the surveyed areas of the Basin Zone.

Taken together, alluvium and colluvium comprise the vast majority of deposits found within the surveyed area of the Basin Zone—amounting to 55 percent of the total deposits encountered. This corresponds closely with its relative occurrence across the entire Basin Zone, spanning roughly half of its total area (GIS files). These deposits are predominantly Quaternary-aged gravels and silts that overlay older terrestrial deposits and include pediment-capping gravel deposits, stream and river alluvium, and alluvial fan deposits. Gravel-capped pediments reflect extensive erosion that followed a long period of deposition beginning with bolson-filling dating back to the Miocene (23–5.3 mya). Since the Rio Grande became established, probably in the Late Pliocene to Early Pleistocene, the fluvial system has been dominated by long periods of erosion punctuated by episodic deposition. In general, the older deposits (mostly fan deposits) reside on higher, typically deeply dissected landforms, whereas younger deposits occur on lower landforms that retain some original surface morphology. Older deposits are usually well consolidated with strong soil carbonate morphology and well-varnished gravels. Younger deposits are generally unconsolidated and development of desert pavement, varnish, and soil carbonate range widely depending on age. Lithography of deposits reflects parent material—those around the Chisos are chiefly igneous, whereas alluvium along the Rio Grande and other streams reflect the geology along the length of their drainage basins (Berry and Williams 2008; Maxwell et al. 1967:151–156).

The Aguja Formation, second in frequency within the surveyed area, is Cretaceous in age and consists of marine sandstone and silty clay in the lower deposits, and nonmarine clay, silt, and coal interbedded with sandstone in the upper deposits. This formation lays uncomformably upon the Pen Formation and just below the Javelina Formation. The lowest portion consists of 1.5–10.7 m (5–35 ft) of yellowish-gray, yellow, or yellowish-brown sandstone. This is followed by a fossiliferous marine clay, typically gray in color, weathering yellowish-brown, and containing thin sandstone lenses 53.3–152.4 m (175–500 ft) thick. The clay contains concretions 0.9–1.2 m (3–4 ft) in diameter, most of which are reddish-brown ironstone. This unit is overlain by an alternating sequence of marine sandstone and clay beds that grade upward to the nonmarine rock that consists of alternating sandstone, clay, and freshwater limestone. Fossils in the formation include dinosaur bone, turtle, and silicified wood (mostly conifers, but also palmwood, some of which is silicified or agatized). In places where igneous intrusions occur, the clay has been baked and in some cases has been metamorphosed to hornfels. Limited coal beds, typically less than 0.6 m (2 ft) thick, occur in various clay deposits throughout the formation. They are generally low grade, except where adjacent to intrusions where they become anthracite grade. While never marketed commercially, the better quality coal was used by some ranchers in their forges and, in a very limited fashion, for heat. One deposit near Study Butte was mined for several years to make producer gas for power and fuel at the Terlingua quicksilver mine. This formation was especially predominant in Blocks B and H, where it comprised half or more of the block (GIS files; Maxwell et al. 1967:79–87).

The remaining 30 percent of the surveyed area was spread out across 16 other geological formations in the basin although most occurred in the Javelina Formation, Chisos Formation, and the Pen Formation—together accounting for an additional 18 percent of the surveyed area (GIS files).

Toolstone Resources in BBNP

The Big Bend region is notable for having a wide range of geological formations that contain lithic raw material sources suitable for the manufacture of stone implements. In this respect, BBNP constitutes a microcosm of the region as a whole, containing both generic as well as relatively unique kinds of siliceous stone that were utilized by prehistoric peoples for millennia. Like other expanses of the eastern Trans-Pecos, the quality, quantity, and availability of raw materials in the park are linked inextricably to rock type and erosional processes that differ—sometimes rather dramatically—from subarea to subarea.

Unfortunately, the ubiquitous toolstone sources of the Big Bend and the Trans-Pecos region as a whole have been notoriously understudied—a problem pointed out previously by Mallouf (1985:88) and Banks (1990:83) and alluded to earlier by Campbell (1970:534). While numerous lithic procurement areas have been noted, and some formally recorded during surveys, only a few specific stone types and sources—all having rather unique qualities—have garnered the repeated attention of researchers. Two such source areas are found within, and for a large part are limited to, BBNP: Burro Mesa cherts and siliceous hornfels. Two other stone types, Caballos novaculite and Maravillas chert, have received a great deal of geologic attention and occur primarily in the northern edges of the park area.

There are, however, numerous other high-quality stone sources in the park. Sedimentary, metamorphic, and igneous raw materials are distributed across the park, and they are found throughout Riverine, Basin, Foothill, and Mountain zones. Banks (1990:83–87), drawing heavily from Maxwell et al. (1967) and the Geologic Atlas of Texas (1979), discusses a number of area geological formations that, as indicated by the literature, are known or suspected to contain siliceous stone sources suitable for the production of knapped stone tools. Among those formations described briefly or mentioned by Banks are the Tesnus, Dimple, Burro Mesa, Del Carmen, Yucca, Javelina, Aguja, Santa Elena, Buda, Canoe, Maravillas, Caballos Novaculite, and Chisos. Based on more recent geological research in the park area (e.g., Turner et al. 2011), this list can be expanded to include Dominguez Mountain, Hannold Hill, Black Peaks, Pen, and possibly South Rim formations.

The variety and quality of raw material generally available to prehistoric toolmakers of the Big Bend are impressive when compared to surrounding regions. Found within and adjacent to the park are sources for a wide range of sedimentary chert types commonly used by prehistoric knappers, including flint, chalcedony, jasper, agate, novaculite, silicified wood, and others. In addition, there are a plethora of sources for toolstone related to metamorphic and igneous processes, such as fine-grained rhyolite, felsite, andesite, basalt, trachyte, quartzite, hornfels, skarn, siltstone, welded tuff, dacite, and claystone. Importantly, with regard to the Big Bend, Banks notes, "Even in those formations described in geological literature as being chert producers [primarily sedimentary limestones], the most basic descriptions of the materials are lacking" (1990:87). The same can be said for toolstone sources and stone types of metamorphic and igneous origins.

As mentioned earlier, some toolstone types that have received at least preliminary attention from archeologists working in the park area include Burro Mesa chert, Caballos novaculite, Maravillas chert, and siliceous hornfels (e.g., Achorn 1997; Banks 1990; Butler and Langford 1974; Campbell 1970:37–41; Mallouf 1985:12–14; Mallouf, Cloud, and Walter 2006:110–127; Mallouf and Wulfkuhle 1989:10–18; Purcell 2004). Archeological debitage assemblages found in the northern and/or western areas of the park often contain significant percentages of one or more of these four toolstone types. A discussion of each of these four major categories follows.

Burro Mesa Cherts

Rising some 305 m (1,000 ft) above the Cottonwood Creek valley, Burro Mesa is a prominent sunken fault block (MacLeod 2008:87; Maxwell 1968:79) on the west side of the Chisos Mountains. Located near the head of Apache Canyon along the western edge of this extensive igneous landform are remarkable outcroppings of high-quality, variegated siliceous toolstone (Figures 2.9 and 2.10). Referred to by various researchers in the past as flint, chert, welded tuff, tuffaceous chert, and/or chalcedony (e.g., Banks 1990; Campbell 1970; Cloud 2002; Corrick 2000; Mallouf 1985), Chmidling (1998:46) attributes its formation to

Figure 2.9 Burro Mesa chert source at the head of Apache Canyon. Photo by R. Mallouf.

Figure 2.10 A pink chert outcrop at Apache Canyon, Burro Mesa. Scale = 30 cm. Photo by R. Mallouf.

"hydrothermal action in which the volcanic tuff was silicified and void spaces filled with silica." Chmidling further notes that petrographic and geochemical analyses (discussed below) indicate that "it is a chert which often, but not always, contains chalcedony" (1998:94). The broad color variability of this chert is illustrated in Figure 2.11.

The toolstone procurement and workshop areas at Burro Mesa have been characterized as encompassing over 40 ha (100 ac) by Butler and Langford (1974:13) who, perhaps being overly enthusiastic, consider this source area as having archeological significance comparable to that of Alibates siliceous dolomite quarries of the Texas Panhandle. Similarly impressed by the Apache Canyon quarries, Campbell states that:

> Unquestionably the Burro Mesa is one of the most important archeological resources of the Big Bend National Park. Its size alone makes it outstanding. But even more important is the fact that this flint was used by local populations throughout the prehistoric period . . . . The vast accumulation of flint debris makes- the quarry area an important laboratory for the study of flint mining and artifact technology. . . . (Campbell 1970:39–40)

Of the major toolstone categories discussed earlier, only Burro Mesa cherts from the Apache Canyon source have thus far been subjected to a preliminary geochemical characterization. In attempting to lay groundwork for future study, Chmidling conducted instrumental neutron activation (INAA) and petrographic analyses of multiple samples from the quarries in order to find "identifiers" that would distinguish the Apache Canyon samples from other toolstone sources in the park. She concludes that correlation and cluster analyses of geochemical data "worked well, and effectively separated Apache Canyon samples" from comparative material studied (1998:109). Chmidling concludes her study with preliminary inferences concerning prehistoric population movement and intergroup contact based on the identification and distribution of Burro Mesa cherts. And she appropriately stresses the need for more geochemical and petrographic sourcing both in the park and across the Trans-Pecos region.

Caballos Novaculite

White novaculite is the primary rock type within geologic outcrops of the Caballos Novaculite Formation. Varieties of knapped Caballos novaculite are found in prehistoric campsites across the park, but are most common in sites to the north of the Chisos Mountains. Accordingly, major sources for novaculite toolstone lie

Figure 2.11 Range of colors of Burro Mesa cherts. Photo by R. Gray.

primarily to the north of the park in ridges (Caballos Mountains) of the Marathon Basin (Figure 2.12) and in arroyos emanating from or nearby those ridges. The renowned geologist Philip B. King provides us with an almost poetic synopsis of their geologic exposure:

> The strongly folded and faulted Paleozoic rocks of the Marathon Basin have been revealed by the stripping of the cover of Cretaceous limestones from the crest of the Marathon dome. They are a segment of the denuded roots of a widely extended mountain system, formed in the later part of Paleozoic time. Two rock formations, more resistant than the rest, stand as ridges in the Marathon Basin. The lower of these stratigraphically is the Caballos novaculite . . . the upper is the Dimple limestone. In their setting amidst the grander features of Trans-Pecos Texas they must be regarded as mountains in miniature, resurrected of late to a mere shadow of their one-time glory by the fortuitous circumstance

> of being denuded of the mantle accumulated on them by the sea, which had formerly entirely buried their ancient summits (King 1937:13).

Within BBNP the only known exposure of Paleozoic rock of sufficient age (Ordovician to Pennsylvanian) to contain Caballos novaculite occurs in the Santiago Mountains at, and a short distance southeast of, Persimmon Gap (Gray and Page 2008:4; Maxwell et al. 1967). Maxwell et al. (1967:27) note the occurrence of a siliceous conglomerate containing dark chert pebbles and gray-white novaculite at the base of the Tesnus Formation at this location. In addition, immediately north of Persimmon Gap are gravel deposits in the walls and floor of Maravillas Creek (Figure 2.13) that contain cobbles of Caballos novaculite, many of which are sufficiently large for the production of a wide range of stone tools (Figure 2.14). Maravillas Creek and its tributaries are the principal streams emanating from the white novaculite-capped ridges to the north. Considering the proximity of this major drainage to the park, it is likely that much of the novaculite material found routinely in park sites is derived from Maravillas Creek gravels.

In general terms, novaculite is a very dense, even-textured, light-colored crypto-crystalline siliceous stone (American Geological Institute 1962:348) that is generally considered by geologists to be a variant of chert. More specifically, Caballos novaculite may be vitreous or “dull-lustered, white or creamcolored, and of porcelainlike texture” (King 1937:50). Park sites containing debitage and/or tools of novaculite frequently contain specimens of olive to dark green chert as well, although in lesser densities. The Caballos Formation is notable for containing green cherts interbedded with novaculite (e.g., Banks 1990:85; King 1937:50) and is thus the likely source for this toolstone as well—at least in northern areas of the park. The rather limited exposures of Paleozoic rocks in the Persimmon Gap area mentioned earlier, as well as Maravillas Creek gravels, should ultimately prove to be the source for distinctive green

Figure 2.12 Caballos novaculite outcropping along a ridgeline in the Marathon Basin north of BBNP. Photo by R. Mallouf.

Figure 2.13 Novaculite and chert-bearing gravel deposits in the bed of Maravillas Creek near Persimmon Gap. Photo by R. Mallouf.

Figure 2.14 Large worked cobble of white Caballos novaculite from Maravillas Creek near Persimmon Gap. Photo by R. Mallouf.

cherts found in reported sites in Persimmon Gap (e.g., Baskin 1978) and along the eastern flank of the nearby Rosillos Mountains (Mallouf and Wulfkuhle 1989:14).

Maravillas Chert

In the Marathon Basin to the north of BBNP are thick deposits of bedded black and brown cherts (Figure 2.15) of the Maravillas Chert Formation (King 1937:37–47). Underlying the Caballos Novaculite Formation, the Maravillas is subject to similar erosional processes that have resulted in numerous exposures of this high-quality toolstone. Black to dark brown in color, Maravillas cherts occur in archeological sites throughout the park and in sites across much, if not all, of the Big Bend region—but typically in small sizes and small quantities. Like white novaculite, this high-quality toolstone is a common constituent of gravels in the floor of Maravillas Creek in the Caballos Mountains and downstream to the vicinity of Persimmon Gap. And, as in the case of white novaculite, small potential source areas for Maravillas chert also exist inside the park among Paleozoic rock outcrops in and immediately southeast of Persimmon Gap.

Hornfels and Metamorphosed Limestone

Hornfels is a fine-grained, non-schistose, metamorphic rock resulting from contact metamorphism (American Geological Institute 1962:236). In the park, hornfels is typically black or dark brown in coloration, fine-grained, homogeneous, and lacking in inclusions such as relic phenocrysts (Figure 2.16).

One of the toolstones favored by prehistoric inhabitants of the park, bedrock outcrops (Figure 2.17) and colluvial/alluvial deposits of black hornfels are intimately linked to rhyolitic and granitic laccoliths such as form the Chisos and Rosillos mountains. In these areas compacted sediments were long ago metamorphosed by contact with expanding volcanic magmas. Black hornfels quarry debris, debitage, and tools are

Figure 2.15 Thick-bedded black Maravillas chert outcropping along Maravillas Creek in the Marathon Basin north of BBNP. Photo by R. Mallouf.

Figure 2.16 A black hornfels core from the Tornillo Creek drainage area in BBNP. Photo by R. Gray.

Figure 2.17 Robert Mallouf documenting a linear outcrop of patinated black hornfels at Rough Mountain in BBNP. Photo by W. Boggs.

found, sometimes in massive quantities, in prehistoric sites across the park and in adjacent areas, as well as in gravels of the riverine zone of the Rio Grande as far downstream as Amistad Reservoir in the Lower Pecos region to the east (Mallouf 1985:12). Chmidling (1998:49) and Maxwell et al. (1967) both note a probable linkage of hornfels outcrops to metamorphosed Pen Formation, exposures of which are found scattered across the park.

Source localities for black hornfels are particularly noteworthy in the vicinities of Rough Mountain, Grapevine Hills, McKinney Hills, Roy's Peak, and the Tornillo Creek valley, all in the northern half of the park. Excellent examples of quarried ledges of hornfels (Figure 2.18) are found along the northwestern edge of Rough Mountain, while terraces along the upper and middle reaches of Tornillo Creek are frequently capped by desert pavements containing vast quantities (Figure 2.19) of knapped, often desert-varnished hornfels. At all five of the source areas noted above, the archeological deposits often contain large hand-sized, hard-hammer removals that are a reflection of the substantial cobbles of hornfels available for reduction and transport.

When accessible to prehistoric knappers, hornfels seems to have been selected primarily for the manufacture of expediency tools used in scraping, cutting, and pounding tasks. More formal tools—such as arrow and dart points, unifacial gouges, and bifacial knives made of hornfels do occur—but are not particularly common in site assemblages. On the other hand, hammerstones of hornfels, in many instances converted to cores or core tools, are encountered fairly routinely.

In and near the desert pavements along Tornillo Creek are numerous, easily discerned work stations where one or a few individuals sat and reduced hornfels cobbles into clustered debitage—removing to their camps only those pieces that met their mental templates for further reduction. The debitage left behind can often be conjoined to recreate the original core, as well as the technique and sequence of its reduction.

Figure 2.18 Prehistorically mined ledge of black hornfels near Rough Mountain in BBNP. Photo by R. Mallouf.

Figure 2.19 Massive quarry deposit of black hornfels debitage in BBNP. Note handtape at lower center for scale. Photo by W. Boggs.

A good park example from Sampling Quadrat B is a tight cluster of hornfels debitage discovered in the vicinity of Grapevine Hills in 1996 (Figure 2.20). The black debitage—all from a single reduced core—stood in stark contrast to surrounding tan sandstone and sediments of the Aguja Formation, making documentation and virtually complete specimen recovery possible. Reconstruction of the core in the laboratory revealed it to be of a blocky rectangular shape (Figure 2.21) and missing only a few relatively straight, flat removals—the latter presumably carried off by the knapper. The reconstruction of cores from these small, uncontaminated workstations can provide significant insight into behavioral patterns during the initial stages of lithic technology, including preferences for cobble size and quality,

Figure 2.20 A single hornfels core reduced to debitage at a prehistoric workstation near Tornillo Creek. Photo by R. Mallouf.

techniques of core reduction, and pieces selected for transport and further modification.

Skarn, a rock composed largely of lime-bearing silicate minerals, can potentially be confused with hornfels by the uninitiated. Morgan and Shanks (2008:43) note that skarn deposits

> are characterized by calc-silicate minerals in limestone or limestone-bearing rocks that have [like hornfels] formed by contact metamorphism resulting from the intrusion of hot magma into cooler country rock.

And, like hornfels, skarn is frequently of toolstone quality. Since skarn outcrops are found in many of the same localities as what has been characterized as hornfels by archeologists (e.g., McKinney Hills/Roy's Peak), an effort should be made to verify that correct terminology is being used by researchers in future studies. This can apparently be accomplished through a simple acid test—skarn fizzes and hornfels does not. It should be noted that in far southern areas of the park, such as in the vicinity of Mariscal Mountain, thick beds of black metamorphosed limestone occur, and debitage of this material (skarn) is fairly common in southern sites.

Other Toolstones

Cretaceous Toolstones

Gray, brown, tan, and banded limestone cherts occur in sites throughout BBNP, but are most common in sites east, northeast, and southeast of the Chisos Mountains. The higher densities found in eastern park sites are logically attributable to the proximity of thick-bedded, chert-bearing Lower Cretaceous limestone formations that constitute the western massif of the Stockton Plateau and northern extent of the Sierra del Carmen. Other toolstone sources are likely present in Cretaceous formations that outcrop along the southern tip and western edge of the park, such as Mariscal Mountain and Mesa de Anguila (Santa Elena Formation limestones). Outcropping Cretaceous Javelina and Aguja clay and sandstone formations found primarily

Figure 2.21 The reconstructed hornfels core from a workstation near Tornillo Creek. Photo by R. Mallouf.

in western and northwestern areas of the park provided good source areas for toolstones such as silicified wood, chalcedony, siltstone, and claystone (Figure 2.22).

Tertiary Toolstones

Tertiary igneous formations in the park likely contain the greatest variety and widest quality of siliceous and other toolstones. The Chisos Formation, which is found throughout central and western areas of the park, is a primary source for a wide variety of siliceous, fine-grained rhyolite, felsite, mudstone, siltstone, welded tuff, basalt, scoria, tuffaceous sandstone, and other rock types of use to prehistoric populations (Geologic Atlas of Texas 1979). Some of these stone types, such as fine-grained rhyolite and felsite, were commonly used in the manufacture of expediency tools. The Canoe Formation, which occurs primarily as small outcrops in the Grapevine Hills area of the park, is known to contain silicified tuff and claystone. Although having very limited exposure, the Hannold Hill Formation—which outcrops on the north side of Tornillo Creek and east of the Grapevine Hills, contains pebbles of black chert. However, it is not known if this latter material is of sufficient size for the production of stone tools.

Various Other Toolstones

Sources for fine-grained felsites, rhyolites, and trachytes, usually of light coloration, occur commonly across volcanic areas of the park. The rather ubiquitous occurrence of these toolstone sources in the park

Figure 2.22 Cherts and agates from the Cretaceous-age Javelina Formation. Photo by C. Covington.

possibly accounts for their having been only cursorily recorded in the past. As in the case of hornfels sources, dense debitage at felsite and/or rhyolite quarries often contain outsized cores, flakes, and true blades. And, like hornfels, tools fashioned from felsite and rhyolite are typically of an expedient nature, although formal tools do occur.

A common toolstone found in park sites is a yellow-red mottled chalcedonic chert or jasper that is also found across the Big Bend region. The only sources for this material inside the park that are known to this writer occur in the vicinity of the northern Rosillos Mountains and Bone Spring (Figure 2.23), where they are found principally as gravels in arroyo systems (Mallouf et al. 2006:167). Outcrop sources certainly occur as well, but remain unrecorded to date.

Figure 2.23 A worked cobble of yellow chalcedonic jasper from the Bone Spring area in BBNP. Photo by R. Gray.

Silicified wood is also fairly common in park sites, with sources known to the writer in the vicinity of the southern Rosillos Mountains and the Dawson Creek area near the western park entrance (Mallouf n.d.c). A third documented source is along Rough Run arroyo, also in the western portion of the park (Cloud 2002:61). Many more source areas for silicified wood probably exist inside the park, as it is a frequent constituent of arroyo gravels. In addition, arroyo floor gravels are common sources, particularly across the Basin Zone, of a wide range of siliceous claystones, mudstones, siltstones, chalcedony, jasperoids, agates, variegated cherts, and welded tuffs that are commonly found as debitage and tools within prehistoric sites in the park.

Ground-stone implements—including portable metates; pestles; and manos of basalt, limestone, indurated sandstone, and other materials—are fairly common in base camps and special activity sites. As would be expected, sources for these materials are found throughout Cretaceous and Tertiary deposits inside the park.

Minerals

A variety of minerals were also utilized by prehistoric peoples in BBNP, the most notable being kaolin, quartz crystals, and hematite. While their occurrence is widespread, artifacts of these materials are relatively rare, never having been found in any notable quantities at individual sites.

Kaolin

Used interchangeably with the term kaolinite, kaolin is a rock composed essentially of clay minerals of the kaolinite group, most commonly kaolinite (American Geological Institute 1962:270). It can form through near-surface weathering of preexisting rocks, or by hydrothermal action related to chemical alteration of feldspars in igneous rocks (Frank Daugherty, personal communication 1996). It is a white-to-gray rock with a hardness of only 2 on Moh's hardness scale.

Kaolin, being a soft stone with a texture and feel similar to soapstone, was used prehistorically throughout the Big Bend in the production of ground-stone ornaments such as beads and pendants. The occurrence of white stone ornaments in the park's archeological sites and raw white stone material in drainages around the Chisos Mountains was first observed by Campbell (1970:113–

115). Working from Campbell's observations, Tom Alex (1990:163–168) deduced that a linkage of kaolin to the Burro Mesa area was likely, and subsequently located a significant source for this material at Apache Canyon. Considering the widespread occurrence of kaolin ornaments in the Big Bend, in adjoining areas of Coahuila and Chihuahua, and across the eastern Trans-Pecos, the existence of other source areas, both within and outside the park, is anticipated. Alex points out that another important source for this stone has been identified by Nobles (1942) in the Davis Mountains.

Quartz Crystals

The use of hexagonal quartz crystals in shamanic healing rituals and as symbolic sources of power in both prehistory and history is well known in North America America (e.g., Heizer 1949; Parsons 1939; Shafer 2003), but has been documented worldwide. Even so, there is as yet only minor archeological evidence to suggest that crystals had magico-religious connotations among nomadic peoples of the Big Bend and eastern Trans-Pecos. Within BBNP, several small quartz crystals have been recovered from open campsites and deposits inside Cielo complex wickiups in the eastern foothills of the Rosillos Mountains (Mallouf and Wulfkuhle 1989:14). At nearby Big Bend Ranch State Park, three examples of similar "dogtooth spar" calcite crystals were found at three different prehistoric sites, one within a stone enclosure (Ing et al. 1996:149–150). Although isolated quartz crystals have been found in various localities in the park, an actual source for this material is unknown to this writer.

Hematite

Hematite is the principal ore of iron and has a wide range of colorations and other physical characteristics. As across the greater Big Bend, hematite is ubiquitous within the park, occurring within a wide range of geological formations and in colluvial and alluvial deposits of the Basin Zone. Soft hematites having red and/or yellow colorations were ground and used as pigments by prehistoric populations of the region. They are a major constituent of rock art in the park, and probably were used in a wide range of other functions. Remnants of red ochre are sometimes observed on grinding slabs, bedrock mortars, and small paint palettes in the region. Red and orange-red pigment stones were recovered during the present survey and were also noted during the Campbell (1970:112) survey. Small pebbles of soft red and reddish-brown hematite, faceted from use, are known from Cielo complex sites in the Rosillos Mountains (Mallouf and Wulfkuhle 1989:14) and from upstream of the park in the La Junta district (Cloud and Piehl 2008:130–131; Kelley et al. 1940:76).

Soils

Soils in BBNP primarily fall within the Aridisol dominant soil order and the Calcid dominant suborder. In general, these soils—common to arid and semi-arid environments across the globe—have a surface horizon lacking fine stratification, are light colored, thin, or have low organic content. They are further characterized by their dryness, where water is not available for the growth of most plants. These soils are typically subject to an extreme imbalance between evapotranspiration and precipitation, often resulting in accumulation of salts or other soluble minerals. The Calcid suborder, extensive across the western U.S., reflects the distribution and accumulation of carbonates. Because precipitation is insufficient to leach or move the carbonates to great depths, the upper boundary of the calcic or petrocalcic horizon is typically within 50 cm (20 in) of the soil surface (NRCS 1999:329–331, 351).

Soil formation, or pedogenesis, is the result of five soil-forming factors that determine the unique characteristics and properties of soil. These factors include (1) the living organisms that live in and on the soil, (2) the different climates to which parent material and soil have been exposed, (3) the length of time these forces have acted upon the soil, (4) the relief or topographic features of the landscape, and (5) the type and mineralogical composition of the parent material (NRCS 2011:219). Soil development in BBNP is most dependent on the parent material—in this case the nature of the bedrock—such as chemical composition, grain size, and hardness. Soils on hills and mountains, in particular, vary significantly in their development. Whereas some show little evidence of development, others have well-developed argillic (clay-rich) and calcic (calcium-rich) horizons (NRCS 2011:235).

Bedrock within BBNP is divided into seven general categories based on age, lithology, and physical characteristics: the Paleozoic formations, the lower massive limestones, the upper flaggy limestones, the shales, the sandstones, the volcanic rocks, and the alluvial deposits. The Paleozoic rocks are restricted to areas in the northernmost portion of the park and include black-to-brown chert deposits, known as Maravillas chert, which was a significant prehistoric lithic resource. The lower massive limestones are thick Cretaceous formations interbedded with calcareous shale, minor chert, and sandstone that form Altuda, Bissett, and Blackgap soils. The upper flaggy limestones are thin-bedded Cretaceous rocks composed of Del Rio clay, Buda limestone, and the much thicker Boquillas formation that create Geefour and Mariscal soils. The Shales include the Pen, Aguja, and Javelina formations—marine and terrestrial shales containing fossil wood and dinosaur bones—which create Geefour and Solis soils. The sandstones consist of lower Tertiary rocks of the Black Peaks and Hannold Hill formations which create Solis soils. The volcanic rocks—consisting of thick deposits of Canoe, Chisos, and South Rim formations containing basalt and rhyolite—create Musgrave, Brewster, Leyva, Mainstay, Puerta, Studybutte, and Terlingua soils. Alluvial deposits consist of Quaternary alluvium derived from both sedimentary and igneous upslope sources (NRCS 2011:232–234).

The Basin Zone of the present project generally corresponds to the "Hot Desert Shrub Vegetative Zone" in the Natural Resources Conservation Service's (NRCS) recent soil survey of BBNP. This vegetative zone, which covers about half of the park area, contains four map units, each with a distinct combination of soils, relief, and drainage. These map units embrace seven major soil groups—Corazones, Geefour, Ninepoint, Solis, Studybutte, Terlingua, and Tornillo series—in addition to areas delineated as "Rock Outcrop." As is typical of desert soils, most of these have loamy and gravelly surfaces and very low organic matter content. Vegetation consists primarily of shrubs and drought-tolerant short- and mid-level grasses (NRCS 2011:13,225).

Corazones soils, located on fan remnants and fan piedmonts from 1 to 30 percent slope, are very deep and fairly permeable. Typically overlain by a layer of pink, very gravelly loam around 10 cm (4 in) thick, the subsoil is a pink, very gravelly to extremely gravelly loam from 10 to 140 cm (4 to 55 in) in depth. This is underlain by light brown, extremely gravelly, sandy loam from 140 to 203 cm (55 to 80 in) in depth. Riverwash is a minor component of this soil, located on nearly level floors of wide, active arroyos that frequently flood. Texture and gravel content is variable depending on the watershed's sediment source (NRCS 2011:13–14).

Geefour soils occur on erosional uplands associated with badlands, and above desert floors on 3 to 45 percent slopes. Very shallow or shallow, these soils are slowly permeable over shale bedrock. The typical surface layer is brown, silty clay about 15 cm (6 in) thick. From 15 to 38 cm (6 to 15 in) is grayish-brown, very gravelly, silty clay. Underlying this from 38 to 63 cm (15 to 25 in) is gray shale that has a silty clay texture (NRCS 2011:14). These soils are associated with the Salty Clay Hill ecological site, which corresponds roughly with the Badlands physiographic zone, most prominent in the southern and far western portions of the park.

Ninepoint soils are characterized as very deep and moderately permeable on nearly level alluvial flats in a semi-bolson landscape on 0 to 3 percent slopes. The typical surface is pale brown clay loam 10 cm (4 in) thick. From 10 to 155 cm (4 to 61 in) is yellowish-brown and light yellowish-brown clay loam. The lower subsoil, from 79 to 203 cm (31 to 80 in), is light yellowish-brown clay loam (NRCS 2011:14).

Solis soils are on sandstone hills from 1 to 60 percent slopes. Very shallow to shallow, these soils are moderately rapidly permeable. The surface is typically light yellowish-brown, fine sandy loam about 5 cm (2 in) thick. The subsurface layer, from 5 to 15 cm (2 to 6 in), is light brown, fine sandy loam. From 15 to 71 cm (6 to 28 in) is very pale brown, platy sandstone and light yellowish-brown platy sandstone. From 71 to 97 cm (28 to 38 in) is light brownish-gray fractured shale (NRCS 2011:14).

Studybutte soils are on hills and mountains on 10 to 60 percent slopes. Very shallow or shallow, these soils are moderately rapidly permeable over very slowly permeable bedrock. The surface is typically reddish-brown, very gravelly loam about 8 cm (3 in) thick. From 8 to 15 cm (3 to 6 in) is reddish-brown, extremely gravelly loam. From 15 to 41 cm (6 to 16 in) is indurated igneous bedrock (NRCS 2011:14).

Terlingua soils are on igneous hills and mountains on 10 to 30 percent slopes. Very shallow or shallow, these soils are moderately rapidly permeable. The surface is typically yellowish-brown, very gravelly, sandy loam about 10 cm (4 in) thick. From 10 to 20 cm (4 to 8 in) is yellowish-brown, very gravelly, sandy loam. From 20 to 41 cm (8 to 16 in) is partially weathered igneous bedrock, below which is igneous bedrock (NRCS 2011:17).

Tornillo soils are on broad valley floors that occasionally flood, have 0 to 2 percent slopes, and are very deep and moderately permeable. The surface layer is typically grayish-brown loam about 13 cm (5 in) thick. From 13 to 48 cm (5 to 19 in) is pale brown loam. From 48 to 66 cm (19 to 26 in) is pale brown, stratified, gravelly, sandy loam. From 66 to 121 cm (26 to 48 in) is light yellowish-brown loam. From 121 to 203 cm (48 to 80 in) is pale brown, stratified, silty clay loam. (NRCS 2011:14)

Rock outcrop signifies areas of exposed bedrock on escarpments and ledges or on the summits, shoulders, and backslopes of hills and mountains. These typically occur in association with other soil types such as Solis, Geefour, and Studybutte. Depending on the associated soil, rock outcrops can refer to either igneous (as in the case of Studybutte-Rock Outcrop) or sedimentary sources (as in the case of Solis-Geefour-Rock Outcrop) (NRCS 2011:14).

In the most recent (2011) soil survey in BBNP, a total of 39 different soils were mapped and defined. Of those, five soil types predominated in the surveyed area of the present project, together accounting for more than half of the total area (Figure 2.24). The highest by far was Corazones very gravelly, sandy loam at 14 percent. This was followed by Solis Rock Outcrop complex and Chilicotal very gravelly, fine sandy loam, each at 12 percent. Geefour silty clay accounted for an additional 7 percent and Strawhouse-Stillwell complex accounted for 6 percent (GIS files; NRCS 2011). Of these, only the Chilicotal and Strawhouse-Stillwell complex were not one of the major soil groups of the "Hot Desert Shrub Vegetative Zone" and are discussed below.

Chilicotal soils are well-drained and deep loamy and gravelly soils on fan remnants on piedmont slopes of 1 to 8 percent slopes. The surface layer is typically very gravelly, fine sandy loam to 5 cm (2 in) thick. From 5 to 36 cm (2 to 14 in) is a very gravelly loam. From 36 to 58 (14 to 23 in) is a very gravelly, clay loam. From 58 to 102 cm (23 to 40 in) is an extremely gravelly loam. From 102 to 130 cm (40 to 51 in) is a very gravelly, sandy loam. From 130 to 203 cm (51 to 80 in) is an extremely gravelly, sandy loam (NRCS 2011:39).

Strawhouse-Stillwell complex soils are well-drained gravelly alluvium and pedisediment derived from limestone on fan remnants on piedmont slopes from 1 to 30 percent slopes. The surface layer is a very gravelly loam to 38 cm (15 in) thick. From 38 to 48 cm (15 to 19 in) is a cemented material. From 48 to 203 cm (19 to 80 in) is a very gravelly loam (NRCS 2011:96).

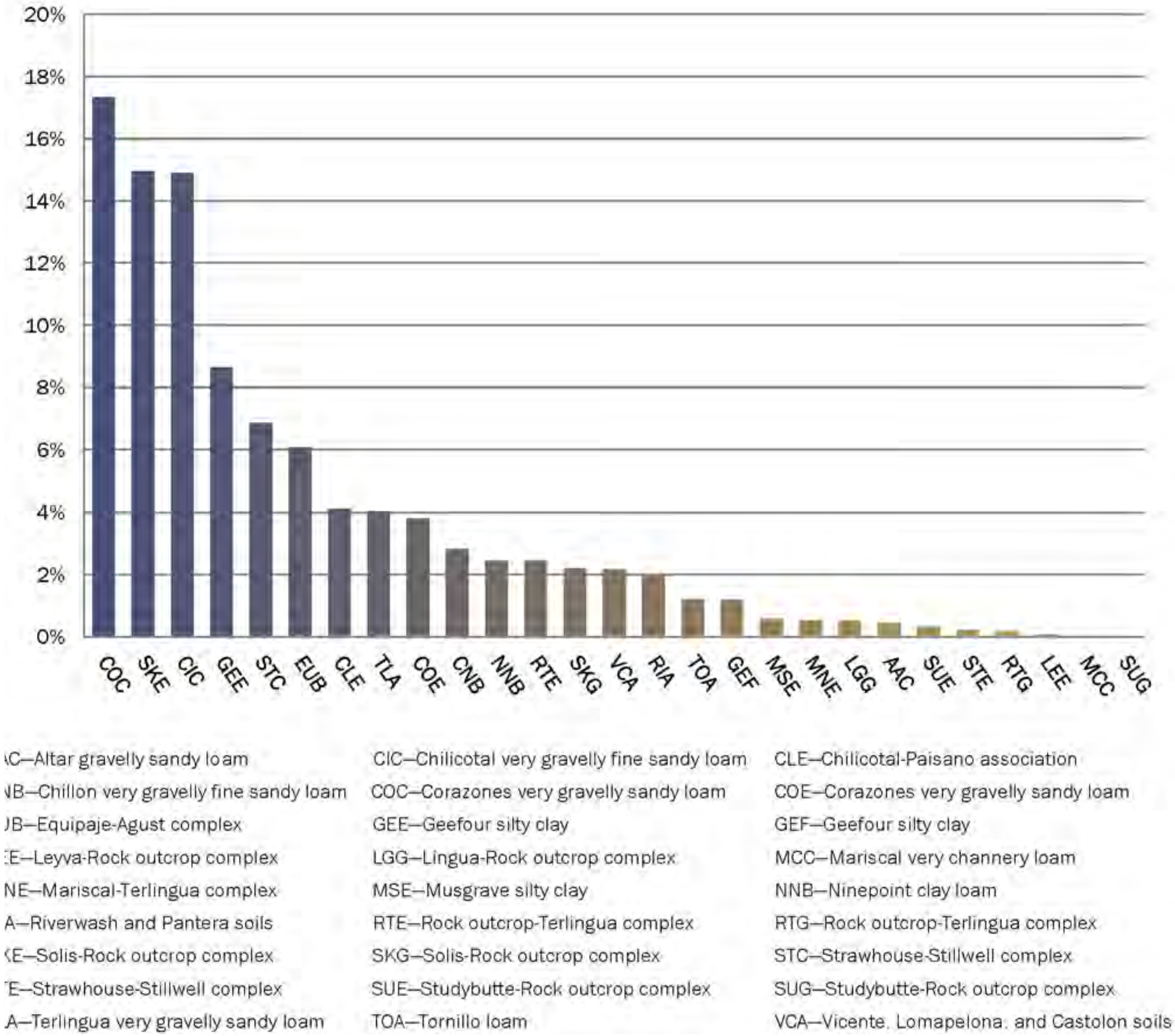

Figure 2.24 Basin soils in areas surveyed as percent of total.

The present survey sampled roughly the same proportion of soils as naturally occurs across the Basin Zone. However, some soil types were "oversampled," whereas others were "undersampled" (arbitrarily defined here as cases where a soil type was surveyed more or less than four percentage points beyond the percentage of the basin naturally covered by these soils; Figure 2.25). Three such soil types exist. Both the Solis Rock Outcrop complex (1 to 20 percent slopes) and Chilicotal very gravelly, fine sandy loam (1 to 8 percent slopes) were oversampled during the present project by 4 and 7 percent respectively. Conversely, Corazones very gravelly, sandy loam (1 to 30 percent slopes) was undersampled by 6 percent. Consequently, we may expect results from the survey of the oversampled soil types to be more robust than the undersampled soil types (GIS files).

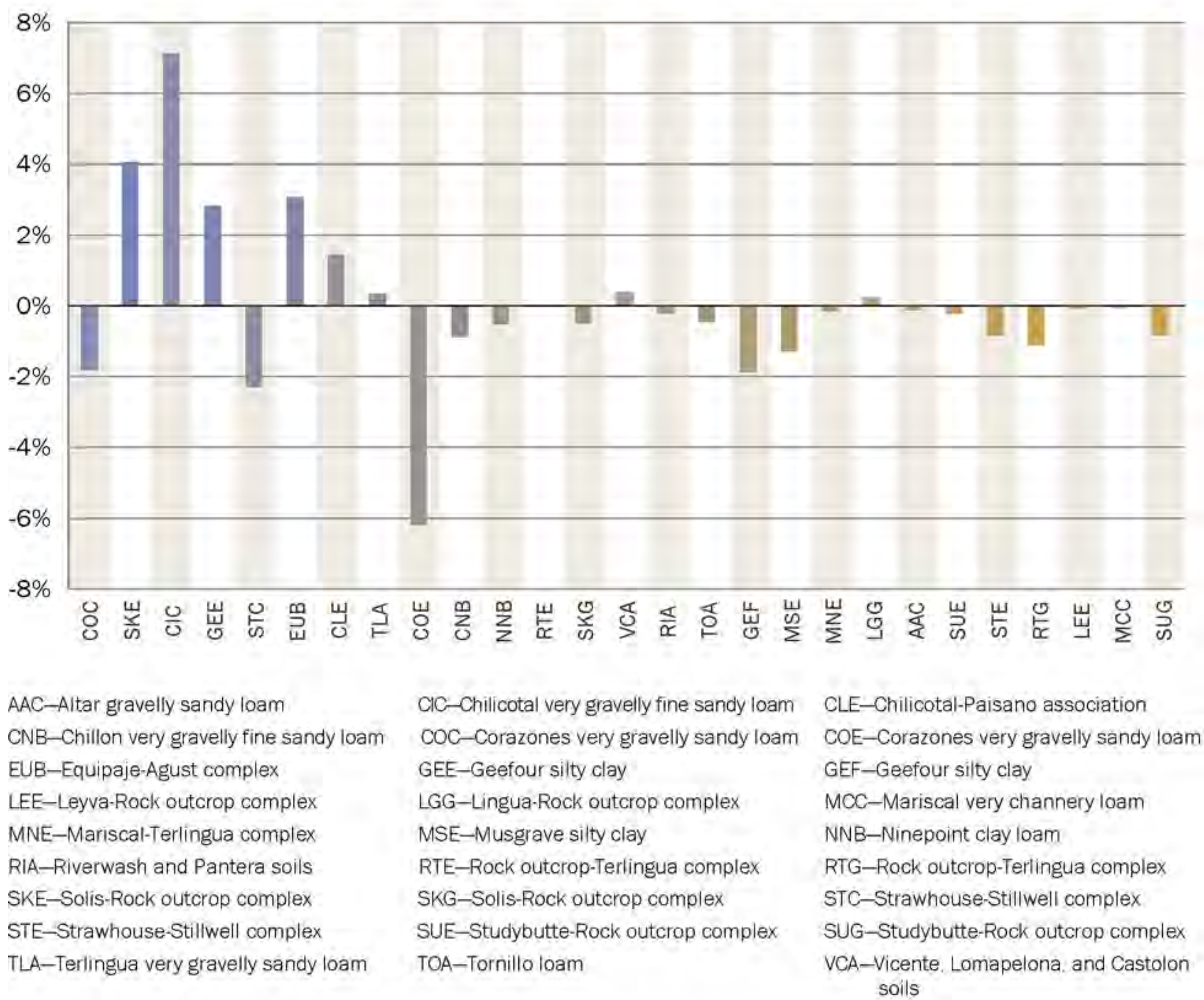

Figure 2.25 Oversampled and undersampled basin soils in areas surveyed, shown as departures from their natural occurrence.

Climate

Big Bend National Park is subject to two climate types present in the Trans-Pecos region of Texas: the mountain climate of the Chisos Mountains and the subtropical arid climate of the surrounding lowlands. The former is characterized by cooler temperatures, orographic precipitation, and less dense air; the latter is characterized by warmer temperatures, less precipitation, and lower relative humidity (Larkin and Bomar 1983:2–3). The park is also part of a large climatic province that extends across the entire northern Chihuahuan Desert. Like most desert climates, the Chihuahuan is characterized as hot, dry, and sunny although the region enjoys more precipitation than other southwestern deserts and is considered a "high elevation" desert as so much of it lies above 1,219 m (4,000 ft) in elevation. Climate across most of the Chihuahuan Desert is relatively uniform with hot summers and cool, dry winters. Of greatest significance are solar radiation and precipitation—two dominant inputs that drive the entire Chihuahuan Desert ecosystem. Seasonality, spatial variability, and duration of precipitation in particular strongly influence soils and vegetation (Davey et al., 2007:9).

Among the signature characteristics of desert climates are high daytime temperatures as well as large diurnal temperature ranges. Both are largely a function of elevation, with the highest temperatures and the greatest temperature ranges occurring in areas of lower elevation. Average high temperatures recorded during June, typically the hottest month, vary by around 9° C or 16° F between Boquillas (elevation 573 m [1,880 ft]) and the Chisos Basin (elevation 1,615 m [5,300 ft]), with the former reporting an average of 40° C (103° F) and the latter reporting an average of 30° C (87° F). Panther Junction (elevation 1,140 m [3,740 ft]), at roughly the midpoint in elevation reports 35° C (94° F) for the same month. Thus, air temperatures tend to be 1°C cooler for approximately every 116 m (or 1° F for every 214 ft) rise in elevation (WRCC).[3]

Diurnal temperature ranges are among the most dramatic aspects of desert climates, largely due to low humidity and minimal biomass that otherwise typically help to moderate such fluctuations. Daytime highs can sometimes rise more than 34° C (60° F) above nighttime lows, with the largest range occurring during the spring, and the smallest occurring in August—the latter a result of the moderating effects of precipitation. Diurnal ranges are largely a function of elevation, with lower elevation areas experiencing wider variation. In BBNP during the month of March when the range is greatest, Boquillas Ranger Station reports an average diurnal range of 22° C (39° F); Panther Junction reports an average range of 16° C (29° F); and the Chisos Basin reports an average range of 14° C (25° F).[4] Thus, an 8° C (14° F) difference in range of temperature occurs across 1,042 m (3,420 ft) of elevation between Boquillas and the Chisos Basin, amounting to 1° C lower temperature range for every 130 m (or 1° F lower temperature range for every 244 ft) gain in elevation (Schmidt 1995:125–126; WRCC).

Freezing temperatures occur during the winter, but are typically the result of short-lived cold fronts. The default winter weather pattern is generally warm in the lowlands and cool in the mountains. The mean temperature in January (typically the coldest month) at Boquillas is 11°C (51°F) whereas the mean at Chisos Basin is 9°C (49°F). The relatively small difference actually reflects the much larger diurnal range in Boquillas rather than true temperature similarities. In actuality, winter daytime highs, as well as nighttime lows, are both more extreme. Thus, the average high in January at Boquillas is 21°C (70°F), whereas the average low is 0°C (32°F). By contrast, the same temperature readings at Chisos Basin are 14°C (58°F) and 3°C (37°F) respectively. Although rare, extreme cold or extended freezing temperatures can significantly alter the vegetative composition, such as occurred during the hard freeze of 2011 (Schmidt 1995:125; WRCC).

Along with solar radiation and associated temperatures and evaporation rates, precipitation is the most important factor in influencing soils and floral composition of the Chihuahuan Desert. In fact, its variability is perhaps the singlemost significant aspect of ecosystem productivity from year to year. As such, drought has been one of the principal historical sources of disturbance in the Big Bend. It is one of the main factors limiting seedling establishment and productivity on an annual basis, while extended drought coupled with hot winds can cause mass mortality of perennial grasses and other plants such as semi-woody perennials, creating bare patches susceptible to erosion. Drought likewise affects wildfire intensity and frequency, water infiltration, and soil temperature (Davey et al., 2007).

3. Climate statistics for each station are derived from the full period of record which varies from 11,824 observation days for Castolon to 22,152 observation days for the Chisos Basin; statistics retrieved from the Western Regional Climate Center (WRCC) website.
4. It should be noted that the lower elevation weather stations report the widest range of diurnal temperatures in March, whereas the higher elevation weather stations report the widest range in April; however, the difference is relatively negligible—by less than 1°C.

Figure 2.26 Rapidly forming cumulonimbus cloud during the summer monsoon. Photo by D. Keller.

On average, the Chihuahuan Desert receives more precipitation than other southwestern deserts, most of which is associated with summer monsoonal thunderstorm activity (Figure 2.26). Rising temperatures throughout the summer months strongly correlate with the onset of the summer rainy season. Consequently, about 70 percent of precipitation falls during the warmest half of the year, often in torrential downpours that are brief but intense. The heaviest and most widespread rains in the region are typically remnants of powerful tropical storms from either the Gulf of Mexico or the eastern Pacific Ocean that lift moisture high into the troposphere. These storms are responsible for most of the large deviations between years. Although more than half of the total precipitation comes from the Atlantic, winter precipitation usually comes from the eastern tropical Pacific via mid-latitude cyclones (Schmidt 1995:124-129).

The aridity of the region is caused by a number of factors including subtropical high pressure, distance from oceans, and "rainshadows" caused by mountain ranges. The subtropical ridge that predominates across the region is a semi-permanent belt of high pressure centered around 30 degrees north latitude resulting from global atmospheric circulation patterns. It is characterized by high atmospheric pressure leading to clear skies, dry air, and stable weather conditions. (It is also this ridge that is responsible for most of the world's deserts.) Aside from the presence of high pressure, dryness is more the result of orographic barriers than continentality. The mountainous masses of the

Sierra Madre Oriental and Sierra Madre Occidental of Mexico (southeast and southwest respectively), in addition to lesser mountain ranges, combine to be effective orographic barriers to the penetration of moisture-laden air into the region. On a smaller scale, localized topography plays a major role in defining spatial patterning of precipitation within the park. In BBNP, the Santiago and Chisos mountains, in addition to other ranges in Mexico, create orographic lift that strongly influences rainfall distribution. Thus, while annual precipitation in the Chisos Mountains averages 44.83 cm (17.65 in), Boquillas, along the flanks of the Sierra del Carmen, averages only 23.72 cm (9.34 in) of rain annually—a difference of 21.11 cm (8.31 in) across a distance of only 34.7 km (22 air miles). Castolon and Panther Junction fall in between at 26.14 cm (10.29 in) and 33.63 cm (13.24 in) respectively (Schmidt 1995:127; WRCC).

The region is also centered well away from large bodies of water that tend to moderate temperatures as well as provide a source of precipitable moisture through evaporation. The closest major source to BBNP is the Gulf of Mexico, which is about 580 km (360 mi) away. All things being equal, average annual precipitation generally decreases the further one travels away from the Gulf, by roughly 2.5 cm for every 24 km (1 in for every 15 mi)—a pattern that is only interrupted by mountains that create moist islands surrounded by much drier lowlands (Schmidt 1995:128).

Although wind in the desert seems almost a constant, because of a general lack of moisture to supply energy, severe windstorms—those above 80 km per hour (kph) or 50 miles per hour (mph)—are rare. Yet, due to the scarcity of vegetation, the perceived aspects of wind tend to overshadow its true characteristics. In fact, the annual average wind speed in BBNP is a mere 18.51 kph (11.50 mph), compared with 25.03 kph (15.55 mph) for Texas and 27.25 kph (16.93 mph) for the entire U.S. However, BBNP also displays increased variability from month to month compared to either the state or nation, and actually exceeds both in average monthly wind speed during the month of September. Although zonal westerly flow predominates more than two-thirds of the year, in July and August a more mixed pattern occurs where southwestern winds prevail, punctuated by moist surges of easterly air. Generally, this easterly flow shifts southward, weakens in September, and is completely gone by October (Schmidt 1995:124, 131–132; USA.com).

The southerly latitude, low humidity, and generally clear skies make the region the sunniest place in Texas and one of the sunniest in the United States. On clear days, the ultraviolet (UV) radiation tends to register on the "very high" to "extreme" end of the UV Index, as developed by the National Weather Service and the Environmental Protection Agency. The index reflects the amount of UV radiation reaching the earth's surface at the solar zenith and, among other factors, is a function of the level of ozone present, cloud cover, and time of day. Readings on the higher end of the index indicate extreme risk of harm from unprotected sun exposure (Environmental Protection Agency 2004; Schmidt 1995:125).

Global climate change is predicted to have significant effects on the Chihuahuan Desert ecoregion, although the type and degree of effects are unknown. These may include increased surface temperatures; changes in the amount, seasonality, and distribution of precipitation; more frequent climatic extremes; and greater variability in climate patterns. Such changes are predicted to affect vegetation at the individual, population, and community level, and to alter ecosystem function and structure (National Park Service [NPS] 2007:10).

Hydrology

BBNP, like most deserts, has precious little surface water. The Rio Grande, which runs along the park's southern periphery, is the only stream with a continuous flow. Within the park itself, the two largest drainages, Terlingua and Tornillo creeks, run only intermittently. In addition, there are countless wet weather drainages that generally flow only during flood events, as well as some 335 springs and tinajas. The following discussion is broken down by these categories.

The Rio Grande

As the only perennial stream in BBNP, the Rio Grande flows along the park's southern boundary for 190 km (118 mi), creating a ribbon oasis supporting a rich riparian ecosystem as it winds through an otherwise near-barren landscape (Figure 2.27). In 1978 Congress designated a 315-km (196-mi) stretch as part of the Wild and Scenic River System, which mandates that the river must remain free-flowing and protected for future generations. This stretch begins in BBNP opposite the junction of the Mexican states of Chihuahua and Coahuila and ends downriver from the park at the Val Verde County line (NPS 2012).

The Rio Grande, which heads in the San Juan Mountains of southern Colorado, is one of the most substantial drainages in the entire Southwest, spanning 8 states in 2 countries (as well as 7 physiographic provinces and 8 terrestrial ecoregions) along its 3,034-km (1,885-mi) length, making it the 24th longest river in the world. The river's watershed drains some 450,000 km2 (173,740 mi2). The Rio Grande is younger than the geologic structures over which it flows, and developed its present course by flowing across lower basin fill and downdropped blocks.

Figure 2.27 The Rio Grande near Santa Elena Canyon, looking northeast. Photo by J. Bush.

The valley itself, called the Rio Grande Depression, is actually a series of interconnected grabens spanning the entire state of New Mexico that began forming some 25 mya (Benke and Cushing 2005:186; Henry 1998:6; Tuttle 1983:404).

Locally, geologists believe the river's course was established across a series of adjacent inward-draining bolsons after they had filled with sediment, subsequently cutting through uplifted formations like Mesa de Anguila to form spectacular sheer-walled canyons—three of which are part of BBNP (Maxwell et al. 1967:21). Based on the size of the Rio Grande Valley and the large amount of recently deposited sediment along the floodplain, it is evident that the volume of the river has fluctuated dramatically over time. During the Pleistocene, when the river was fed by mountain glaciers in the Southern Rockies, its flow was substantially greater. Conversely, during drier climatic episodes (such as the Holocene Climatic Optimum), the river's flow was probably much less. These alternating cycles brought periods of both aggradation and degradation, creating a highly dynamic river system that, over millennia, formed its present structure (Tuttle 1983:404).

As the Big Bend has grown gradually warmer and drier over the past 10,000 years, the importance of the Rio Grande as a resource for humans likely grew proportionately. That the river was significant prehistorically is clearly evident by much greater site density along the river corridor than away from it (springs excepted). There is little wonder why. In addition to its use as a source of drinking water, the river attracts a broad array of wildlife and contains substantial endemic aquatic resources. Although nearly four dozen species of fish have been recorded in BBNP, most are minnows that have long dominated the fish assemblage in the Rio Grande. However, at least 10 of the river's historic fish species are large enough to eat, and a great many other floral and faunal resources would have been attractive to prehistoric people (also see Economically Significant Fauna below; Wauer and Fleming 2002:112–116).

Historically, the Rio Grande's peak flow occurred from April to June above the confluence with the Río Conchos (at Presidio, Texas) due to montane snowmelt in the southern Rocky Mountains. As the largest tributary (historically the average annual flow was around 30 cubic meters per second), the peak flow of the Río Conchos—which is more affected by the monsoonal rainfall of northern Mexico—usually occurred between August and October. Thus, historically, the Rio Grande downstream of its confluence with the Río Conchos enjoyed two annual high-water events: the springtime peak flows and the summer monsoonal flows (Benke and Cushing 2005:188).

However, stream flow along the lower Rio Grande changed dramatically following construction of La Boquilla Dam on the Río Conchos, completed in 1915, and of Elephant Butte Dam in Southern New Mexico, completed in 1916. Subsequent dams were built on both the Rio Grande and the Río Conchos between 1938 and 1967. The dams in southern New Mexico, coupled with irrigation diversions in the El Paso-Juarez valley, completely eliminated the natural spring snowmelt flood of the upper Rio Grande. Today more than 90 percent of the stream flow below Presidio, Texas, comes from the Río Conchos despite the fact that the Conchos' flow has also experienced significant reductions (Dean and Schmidt 2011).

Along with reductions in stream flow, riparian vegetative communities have undergone significant changes. Historically, riparian communities were more heterogeneous, with sparse patches of seepwillow (*Baccharis salicifolia*) on sandbars and discontinuous stands of willow (*Salix exigua*) and cottonwood (*Populus spp*.) along the channel margins. Within the larger floodplain were dense thickets of mesquite (*Prosopis spp*.). More recently, nonnative vegetation has come to dominate the assemblage. Tamarisk (*Tamarix spp*.) was present in West Texas by 1912 and giant cane (*Arundo donax*) was present in the Presidio Valley by 1938. Today, these two species are the most pronounced along much of the Rio Grande and are implicated in recent channel narrowing and floodplain accretion (Figure 2.28; Dean and Schmidt 2011).

Figure 2.28 Dense tamarisk in the Rio Grande floodplain creating an impenetrable thicket. Photo by D. Keller.

As a result of changes in both stream flow and vegetation, the geomorphology of the river has also changed over the last century. Studies have demonstrated that channel avulsions (abrupt shifts in channel location) were common in portions of the Rio Grande before major discharge changes due to agriculture and impoundment, most notably that of Elephant Butte Reservoir. Subsequent to the reservoir construction, channel capacity has decreased and stabilized, while the river has migrated away from major tributaries and its banks have steepened (Benke and Cushing 2005:187).

One recent study conducted in BBNP concluded that recent channel narrowing has occurred through deposition of sediment along the edges of the active channel, creating floodplains inset within the previous channel margins. Gravel bars within the active channel initially served as platforms for sedimentation. Vegetation subsequently became established during years of low flow, which stabilized the developing surfaces. Further deposition along the channel margins during moderate flooding expanded the floodplain while creating natural levees that contained the river within a narrow channel. In a positive feedback loop, as the channel lost its water-carrying capacity, overbank flooding became more common, causing additional deposition on the floodplain, thus raising it further above the active channel, increasing the river's confinement (Dean et al. 2011).

Today, the Rio Grande is considered to be one of the most impacted rivers in the world, with both water quality and quantity being of major concern. The conservation organization, American Rivers, ranked it as one of the 10 most endangered rivers in the United States. Due to the array of changes the river has experienced, its flow and its associated ecosystem have been permanently altered, reducing the natural heterogeneity of the system and severing connections between the patches within it. Portions of the river, notably the stretch between Elephant Butte and the confluence with the Río Conchos, operate largely as a ditch for water delivery for agricultural and municipal use. Riparian areas are in decline, with nonnative species (notably tamarisk) dominating many stretches. In recent years, evapotranspiration, groundwater recharge, and human appropriation of water have resulted in less than 1 percent of basin precipitation reaching the Gulf of Mexico. For several months in 2002 and 2003, the river failed to reach the Gulf at all. Fecal coliform, nutrients, low dissolved oxygen, pesticides, herbicides, metals, and other organic contaminants remain significant concerns along the Texas portion of the river (Benke and Cushing 2005:187,192; Stotz 2000).

Intermittent Streams

The two largest drainages in BBNP, Terlingua and Tornillo creeks, can be classified as intermittent, at least during years with "normal" rainfall. These are streams that only flow with regularity during the wet season (late summer and fall) and typically cease flowing during the dry season (winter through spring). However, as the surface flow within these stream channels dry up, depending on the substrate, water may continue to flow below the ground surface—especially through coarser materials such as gravel and coarse sand—and can continue to support healthy riparian vegetative communities (Osterkamp 2008).

Terlingua Creek's headwaters rise far north of BBNP, along the eastern flanks of Goat Mountain, approximately 25.5 km (16 air-miles) south of Alpine (Figure 2.29). However, its main branch is formed in Paradise Valley by the confluence of Paradise and Hackberry draws. From there it meanders southward approximately 105 km (65 mi) to the boundary of BBNP where it flows southward an additional 7.9 km (4.9 mi) across the far western edge of the park to its confluence with the Rio Grande at the mouth of Santa Elena Canyon. Because Terlingua Creek intercepts Rough Run and Dawson creeks, in addition to several lesser drainages, it drains a sizable portion of the western half of the Sunken Block, around 27,519 ha (68,000 ac). Although Terlingua Creek's flow is variable along its course and long stretches are frequently dry, with its combined annual flood events, it averages 48,610 thousand cubic meters (TCM) or 39,409 acre feet (ac-ft) annually as measured near its confluence with the Rio Grande. Peak flow occurs in September with an average of 10,772 TCM (8,733 ac-ft) whereas the lowest flow occurs in January with an average of 1,102 TCM (893 ac-ft) (GIS files; International Boundary and Water Commission 2005).

According to historical accounts, the creek's flow and the extent of its arboreal community was much greater than it is today. James B. Gillett, foreman of the old G4 Ranch, claimed that in 1885 it was a

> bold running stream, studded with cottonwood timber and was alive with beaver. At the mouth of Rough Run there was a fine grove of trees . . . . Today there is probably not one tree standing on the Terlingua that was there in 1885 (Gillett 1933).

The theorized decline in flow may be attributed to a general decrease in spring flow that has been documented across the state. The near absence of trees is typically attributed to historic wood harvesting to fuel the ore furnaces of the Terlingua mines as well as for construction and domestic use (Wauer and Flemming 2002:26).

Compared with Terlingua Creek, a much longer portion of Tornillo Creek is located within the park (Figure 2.30). It rises along the eastern flanks of the Christmas Mountains just north of the park boundary and flows eastward for approximately 15.5 km (9.6 mi)

Figure 2.29 Terlingua Creek north of BBNP. Photo by D. Keller.

before entering BBNP. It then trends southeastward for approximately 46.7 km (29 mi) to its confluence with the Rio Grande just upstream from Langford Hot Springs near Boquillas. Draining approximately 77,022 ha (190,325 ac) within the park—mostly from the northern and eastern flanks of the Chisos and the western flanks of the Dead Horse Mountains—it is the most substantial drainage in BBNP (GIS files). Dry along the vast majority of its length, the stream typically emerges about 400 m (1,312 ft) southwest of the hot springs and joins the Rio Grande just past the ruins of the old Langford Hot Springs resort. Because the water leaving Tornillo Creek is clear and thermally stable seasonally, it serves as a nursery and spawning area for at least six species of fish, including the Mosquitofish (*Gambusia affinis*) as well as the rare Chihuahua Shiner (*Notropis Chihuahua*) and Mexican Stoneroller (*Campostoma ornatum*) (Hubbs and Wauer 1973; Wauer and Fleming 2002:112).

Together, both streams intercept most of the drainages to the north, east, and west of the Chisos although a number of smaller streams drain off the southern flanks of the Chisos directly into the Rio Grande. In places these two streams cut through sections of bedrock as well as gravel that blankets much of the Sunken Block. Both have broad, cobbly channels but also pass through steep-walled gorges where they are largely clear of debris. During most years, and especially during the wet season, these streams maintain a small current and/or standing pools that provide important sources of water for wildlife and aquatic flora and fauna (Maxwell et al. 1967:14).

Figure 2.30 Wild ducks on Tornillo Creek west of the McKinney Hills. Photo by D. Keller.

Ephemeral Streams

Aside from the one perennial and two intermittent streams in BBNP, there are countless arroyos and washes classified as ephemeral streams whose flow depends primarily on flood events. These drainages typically only flow for brief periods of time (hours or days) following significant rainfall. Because they can fill quickly during rain events, they sometimes produce a sudden torrent of water, or "flash flood," when sufficient rain falls within the drainage basin. Because the rainfall is often far upstream, these flash floods can catch the unwary by surprise and sometimes exact a toll on both life and property.

The most substantial of such drainages within BBNP include, roughly north to south: Nine Point Draw, Rough Run, Alamo Creek, Blue Creek, Smoky Creek, Fresno Creek, Juniper Draw, and Glenn Draw. A number of these, such as Nine Point Draw and Rough Run, merge into larger intermittent drainages (Maravillas and Terlingua creeks respectively). Others, notably Alamo Creek, Smoky Creek, Fresno Creek, Juniper Draw, and Glenn Draw—all of which drain off the southern flanks of the Chisos—flow directly into the Rio Grande (GIS files).

Springs and Tinajas

As part of the process of developing the predictive model, water sources within the park were ranked to provide an index of their potential attractiveness to humans through time. Each source was valued according to a number of criteria (flow rate and reliability, vegetation, and human use, among others) to derive a number indicative of its overall dependability as a water source. Based on existing park data as well as new data, some 801 natural water sources were evaluated (B. Alex 2008).

Spatially, springs are not uniformly distributed across the landscape in BBNP, but tend to cluster around the periphery of the Chisos Mountains. Those along its southern flanks actually account for nearly a third of the total number of springs within the park (B. Alex 2008). Historical evidence suggests that springs in BBNP were formerly larger and more numerous. Overgrazing and logging activities in the early twentieth century removed vegetation and soil, serving as a protective mulch, that previously allowed rainwater to percolate slowly into the soil to recharge aquifers. This, in addition to pumping of groundwater, is believed to have depleted the groundwater table (Brune 1981:85).

Of the total number of natural water sources in BBNP, 51 are classified as tinajas—a Spanish term used across the American Southwest meaning "large earthen jar" to refer to water-bearing depressions that develop below waterfalls or are carved out by minor spring flow or seepage (Osterkamp 2008). These water sources often occur in otherwise dry areas, away from springs or streams, and serve as important sources of water for wildlife and plant communities (Figure 2.31). Thirty-three of these are classified as tinajas with springs—where the spring flow contributes to the water volume contained within the tinaja. The remaining

Figure 2.31 A tinaja in the Red Ass Spring Drainage. Photo by C. Covington.

18 tinajas have no permanent water source and rely on rainfall and/or surface flow for recharge (B. Alex 2008).

Aside from the tinajas, of the 284 water sources that remain, all are springs (Figure 2.32). These springs were assigned a value between 1 and 16, the larger the number reflecting more dependable water sources. Only two springs in the park—Buttrill Spring A and Oak Spring—were assigned the highest value. The majority of the springs (77 percent) fell in the lower half of the ranking (between 1 and 8); only 22 percent ranked higher than 8. Most of the springs that ranked 9 or above were considered perennial—meaning that there was a regular year-round flow. In addition to providing a dependable flow, the higher-ranking springs also tended to host an array of riparian vegetation including cottonwood, willow, and tamarisk (B. Alex 2008).

Hydrogeologically, the majority of the springs in BBNP fall within the "rheocrene" or "hanging garden" spring classification system according to Springer and Stevens (2008). The former is described as a discharge that emerges as a flowing stream or streams. Examples of this type of spring are often found within the streambed of perennial drainages. The latter is defined as a spring that emerges along geologic contacts and that seeps, drips, or pours onto underlying walls. These springs typically support distinctive assemblages of wetland, riparian, and desert plants (Figure 2.33). In the southwestern U.S. these typically emerge from perched, unconfined aquifers in aeolian sandstone units (Springer and Stevens 2008).

During the BBNP project, a total of 43 springs and tinajas were located within the survey blocks. Of these, six were classified as tinajas, five of which

Figure 2.32 Gano Spring west of the Chisos Mountains. Photo by J. Nowak.

Figure 2.33 Fremont Cottonwoods at Neville Spring. Photo by D. Keller.

were in association with a spring (Wright Pool, Allison's Tinaja, Upper Boot Spring, Tinaja Verde, and Equinox Spring). In addition, Swirl Tinaja was classified as a tinaja without a spring. The remaining 37 water sources were springs that ranked from 1 to 14 (from lowest flow to highest flow), with the majority (22 springs) ranked on the lower end between 1 and 7. Among those on the higher end, 3 springs (Bone Spring, Neville Spring, and Snippur Spring) ranked a 12, while only one (Dugout Wells) ranked a 14. Out of the 58 blocks surveyed during the current project, only 20 contained springs, and only 7 blocks contained more than one spring. One of these (Block E) contained a total of 12 springs, making it by far the most "hydrologically dense" block of the entire project (B. Alex 2008).

Flora

The Chihuahuan Desert is the most biologically diverse desert in the Western Hemisphere and one of the most diverse in the world. Despite the relative homogeneity of the most dominant plants, more than 1,000 endemic species are found here. In addition, the desert's eastern edge is considered to be one of the oldest and richest centers of plant evolution in North America (Brown 1994:169; NPS 2009). Within the State of Texas, the Big Bend is part of the Chihuahuan Biotic Province that encompasses all of far western Texas. In BBNP there are at least five distinct vegetative zones, determined almost exclusively by their elevation (Blair 1950:105).

Beginning with the lowest elevation, the River Floodplain-Arroyo Formation along the Rio Grande and its tributaries occurs between 549 to 1,219 m (1,800 to 4,000 ft) in elevation. Among the hottest and driest areas to be found in the Chihuahuan Desert, this formation is also one of the most abundant floristically. This formation is characterized by plants that prefer water-retaining soils; are fast growing; and often produce a dense, jungle-like environment. Characteristic vegetation in this zone includes a limited variety of trees, the largest of which are the lanceleaf cottonwood (*Populus angustifolia acuminate*) and Fremont cottonwood (*P. fremontii*). Three types of willows occur in this zone, the largest of which is the Goodding's willow (*Salix gooddingii*). Narrowleaf or sandbar willow (*S. exigua*) and yewleaf willow (*S. taxifolia*) are primarily restricted to the Rio Grande area (Wauer and Fleming 2002:26-27).[5]

Smaller trees are also commonly found in this zone. The native honey mesquite (*Prosopis glandulosa*), which often grows in dense tangles on floodplains (referred to as *bosques*, meaning grove in Spanish), historically has provided important habitat for birds and other animals. Responsible for much of the "jungle-like" growth along the river's margins are the large moisture-loving grasses, predominantly the native common reed (*Phragmites australis*) and the exotic giant reed (*Arundo donax*), creating dense stands that line both banks of the Rio Grande. Since the early part of the twentieth century, the exotic, invasive, water-chugging tamarisk (*Tamarix* sp.) has increased to the detriment of native trees and shrubs, not to mention the water table. Other common plant species in the floodplain zone include four-winged saltbush (*Atriplex canescens*), creosotebush (*Larrea tridentata*), catclaw (*Acacia greggii*), copper globe mallow (*Sphaeralcea angustifolia*), and thick mats of exotic Bermudagrass (*Cynodon dactylon*) (Powell 1994, 1998; Wauer and Fleming 2002:27–29).

The vegetation across most of the Rio Grande floodplain has changed dramatically over the last century due to the absence of flood events that used to regularly scour the floodplain, creating a very different vegetative distribution that was more dynamic and patchy than today. Since the establishment of Elephant Butte Dam in 1916 and subsequent upstream irrigation that both regulates and diminishes the Rio Grande's flow, this annual historic disturbance has been absent. Among the results of this absence has been a proliferation of vegetative growth and invasion by exotic species like giant cane and tamarisk. In recent years the NPS has conducted prescribed burns in an attempt to reduce the density of vegetation and to re-establish the historically open floodplain. In addition, the experimental release of tamarisk leaf beetles (*Diorhabda* spp.) in 2006 has significantly reduced regional populations of tamarisk (Keller and Cloud 2007; Ritzi and Hilscher n.d.; Stotz 2000).

Slightly higher in elevation, extending from the floodplain edge to the toeslope of the Chisos Mountains, is the Shrub-Desert Formation that occurs from 549 to 1,067 m (1,800 to 3,500 ft) AMSL (Figure 2.34). Characterized by less than 25 cm (10 in) of rain annually, this is classic Chihuahuan Desert scrubland where plants are low-growing, widely spaced, and often succulent in nature. This zone also roughly corresponds to the physiographically defined "Basin Zone" that was the target of the present survey and covers roughly half of the total area within the park (Wauer and Fleming 2002:22).

Vegetation in the Shrub-Desert Formation includes a wide array of desert plants well adapted to arid conditions. This "succulent scrub" community includes a great many leaf succulents (such as agaves) as well as stem succulents (such as cacti) that use a variety of strategies to effectively retain water. This formation, like the greater Chihuahuan Desert itself, is dominated by shrubs. The most prominant species include creosotebush; American tarwort, more commonly known as tarbush (*Flourensia cernua*); viscid, or whitethorn acacia (*Acacia neovernicosa*); ocotillo (*Fouquieria splendens*);

5. Common and scientific names were verified, and often corrected, through the plants.usda website, considered the authority on botanical naming conventions.

Figure 2.34 Abundant creosotebush and ocotillo in the Shrub Desert Formation, just south of Elephant Tusk and the South Rim of the Chisos Mountains shown in the background. Photo by J. Bush.

and mesquite (Brown 1994:173, 177). Of these, creosotebush is by far the most common shrub in the Chihuahuan Desert, occurring almost everywhere below 1,219 m (4,000 ft) Other common shrubs include mariola (*Parthenium incanum*), Big Bend barometerbush or silverleaf (*Leucophyllum minus*), various condalias (*Condalia* sp.), crown of thorns or allthorn (*Koeberlinia spinosa*), fourwing saltbush, as well as a variety of yuccas (*Yucca torreyi* and *Y. elata* being the most common). In addition are a variety of "understory" plants such as the economically significant candelilla (*Euphorbia antisyphilitica*) common to limestone soils (B. Alex, personal communication 2014; Wauer and Fleming 2002:31). Another low-growing plant, the lechuguilla (*Agave lechuguilla*), occurs throughout the Shrub-Desert Formation and extends upslope into the grasslands. Because lechuguilla is restricted to the Chihuahuan Desert, it is considered its primary indicator species. Other common subshrubs include littleleaf or range ratany (*Krameria glandulosa*), leatherstem (*Jatropha dioica*), catclaw acacia (*Acacia gregii*), and several species of ephedra (*Ephedra* sp.) (Powell 1998:39, 57; Wauer and Fleming 2002:56–57).

Although not always conspicuous, cacti are especially well represented in BBNP, which boasts a greater variety than any other U.S. national park. Approximately 65 species have been recorded, most of which reside in the desert lowlands. Among the most common are those of the Opuntia genus, especially tree or cane cholla (*Cylindropuntia imbricata*), and a variety of prickly pear, notably the Texas prickly pear (*O. engelmannii*) and the long-thorned purple prickly pear (*O. santa rita*). There are also several common low-growing, creeping chollas such as dog cholla (*Corynopuntia* spp.) and Graham's pricklypear (*G. grahamii*). Inconspicuous, often hidden in grass or creosotebush, is the dreaded tasajillo or Christmas cactus (*Cylindropuntia leptocaulis*) that can pierce the unwary, causing pain disproportionate to the size of its spine. The most common hedgehog cacti are the spiny hedgehog cactus (*Echinocereus dasyacanthus*), strawberry hedgehog cactus (*Echinocereus stramineus*), and the brownspine hedgehog cactus (*Echinocereus russanthus*). Other less common species include turk's head (*Ferocactus hamatacanthus*), Chihuahuan fishhook cactus (*Sclerocactus uncinatus* var. *wrightii*), and the cryptic, virtually camouflaged, chautle living rock (*Ariocarpus fissuratus*) (Wauer and Fleming 2002:65–75).

Forbs and grasses often go unnoticed in the lowlands, but they form a significant part of the plant assemblage. Both annual and perennial forbs draw little attention until significant rainfall, after which they are among the most visible and attractive plants in the desert. Perhaps the showiest (and earliest to flower) is the beautiful Big Bend bluebonnet (*Lupinus havardii*). One of the most common to find in bloom is the widespread bicolored fanmustard (*Nerisyrenia camporum*) and, by roadsides and drainages, the Davis Mountain mock vervain (*Glandularia bipinnatifida* var. *ciliata*). Where water collects, copper globemallow (*Sphaeralcea angustifolia*) can occur in abundance. Others that are commonly observed include the Havard's fiddleleaf (*Nama havardii*), gypsum phacelia (*Phacelia integrifolia*), desert marigold (*Baileya multiradiata*), hairyseed bahia (*Bahia absinthifolia*) and the Chisos Mountain pricklypoppy (*Argemone chisosensis*) (B. Alex, personal communication 903; Wauer and Fleming 2002:46–48).

Except in isolated areas, grasses do not occur in abundance in the Shrub-Desert Formation. Aside from occasional stands where the soil is conducive to their growth, or around springs where moisture is sufficient, grasses are often restricted to hillsides and tend to be sparsely distributed across the landscape. Drought-tolerant short and mid grasses common in the lowlands include black grama (*Bouteloua eriopoda*), bush muhly (*Muhlenbergia porteri*), chino grama (*Bouteloua ramosa*), low woollygrass (*Dasyochloa pulchella*), and perennial threeawns (*Aristida* sp) (NRCS 2011:13; Powell 1994:143, 176, 215, 217, 239).

Upslope from the Shrub-Desert Formation, largely along the flanks of the Chisos Mountains and other smaller ranges, is a distinct belt of vegetation known as the Sotol-Grassland Formation (Figure 2.35). From approximately 975 to 1,676 m (3,200 to 5,500 ft) AMSL, this formation is characterized by many grasses and short- to mid-level shrubs with very little open ground. With substantially greater precipitation, vegetation in this zone is able to grow more densely and much more robustly than in the desert below. Although trees are not dominant in this zone, Mexican Persimmon (*Diospyros texana*), spiny hackberry (*Celtis pallida*), netleaf hackberry (*C. reticulata*), little walnut (*Juglans microcarpa*), and desert olive (*Forestiera angustifolia*) are common along drainages in the formation. Among the most visible shrubs are those in the lily family, particularly yucca, sotol, and foothill nolina. Four types of yucca are found within the park. In addition to the already mentioned *Y. torreyi* and *Y. elata*, are the Thompson yucca (*Y. thompsoniana*) and the soaptree yucca (*Y. elata*) as well as the mighty Spanish dagger, also known as Eve's needle (*Y. faxoniana*). One of the most common and distinctive plants—also an indicator of this vegetative zone—is green sotol (*Dasylirion leiophyllum*). Used prehistorically as a food source, this plant is conspicuous with its large cluster of narrow, toothed leaves and its 5 to 12-foot-long flowering stalks that rise like flagpoles out of a sea of grass and shrubs (Wauer and Fleming 2002:24, 33–35)

Other prominent shrubs in this formation include foothill beargrass (*N. erumpens*), which is similar to sotol but with finer, untoothed leaves and a short, flowering stalk. Very common, and indicative of overgrazed

Figure 2.35 The Sotol-Grassland Formation below Panther Peak. Photo by D. Keller.

rangelands, is mariola (*Parthenium incanum*), a low-growing, aromatic shrub with whitish branches and leaves. Evergreen sumac (*Rhus virens*) along with fragrant sumac (*R. aromatica*) and littleleaf sumac (*R. microphylla*) are also found frequently in this zone as is the beautiful and fragrant ceniza, also known as Texas barometer bush (*Leucophyllum frutescens*). Also common is the Apache plume (*Fallugia paradoxa*), skeletonleaf goldeneye or resinbush (*Viguiera stenoloba*), algerita or agarito (*Berberis trifoliolata*), feather dalea or featherplume (*Dalea formosa*), and plumed crinklemat (*Tiquilia greggii*). Although lechuguilla is relatively diffuse in the desert lowlands, in the grasslands and the irregular ecotone between lowlands and grasslands, it can form continuous mats that make travel hazardous if not life-threatening (Powell 1998:57, 99, 333; Wauer and Fleming 2002:33–38).).

As suggested by its name, grasses within the Sotol-Grassland Formation are very prominent. Native grasses in this zone include short and mid grasses associated with shrubs. The dominants include black grama, blue grama (*Bouteloua gracilis)*, burrograss (*Scleropogon brevifolius*), cane bluestem (*Bothriochloa barbinodis*), streambed bristlegrass (*Setaria leucopila*), sideoats grama (*Bouteloua curtipendula*), green sprangletop (*Leptochloa dubia*), and tobosagrass (*Hilaria mutica*). Forbs are also common and include the rigid Indian paintbrush (*Castilleja latebracteata*), Big Bend Beardtongue (*Penstemon havardii*), plains blackfoot (*Melampodium leucanthum*), hillside vervain (*Verbena neomexicana*), and velvet leaf senna (*Senna lindheimeriana*), among many others (NRCS 2011:15,17; Powell 1994:148, 152, 206, 208, 215, 225, 305, 328; Wauer and Fleming 2002:49–52).

Fagure 2.36 The Woodland Formation of Boot Canyon within the Chisos Mountains. Photo by D. Keller.

The Woodland Formation occurs just upslope from the Sotol-Grasslands and extends to the top of the Chisos Mountains, between approximately 1,128 and 2,377 m (3,700 and 7,800 ft) AMSL (Figure 2.36). Due to greater moisture and moisture effectiveness because of cooler temperatures, this formation boasts the largest and densest vegetation in BBNP—including a wide variety of evergreen and deciduous trees. Two species of pines occur in the Chisos. The Mexican pinyon (*Pinus cembroides*) is found almost everywhere above 1,524 m (5,000 ft) AMSL, whereas the Arizona yellow pine (*P. arizonica* var. *stormiae*) is restricted to moist canyons. Three species of junipers occur here, including the alligator juniper (*Juniperus deppeana*), the rose fruited juniper (*J. coahuilensis*), and the drooping juniper (*J. flaccida*)—the latter of which occurs nowhere else in the United States. The showy, multi-colored peeling bark of the Texas madrone (*Arbutus xalapensis*) is fairly common throughout the mountains and is a popular ornamental. Oaks are among the most common and widespread trees in the Chisos, of which 12 species have been identified. Of these, the gray oak (*Quercus grisea*), Emory oak (*Q. emoryi*), and the Chisos red oak (*Q. gravesii*) are most widespread. Two oaks, the lateleaf oak (*Q. tardifolia*) and the robust oak (*Q. robusta*), occur nowhere else in the United States. Other common trees include whitebrush or beebrush (*Aloysia gratissima*), mountain mahogany (*Cercocarpus montanus*), and Mexican buckeye (*Ungnadia speciosa*) (B. Alex, personal communication 2014; Wauer and Fleming 2002:22, 39–44)..

Mid and tall grasses and forbs occur as an understory and within canopy openings in the Woodland

Formation. Warm-season grasses include bullgrass (*Muhlenbergia emersleyi*), sideoats grama, cane bluestem, Texas bluestem (*Schizachyrium cirratum*), and blue grama. Cool season grasses include pinyon ricegrass (*Piptochaetium fimbriatum*) and finestem needlegrass (*Stipa tenuissima*). Among the common forbs found in the mountains are threadleaf phlox (*Phlox mesoleuca*), Stewart's gilia (*Gilia stewartii*), Slimleaf plainsmustard (*Schoenocrambe linearifolia*), firecrackerbush (*Bouvardia ternifolia*), Lewis flax (*Linum lewisii*), Texas milkweed (*Asclepias texana*), and broom snakeweed (*Gutierrezia sarothrae*), among many others (B. Alex, personal communication 2014; NRCS 2011:18; Powell 1994:56, 58, 174, 332; Wauer and Fleming 2002:52–54).

Nested within portions of the Woodland Formation, the most mesic vegetative zone is the Moist Chisos Woodland Formation, which occurs in very restricted areas in the high Chisos, and accounts for only a tiny percentage of the park's total area. This is where a number of the Chisos' relict species occurs, left over from the wetter and cooler Pleistocene. The stately Arizona cypress (*Cupressus arizonica*) grows only in Boot Canyon and is found nowhere else in the state. Another relict species is the quaking aspen (*Populus tremuloides*), found on the high talus slope on the north and west sides of Emory Peak. Also present in modest numbers are Douglas firs (*Pseudotsuga menziesii*), including the state champion tree in Boot Canyon with a height of 22 m (72 ft) A similar mesic species is bigtooth maple (*Acer grandidentatum*), which offers spectacular fall colors. Forbs that are restricted to moist environments include radishroot woodsorrel (*Oxalis albicans*); Drummond's woodsorrel (*O. drummondii*); and the longspur columbine (*Aquilegia longissima*), which occurs only in the Chisos and in adjacent Mexico. In addition to pinyon ricegrass and finestem needlegrass, other mesic, cool-season grasses occurring in this zone include Big Bend bluegrass (*Poa strictiramea*), prairie Junegrass (*Koeleria macrantha*), and the rare Guadalupe fescue (*Festuca ligulata*) (Powell 985:986, 987, 988; Powell 1994:67, 75, 78; Powell 1998:32–33; Wauer and Fleming 2002:25, 39–44, 52–53).).

Economically Significant Flora

The Chihuahuan Desert contains a vast array of economically significant plants that were used both prehistorically and historically. A complete discussion would include not only plants utilized as food, but also those used medicinally or ritually, to fashion tools, for construction, and those processed historically to render commercial products. Because such a discussion is beyond the scope of this report, what follows summarizes a few of the most important native plants used prehistorically and historically.

Lechuguilla

Lechuguilla (*Agave lechuguilla*) was one of the most important plants available regionally during prehistory for its use as both food and fiber (Figure 2.37). Every part of the plant had some use, including the leaves (for fiber), the stem or "heart" (for food), and the woody flowering stalk (for dart shafts, tools, construction, and a range of other purposes). Because of its broad array of uses, lechuguilla plant fragments often comprise the largest part of plant remains in perishable assemblages (recovered from dry rockshelters) in the region. Theorized to be of particular importance to the prehistoric diet, lechuguilla provided a ready source of carbohydrates contained within the stem and leaf bases. However, because these are complex, long-chain sugars, processing was crucial to render the plant edible. This was done by baking the pulpy central stem for 48 hours in an earth oven before pounding and forming the cooked heart into patties that could be dried and stored for months (Dering 2008).

Historically, lechuguilla fibers have been used to make rope, especially in Mexico. Locally, a lechuguilla rope factory existed in BBNP in the 1930s (BIBE91). Operated by C.L. Hannold, who also had a farm and a store along a stretch of lower Tornillo Creek, the factory included a handmade lechuguilla "shredder" used to break apart the leaves and separate the fibers that were then twisted together to make twine (Casey 1972:173). From the twine, Hannold was able to manufacture a

Figure 2.37 A stand of lechuguilla, also known as "shin-daggers" due to their low-growing, sharply pointed leaves. Photo by K. Baer.

number of fiber goods. Photographer W.D. Smithers recounted, "Mr. Hanold [sic] had unique handmade foot- and hand-powered equipment to make numerous items from agave fibers. Ropes, cords, mats, bags, and brushes were his factory's major products, and he made them on a large scale, employing many workers" (Smithers 1976:132–134). Although Hannold's rope factory was not commercially successful, lechuguilla is still a source of modern fiber known as "istle" used for rope, twine, and other materials (Powell 1998:57).

Sotol

An evergreen rosette plant similar to lechuguilla, sotol was another food staple utilized prehistorically, although possibly of less significance (Figure 2.38). Because of sotol's size, it was more difficult to harvest and transport than the much smaller lechuguilla, requiring considerably more effort and manpower. Also, similar to its smaller counterpart, sotol required processing in an earth oven to render it edible. In addition to the sotol "hearts," the young flower stalks could also be roasted and eaten. In Mexico, the spongy pith inside the basal trunks are roasted, fermented, and distilled to make a liquor, also known as "sotol." As a fiber, the narrow fibrous leaves were used to fashion baskets, mats, cordage, and other items. In addition, the long flower stalks of the sotol plant were used to fashion tools, as construction materials, and have been used extensively in the Big Bend region and Mexico historically to construct temporary shelters, ramadas, corrals and other structures. Ranchers have also fed the

Figure 2.38 Long serrated leaves of the sotol plant. Photo by D. Petrey.

trunks and leaf bases to cattle during droughts (Dering 2008; Powell 1998:53).

Prickly Pear

In addition to native use of "mescal" (agaves), nearly every early Spanish account of Indians in the region made mention of the importance of "cactus" in the indigenous diet. These explorers were probably referring to the prickly pear cactus (Figure 2.39) whose pads (*nopales*) and fruits (*tunas*) served as important food sources prehistorically—the former a good source of Vitamin A, the latter a source of vitamin C and carbohydrates. The cactus is also a ready source of water, containing some 85–90 percent by weight. The pads and fruits were consumed after the spines were removed, either by physical action or by searing. The fruits mature in midsummer and in adjacent regions formed the majority of the diet during those months. The pads—especially the young ones—can be eaten year-round. Coprolite studies in Hinds Cave in the Lower Pecos demonstrate that such pads were consumed almost daily (Texas Beyond History website).

Mesquite

Honey mesquite pods are rich in protein and carbohydrates, while having a low moisture content, which allowed for easy storage. The pods were pounded into meal using a mortar and pestle and then winnowed to remove the endocarp and inedible seeds. The remaining meal could be eaten raw or dried into flat cakes

Figure 2.39 A heart-shaped pad of the Prickly Pear cactus. Photo by K. Baer.

and stored. Gum exuded from the bark was applied to sores and wounds or boiled to make eyewash and dyes. Mesquite is also favored fuelwood and has been the predominant wood found in prehistoric hearths in regional excavations. Historically, the seedpods have been important livestock feed, especially during drought years. The wood is sometimes used for construction and is hailed as one of the best for cooking meat (Powell 1998:179; Puseman, Cummings, and Yost 2013:8; Texas Beyond History website).

Candelilla

The slender, cylindrical stems of the candelilla plant produce a wax coating as an adaptation to arid environments (Figure 2.40). This high-grade wax has been marketed for waterproofing military tents and in making candles, waxes and lubricants, chewing gum, and a variety of other products (Powell 1998:221). It is unknown if candelilla was utilized prehistorically, but it served as an important plant resource in historic times. Around 1905, Oscar Pacius of Monterey, Mexico, developed a process for manufacturing commercial wax from candelilla, essentially through a process of boiling the stems in a solution of water and sulfuric acid, the resulting "cerote" skimmed from the surface to be further processed (Tunnell 1981).

In 1912, a candelilla wax factory was established at McKinney Springs in present BBNP. In 1914, the owners moved the operation to Glenn Springs

Figure 2.40 Thin, waxy stems of the Candelilla plant. Photo by D. Hart.

where production greatly expanded, especially following increased demand during World War I where it was used as a waterproofing agent for tents and ammunition. Soon, other factories began operations, including the Mex-Tex Wax Company established at Cerro Chino around 1922. By 1935 a simpler method of extracting the wax was developed which caused a proliferation of smaller operations, one of which was documented during the project. Although many synthetic substitutes exist today, candelilla remains a valuable commodity that commands high prices. Production, however, has shifted almost completely to Mexico (Keller 2012; Texas Beyond History website; Tunnell 1981).

Guayule

Guayule (*Parthenium argentatum*), which generally grows in rocky limestone habitats, produces a high-quality natural rubber in the stem and root tissue. The rubber was extracted and marketed commercially beginning in 1892 in Mexico but has never been able to compete on the open market against rubber produced from the rubber tree Hevea (Powell 1998:421).

In addition to those mentioned above, other significant flora used prehistorically include pinyon nuts, Arizona walnut (*Juglans major*), various oak acorns (notably *Quercus gembelii* and *Q. emoryi*), Mexican persimmon, hackberry, serviceberry (*Amelanchier* *utahensis*), mountain mulberry (*Morus microphylla*), saltbush (*Atriplex canescens*), grass seeds, acacia seeds, algerita berries, amaranth, and chokecherry (*Prunus virginiana*), to name a few (Powell 1998:73, 84, 99, 102, 144, 149).

There is no direct evidence of the use of cultigens in BBNP, although the presence of ceramics at some locations may suggest at least ephemeral cultivation efforts (it should be noted, however, that ceramics are also found in other locations across the region far from perennial water sources and, thus, are indicators of dubious merit). Known exotic ceramics have been recovered from three sites (BIBE149, 1676, and 1702), and ceramics suspected of being locally produced prehistorically were recovered from three additional sites BIBE1738, 1910, and 859. However, unlike the extensive farmable floodplains in the La Junta district, the agricultural potential of the lower Big Bend was restricted due to the proximity of old, gravel-capped pediments, especially those south of the Chisos Mountains, which in many cases extend to the water's edge. Thus, expansive floodplains are few. The best is below Santa Elena Canyon, near Castolon, where the most extensive historic agriculture took place within the park, and one of few places where prehistoric ceramics have been recovered. A few other places also hosted smaller farms, including areas around Solis, Rio Grande Village, and Terlingua Abajo (Wauer and Fleming 2002:16).

Fauna

The larger Trans-Pecos region has the highest mammalian diversity as well as the greatest number of localized species of any region in the state. Almost one-third of its 92 species of mammals are found nowhere else in the state (Davis and Schmidly 1994:2–5). A similar pattern exists for other vertebrates. An inventory conducted in BBNP revealed over 600 vertebrate species, including 11 species of amphibians, 56 species of reptiles, 40 species of fishes, 75 species of mammals, and 450 species of birds (National Park Service 1998).

Among the more conspicuous mammals in BBNP are the black-tailed jackrabbit (*Lepus californicus*) (Figure 2.41), desert cottontail (*Sylvilagus audubonii*), collared peccary (*Tayassu tajacu*), and mule deer (*Odocoileus hemionus*). In addition, there are at least 25 or more different species of rodents, including squirrels (family Sciuridae), gophers (family Geomyidae), mice (families Heteromyidae and Muridae), and porcupines (*Erethizon dorsatum*) (Schmidly 1977:27; Yancey 1997:24). Major carnivores in the region include mountain lions (*Felis concolor*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), and kit fox (*Vulpes velox*). Less common carnivores include badgers (*Taxidea taxus*), raccoons (*Procyon lotor*), ringtail cats (*Bassariscus astutus*), striped skunks (*Mephitis mephitis*), spotted skunks (*Spilogale gracilis*), and hog-nosed skunks (*Conepatus mesoleucus*) (Schmidly 1977:131–59; Yancey 1997:24). Although absent from the park for more than 40 years, black bears (*Ursus americanus*) migrated from adjacent northern Mexico in the late 1980s, establishing a small, apparently stable, population, estimated to number between 20 and 25 bears (NPS 2008; Raymond Skiles, personal communication 2014).

The region is especially recognized for its diverse bat fauna. Of the 32 species that occur in the state, 23 live in the Trans-Pecos with some of the rarest and least-known species occurring abundantly in the Big Bend. The Mexican long-nosed bat (*Leptonycteris nivalis*), for example, occurs in the U.S. only in Big Bend where a single colony is located in the Chisos Mountains, with their annual migration from Latin America timed to the blooming of the century plant (*Agave havardiana*) (Schmidly 1977; Wauer and Flemming 2002:89).

More species of birds have been recorded in BBNP than in any other national park in the U.S. and of the 450 species identified, at least 56 are year-round residents. Some of the most conspicuous are roadrunners (*Geococcyx californianus*), blue quail (*Callipepla squamata*), mourning dove (*Zenaida macroura*),

Figure 2.41 Black tailed jackrabbits are among the most commonly-seen mammals in the park. Photo by C. Covington.

lesser nighthawks (*Chordeiles acutipennis*), northern mockingbird (*Mimus polyglottos*), the ubiquitous turkey vulture (*Cathartes aura*), and a variety of raptors. The park's most "famous" bird is the Colima warbler (*Vermivora crissalis*), which nests nowhere else in the United States, and can only be found in portions of the high Chisos Mountains (Wauer 1985; Wauer and Fleming 2002:91–99).

Reptiles are also abundant in BBNP and are among the most commonly seen class of wildlife. Thirty-one species of snakes, 22 species of lizards, and 7 species of turtles have been identified in the park. Among the most frequently sighted of the lizards are the whiptails (*Cnemidophorus* sp.), the western collared lizard (*Crotaphytus collaris baileyi*), and the greater earless lizard (*Cophosaurus texanus*) (Figure 2.42). Snakes are among the most diverse group of the region's herpetofauna. Of those most commonly seen are the western coachwhip (*Masticophis flagellum testaceus*) and the western diamondback rattlesnake (*Crotalus atrox*) (Figure 2.43). Although the diamondback is probably the most abundant of the park's venomous snakes, the Mohave rattlesnake (*Crotalus scutulatus)*, blacktail rattlesnake (*Crotalus molossus)*, banded rock rattlesnake (*Crotalus lepidus klauberi),* and mottled rock rattlesnake (*Crotalus lepidus lepidus)* (Figure 2.44) are also common. The secretive and nocturnal Trans-Pecos copperhead

Figure 2.42 A greater earless lizard perched on a rock. Photo by D. Keller.

(*Agkistrodon contortrix pictigaster*), however, is only infrequently sighted (NPS n.d.; Wauer and Fleming 2002:100–111).

The Rio Grande and its tributaries also support several species of native fish (also see Economically Significant Fauna section below). About three dozen species have been recorded in the park, including three types of catfish (*Ictalurus* sp.) and the predatory longnose gar (*Lepisosteus osseus*). The most common—as well as some of the most geographically restricted—species are minnow sized. Most notable is the endangered Big Bend gambusia (*Gambusia gaigei*), which occurs only in the park and, in fact, has the smallest geographic range of any known vertebrate species (Wauer and Fleming 2002:112–113).

Economically Significant Fauna

Faunal remains that have been analyzed from excavated contexts in the Big Bend indicate that animals played a significant role in the prehistoric diet and during certain time periods may have played a dominant role. However, stable isotope analyses of human remains of regional hunter-gatherers indicate that plant foods were likely more significant than animal foods for much, if not most, of the prehistoric period. One analysis, for example, suggests that this reliance on floral resources was greater during the Late Archaic than the Late Prehistoric (Piehl 2009:79–81).

Similar data from earlier time periods is not presently available. However, other lines of evidence suggest that this trend may have begun much earlier. Although

Figure 2.43 A western diamondback rattlesnake prepared to strike. Photo by D. Keller.

Figure 2.44 The mottled rock rattlesnake is one of two subspecies of rock rattlesnakes found in BBNP. Photo by D. Hart.

conventional thought holds that megafaunal resources were the primary focus during the Paleoindian period, this universal model has come under increasing scrutiny in recent years. It is being replaced by a model that sees Paleoindian adaptations as much more place-specific, tailored to regional peculiarities and available resources.

In the Big Bend region, it is theorized that Paleoindians had a much greater diet breadth than adjoining regions such as the Southern Plains. Preliminary investigations at the Genevieve Lykes Duncan site in Green Valley, north of BBNP, indicate the use of both ground-stone as well as earth ovens, suggesting an early reliance on plant-based foods. Similarly, a Late Paleoindian hearth in Baker Cave, a rockshelter in the Lower Pecos region, produced food remains from both plants and animals. Other excavations outside the region have amply demonstrated similar dietary variety, including the use of small animals, even rodents (Cloud and Walter 2014; Seebach 2011:92).

As discussed in the Culture History (Chapter 3), regional excavations of Early Archaic sites to date also suggest an adaptation based largely on plant foods, a trend that may have intensified during the Middle Archaic but that almost certainly did by the latter half of the Late Archaic following a brief mesic period. Limited stable isotope analyses of human remains in the region indicate that the Late Archaic diet consisted of more plant foods, especially succulents and grass seeds, than for foragers during the Late Prehistoric period (Piehl 2009:79–81).

Animal foods appear to be more evident in the Late Prehistoric diet, likely indicating the greater abundance of game. However, a significant percentage of the animal foods were small species that were both more abundant and easier to catch. Coprolite studies from Hinds Cave in the adjacent Lower Pecos demonstrate that prehistoric populations there ate "essentially everything edible they could get their hands on and ate many things with little or no preparation." Rodent bones were most common, followed by rabbit and bird bones. The absence of preparation is evident in the fact that 47 percent of coprolites in one study contained rodent cranial fragments. However, despite the presence of animal bones in 97 percent of coprolites, the mainstay of the diet appeared to be prickly pear, which was eaten almost every day, followed by wild onions (Texas Beyond History Website).

Faunal recovery from Hinds Cave presents a more complete picture when examined by inferred "useable meat weight." The analysis of one analytical unit from the cave containing some 9,046 bones, estimated to represent 428 animals, indicated that deer comprised the majority of the meat consumed, 42 percent of the total. An additional 30 percent was represented by carnivores (coyote, dog, fox, bobcat) followed by rabbits (10 percent), rodents (10 percent), birds (4 percent), fish (2.3 percent), and reptiles (1.5 percent) (Texas Beyond History Website).

In Bee Cave, just north of BBNP, excavations conducted in 1929 produced bone fragments of rats, rabbits, badgers, coyotes, deer, turtle, and—possibly—bison. Unfortunately, the temporal association of the faunal remains is unknown. Both deer and peccary remains were recovered from the Millington site, one of the pueblos at La Junta (Cloud and Piehl 2008:193; Coffin 1932:5, 60). As an indication of their relative significance to prehistoric people, animals are also frequently depicted in regional rock art, including images of bison, elk, deer, canids, felines, snakes, and owls, among others (Reeda Peel, Personal Communication 2014).

Some of the more significant regional faunal resources are briefly mentioned below. However, it should be remembered that many studies indicate that prehistoric desert hunter-gatherers had a broad-spectrum foraging economy that included many protein sources aside from standard game species, including rodents, reptiles, and insects. Unless otherwise indicated, the following discussion is based primarily on information obtained from the Texas Beyond History Website.

Bighorn Sheep

The remains of desert bighorn sheep (*Ovis Canadensis nelson*i), a large regional prey animal, have been found in upland sites and mountain rockshelters, but are generally uncommon in the archeological record. Because of their limited range, centered around steep rocky slopes of mountainous areas—as well as their wary nature—sheep were likely one of the most difficult of prey to take, and possibly one of the most highly valued.

Pronghorn Antelope

Pronghorn antelope (*Antilocapra americana*) remains have been discovered from both lowland and upland prehistoric sites. With their speed and excellent vision, they are well adapted to life in open terrain, typically grassland plains. Today their range is mostly restricted to the Marfa Plain, the Paisano Plateau, and similar areas where open space and broad vistas are found.

Deer

Both mule deer (*Odocoileus hemionus) and* white-tailed deer (*Odocoileus virginianus*) (including the Carmen white-tailed deer [*Odocoileus virginianus carminis*]), a subspecies confined to the Chisos and Chinati Mountains) were likely among the most sought after prey animals due to their size, offering significant caloric rewards in addition to a large hide and other resources such as hooves, bones, and antlers which were used for a variety of decorative and utilitarian functions. In faunal assemblages of lowland sites in the region, deer are usually second in abundance only to rabbit, and in mountain rockshelters are often the dominant animal represented. At one shelter in south-central New Mexico, deer represented 99 percent of the Late Archaic faunal assemblage.

Rabbits

As one of the most common and abundant animals in the Chihuahuan Desert, rabbits were among the most important animals in the prehistoric diet, especially as episodic drier conditions led to a scarcity of larger prey in lowland areas. Both black-tailed jackrabbits and desert cottontails were harvested, often using "rabbit sticks" which were thrown to kill or immobilize them, one of which was recovered from Bee Cave just north of BBNP. In addition, group "rabbit drives" are known from ethnographic contexts. Nearly every site in the Trans-Pecos with good preservation contains rabbit remains, and they often dominate the faunal assemblage.

Because of this, coupled with field observations of rabbit behavior, one feature type identified during the survey (rock groupings) are theorized to have been a type of prehistoric rabbit trap. Often occurring on top of pediments, these curious groupings of bowling ball-sized or larger stones, typically in groups of three, were frequently noted to contain rabbit droppings. The hypothesis is that these stones attracted rabbits as a form of shelter, which could be used to camouflage a twine snare or similar device to capture or kill the rabbit (also see Chapter 6-IV on Isolates). Additional research is needed to test this hypothesis.

Other Rodents

Other rodents, such as blacktailed prairie dogs (*Cynomys ludovicianus*), ground squirrels (*Spermophilus* spp.), pocket gophers (*Geomyidae* sp.), mice (*Peromyscus* sp. and *Reithrodontomys* sp.), and rats (*Neotoma* sp.), also provided a ready source of protein and fat prehistorically. Remains of woodrat (*Neotoma* sp.), cotton rat (*Sigmodon hispidus*), and kangaroo rat (*Dipodomys* sp.) have been recovered from Granado Cave in eastern Culberson County and other dry rockshelters in the region (Wauer and Fleming 2002:86).

Birds

Birds were sought for both meat and feathers, and their eggs served as a quick source of protein. Turkey, quail, owl, and other species of birds have been recovered from sites in the region and they are frequently depicted in rock art, attesting to their symbolic significance to prehistoric people.

Reptiles

Snakes, lizards, frogs, and turtles were also widely available faunal resources and may have provided a significant portion of the prehistoric diet, especially in the desert lowlands. Western box turtles (*Terrapene ornate*), western diamondback rattlesnakes (*Crotalus atrox*), Texas horned lizards (*Phrynosoma cornutum*), and toads (*bufo* sp.) have been found at several dry rockshelter locations in the broader region. Reptiles were probably not a targeted prey animal but were likely taken opportunistically when encountered. Most could be captured or killed with minimal effort and were likely eaten with little or no preparation.

Aquatic Fauna

For prehistoric people who lived within reach of the Rio Grande, an array of aquatic resources offered another significant, and likely reliable, faunal resource. Yet only very limited evidence of fishing has been discovered in BBNP. Net sinker stones, relatively common in assemblages in the La Junta district, are nearly absent within the park. The singular exception is BIBE1520 where two notched pebbles, believed to be net sinker stones, were recovered. However, other artifacts recovered during the present survey indicate definite prehistoric interaction with aquatic resources. Both modified and unmodified freshwater mussel shells were recovered from nine sites, including two matching mussel shells associated with a Middle Archaic dart point cache (the Lizard Hill Cache, BIBE1853). In addition, two pierced turtle shell fragments were recovered from BIBE1594, and fish vertebrae were collected from BIBE1975.

Aquatic faunal remains have been much more abundant at La Junta where freshwater drum (*Aplodinotus grunniens*), catfish (*Ictaluridae*), and minnows—among others—have been identified in excavated contexts. Although limited stable isotope analysis of human remains from La Junta have not supported a heavy dietary reliance on aquatic resources, the fact that Spanish explorers referred to one La Junta group as the *Pescados*, or fishermen may suggest that fish consumption was, at least in part, culturally conditioned (Piehl 2009:81).

Larger fish native to the Rio Grande that could have been targeted prehistorically include blue catfish (*Ictalurus furcatus*), channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), alligator gar (*Atractosteus spatula*), spotted gar (*Lepisosteus oculatus*), longnose gar (*Lepisosteus osseus*), shovelnose sturgeon (*Scaphirhinchus platorynchus*), blue sucker (*Cycleptus elongates*), smallmouth buffalo (*Ictiobus bubalus*), black buffalo (*Ictiobus niger*), river carpsucker (*Carpiodes carpio*), and American eels (*Anguilla rostrata*). Migrating Atlantic sturgeon (*Acipenser oxyrhynchus*) also may have been taken prehistorically (Texas Beyond History Website; Wauer and Fleming 2002:112–116).

Turtles also may have been significant aquatic resources prehistorically. Whether or not they were targeted as a food source, their shells—such as those found at BIBE1594—were clearly utilized prehistorically for ornamentation and, likely, other uses. Additionally, the discovery of several turtle or turtle-like petroforms in the park and in other parts of the Big Bend suggest the importance of these reptiles (or the water with which they are associated) to regional prehistoric peoples. The largest Rio Grande turtle is the Texas spiny softshell (*Apalone spinifera emoryi*), which is restricted to permanent waters of the Rio Grande and can reach lengths of more than 36 cm (14 in). The smaller Big Bend slider (*Trachemys gaigeae*) and Big Bend mud turtle (*Kinosternon hirtipes murrayi*) are less likely to have been targeted for food or shell, although they may have been utilized opportunistically (Wauer and Fleming 2002:102–103).

Paleoenvironment

Throughout the span of human occupation in the Big Bend, research shows it has grown generally hotter and drier with periodic pulses of more mesic and temperate conditions (Figure 2.45). The maximum expansion of the Wisconsin continental glacier occurred around 18,000 years ago, and its influence persisted until at least 13,000 years ago. During this period, the climate in the region appears to have been much more moderate than today, generally cooler and wetter with fewer seasonal extremes (Van Devender and Wiseman 1977:22).

Analyses of packrat middens from the Big Bend suggest milder winters, much cooler summers, and somewhat greater annual precipitation during this period (Van Devender 1986:15). In addition to many of the animals that exist today, several of the classic Pleistocene megafauna, such as horses (*Equus* sp.), bison (*Bison* sp.), and Columbian mammoth (*Mammuthus columbi*) roamed the area. Their remains have been found in the ancient soils around Terlingua, Elephant Mountain, and Alpine (Albritton and Bryan 1939) as well as one location south of Marathon (Mallouf 2001a).

Some evidence suggests that by 11,000 years ago, around the time of the earliest documented human presence in the Trans-Pecos, the process of desertification was already well underway. However, according to some researchers, this process was more strongly influenced by decreasing precipitation than by increasing temperatures (Van Devender and Wiseman 1977:22).

Paleoclimatic changes appear to have transformed the landscape from oak-juniper-pinyon woodlands and grasslands to desert scrub over the course of about 10,000 years, beginning during the late Pleistocene, about 14,000 years ago, and ending about 4,000 years ago. Vegetation changes mark the boundaries between the early (11,000 to 8,000 B.P.), middle (8,000 to 4,000 B.P.), and late Holocene (4,000 B.P. to present) (Van Devender 1986:6–7).

Today, oak, juniper, and pinyon still inhabit the higher elevations, and grasslands cover the mid-elevation areas, but desert scrub has claimed much of the lowlands and irregular terrain, and almost nothing survives on the badland flats. In spite of episodic wetter, cooler times, desertification has been the general trend, with some periods being even hotter and drier than the climate of today.

The Early Holocene Xeric Woodland (11,000 to 8,000 B.P.)

The drying period that began about 14,000 years ago initiated the loss of the more mesophytic species such as Colorado and Mexican pinyon and Rocky Mountain juniper (*Juniperus scopulorum*) from all but the highest elevations by 11,000 years ago (Van Devender and Spaulding 1979:706; Van Devender 1986:5).

At mid-elevation sites, early Holocene vegetation was characterized by a transitional xeric oak-juniper woodland that developed synchronously with the disappearance of pinyon pine, and prevailed from 11,000 to 8,000 years ago. Warm desert species were common within these woodlands at lower elevations (Van Devender 1986:6; Van Devender and Spaulding 1979:702, 706).

At lower elevation sites, packrat middens suggest the development of incipient desert grasslands during the early Holocene. This grassland was dominated by honey mesquite and represents the earliest record of the shift from woodlands to desert grasslands in the entire Southwest. In addition, 11,000 year-old macrobotanical samples from a Late Paleoindian site located on Terlingua Creek north of the park are dominated by two classic xeric species—mesquite and saltbush (*Atriplex* spp.) (Van Devender 1986:3, 7; Puseman et al. 2013).

Packrat midden evidence also indicates that the area around Rio Grande Village in the southeastern most part of BBNP may have remained warmer and drier throughout the late glacial and Holocene periods. This area is located in the lowest part of the Chihuahuan Desert (at about 600 m, or 1,850 ft AMSL), and may have served as an Ice Age refugium for some of the more important Chihuahuan Desert flora. Many such desert plants were common in the pinyon-juniper-oak woodlands of the Late Wisconsin Glacial Episode, including lechuguilla and crucifixion thorn or allthorn (*Koeberlinia spinosa*) (Van Devender 1990).

It was during the Early Holocene period, corresponding archeologically to the Paleoindian Period, that the earliest human presence has been established in the Big Bend region. In addition to the 11,000-year-old site noted above, the J. Charles Kelley site in the Chisos Mountains of BBNP contained two buried, charcoal-bearing thermal features that yielded radiocarbon dates of 9,988 and 10,014 median cal B.P. (T. Alex 1999:14).

Middle Holocene Grasslands (8,000 to 4,000 B.P.)

The contraction of the early Holocene woodlands appears to have been a rapid, widespread event. At the beginning of the middle Holocene, woodland species became restricted to higher elevations and disappeared in the lowlands. At the same time, desert-adapted species increased in abundance and dispersed into new areas (Van Devender and Spaulding 1979:706).

In the Chihuahuan Desert, packrat midden evidence suggests the middle Holocene was characterized by desert grasslands that lacked both woodland and many important Chihuahuan desert scrub plants. Other evidence indicates that many of the components of the modern plant communities were well established early in this period and that the transition to the present desert scrub community was completed by the end of this period 4,000 years ago (Ohl 2006; Van Devender and Spaulding 1979:707; Van Devender 1986:7). Recent findings from a site on Alamito Creek west of the park indicate modern desert species there as early as 7,000 years ago (Puseman and Cummings 2008).

It was probably during this period, coinciding with the Holocene climatic optimum between roughly 9,000 and 5,000 years ago, that a summer precipitation pattern became entrenched. Although the annual precipitation remained nearly the same, the season in which it fell shifted to the summer monsoon rainfall pattern of today's northern Chihuahuan Desert climate (Van Devender 1990; Hoyt 2000:184).

Numerous archeological sites dating to the middle Holocene period have been documented in the Greater Big Bend area. Although it is highly likely that indigenous groups continued to rely on animal foods, evidence from several of these sites indicates a shifting emphasis to plant gathering with some processing of the increasingly abundant desert succulents.

Late Holocene Desert Scrub (4,000 B.P. to present)

Development of much of the modern desert scrub communities is believed to have been largely a late Holocene event. Even though many of the desert-adapted species were endemic by 4,000 to 8,000 years ago, some of the key species associated with the Chihuahuan Desert were apparently late arrivals. Packrat midden evidence suggests that creosotebush, ocotillo, and lechuguilla arrived in the northern Chihuahuan Desert during this later period (Van Devender 1986:6). However, creosotebush pollen was present in south-central Pecos county by at least 6,000 years ago and macrobotanical evidence has been recovered from lowland sites in the area dating as far back as 9,000 years ago (Hoyt 2000:49).

During the early years of the late Holocene, archeological evidence indicates a heavy reliance on desert succulents. However, by the later part of prehistory, the climate appears to have moderated enough to support a more balanced hunter/gatherer subsistence pattern. Most paleoenvironmental studies report that widespread mesic conditions returned to the region by at least 2,500 years ago, reaching a peak in annual precipitation about 1,000 years ago (Hoyt 2000:186).

TEMPORAL DATA				PALEOENVIRONMENTAL DATA		
Years Ago	**Years B.C. or A.D.**	**Geological Epoch/Period**	**Archeological Period**		**Big Bend** (based mostly on Van Devender pack rat midden data)	**Lower Pecos**
0	2,000	**Late Holocene**		Climate ameliorates to slightly **mesic conditions**	**Desert scrub** persists, modern vegetation communities	
500	1,500		**Late Prehistoric** (A.D. 700–1535)			
1,000	1,000					**Mesic period** Little ice age A.D. 1350–1850, colder winters and increased moisture, bison spread southward
1,500	500		**Late Archaic** (1000 B.C.–A.D. 700)			
2,000	0					
2,500	500					**Mesic period** Mesic period, 1000–500 B.C. Devils Mouth pollen record and Bonfire bone bed, cool and wet, bison enter from north as their habitat expanded.
3,000	1,000		**Middle Archaic** (2500–1000 B.C.)			
3,500	1,500					
4,000	2,000	**Middle Holocene**			Woodlands retreat northward and to higher elevations Desert species spread, grasslands and desert scrub establishing; warming, drying, summer rainfall	
4,500	2,500		**Early Archaic** (6500–2500 B.C.)			
5,000	3,000					**Altithermal (ca. 3000–6000 B.C.)** flooding events, extreme dryness, hot summers, mild winters. Arenosa and Devils Mouth sites flood.
5,500	3,500					
6,000	4,000					
6,500	4,500					

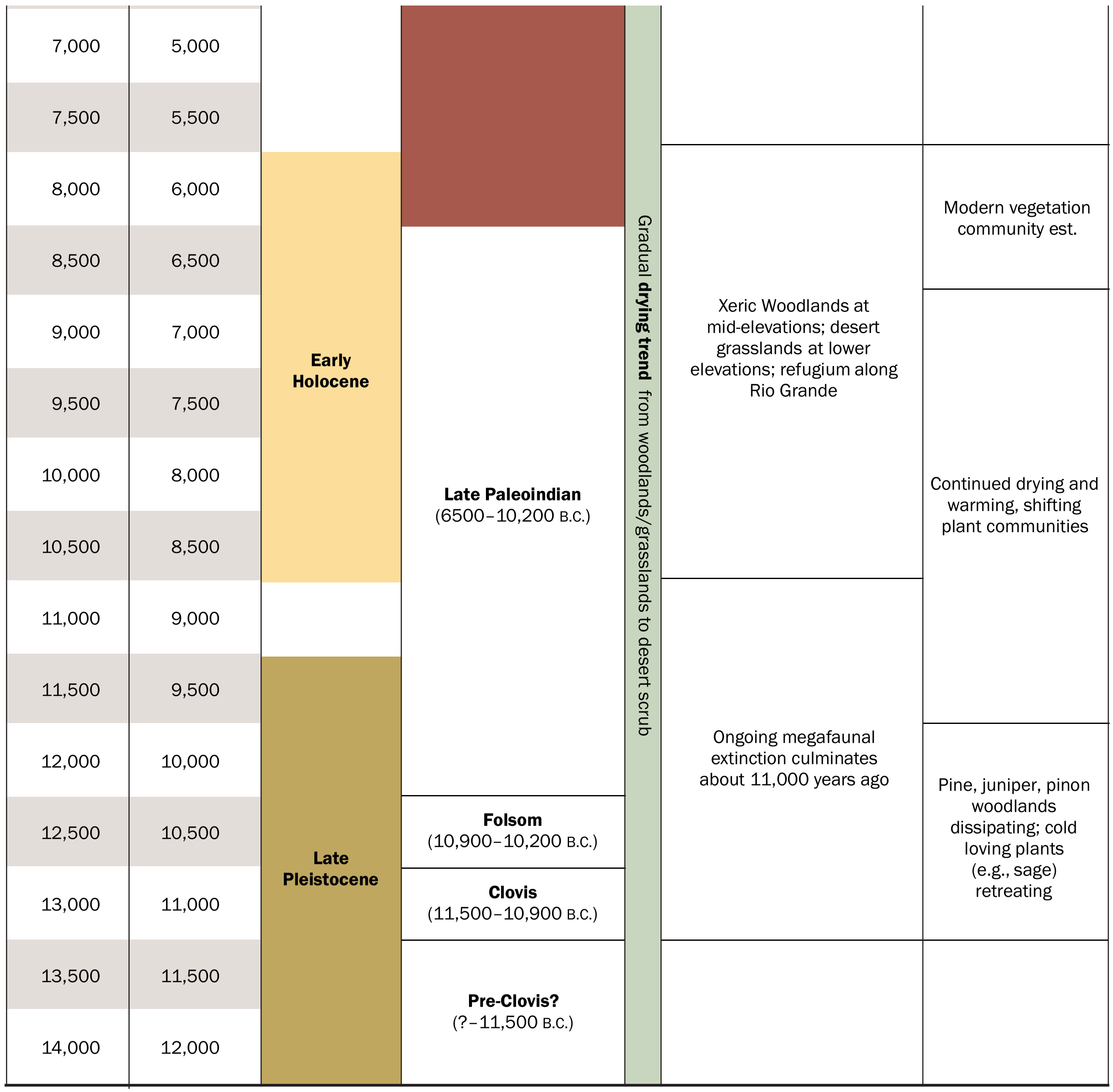

Figure 2.45 Paleoenvironmental timeline for BBNP.

Based on a variety of evidence, then, most researchers believe the Big Bend area has experienced a near linear trend towards increasing aridity since the beginning of the Holocene, with modern xerophytic vegetation in place by at least 4,000 years ago, allowing a desert-based subsistence strategy to have developed by the Middle Archaic period.

3

History of Investigations

Archeological research in the Big Bend spans nearly a century and encompasses a number of early projects that were largely sporadic and unrelated. Although the most substantive early excavations occurred outside the park, a number of rockshelters within the present park boundaries were also excavated. Because more recent subsurface investigations have been mostly compliance-driven, they have been focused on mitigating impacts of specific projects rather than having research objectives. However, two major reconnaissance-level surveys occurred within the present-day confines of Big Bend National Park (BBNP), one undertaken prior to its establishment in the 1930s and the other in the 1960s. Since that time, most archeological surveys in the park have been done in-house or through cooperative efforts with the Center for Big Bend Studies (CBBS). The following history of investigations is presented in roughly chronological fashion. The first part of this chapter addresses the general history of investigations in the region with special focus on projects conducted within and immediately adjacent to the park between 1920 and 1990. The second part of the chapter addresses in-house and NPS-sponsored archeological work conducted from 1982 to the present.

General Investigations in BBNP and Adjacent Areas, 1920–1990

Early Investigations: The 1920s and 1930s

The earliest significant archeological work in the greater Big Bend was conducted in the 1920s and early 1930s. Many of these investigations were spearheaded by Victor J. Smith, head of the Department of Industrial Arts and curator of the Big Bend Memorial Museum at Sul Ross State Teacher's College. Smith and other faculty members formed the West Texas Historical and Scientific Society in 1925 which endeavored to "preserve and study items of scientific importance in West Texas" (Kelley, Campbell, and Lehmer 1940:18; Figure 3.1). Smith, long-time president of the society, Henry T. Fletcher, and other members recorded and investigated several hundred sites throughout the region although their focus was generally in areas north of BBNP (V. Smith 1927, 1931; Fletcher 1931). Smith placed much of his attention on rockshelters, directing systematic excavations at Muller, Carved Rock, Hord, and Meriwether rockshelters in the vicinity of Alpine during the early 1930s (V. Smith 1927, 1932; Tunnell 1992; Figure 3.2). Although Smith's focus was upon the rockshelters in the northern portion of the Big Bend, his work formed the foundation for future research across the entire region (Wulfkuhle 1990:118).

While Smith, Fletcher, and others made important strides within the region, most other early archeological investigations in the Big Bend were conducted by researchers affiliated with various outside institutions. These consisted of the Mrs. Thea Heye Expedition

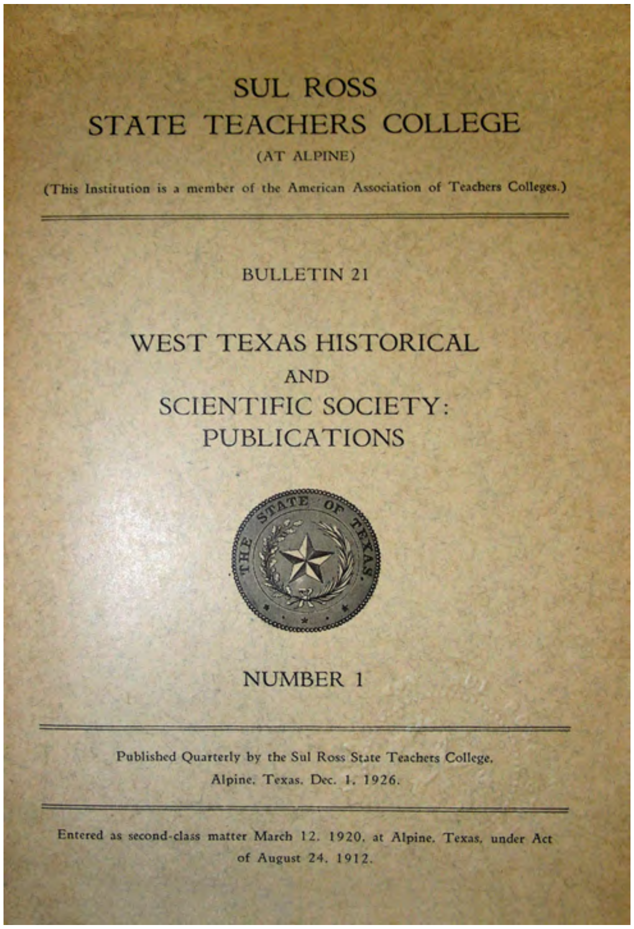

Figure 3.1 A 1926 West Texas Historical and Scientific Society publication.

sponsored by the Heye Foundation's Museum of the American Indian and the University of Cambridge (Harrington 1928; Coffin 1932), a University of Texas-Witte Museum project (Young 1929), a Smithsonian Institution project (Setzler 1933), the Woolford-Martin Expedition sponsored by the Witte Museum (Martin n.d.), a brief reconnaissance sponsored by the Gila Pueblo (Sayles 1935), reconnaissance-level surveys and testing by the National Park Service (Reed 1936; Niebuhr 1936; Cook 1937), notations from an independent researcher (Redfield 1937), and an important interdisciplinary project co-sponsored by the Peabody Museum of Archaeology and Ethnology of Harvard University and Sul Ross State Teachers College (Kelley et al. 1940; Albritton and Bryan 1939).

Museum of the American Indian and the University of Cambridge— M.R. Harrington and Edwin F. Coffin

Like Smith, other early researchers also concentrated on rockshelters—largely as a result of a trend during this time of obtaining perishable items for museum displays. Exploring archeological sites across the Southwest during the Mrs. Thea Heye Expedition, in 1928 M.R. Harrington excavated three small rockshelters/caves in Pine Canyon—the first formal archeological work in what would become BBNP (Harrington 1928; Figure 3.3). The largest cave measured ca. 8.2 m wide and had a depth of ca. 11.6 m, yet Harrington was ". . . disappointed to find that the deposits of grass and fiber for the greater part had been burned away, leaving only ashes" (Harrington 1928:311). He further indicated the second cave contained a very shallow cultural deposit and that the third evidenced a relatively short occupation. Despite these drawbacks, Harrington recovered 205 specimens from the three caves (currently recorded in state records as a single site, (BIBE2832), including a nearly perfect woven basket; two types of sandals; matting fragments; grinding implements; arrow points and other stone tools; and a variety of wooden items, among them fragments of arrows including one with attached sinew and a feather.

Although Harrington did not mention visits to other sites in the vicinity of these caves, an inventory of materials collected from Texas at the National Museum of the American Indian (NMAI)—the repository holding the Pine Canyon cave specimens—lists three other sites in Brewster County that would have been on property eventually subsumed by the park: one at Glenn Spring (notation reads "Glen Springs"), one at Burnham's Ranch (notation reads "Chisos Mountains, Burnam's Ranch In, Village Site At"), and one likely on the west side of Dagger Mountain (notation reads "Marathon, 50 Mi S Of, Boquillas Road, E side, Rockshelter"). From these three sites Harrington collected a total of 344 specimens with the majority (n=281) attained from the "village site" at Burnham's Ranch. Almost all of

Figure 3.2 Victor Smith displaying an artifact in his field-ready Model T Ford. Courtesy of Sul Ross State University.

Figure 3.3 M.R. Harrington conducted the first formal archeological research in what would become Big Bend National Park. Courtesy of the Smithsonian Learning Lab Resource, Smithsonian Institution Archives.

these 344 specimens are comprised of chipped/ground stone implements, including 47 projectile points.

That same year Harrington began excavations in a large south-facing rockshelter—Eagle Canyon, later renamed Bee Cave Canyon—on Chalk Draw, located in the central portion of Brewster County just north of BBNP (Harrington 1928; Coffin 1932; Kelley et al. 1940:19). Originally referred to as "Eagle Cave" and "Bee Cave Canyon Rockshelter," it is now known as "Bee Cave" by most. Measuring ca. 235 m in length and over 30 m from drip line to the back wall, Bee Cave is the largest and arguably the most scientifically significant rockshelter in the Big Bend. In his report, Harrington (1928:313) described the shelter as containing "ruins of rooms rudely built of stone" along the back wall and crude rock art "including representations of human hands, men, birds, and possibly animals." His report also indicated the presence of a mass of large boulders—what appeared to be roof fall—in the central portion of the shelter near the drip line; among these boulders were several small "caves."

Two hand-dug trenches were excavated at the site by Harrington, one of which uncovered a line of stone slabs set on edge, the foundation of one of the "rooms" (roughly rectangular in plan view with rounded corners, later designated House-site 5). Harrington thought he had identified two separate house floors representing different occupations. The second trench was placed along the back wall, behind and north of the mass of large boulders. Here he found the remains of a skull-less, flexed burial, apparently interred with three red painted stones; two stone knives; "a bowl-shape coiled basket, part of a twined open-work cigar-shape basket, fragments of a bag made of fiber cord, many small beads made of cane, and part of a necklace made of sections of the legs of some large iridescent green beetle neatly strung on a fine fiber cord" (Harrington 1928:315). In addition, a projectile point identified as a "spearhead"—but not illustrated in Harrington's report—was found among the vertebrae. The report indicated that perishable materials recovered, with a few exceptions, were similar to those from the shelters in Pine Canyon.

At the end of the 1928 field season, Harrington resigned his position with the museum. Edwin F. Coffin, also of the Museum of the American Indian, took over the project and completed the Bee Cave excavation in June 1929 (Figure 3.4). Significantly, Coffin's (1932) report provides descriptive information on cultural features—six circular to rectanguloid, stone-based "houses"; two "caves" or boulder shelters located amongst the roof fall with evidence of occupation; two large "firepits" or baking pits; and pictographs—and the diverse material culture recovered during the excavation. However, abbreviated and lacking detail, his report failed to include important contextual information needed to understand the stratigraphic associations.

To his credit, however, Coffin generated a fairly detailed map of the site which helps to sort out some of the contextual issues, including the location of the primary cultural features and Harrington's previous excavations. Unfortunately, this map fails to illustrate the extent and limits of Coffin's own excavations at the site which, along with basic methodological information, is required to properly interpret his results. Thus, his report lacks the level of detail that would provide a firm understanding of the features and artifacts and their attendant associations. Despite these failings (by today's standards), the report provides important information about the site, the interior structures, and material culture in use within the region during prehistoric times.

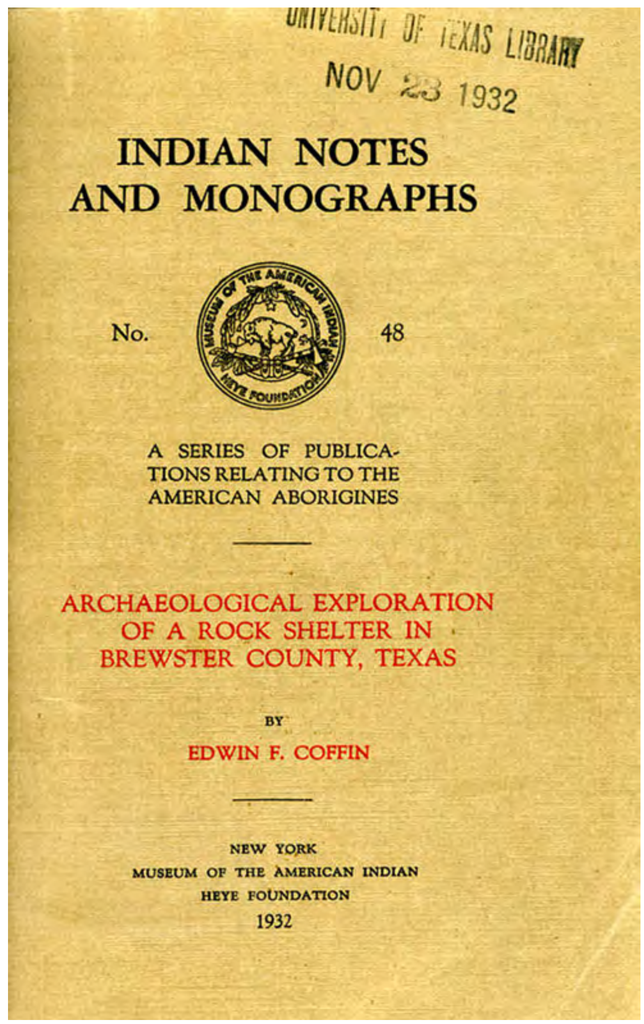

Figure 3.4 Edwin Coffin's 1932 publication on the excavations at Bee Cave.

Coffin (1932:6–21) indicated the excavated structures had stone foundations, superimposed grass-covered floors, and an absence of any evidence of roofs. The foundations were laid on or just above the lower floor levels, with many of the basal stones set on edge. In some cases, portions of the walls were plastered or chinked with a mixture of adobe and ash.

While Coffin claimed that both dart/spear and arrow points were recovered, he failed to provide counts or illustrate any of these projectiles (Coffin 1932). However, the CBBS recently acquired information on these specimens, now housed in separate collections at the NMAI in Washington, D.C., and the Cambridge University Museum of Archaeology and Anthropology (CUMAA) in England. Photographs of the inventory at the NMAI indicate there are 36 projectile points in that collection, with dart points (n=29) greatly outnumbering arrow points (n=7). The Middle Archaic period is minimally represented amongst the former, the vast majority appearing to be Late Archaic types. Select photographs of portions of the CUMAA collection provide similar data—of 23 projectiles, there are only 2 probable arrow points and 1 obvious Middle Archaic specimen; the remainder represents Late Archaic types.

Other items represented include a wide variety of wood and stone tools, gourd vessels, unfired clay figurines, painted stones, basketry and sandal fragments, pottery sherds, and extensive floral and faunal remains (Coffin 1932). Although the latter were not reported on by Coffin, data on floral and faunal remains is provided in a separate article published by the West Texas Historical and Scientific Society (Fletcher 1930).

While the preponderance of time-diagnostic materials recovered from Bee Cave suggests that human occupation of the shelter was paramount during the Late Archaic period, the lack of associated provenience data precludes chronological assignments for the houses, rock art, and other features identified. Regardless, the Harrington and Coffin excavations provide substantive data on indigenous structural remains and illustrate the vast array of material culture in use in the region during the latter portions of prehistory, thus setting the stage for further archeological investigations in the Big Bend.

University of Texas and the Witte Museum—Claude S. Young

In December 1929, several months after the Bee Cave excavation came to a close, Claude S. Young—a Lieutenant Commander in the United States Naval Reserve—conducted some archeological work in areas that would later be part of BBNP. Sponsored by the University of Texas and the Witte Museum of San Antonio, his efforts consisted primarily of test excavations inside a large cave in Santa Elena Canyon and another in the vicinity of Smoky Creek and Mule Ear Peaks. His report also described some minor reconnaissance and visits to several large rock art sites while in the Big Bend (Young 1929).

The stated objective of the University of Texas-Witte Museum project was to "carry on an archaeological survey of the Santa Helena [Elena] Canyon, in the Big Bend District of Brewster County, Texas" (Young 1929:1). A large and practically inaccessible cave on the Mexico side of the canyon was the primary target and Young referred to it as "Doric Cave." Situated about two mi up from the canyon mouth, the immense cave has a maximum width of ca. 35 m, a depth of ca. 60 m, and a height of over 40 m (Young 1929:9). Young's report indicated there was no obvious rock art or smoke-blackening on the walls, and that 12 test holes yielded "no sign of grass or any other sign of human habitation," the latter notation likely a reference to the grass floors discovered at Bee Cave by Harrington and Coffin.

After the abbreviated investigation of Doric Cave, Young and his group conducted a brief reconnaissance up Terlingua Creek before departing for an area in the southwest portion of the Chisos Mountains near Trap Spring. Young had previously conducted some reconnoitering and discovered a previously inhabited "cave" near this spring. The group camped at the spring and rediscovered the shelter beneath a pour-off—apparently what later became known as Cartledge Cave (now designated site BIBE848; see below). Young (1929:13) indicated it had a ca. 18-m-wide and 2-m-high entrance, a depth of ca. 15 m, a maximum ceiling height of ca. 6 m, a smoke-blackened ceiling, and floor space that measured ca. 204 m^2. A large area along the back wall, comprising ca. 10 percent of the shelter, had been destroyed by "treasure hunters," and Young (1929:14) noted "they had used the Indian grass beds and pieces of basketry to kindle" two small campfires in this area. An investigation of the "treasure pits," one ca. 3 m deep, revealed the presence of multiple occupations as evinced by distinct grass layers. At the mouth of the shelter, profile "faces" were cut into a "high rubbish heap" and this effort revealed "grass cultures down to nine feet" (Young 1929:14). The shelter was mapped, gridded into 10-ft) squares, and apparently a trench was excavated through a portion of the "rubbish heap." Young (1929:15) briefly described some of the findings:

> We opened up the face . . . and the first grass layer was mostly filled with chewed sotol, a good deal of light colored grass that was full of long thorns. . . . We went down to bench 3 (second grass culture) and in this section we found many tied grass strings and many knots also two pieces of basketry about two inches square, cross weave. . . . Here we hit the first ashes on bench three, that were three feet deep. This is eight feet below present surface. Here we found several pockets of red brown seeds, about thirty-five seeds in each pocket. The usual matted grasses, palm and sotol butts and many peyote heads were uncovered during the day also many small pitahayas [pitayas], all dried out and hard.

Young's investigation was cut short by an intense storm, but not before he had recovered 12 pieces of basketry from the various layers (stratums 3–8) as well as 196 other items, and what he referred to as a 175-lb) metate; images of the latter indicate it would be more properly classified as a large boulder mortar. Included in the inventory of materials collected were such items as knotted string, knots, grass, fiber, rabbit hair string and cord, twisted rabbit hair cord, lechuguilla threads, chewed sotol, a sandal fragment, a probable arrow point, a dart point, and various plants and plant parts (e.g., sotol, cactus, pitaya, peyote, acorn, seeds, palm, and gourd; Figure 3.5). Also listed on the inventory was a human foot bone, an indication that the shelter had housed at least one burial (Young 1929: Appendix p. 4).

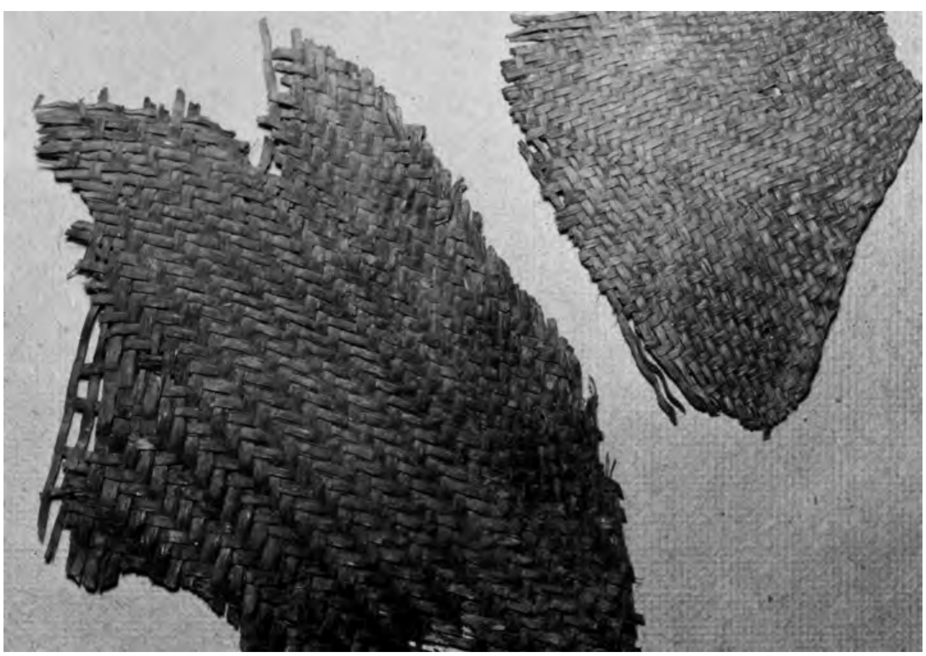

Figure 3.5 Textiles recovered from Cartledge Cave. Courtesy of National Park Service, BBNP.

While in the Cartledge Cave area, Young discovered a spring and three additional "caves" with smoke-blackened roofs. On the way back to San Antonio (via Alpine), Young visited two important rock art sites along the western edge of what is now BBNP, a site with extensive petroglyphs on the east side of Indian Head Mountain and an important pictograph site above Payne's Water Hole. Ultimately, Young brought the recovered artifacts back to the Witte Museum where they are housed today.

Smithsonian Institution—Frank Setzler

During these same years, the Smithsonian Institution also worked in the area of present-day BBNP. From March to June 1932, Frank Setzler of the Smithsonian oversaw intensive excavations in three shelters in the southwestern part of the Chisos Mountains: two on Mule Ear Peaks ("Cave 1 and Cave 2," now designated sites 41BS435 and 41BS436) and another at nearby Cartledge Cave (Setzler 1933; Kelley et al. 1940:18–19; Figure 3.6). Setzler's report (1933:53) indicated the two Mule Ear caves were completely excavated and that Cartledge Cave "yielded information not found elsewhere," but provided extremely limited data on his findings from these excavations. In fact, Setzler made no mention of the impacts by looters or the previous work conducted by Young at the site.

Despite the shortcomings of Setzler's report, more information about his discoveries were revealed much later by Prewitt (1970) through an inventory and brief description of the materials that were collected and housed in the Smithsonian Institute. Prewitt indicated that floor plans of the caves and some photographs existed but there was no provenience data for the excavations at Mule Ear Peaks caves. Amongst the 17 items collected from Cave 1 were a small corncob and 13 perishable items, consisting of netting, matting, cordage, and a grass coil. Thirteen perishable artifacts were also collected from Cave 2, consisting of fragments of sandals, basketry, matting, and cordage. More documentation was found for the larger Cartledge Cave, including photographs, a floor plan with some artifact locations, and a profile sketch of the

Figure 3.6 Frank Setzler's rockshelter excavation field crew in 1932. Courtesy of National Park Service, BBNP.

deposits. Over 300 artifacts were collected from this shelter, including 2 arrow points (unknown types), a painted pebble, both atlatl-dart and bow-arrow fragments (the latter more prominent), fireboards and drills, basketry, matting, netting, sandals, cordage, 7 small corn cobs, and 3 textiles (containing fiber and possibly cotton cordage).

Witte Museum—Woolford-Martin Expedition

What became known as the Woolford-Martin Expedition investigated additional rockshelters in the Big Bend in 1931. This reconnaissance survey, sponsored by the Witte Museum, visited various sites and apparently excavated a number of shelters (Martin n.d.; Kelley et al. 1940:19). The brief report by George C. Martin on this effort focused on arguing for a connection between the Big Bend sites and Anasazi "Basket Maker" sites of the American Southwest, while only providing very cursory provenience data (Figure 3.7). Martin does mention a shelter on Pummel Peak at the northeastern edge of the Chisos Mountains from which a dart nock and slab-lined fiber cache were uncovered, but this is the only site mentioned in the present confines of BBNP. General information from the expedition mentioned the lack of pottery or Historic Indian findings in any of the shelters visited and the sparse occurrence of pottery on open sites in the region.

To further his argument for a linkage with Anasazi sites, Martin (n.d.) offered the term "Big Bend Basket Maker" for the "cave culture" of the Big Bend. Indeed, it was an academic trend at the time to compare the material culture between these two areas. For several years Victor Smith had investigated potential prehistoric relationships between the "Big Bend Culture" and that of the broader American Southwest. While cautioning that more work was needed to sort out the issue, he had concluded there was enough evidence to suggest a linkage of some sort between the two (V. Smith 1931, 1932). By contrast, Frank Setzler (1935), in an article entitled "A Prehistoric Cave Culture in Southwestern Texas" in which he summarized the work done in the greater region (including the Lower Pecos), concluded that the Big Bend cultures were distinct from the Basket Maker cultures, citing differences in coiled basketry and sandals among other items (Setzler 1935:110).

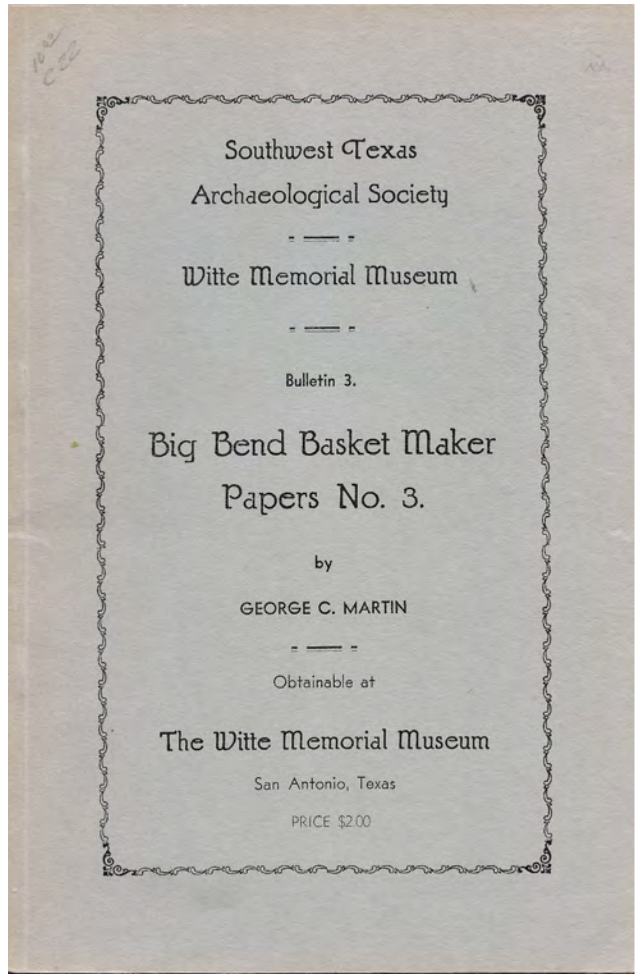

Figure 3.7 George C. Martin's report of investigations from the Woolford-Martin expedition of 1931.

Gila Pueblo—E.B. Sayles

Because of the focus on rich perishable-laden deposits contained within caves and rockshelters, these early investigations tended to ignore open sites. This deficiency was partially addressed in the early 1930s when E.B. Sayles of the Gila Pueblo in Arizona made a brief visit to the Big Bend during a broad-based archeological reconnaissance of the state (Figure 3.8). His investigation

Figure 3.8 E.B. Sayles (right) and his assistant, John Olgin, ready to depart on a reconnaissance of Texas archeological sites for the Gila Pueblo in December of 1931. Courtesy of the Texas Archeological Research Laboratory, University of Texas at Austin.

of the full range of sites (including open sites), coupled with the known archeological record, resulted in the first conceptualization of the past in which he named and defined a series of cultural units. The oldest of these was called the "Pecos River Cave Dweller," followed by the "Big Bend Cave Dweller," the "Edwards Plateau Culture," the Hueco Cave Dweller," the "El Paso phase," the "Jumano phase," and—most recently—the "Lipan phase" (Sayles 1935). Broadly speaking, the earlier names were applied to Archaic groups and the later ones to Late Prehistoric and Historic groups although Sayles did not make such distinctions. Even though Sayles' publication provided little information on specific sites in the Big Bend, his preliminary construct provided the first wider cultural context for the region.

National Park Service Investigations in the 1930s—Erik K. Reed and Ruel R. Cook

In the mid-1930s, as the National Park Service (NPS) became interested in the natural and cultural resources within what was to become BBNP, the full range of archeological sites again came under scrutiny. Erik K. Reed and Ruel R. Cook, both affiliated with the NPS, conducted reconnaissance-level surveys and select test excavations within present BBNP in 1936 and 1937, respectively. However, because access dictated much of the work during the Reed and Cook surveys, there were huge gaps in the areas covered. Tragically, some of the primary records and all of the artifacts recovered during these investigations were destroyed by fire in the park's Civilian Conservation Corps (CCC) Museum on December 26, 1941.

In the summer of 1936, Reed with the help of three student technicians—Edgar C. Niebuhr, J. Charles Kelley, and William M. Pearce—documented 184 sites (Figure 3.9). Of these, 89 were identified as "open camps" and 95 as "caves," or "rather sheltered" sites, the latter including 13 "boulder-shelters" (Reed 1936:21). In addition to surface documentation, the team also conducted test excavations at four sites.

Reed's report is organized much like compliance reports are today, containing a discussion of research issues pertinent to the survey, background data from the region, data recovered during the survey, a summary discussion, and detailed information from the site excavations. Reed also discussed amateur excavations and looting/vandalism in the area, with Elmo Johnson and his wife of Castolon mentioned in a positive light, and Tom and Roy Miller of San Vicente cast in a more negative light. A few sites in Mexico were also discussed although a notable site containing extensive petroglyphs in Canyon de los Altares was the only one actually visited. The survey party also visited Bee Cave and collected 21 artifacts from Coffin's backdirt piles.

In his discussion of the survey, Reed indicated the 89 open camps recorded consisted of both large (n=49) and small (n=36) varieties and included 4 sotol pits. The large sites, also termed "extensive camps," often consisted of accumulations of refuse (ashes and burnt rocks) and/or dense scatters of lithic debris "over an

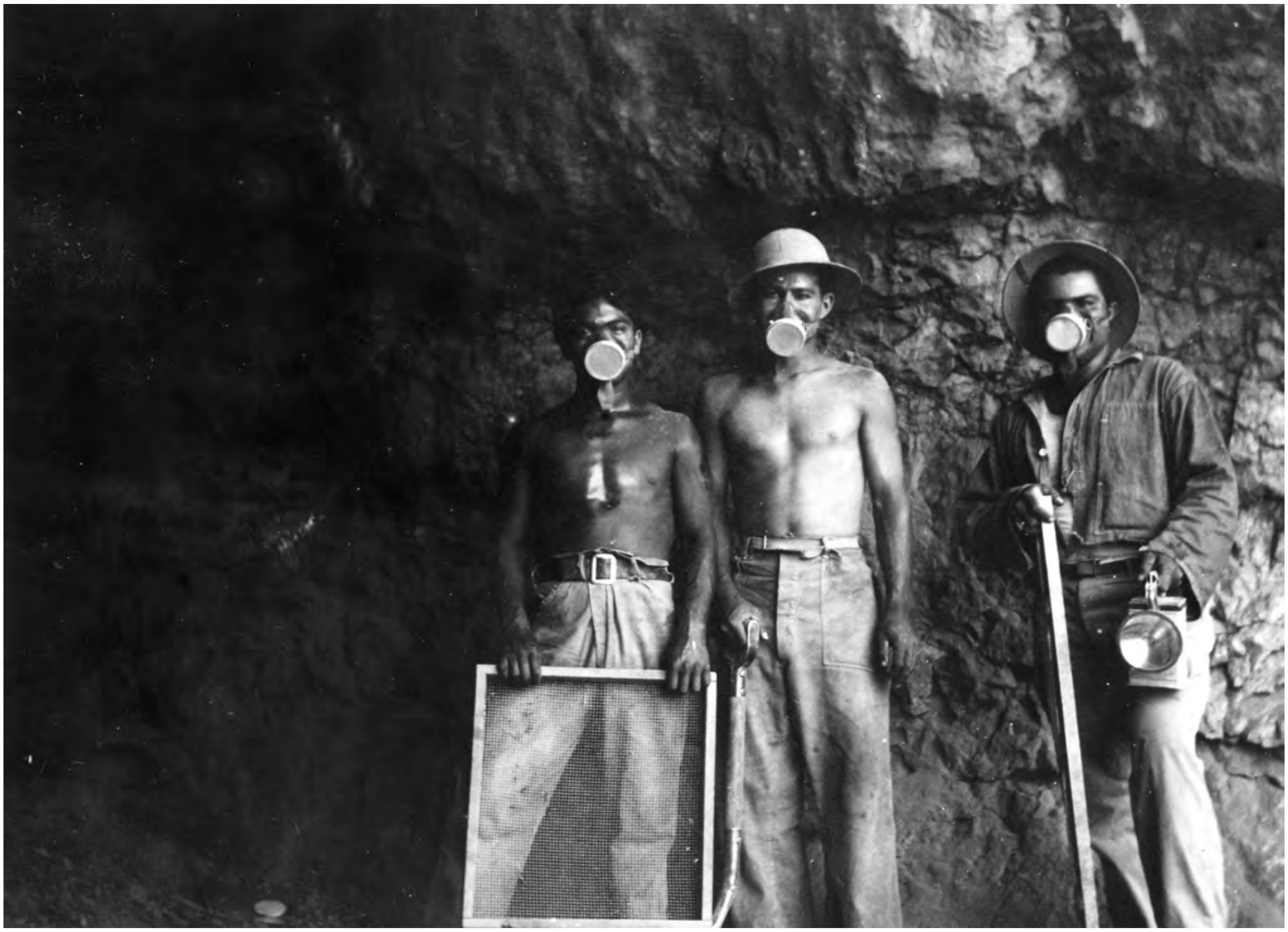

Figure 3.9 Archeology students under the supervision of Erik K. Reed during the excavation of a rockshelter in the Dead Horse Mountains (Chisos 8:2) in July of 1936. Photo by J. Charles Kelley. Courtesy of National Park Service, BBNP.

area a few hundred feet each way" (Reed 1936:21). He also indicated the small camps included a specific site type, offering the term "hunter sites" for those containing a few rock hearths and little else. These he noted were frequent along the Rio Grande and in alluvial flats, but uncommon in the mountain ranges and broken country. Reed briefly discussed sotol pits, their construction and presumed function, and noted the common occurrence of prehistoric and historic sites at the same location. He indicated three pictograph sites were found (at two boulder shelters and a "cliff-shelter") with very simple designs and rendered mostly in red; yet no petroglyph sites were discovered. Notable among the 177 artifacts collected during the survey were 20 projectile points "some comparable to Lipan points, to Pecos River types, [and] to the Mt. Livermore type" (Reed 1936:24), indicating the presence of both dart (Pecos River types) and arrow (Lipan and Mt. Livermore type) points in the collection.

The four tested sites consisted of: 1) Chisos 6:2, an open debris-midden site below a shallow shelter positioned on the lower slopes between Vernon Bailey Peak and Pulliam Peak in the Chisos Basin; 2) Chisos 6:11, a boulder shelter on the south side of Vernon Bailey Peak in the Chisos Basin (southwest of Chisos 6:2); 3) Chisos 8:2, a cave in the western foothills of the Dead Horse Mountains; and 4) Chisos 11:3, a small cave on the lower eastern flank of Mariscal Mountain (Reed 1936).

Reed and his three assistants excavated the small, shallow shelter with a large associated midden at Chisos 6:2 where he indicated that, "Treasure-hunters had dug a pit . . . near the center of the midden" (Reed 1936:29). The south-southeast facing shelter is only about 4.3 m wide, a meter deep, and 2 m high; the midden measured ca. 10.4 x 12.8 m (the long axis paralleling the mouth of the shelter), its center positioned about 7–8 m in front of the shelter. The systematic excavation utilized multiple datums for horizontal and vertical control and concentrated on the midden, shelter, and area immediately outside the shelter. A single "hearth" characterized as a "definite concentration of soft, white ash and fragments of charcoal" covering a ca. 1.6 m^2 area was uncovered in the midden (Reed 1936:30). A total of 89 well-provenienced artifacts were recovered during the investigation and included 2 metates, 18 manos, 17 scrapers, 24 dart points, 5 arrow points, and a shell pendant. Some stratification of the midden was noted: an upper portion of dark, ashy soil about 56 cm thick, and an ashy but lighter-colored soil that varied from ca. 46 to 200 cm in thickness. These data indicate the midden, at its deepest extent, was over 2.5 m thick. Reed (1936:31) indicated the arrow points (described as being similar to the Livermore type) were generally recovered from the upper portion of the midden and dart points from the lower portion, mirroring the stratification observed in the midden soils.

The investigation of Chisos 6:11, essentially a sheltered area beneath "a great boulder," resulted in the recovery of no artifacts, but "considerable vegetal material" (Reed 1936:32). The low sheltered area (generally less than a meter from ceiling to floor) has a ca. 6.5-m-wide, south-facing entrance and extends back to the north ca. 7.5 m. Fill in the shelter was ca. 50 cm thick above sterile soil and consisted of three zones that graded into one another. There were three noteworthy findings: 1) strands of grass on what was thought to be an old floor, 2) a ca. 35-cm-wide and 10-cm-deep cist lined with grass and prickly pear pads that contained several small black, unidentified nuts, and 3) a cache of dry seeds thought to be mesquite. The locations of these were provided on a site map in the report although there was no accompanying vertical information. However, stratigraphic descriptions of the three zones suggest all of these were at least 20 cm below the surface.

Niebuhr (1936) conducted the excavation at Chisos 8:2 (site 41BS1372) and indicated in his report that cultural deposits in the cave varied from ca. 2.5 to 90 cm in thickness. The main chamber of the cave is tunnel-like, ca. 15 m long, ca. 4–5 m wide for most of its length, and ca. 4 m high. At the rear of this chamber, the width constricts to a little over a meter; perpendicular passageways extend in both directions from this area. Excavation was concentrated in the cave entrance and at the rear of the main chamber, including short segments up each passageway. Rodent disturbances were widespread within the deposits and material culture was sparse, but woven materials (such as sandals, matting, and netting), wooden implements, and a few stone artifacts (including a single broken projectile point from the talus) were recovered, most of which came from the back of the main chamber (Niebuhr 1936:26–28). It was in this area that an interesting feature was discovered:

> . . . the most important find was a storage bin or cist lined with fiber matting. The cist was basin shaped, two feet six inches long, two feet wi[d]e and eight and one half inches deep in the center. The matting was of checker (one-under-one-over) and twilled (two-under-two-over) weaves and was in a fairly good state of preservation. Inverted in the center of the cist was a half of a little-used metate. Contained also in the cist was a sprig of unidentified brush and several prickly pear leaves. About one half of the bin was covered over with overlapping cactus leaves (Niebuhr 1936:26–27).

Reed indicated in his report that Chisos 11:3 faced the northeast (although the site map shows it facing north) and overlooked the northern extremity of Sierra San Vicente. Tunnel-like, the cave has a ca. 1.8-m-wide entrance that narrows to ca. 1.3 m for most of its ca. 3.6 m length; the ceiling-to-floor measurement is ca. 1.7 m. Well-preserved perishable items observed on the floor prior to excavation consisted of "a number of reeds, a wooden implement, and fragments of cordage" (Reed 1936:33). The reeds numbered ca. 40, with 12 loosely bound together with untwisted fibers; the wooden implement was ca. 70 cm long, pointed on one end, and was thought to be a digging stick; and the cordage fragments, in numerous small pieces (all less than 10 cm long), were described as two-strand and tied with ordinary square knots to form a netting of some sort. It was noted that there was no cultural deposit or smoke blackening of the cave's interior, and Reed thought these, along with the cave's small size, suggested it was used as a storage cache rather than a habitation.

In 1937 the NPS investigation continued, with student technician Ruel R. Cook placed in charge of the reconnaissance survey. Apparently working alone from June 9 through September 3, he recorded an additional 140 sites: 102 open campsites (including 7 sotol pits), 10 caves, and 28 rockshelters (Cook 1937:1). He also collected 715 artifacts, excavated a cave in the Dog Canyon area (Bone Spring 5:8), and conducted minor testing at an open site near Grapevine Hills (Chisos 2:7). Cook's report consisted of a brief two-page summary of the survey but, importantly, includes an attached inventory and brief description of each site visited.

Cook's inventory contains 176 sites, 36 of which appear to be revisits to sites previously recorded. Among these are the Mule Ear Peak shelters excavated by Setzler (Chisos 9:6 and Chisos 9:7) and a triple-cave site in Panther Canyon said to have been worked in by Martin (Chisos 6:3). A perusal of the inventory indicates that five of the sites visited had been looted (Chisos 1:2, Chisos 5:12, Chisos 6:8, Chisos 6:34, and Terlingua 6:6) and six contained rock art—pictographs at Chisos 5:4, Chisos 6:1, and Chisos 10:5; abrading grooves at Chisos 7:12; and scratched walls at Terlingua 6:6 and Terlingua 6:7. Of the rock art sites, the pictographs at Chisos 10:5 were indicated to be the most elaborate:

> On cliff face are several small badly faded pictographs in yellow, cinnabar red, and black. Designs mostly of alternate lines, small red circles and small square shouldered line body figures of anthropomorphic type (Cook 1937).

At Bone Spring 2:7, Cook excavated a trench across what he described as a "hearth of lava boulders" that measured ca. 1 x 1.7 m. An accompanying sketch of the feature shows an oblong open ring of stones with the long axis oriented in a 20–200º direction. Cook's trench was excavated to a depth of ca. 60 cm and uncovered charcoal, but no artifacts.

Cook's (1937:1) report indicated that appreciable "time was spent in and around Dog Canyon in the Bone Springs Area" and that a partial excavation of Bone Spring 5:8 was conducted on July 24 and 25. This southwest-facing cave is only about 9 m above the base of the mountain and has a small opening only ca. 2 m wide and less than a meter in height. Inside, the cave extends toward the back wall for ca. 4.5 m; about halfway back it opens up laterally in each direction, for a total width of 6.4 m. Maximum ceiling height is ca. 3 m. Cook's findings are presented in plan view and cross-section maps, and in a brief description:

> In excavating the cave very little was found until the center of the deposit was reached. From the center of the cave on back there was what appears to have been a storage cist, which had been disturbed by rodents. Around this food-storage bin were rocks arranged in a definite order. Near the center of the bin two sandals were found, resting on top of a rock. The storage bin and the sandals were about 2 [feet] under the surface. Underneath the grass which formed the cist were found several bones of deer or antelope. No flint or other stone artifacts were found in the excavation (Cook 1937:2).

The floor plan shows the rocks mentioned above—seven stones in a near-continuous ring with a diameter of ca. 90 cm—but they are not illustrated in the cross section, thus it is not clear whether or not these stones were on the surface or buried. Also illustrated on the plan view, as well as on the cross section, was a concentration of ashes found along the back wall. These ashes were separate from the bin and extended from the top to the bottom of the deposit, suggesting they were contained in a pit. The cross section indicates the overall thickness of the cultural deposit in the cave was ca. 60 cm.

Through the work of Reed and Cook, a total of 324 sites were recorded. Of this total, 34 are outside the current boundaries of the park, roughly situated to its west, between Study Butte and Lajitas (Campbell 1970:25). Thus, 290 sites in the current confines of BBNP were recorded during these two reconnaissance surveys and the data collected shed appreciable light on the wide variety of cultural resources in the study area. Despite this jump start to understanding the archeology of the Big Bend, however, early park planners seem to have overlooked the importance of cultural resources. Since the park's beginning in 1944 there has been a much greater emphasis placed on the natural environment and far less on the cultural one (Mallouf, Cloud, and Walter 2006:18). Likely for this reason, some 30 years would go by before the next significant project would address cultural resources in the park.

Robert C. Redfield

In the summer of 1937, Robert C. Redfield, a geology student from the University of Texas with some archeological training, apparently conducted private research within the proposed park. He reconnoitered portions of the study area and left a file document entitled "Sites in the Chisos Mountains, Brewster County, Texas" (Redfield 1937).

His two pages of notes contained primary headings entitled: "Sites in the Chisos Mountains," "Flats Outside of Mountains," and "Lajitas Area." The first had subheadings listed as "Basin," "Boot Canyon," and "South Rim"; the second had "Tornillo Flats" and "McKinney Hills" as subheadings; the final heading lacked any breakdown. His typewritten notes are supplemented by handwritten corrections and additions and provide cursory information on the environmental and cultural phenomena he observed. Although most of his archeological notations are somewhat broad and general, his "Basin" and "Boot Canyon" subheadings contain specific information on sites that would later be recorded as BIBE882 and BIBE467, respectively. The former, said to be a series of small caves at the southern base of Toll Mountain (but outside of the Basin proper), contained ashes, dust, animal bones, knotted fiber, and basketry (this same shelter would later be tested by Kristin Sobolik in 1994). The latter, a boulder shelter site on the saddle between Boot Canyon and Blue Creek Canyon, was said to have an extensive midden deposit as much as three feet in depth. Redfield also matter-of-factly, and erroneously, reported that there were no sites on Mesa de Anguilla, citing the lack of water, pasturage, suitable campsite locations, and its difficult access as reasons for this absence (Redfield 1937). Thus, it seems evident he did not extensively reconnoiter all the areas mentioned in his report.

Peabody Museum-Sul Ross State Teachers College Interdisciplinary Project

Sayles' (1935) scheme for the culture history of Trans-Pecos Texas proved to be relatively short-lived following completion of an important interdisciplinary project in the Big Bend in the late 1930s. Jointly sponsored by the Peabody Museum of Archaeology and Ethnology of Harvard University and Sul Ross State Teachers College in Alpine, the project attempted to correlate archeological finds in the region with the Quaternary deposits in which they resided for a better understanding of their respective ages. The project geologists, Claude C. Albritton and Kirk Bryan, identified three broad depositional formations surrounding the deposits and named them, from oldest to youngest, "Neville," "Calamity," and "Kokernot" (Albritton and Bryan 1939:1426–1427; Kelley et al. 1940:49–51).

Meanwhile, the archeological team, headed by J. Charles Kelley and T.N. Campbell, conducted both reconnaissance and substantive excavations in open sites throughout the Big Bend (mostly north and west of the park). Their work, in combination with the stratigraphic sequence developed by the project geologists, led to a revision of Big Bend culture history (Figure 3.10). The larger cultural constructs offered at this time consisted of the "Big Bend Cave aspect" (Archaic to Late Prehistoric foragers) and the "Bravo Valley aspect" (Late Prehistoric to Historic agriculturalists). The former was subdivided into two foci, the "Pecos River" (Middle to Late Archaic foragers) and "Chisos" (Late Archaic foragers). The latter was divided into five foci that applied only to the La Junta Archeological District (an area separate and upstream from the park)—"La Junta" (Late Prehistoric agriculturalists), "Concepcion" (Late Prehistoric to Historic agriculturalists), "Conchos" (Historic agriculturalists), "Alamito" (Mexican period occupants), and "Presidio" (Anglo-American and Mexican-American occupants). Another focus, this one not affiliated with an aspect, was proposed—"Livermore"—to account for certain other Late Prehistoric sites generally found outside the La Junta district (Kelley et al. 1940:23–38). All of the foci presented in this construct remain in use today, although the term "focus" has been replaced by "phase," and there are continual efforts to revise these constructs.

The Late 1940s–Early 1980s

Beginning with American involvement in World War II, there was a long hiatus of archeological fieldwork in the greater Big Bend. Although several archeological investigations under the direction of J. Charles Kelley occurred in the western portion of the region in the late 1940s, these only provided data concerning the La Junta district and areas upstream along the Rio Grande. The first of these, conducted in 1948, was a reconnaissance on the Texas side of the river between Redford and Fabens (Kelley 1949, n.d.; Figure 3.11). It included excavations of two house structures at the Polvo site outside of Redford, and provided the impetus for a subsequent investigation at the site the following year—a University of Texas archeological field school that included excavations of another house structure along with four circular pit structures and five burials (Shackelford 1951; Figure 3.12). Although Kelley continued to publish on La Junta archeology (1952a, 1952b, 1953), little of that research was directly related to nomadic cultures of the Big Bend. However, in response to skepticism expressed by Suhm, Krieger, and Jelks (1954) about the Livermore phase construct,

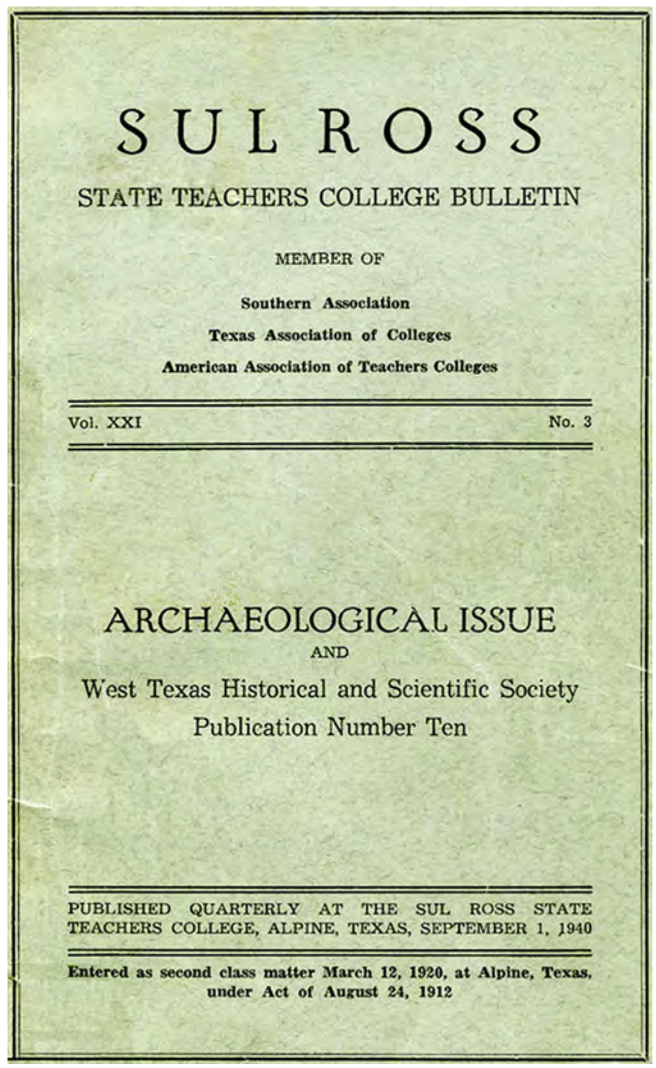
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Figure 3.10 Cover of the seminal 1940 study of the association between geological and archeological deposits in the Big Bend region of Texas.

Figure 3.11 J. Charles Kelley and his fieldwork rig during the 1948 Rio Grande reconnaissance. Courtesy of Sul Ross State University.

Figure 3.12 The 1949 University of Texas field school at Polvo. Courtesy of Sul Ross State University.

Kelley (1957) published an article that clarified his thoughts and further explained his findings related to the phase.

The next period of research in the Big Bend was ushered in by Donald J. Lehmer (1958) through a published synthesis of Trans-Pecos archeology. Almost 10 years later, T.N. Campbell (1970) of The University of Texas at Austin directed another major archeological survey in BBNP, after the park had been open to the public for over 20 years. Additional contributions within, adjacent to, or concerning archeological resources in the park during this period consisted of an overview and assessment project (Bousman and Rohrt 1974), reconnaissance efforts along the Rio Grande (Tunnell and Mallouf 1975, n.d.; Mallouf and Tunnell 1977), Texas Natural Area Surveys (Baskin 1976a, 1976b; Hudson 1976a, 1976b; Mallouf and Baskin n.d.; Marmaduke and Whitsett 1975; Mallouf and Tunnell 1977; Greer, Richmond, and Loscheider 1980; Cherry and Torrence 1973a, 1973b), a highway realignment project (Baskin 1978; Panowski 1981), a reconnaissance along Bear Creek north of the park (Marmaduke 1978a), another synthesis of regional archeology (Marmaduke 1978b), and a reconnaissance and testing project in the northern Rosillos Mountains (Mallouf and Wulfkuhle 1989).

Synthesis of Trans-Pecos Texas Archaeology—Donald J. Lehmer

Although little archeological fieldwork had occurred in the region since the late 1930s interdisciplinary project (i.e., Kelley et al. 1940), Donald J. Lehmer—a member of that groundbreaking research team—published a synthesis of Trans-Pecos archeology in 1958 (Figure 3.13). Lehmer subdivided the region into four districts based on archeological findings: southeastern, El Paso, La Junta, and northeastern (tentative). The southeastern district was the largest, encompassing much of the Big Bend and extending eastward to the Pecos River. The El Paso and La Junta districts were the smallest and centered on areas where Late Prehistoric and Historic groups practiced agriculture. The northeastern district was listed as tentative at the time, mainly due to a dearth of data. Lehmer's synthesis provided abundant background information concerning previous work, site types, and Historic Indian groups in the region, and he also discussed current interpretations, appropriate excavation techniques, and unresolved questions.

Drawing from his extensive experience in the Trans-Pecos, especially in the La Junta district, Lehmer detailed previous work, highlighting the efforts of Victor J. Smith, E.B. Sayles of the Gila Pueblo, and J. Charles Kelley. He also pointed out contributions made by Suhm et al. (1954) in "An Introductory Handbook of Texas Archeology," which presented detailed trait lists for the archeological complexes of the Trans-Pecos as defined by Kelley and others. However, Lehmer took issue with the authors for limiting their discussion to western and southeastern sub-areas, arguing for the La Junta district as a distinct and viable construct in the region.

Lehmer divided archeological sites in the region into five broad categories: villages, rockshelters, open camps,

Figure 3.13 Donald J. Lehmer later in life as chair of the Department of Anthropology and Sociology at Dana College, Blair, Nebraska. Courtesy of the Society for American Archaeology.

buried sites, and a miscellaneous group (consisting of caches, pictographs and petroglyphs, cairns, and isolated burials). Noting that certain classes of sites were restricted geographically and others were characteristic of particular periods in prehistory, he provided descriptions and listed the kinds of material culture found at each site type. Lehmer indicated that both geological interpretations and cultural constructs proposed during the 1930s interdisciplinary project were still in use and provided "a good outline for the procession of native cultures which followed one another through time" (Lehmer 1958:122). He pointed out, however, that there was a need for additional data to fully assess most of the constructs.

T.N. Campbell's BBNP Survey Project

The next major archeological endeavor in the region occurred during the summers of 1966 and 1967 when the NPS sponsored a broad-based survey of BBNP. Attempting to relocate and assess the sites recorded in 1936–1937, and to record new sites and collect samples of associated artifacts, this reconnaissance survey added 351 prehistoric sites to the park inventory (Campbell 1970). Under the direction of T.N. Campbell of The University of Texas at Austin, and with the help of two student assistants each year, this investigation greatly increased the number of recorded sites in the park and helped lay the groundwork for subsequent work in the region (Figure 3.14).

As in the earlier NPS surveys, the areas investigated were largely determined by accessibility. Both the summer's heat and monsoonal rains presented problems, exacerbated by the park's limited road system. Campbell (1970:26) indicated the ". . . earlier survey parties had the advantage of numerous ranch roads that have since been abandoned and are now impassable, largely because the stream crossings have developed vertical banks." The rugged terrain, site densities, and available maps also caused issues; heavy site density in some areas and the lack of large-scale maps (i.e., 7.5' maps with a 1:24,000 scale) made precise site plotting difficult or impossible. Although Campbell (1970:32–33) used aerial photographs to increase the accuracy of his site plottings, relocating many of these sites remains a problem to this day.

Unlike Reed and Cook, who had concentrated their work on sheltered sites, Campbell spent considerable time recording open sites in the vast lowlands that dominate the park environs. This focus on open sites brought the surveyors to locales where numerous artifacts could be found and collected, which helped to replace the artifacts destroyed in the 1941 park fire (Campbell 1970:27). Disturbances were noted at sites visited, and Campbell (1970:28) observed:

> It is judged that there is much less indiscriminate digging in these sites today than during

Figure 3.14 T.N. Campbell, professor of Anthropology at the University of Texas, who led the groundbreaking 1966–67 reconnaissance archeological survey of BBNP. Photo by M. Collins. Courtesy of www.texasbeyondhistory.net, Texas Archeological Research Laboratory, University of Texas at Austin.

> the pre-park ranching period. However, it is believed that surface artifact collecting is more common today than formerly, simply because more people visit the area.

In an early attempt to stratify the park landscape, Campbell (1970:29–31) provided a list of topographic features he believed were factors in site selection. He argued that proximity to water was especially important to settlement patterns, noting high site concentrations adjacent to and near springs and along terraces and terrace remnants of major arroyos. While little survey was done along the Rio Grande, the brief forays conducted there led Campbell to suspect that numerous campsites lay buried in terraces along its course. Other noteworthy topographic features with concentrated sites included isolated and prominent landforms (peaks and hills) as well as the base of massive talus slopes where large boulders had come to rest.

Following completion of the survey, Campbell (1970:35) reported 628 known sites in the park, including 480 open campsites, 130 sheltered sites, and 6 stone quarries. While much of the report deals with open sites, Campbell (1970:36) indicated the sheltered sites consisted of "small walk-in caves, rock shelters formed by overhanging cliff walls, and small shelters formed by large tilted or undercut boulders," and that at least 100 of these were "shelters in cliff faces." He noted that many of these appeared to have been dry for an appreciable time and undoubtedly contained perishable materials, as was found during the shelter excavations.

In regard to toolstone quarries, Campbell (1970:37–40) indicated there was evidence for quarrying or procurement of two types of stone in the park: "basalt" and "flint." It was indicated that the former, now known as hornfels, occurred widespread as lag deposits along Tornillo Creek and its tributaries. A rather lengthy discussion is provided for a large and important "flint" outcrop documented during the survey on the western side of Burro Mesa known as the Burro Mesa Quarry (Chisos 5:75/BIBE693). Comprised of a range of colors, including white, tan, brown, yellow, red, gray, and blue, the toolstone (now referred to as "silicified tuff" by some researchers) was quarried from masses that extend above the surface as well as from ledges and small shelters along adjacent Apache Canyon. Campbell (1970:321) pointed out that lithic debris densely litters an area estimated at 40–50 ac at the site, and scattered test excavations indicated flakes occurred at a depth up to ca. 30 cm. He suggested the quarry was one of the most important archeological resources in the park, but noted that Burro Mesa artifacts were typically not found at sites distant from the source, an indication that locally available stone was used when present (Campbell 1970:39–40).

It was noted that stone-paved hearths occurred in a variety of sizes and constructions and were the most prevalent features documented during the project (Campbell 1970:41). Other cultural features discussed in the report were hearthstone middens, midden circles, stone enclosures, stone walls, stone cairns, pictographs and petroglyphs, small clearings in rocky areas, and bedrock mortars and metates. Most significant among these were the discussions of hearthstone middens, midden circles, and stone enclosures.

Campbell (1970:47) offered that hearthstone middens, recorded at 44 sites in the park, were "evidence of repeated and prolonged occupation," containing "great quantities of thermally fractured rocks . . . enclosed in a matrix of black soil (high carbon content), along with other cultural debris, such as chipped flint and other stone artifacts." He interpreted these features as residue from numerous stone-lined hearths, indicated they were "more or less mounded accumulations of varying sizes," and compared them with similar middens (known as burned rock middens) extending westward from Central Texas (Campbell 1970:48). On the other hand, he described "midden circles" as specialized versions of hearthstone middens. Campbell (1970:49) noted the primary difference between the two was that the latter "has a depression instead of a mounded summit near the center." He indicated that while these features are not common, they were documented at 23 sites in the park in a variety of environmental settings from the low, open country to the upper reaches of the Chisos Mountains. While various descriptive names have been used for these distinctive features through the years (Greer 1965), archeologists working in the region today usually refer to them as "ring middens."

Importantly, Campbell (1970:52) was the first researcher in the park to formally recognize certain stone features as structural foundations, referring to them as "stone enclosures." These circular-to- rectanguloid arrangements of several courses of stacked stone were recorded at 22 sites. Campbell indicated the mortarless walls of these structures were substantial, up to a meter thick, and although stones had often fallen from the walls, some still stood about a meter high. He further indicated that the walls of some enclosures were punctuated by a gap suggestive of an entryway. Campbell (1970:53) suggested "these structures enclosed the lower walls of a temporary shelter of some kind, possibly a brush-covered hut or even a tent," and "speculated that the stones were stacked around the . . . houses for greater stability, possibly to aid in protection against wind and water."

Campbell trenched one enclosure at a site on Lone Mountain, near the park headquarters, that contained two such features (Chisos 2:47/BIBE596), but recovered no cultural material in the shallow fill. Since only Late Archaic projectile points were recovered from the surface of the site, Campbell (1970:54) offered that "some stone enclosures may have been built prior to Neo-American [Late Prehistoric] and Historic occupations." Since Campbell's survey, appreciable research has been conducted on these distinctive stacked-stone structural remnants (Mallouf 1992, 1999, 2013c), which are now referred to as domiciles of the Cielo complex, a Late Prehistoric to Protohistoric culture of the Big Bend that roughly spanned the period from ca. A.D. 1250–1680.

An impressive total of 3,986 specimens were collected from the surface during the two field seasons. Thus, the goal of replacing artifact collections lost in the 1941 park fire was soundly accomplished. The collection included 734 projectile points and Campbell (1970:66–86) placed these in three general categories: Paleoindian dart points (n=7), Archaic dart points (n=483), and arrow points (n=244). The Paleoindian specimens, recovered from four separate sites, consisted of one Clovis point (made from Burro Mesa "flint"), four Plainview Golondrina points—a variant form of Plainview originally defined by Johnson (1964:46–52), now simply referred to as Golondrina—and two possible Angostura points. Campbell (1970:71) offered that the scant evidence of Paleoindians in the Big Bend may have been related to environmental factors, pointing out that wood rat midden data from the park suggests there was a dense forest across the area during Paleoindian times. He postulated that such cover may have precluded the presence of mammoth and bison in the region in sufficient numbers to attract Paleoindian hunters.

Archaic dart points were recovered from 152 sites and classified using established types from across the state. Campbell relied heavily on form and appearance in making these classifications and most archeologists today, armed with a plethora of archeological and geographical data that he did not have, would take issue with some of his typological placements. Despite this, Campbell's collection and analysis of the projectile points shed appreciable light on the forms and types most common in the park. For the Early Archaic period, the Travis (n=62), Zorra (n=13), Bulverde (n=10), and Pandale (n=9) types were the most numerous; for the Middle Archaic period, the Langtry variant (now subsumed under the Almagre, Jora, and Arenosa types; n=112), and Langtry (n=50) types were most numerous; and, for the Late Archaic period, the Paisano (n=45), Shumla (n=25), Frio (n=23), and Ensor (n=16) types occurred in the highest numbers. While some of these quantities would undoubtedly change if the collection were to be re-analyzed today, most of these types are well represented in the present project collection. Campbell indicated that "the high frequency of Archaic materials, as well as the presence of dart point types indicative of early, middle, and late Archaic phases, reflects continuous occupation over a period of at least 6,000 years by desert-adapted populations" (Campbell 1970:528). He noted the similarity in Archaic dart point types and forms in the collection to specimens known from excavations to the east (Central Texas), southeast (Lower Pecos region), and south (Coahuila, Mexico) (Campbell 1970:71), yet later in the report inexplicably suggested the park's "Archaic populations . . . may have been migrants from dry lands to the south or west" (Campbell 1970:529). Regardless, Campbell (1970:529) suggested the terms "Chisos Archaic" or "Big Bend Archaic" for the long-lasting, slow-changing, and localized cultural development during the Archaic period in the region.

The 244 arrow points in the Campbell collection were recovered from 80 different sites. The Perdiz (n=87) type was best represented, and the Fresno (n=43), Scallorn (n=36), Toyah (n=20), and Cliffton (n=17) types also occurred in relatively high frequencies. These types are also well represented in the collections from the present project. Campbell (1970:531) indicated that the arrow points collected from the park were indistinguishable from points found in adjacent areas. Although far fewer arrow points were recovered than dart points, Campbell (1970:528) thought this was mostly due to a shorter overall period of time for the use of arrow points (ca. 1,500 years compared to over 6,000 years for the Archaic period), hypothesizing that the population density was similar during the Archaic and Late Prehistoric stages. Noting the lack of pottery in the collection, Campbell (1970:531) tentatively suggested there had been little overall change to the Archaic hunting-gathering economy during this period.

The Campbell collection includes 1,499 knives and heavy bifaces; 1,451 other chipped stone tools, including over 1,000 scrapers; 252 ground and/or pecked artifacts; 36 ornaments or ornament blanks; and 12 faunal specimens, including 2 marine shells. Notable in the knife category was the recovery of two distinct specimens thought to have been intrusive to the region: 1) "a Jowell type knife from the Allen culture, an early historic phase of the Caddoan area in northeastern Texas," and 2) "a fragment of the four-edge, diamond-shaped alternatively beveled form, sometimes referred to as the Harahey knife . . . widely known in the Great Plains during the late prehistoric period (after A.D. 1100)" (Campbell 1970:92). In regard to the ornaments and ornament blanks, Campbell (1970:113) noted the use of a "tabular white stone" for beads, pendants, and ornament blanks, indicating water-worn fragments of it were found "widely but thinly distributed in gravel deposits around the Chisos Mountains." In the late 1980s, specimens of this white stone in the Campbell collection were identified as kaolinite, a metamorphosed clay. In 1987, a search for a kaolinite outcrop by the park archeologist resulted in the discovery of a tabular seam of kaolinite adjacent to the Burro Mesa quarry (T. Alex 1990).

Campbell (1970:113) felt both the 1930s and 1960s surveys had only superficially sampled the park environs and that the 628 sites recorded in BBNP at that time represented a mere fraction of the total number of sites, estimating there could be as many as 5,000 archeological sites in the park. He indicated the next phase of archeological work in the park "should be a long series of excavations" to recover normative data needed "toward identification and description of the various cultural units represented in the area and arrangement of these units in chronological sequence" (Campbell 1970:532). Campbell believed the archeological remains in the Big Bend to have significant research potential and to be ripe for interdisciplinary studies. He closed his report stating, "The opportunities for man-related research in the Big Bend National Park are almost limitless, and one cannot foresee an early exhaustion of the possibilities" (Campbell 1970:534).

Southern Methodist University Archeological Assessment

The next archeological effort in the park took place in 1973 when the Archaeology Research Program of Southern Methodist University (SMU) conducted a brief archeological assessment of BBNP that was part of assessments conducted at five national parks and monuments. Funded by the NPS, the BBNP assessment was designed to synthesize literature concerning the prehistory of the park, identify weaknesses, and propose means of alleviating those weaknesses (Bousman and Rohrt 1974:1). Although one week was spent in the field re-recording previously recorded sites, no new sites were added to the park inventory as a result of the project.

The SMU report indicated BBNP had a total of 420 campsites, 128 shelters, 5 caves, 27 quarries, 11 rock art sites, 18 historic sites, 34 sites that lacked records or contained records not used, and 19 sites listed in a nebulous "other" category (Bousman and Rohrt 1974:28–46). However, because a number of sites were classified under more than one site type (such as Chisos 5:5, which was listed as a campsite, a shelter, and a historic site), the categories cannot be summed to arrive at the total number of sites. Bousman and Rohrt (1974:47–48) recommended: 1) a survey of all microenvironmental zones and niches in the park to focus on critical factors such as water supplies, edible plants and animals, and other resources; 2) a comprehensive literature search to compile all available data, including records like field notes and information on collected artifacts; 3) an environmentally stratified archeological survey of 180,000 ac, or 25% of the park; and 4) a testing and excavation program to follow the survey. Included in the report were proposed budgets for the literature search ($27,557.00) and larger survey ($146,199.00) (notably, a fraction of today's project costs). However, no further work resulted from these recommendations.

Wild and Scenic River Reconnaissance—Curtis Tunnell and Robert J. Mallouf

From 1973 to 1980, a number of archeological reconnaissances were conducted by canoe along the Rio Grande by personnel from the Office of the State Archeologist (OSA), Texas Historical Commission (THC) (Tunnell and Mallouf 1975, n.d.; Mallouf and Tunnell 1977; Figure 3.15). Initially known as the Wild River Reconnaissance, these investigations were conducted both within and outside the limits of BBNP. They allowed some of the first archeological evaluations of sites within the canyons of the Rio Grande, although sites between these canyons and within BBNP were also scrutinized. A total of five separate trips were completed, all of which included reconnaissance on the Mexico side of the river. Two of the trips occurred in the Lower Canyons of the Rio Grande (now within BBNP's jurisdiction and referred to as the Rio Grande Wild and Scenic River) and over 80 sites were recorded during these trips, including at least 37 on the Mexico side of the river (Mallouf and Tunnell 1977:41).

One of the OSA canoe trips passed through Colorado Canyon upstream of BBNP, and during this trip a site on the Mexico side of the river (the Fiero site) was discovered with an exposed hearth. Charcoal recovered from the hearth yielded a corrected radiocarbon date of A.D. 560±335 or 1390±335 B.P. (TX-No. 4638; Mallouf 1985:33, 1999:61). Importantly, a Paisano dart point was found in good association with the hearth, making this the only firm chronometric data for this point type west of the Lower Pecos River region. While the date has a broad range, it generally mirrors dates secured for Paisano points in the Lower Pecos.

It is noteworthy that during the first Lower Canyons trip in 1973, members of the expedition conducted what was probably the first modern experimentation with "hot rock/thermal oven" processing of sotol and lechuguilla ever attempted in Texas. A description of this experiment along with a cross section of the oven is provided in the final report on this project (Mallouf and Tunnell 1977:59–62). Although the expedition's itinerary precluded an adequate amount of time for the plant bulbs to be thoroughly cooked, all group members felt the experiment was a success.

Natural Area Surveys

In the mid-1970s, the Lyndon B. Johnson School of Public Affairs of The University of Texas at Austin

Figure 3.15 Crew of the first Wild and Scenic River Reconnaissance of the lower canyons in 1973 at the takeout at Dryden Crossing. Courtesy R. Mallouf.

sponsored interdisciplinary natural area surveys in various locations across the state. The OSA conducted the archeological assessments of most of the studies in the Big Bend region, including the Bofecillos Mountains (Baskin 1976a; Figure 3.16), Colorado Canyon (Baskin 1976b), the Solitario (Hudson 1976a), Fresno Canyon (Hudson 1976b), Bullis Gap (Mallouf and Baskin n.d.), Mount Livermore and Sawtooth Mountain (Marmaduke and Whitsett 1975), and the aforementioned Lower Canyons of the Rio Grande (Mallouf and Tunnell 1977). Other nearby natural area surveys to the west and northwest were carried out in the Chinati Mountains (Greer et al. 1980), at Capote Falls (Cherry and Torrence 1973a), and in Victorio Canyon (Cherry and Torrence 1973b). These reconnaissance-level studies were focused on some of the more striking environmental niches in the region and provided abundant data on site density, distribution, type, and condition in areas of the eastern Trans-Pecos that had been archeologically unknown.

Persimmon Gap Highway Realignment Project—Barbara J. Baskin and Bruce Panowski

In the late 1970s, a highway realignment project just within the park entrance at Persimmon Gap resulted in test excavations at two prehistoric open campsites, BIBE1048 (Baskin 1978) and BIBE526 (Panowski 1981). Sponsored by the NPS, these investigations provided a host of data on the stratigraphic setting and cultural manifestations, including subsurface chronometric data.

In November 1977, Barbara J. Baskin (1978) tested site BIBE1048. Numerous hearths, a partially intact

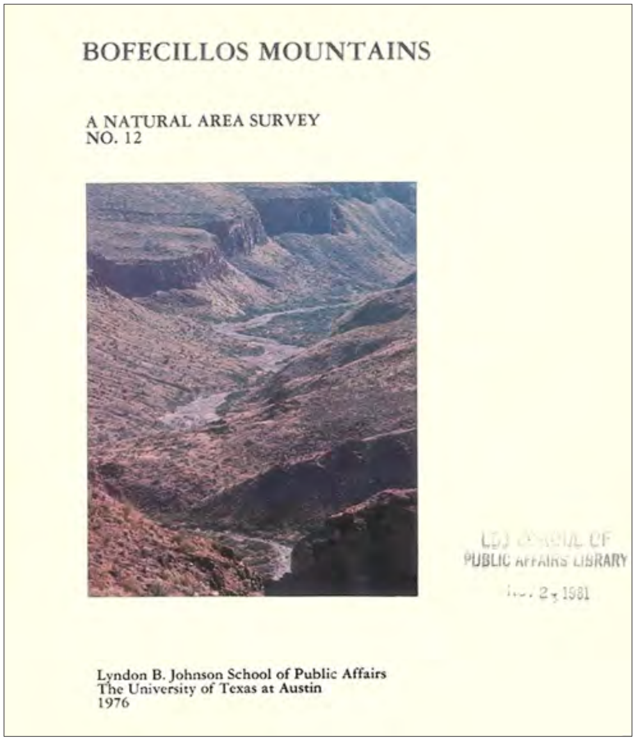


Figure 3.16 1976 report on the natural area survey of the Bofecillos Mountains in what is now Big Bend Ranch State Park.

"midden circle," and a large diffuse midden were exposed on the surface of the site within an eroded, alluvial fan setting. Due to its location along the roadway, the focus of the investigation was on the large midden deposit to determine its extent and research potential. Six short backhoe trenches and three excavation units (two 1 x 2 m units, and a single 1 x 1 m unit) excavated in 20-cm levels were employed. The testing uncovered three buried thermal features and revealed at least four distinct occupations that were stratified in the midden area, separated by sterile detritus deposits of the alluvial fan. Charcoal from one of the thermal features yielded a radiometric date of A.D. 1490±70 or 460±70 B.P. (TX-No. 2869), while a sample from the lower midden deposit with less integrity provided a date of A.D. 290±50 or 1660±50 B.P. (TX-No, 2870; Baskin 1978:34). Three Ensor dart points were recovered from the surface of the site and two contracting stem arrow points were found buried within the upper portion of the midden. Based on the available data, Baskin theorized the stratified occupational zones date "either within a temporal span from Late Archaic through Late Prehistoric, or within a pure Late Prehistoric range" (Baskin 1978:34). Baskin recommended the site be nominated to the National Register of Historic Places (NRHP) and be avoided during the highway realignment project; if avoidance was not possible, she recommended the site be further excavated.

Baskin's avoidance recommendation was heeded, but the resulting realignment of the highway placed another prehistoric site within the area of impact, site 41BS41. Bruce Panowski (1981) and William Creutz, NPS archeologists, tested this site in March 1978. Only about 65 m from site BIBE1048, site BIBE526 contained five exposed midden circles, at least three surficial hearths, and a small rockshelter. One of the middens, and the only one to be affected by the revised project plans, was investigated with a long backhoe trench and ten 1 x 1 m excavation units. In addition, surface collection grids were established in several areas of the site. The excavation units revealed the midden circle had a maximum depth of ca. 1 m, but failed to delineate any stratified occupation levels. Projectiles recovered during the project consisted of an Ensor dart point from the surface and a Langtry dart point buried in a lower portion of the midden circle. Lacking any radiocarbon data, Panowski (1981:30–31) suggested the midden dated from Middle to Late Archaic times and that the testing phase had sufficiently mitigated any damage from the proposed highway realignment. Based on his findings, he recommended the site be determined eligible for inclusion in the NRHP.

Bear Creek Reconnaissance and Testing Project—William S. Marmaduke

Several other archeological projects were conducted by the OSA during the late 1970s and early 1980s in the vicinity of the park, beginning with an intensive reconnaissance and testing project along Bear Creek (Pope Ranch) in 1975 (Marmaduke 1978a). William S. Marmaduke's 1975 investigation of the broken landscape ca. 20 km east-northeast of BBNP's Persimmon

Gap was spawned from a visit to the area 10 years earlier by then-state archeologist Curtis Tunnell. After observing a dense concentration of rockshelters and open midden sites during his brief foray in 1965, as well as numerous looters' holes in the shelters, Tunnell recommended further work in the area. A decade later this effort, what became known as the Bear Creek Project, was funded by the OSA and conducted by Marmaduke (1978a). The project area contained a broad swath of terrain along the middle stretches of Bear Creek and headwaters of Cave Creek—both tributaries to the primary drainage in the area, Maravillas Creek—and was roughly divided into ridge and valley environmental zones.

Marmaduke spent 20 days in the field during the reconnaissance, documenting a total of 110 sites (including the 10 sites Tunnell observed). Thirty of this total contained one or more shelters of some type, including several described as caves and a single sinkhole with a canted floor. Marmaduke indicated the shelters were characterized by their small size, large talus deposits, and south-facing orientations, although exceptions to all of these can be found in the dataset. Furthermore, he noted the presence of petroglyphs (random linear grooves or cut marks) on horizontal surfaces of fallen roof-blocks in many of the shelters, often in association with polished areas on the stone surfaces (Marmaduke 1978a:38–39). Another notable finding was the occurrence of numerous middens—both ring middens and what he called "ordinary middens." He indicated all of the latter were found either amongst a cluster of sites, or in association with individual hearths and/or ring middens. Two types of hearths were distinguished: a simple variant consisting of a tight cluster of burned rock, and a larger, more complex, circular pavement style. Marmaduke also indicated the predominantly limestone landscape contained abundant quantities of a medium- to low-grade chert in the form of fossil molds, with dull pink, blue, and brown colors dominating. The data indicated these sources of knappable stone were widely procured, rather than being recovered from a single or handful of quarries (Marmaduke 1978a:46–93).

Following the reconnaissance, 30 days were spent testing 7 of the larger sites to gain insights into their cultural content and structure and to evaluate them for further work. At each site two or three 1 x 1 m units were excavated in arbitrary 10-cm levels. Both interior and talus deposits were sampled at each rockshelter/cave tested, while middens were investigated with units placed in both dense areas of FCR and areas along their peripheries. Significant amongst the findings were that several of the shelters, especially the smaller ones with limited space, had been frequently "cleaned out" by subsequent occupants, and discovery of a single Ensor dart point near the base of one ring midden suggested a Late Archaic date for its initial formation (Marmaduke 1978a:94–116).

In discussing findings from the project, Marmaduke indicated the area had been progressively utilized to a greater extent through time, and proposed a chronology with ebbs and flows of use at specific periods based on the numbers of diagnostic projectile points recovered. Highest use was proposed for both the Middle Archaic and terminal Late Archaic periods, with the early and middle portions of the Late Archaic and Late Prehistoric periods also showing relatively high use. These data suggested the Paleoindian and Early Archaic periods were times of low use. Noting a dichotomy between the distribution of cultural debris in ridge and valley settings, Marmaduke proposed that ridge locations—where dense stands of cacti and *Agave lechuguilla* now occur—were primarily used for plant food gathering whereas valley settings were utilized more for hunting activities. He also suggested an increasing focus on xeric vegetation throughout prehistory, specifically *Agave* (Marmaduke 1978a:164–175).

William S. Marmaduke's Dissertation

At the same time that Marmaduke was finalizing the Bear Creek report, he was finishing his Ph.D. dissertation at The University of Texas at Austin, a study focused on prehistoric cultures of the Trans-Pecos from an ecological perspective (Marmaduke 1978b).

Following in the footsteps of J. Charles Kelley and Donald J. Lehmer, his dissertation essentially provided a synthesis of archeological data previously collected from the region. He chose specific data sets/projects within the region—where the data had been collected in a like manner and was cohesive (e.g., T.N. Campbell's work in BBNP in the 1960s)—and thoroughly examined all data recovered, including artifacts. Through his Bear Creek and dissertation work, in tandem with the presence of more modern analytical methods (e.g., radiocarbon dating), he was able to successfully add to the Kelley et al. (1940) and Lehmer (1958) cultural syntheses for the region, while making good use of comparative data in adjacent regions (especially the Lower Pecos and Central Texas). Importantly, he proposed hunting and gathering economies in the region had changed very little through prehistory, although there had been minor adjustments or adaptations apparent in the archeological record at times due to environmental and/or social pressures. For example, intensified use of previously underutilized food sources, such as *Agave lechuguilla*, occurred in prehistory during several times of stress as hunting-gathering lifeways were maintained, rather than being abandoned or severely altered (Marmaduke 1978b:268–277).

Rosillos Mountains Project—Robert J. Mallouf

In the late 1970s and early 1980s, under the direction of Robert J. Mallouf, the OSA also conducted a reconnaissance and testing project on the North Rosillos Mountains Ranch—an area that is now within the boundaries of BBNP. Reconnaissance was conducted during two field sessions in 1979, and single sessions in 1980 and 1982, all focused on the northern portion of the range and adjacent areas. A total of 62 sites were recorded in 3 environmental zones: 23 sites in the basin; 37 sites in the foothills; and 2 sites in the mountains (Mallouf and Wulfkuhle 1989:8–18). During latter stages of the project two spring-side sites, adjacent to Alamo and Equipaje springs, were tested.

Focusing on the reconnaissance findings, Mallouf and Virginia Wulfkuhle made a number of observations about the archeology in the project area. Although the basin on the west side of the mountains (Corazones Flats) contained no sites, the basin on the east side contained a variety of sites: prehistoric open campsites, lithic scatters, quarries, and two historic ranching sites (i.e., the Bone Spring site BIBE415 and Stone Tank site BIBE1103). The quarries were found on elevated settings where pavement-like exposures of knappable stone occur. Few buried sites were discovered in this zone (n=9), and these were thought to be relatively shallow (ca. 20–100 cm) in vertical extent. Prehistoric activities in the basin were also focused on landforms that rose above the mostly featureless ground surface. One adjacent to Nine Point Draw, the Lone Dune Site (BIBE418), had abundant campsite debris on a well-elevated linear sand dune. Campsites tended to be rather large, especially those along major drainages, where "hearthfields" often extended several hundred meters. In addition to hearths, various burned rock features were discovered in the basin, including incipient ring middens. Finding a dearth of temporally diagnostic projectile points, the researchers posited that long-term relic collecting in the basin had compromised the overall integrity of sites (Mallouf and Wulfkuhle 1989:8–10).

The foothills, rising abruptly from the basin zone, were found to contain both the richest diversity of resources and the best locations for human habitation in the project area. Level surfaces suitable for campsites, although limited in size and extent, were found throughout this zone, and most active springs in the project area were also found here. Of the 37 sites recorded in this zone—consisting of prehistoric open campsites, rockshelters, and lithic scatters in addition to 2 prehistoric scatters mixed with historic ranching components (Buttrill Ranch BIBE411 and San Juan Spring BIBE419)—all but 3 were in association with active or extinct springs or spring-fed arroyos. Bedrock mortars and deep midden deposits frequently found at these sites indicate there was repeated and intensive use of this zone. A full range of prehistoric feature types were found in the foothills, including single- and multiple-tier stone wickiup enclosures. Both sites tested (Alamo Spring BIB403 and Equipaje Spring BIBE404) were open campsites containing such stone enclosures, hallmark cultural features of the foothills that are now attributable to the "Cielo complex"—a cultural construct for nomadic to semi-nomadic bands in the southern Trans-Pecos and northeastern Mexico from ca. A.D. 1250 to 1680 (see below; Figure 3.17). Testing revealed cultural deposits at these sites were up to 1.5 m in depth. In addition, three relatively small rockshelters were found in the Chalk Hills, elevated limestone country immediately north of the Rosillos Mountains. Notably, two of these shelters had been completely destroyed by vandalism, while the third (Lion Shelter BIBE402) exhibited a thin, yet intact, cultural deposit with perishables (Mallouf and Wulfkuhle 1989:10–16).

The mountain zone, including all of the peaks, saddles, and high canyon systems of the Rosillos, was only cursorily inspected during the project. Two open campsites were documented, one in the highest location in the zone (Rosillo Peak BIBE917—see below) and the other on a nearby saddle (the Saddle BIBE428). A number of dart points were recovered from these sites, representing Early Archaic (diminutive Pandale points), Late Archaic (Palmillas and Shumla-like points), and terminal Archaic (Ensor/Figueroa and Figueroa points) components. At Rosillo Peak, scattered burned rock, hearths, and midden-like deposits were also reported (Mallouf and Wulfkuhle 1989:16–18).

Based on recovered projectile points, Mallouf and Wulfkuhle (1989:18–22) indicated there was intensive use of the project area during latter stages of prehistory,

Figure 3.17 Excavation of a Cielo complex wikiup in 1982 as part of the Rosillos Mountains Project undertaken by the Office of the State Archeologist. Photo by R. Mallouf.

specifically during the Late Archaic and Late Prehistoric periods. Components from both the Early and Middle Archaic periods were also present, but to a much lesser degree. Sites in the basin tended to be rather large, positioned along drainage courses or on elevated landforms, and contained diverse thermal features. Foothill sites were found clustered on suitable landforms near springs and canyon outlets, many containing circular stone enclosures thought to be attributable to the Cielo complex. Although very little reconnaissance was done in the mountains, discovery of two sites in the highest portion of this zone were significant given ". . . their inaccessibility and great distance from known water sources" (Mallouf and Wulfkuhle 1989:20).

The Mid 1980s–1990

Throughout the 1980s, the OSA played a major role in archeological research in and around BBNP. Two additional research avenues sprang forth from the Rosillos Mountains project: 1) the investigation of a previously unknown Late Prehistoric to Protohistoric social group now termed the "Cielo complex" (Mallouf 1985, 1986, 1992, 1993, 1995, 1999, 2013c); and 2) the detailed recording of Buttrill Ranch (Wulfkuhle 1986), an early Euro-American ranching site. During this same time, Mallouf, then-state archeologist and director of the OSA, contributed to regional academic inquiry with his master's thesis, an updated synthesis of eastern Trans-Pecos archeology (Mallouf 1985). Meanwhile, the OSA and THC were involved in several other research initiatives both in the park, through cooperative efforts with the park archeologist, and in adjacent portions of the region. These consisted of documentation of several stone quarries, reporting a prehistoric burial excavated by relic hunters near the village of Las Haciendas in Mexico (Mallouf 1987), and salvage prehistoric burial excavations in BBNP—the Black Willow (Mallouf, n.d. a) and Rough Run burials (Cloud 2002, 2013a).

Cielo Complex—Robert J. Mallouf

Based upon extensive archeological work in the region in the 1970s, 1980s, and 1990s, including test excavations at two sites in the Rosillos Mountains, Mallouf (1985, 1986, 1992, 1993, 1995, 1999, 2013c) identified a unique cultural phenomenon that he has termed the "Cielo complex." It is described as "a Late Prehistoric to Contact period (ca. A.D. 1250–1680) aceramic manifestation that is found across most of the Texas Big Bend and for an undetermined distance southward into northeastern Chihuahua and northwestern Coahuila" (Mallouf 1999:65). Importantly, the vast majority of Cielo complex sites are positioned on elevated settings with good viewsheds of desert basins and canyon drainage systems. In the La Junta Archeological District west of BBNP, Cielo complex sites, such as Cielo Bravo and Arroyo de las Burras (both base camps and type sites of the complex), are present on "elevated pediments that overlook the river basin terraces that were used for farming and habitation by coeval La Junta phase agriculturalists" (Mallouf 1999:67; Figure 3.18). Mallouf feels the complex

Figure 3.18 Cielo complex wikiup at the Arroyo de las Burras site on a pediment overlooking the Rio Grande near Redford. Courtesy of R. Mallouf.

consisted of a range of individual site types across the landscape, including base camps (short-term residential sites), specialized resource-procurement sites, and ritual locales (Mallouf 1999:65).

Base camps of the complex are characterized by sometimes substantial, above-ground, circular-to-oval, stacked stone wickiup foundations with internal diameters of 2.7–3.4 m, and narrow entranceway gaps (typically ca. 70 cm wide), and a variety of other constructions related to various special functions (Mallouf 1992, 1999, 2013c, personal communication 2006). Material culture associated with earlier occupations of the complex at Cielo Bravo includes:

> Perdiz arrow points and preforms, flake drills, unifacial end scrapers and side scrapers, occasional fragments of beveled bifacial knives, a host of expediency tools fashioned on both flakes and blades, occasional oval pestles, a variety of manos, end-notched sinker stones, fragments of bone rasps, fragments of deer-ulna awls, small bone and stone beads, tiny turquoise beads, and a few *Olivella* shell beads (Mallouf 1999:69).

Artifactual materials from the final occupation at that site were very similar to the earlier assemblages, with some notable differences: the addition of Garza/Soto-like arrow points, a lower incidence of groundstone, the lack of end-notched sinker stones, a higher incidence of triangular end scrapers and beveled-knife fragments, and the addition of small trianguloid shell (freshwater) pendants (Mallouf 1999:71).

Mallouf (1992, 1999, 2013c) has theorized that both the La Junta phase and the Cielo complex are ancestral manifestations of the sixteenth century group identified in Spanish documents as "Jumano Indians." He further suggests that these related groups had shared identities dating back as far as A.D. 1250 and that both had non-Athapaskan ethnic origins among hunter-gatherers indigenous to the Southern Plains or northwestern Chihuahuan Desert region. His model suggests that the La Junta phase and Cielo complex peoples were interacting somewhat like genetically-linked "cousins," with the La Junta folks practicing a semi-sedentary, agricultural-based (supplemented by hunting and gathering) lifestyle, and Cielo complex groups relying on a hunting and gathering lifeway. After collapse of the Casas Grandes interaction sphere in ca. A.D. 1450 (Ravesloot 1988), Mallouf (1992, 1999, 2013c) has suggested that the La Junta phase peoples may have joined their "cousins" in the hunting and gathering lifeway, archeologically manifested as the Cielo complex. Furthermore, using data from the final occupation at Cielo Bravo, he has suggested a linkage in the area between early Apachean groups and Cielo complex peoples (Jumano-Apache) by approximately A.D. 1650, or perhaps a little earlier (Mallouf 1999:85).

Buttrill Ranch—Virginia A. Wulfkuhle

Buttrill Ranch (BIBE411), a historic site recorded in 1980 during the Rosillos Mountains project and now within the confines of BBNP, became the focus of additional research by a member of the reconnaissance team, Virginia A. Wulfkuhle (1986). Wulfkuhle took particular interest in this early ranching complex on the northwest side of the mountains at Buttrill Spring, completing a scaled map of the site and measured drawings of the ruins (remnants of three adobe structures and one adobe feature) during a return trip to the ranch in 1984.

Using oral history interviews and archival records to supplement data recovered during the archeological reconnaissance, she discovered the odd mixture of architectural styles at the complex was a product of Anglo-American owners and Mexican laborers, resulting in ". . . variations in traditional floor plan, size of rooms, and roof design" (Wulfkuhle 1986:58). Her research indicated Lou and Margaret Buttrill initially purchased the property in 1899 and that the first ranch headquarters was established there in 1901. The Buttrills lived and raised cattle on the land until 1917, at which time it was sold to Joe H. Graham. Graham's family continued the ranching legacy, but focused on sheep and goats during their approximate six-year tenure as owners. In 1923, the Commonwealth Bank and Trust Company of San Antonio is listed as the owner of the property and in 1927 it was forfeited to the state. The chain of title seemed to end there, at least until the ranch was purchased as part of a larger tract by Houston and Edward Harte, the owners during the OSA project. Wulfkuhle's research provided important information on an early ranching settlement in the Big Bend, especially in regard to identifying cultural affiliations of past occupants through artifactual and architectural clues.

Robert J. Mallouf's Thesis

Mallouf's thesis (1985) entitled "A Synthesis of Eastern Trans-Pecos Prehistory" built upon the previous syntheses of regional archeology (Sayles 1935; Kelley et al. 1940; Lehmer 1958; Marmaduke 1978b) and unveiled the first information concerning his Cielo complex construct (see above). Focusing on the eastern portion of the larger Trans-Pecos, he broke the environment into four major ecological zones—mountain, foothill, basin, and riverine—and provided detailed information on natural resources in each that would have been useful to prehistoric peoples. Similar to what Lehmer had done, he divided the region into three sectors—southern, central, and northern—to facilitate discussion of past findings, chronological periods, etc. The sectors were of roughly equal size, divided by approximated boundaries that paralleled one another. Mallouf indicated most substantive excavations in the region had been conducted in the southern sector, thus allowing a better archeological understanding of it compared to the northern and central sectors (Mallouf 1985:36–37).

Findings from 15 of the best-documented excavations in the region were summarized, including 9 in the southern sector. To qualify these data, Mallouf pointed out inherent problems with the database—the paucity of investigations across the region, especially in the central and northern sectors; the specimen-oriented methodological approaches of the early excavations; the limited scope of more recent excavations; the lack of data to address intrasite patterning and feature-artifact associations; and the need for information from well-stratified rockshelters (Mallouf 1985:36–59).

The synthesis included an analysis of a wide range of archeological data from the region, including detailed information on sites, environmental parameters, and cultural features, and also provided extensive overviews of recognized chronological time periods and associated cultural constructs. Unlike previous researchers who had developed regional syntheses, Mallouf had at his disposal a computerization program recently developed by the THC that allowed a more holistic analysis of the diverse database. Among other findings, he noted that site densities were greatest in the basin and foothill zones, that elevated or prominent environmental features were almost always locations of concentrated occupations/activities, and that Cielo complex sites were invariably in foothill settings in the southern sector (Mallouf 1985:154–155). Furthermore, he suggested "That an important symbiotic relationship existed between Cielo complex nomads and farmers of the La Junta district in Presidio County" and that "La Junta villagers may have established agricultural villages as far down the Rio Grande as Mariscal Canyon, at least on the Mexican side of the river" (Mallouf 1985:157–158).

Mallouf ended by offering a series of research questions to illuminate uncertainties in the record and to guide efforts to address those deficiencies. Over the 30 years since the synthesis was completed, new findings in the region, including those in this volume, have generally supported his hypotheses and observations. Accordingly, his synthesis still stands as the most comprehensive and useful document concerning the archeology of the eastern Trans-Pecos region.

BBNP Stone Quarries—OSA/THC

Several prehistoric stone quarries in the park were also investigated in the 1980s by the OSA/THC. The most significant of these is located west of the Chisos Mountains on the western flank of Burro Mesa—the

Burro Mesa Quarry. It covers over 16 ha (40 ac), and is the largest actual quarry in the park. Intensively used by prehistoric inhabitants through time, the quarried stone, historically called "Burro Mesa flint/chert," is technically a silicified tuff. It occurs in myriad solid, mottled, or banded colors, although white with purple and dark brown speckles predominates. In fact, much of the ground surface across the quarry is white, littered with the waste debris from stone tool manufacturing over millennia. The tuff is mostly fine-grained and of a high quality, with a waxy and lustrous appearance. Small overhangs in several areas of the quarry facilitated the mining of unweathered portions of the stone, and fire seems to have been used to break down the material in these areas. Four prehistoric and two historic sites were recorded during the OSA/THC initiative at the quarry and the cluster was nominated to and accepted in the NRHP as the Burro Mesa Archeological District (Seaman and Howard 1984). Stone tools and waste debris that emanated from the quarry are found in abundance at numerous sites in the park, being especially prevalent in the western, central, and northern portions.

Several hornfels quarries and/or procurement sites in the park were also investigated and documented by OSA/THC staff at that time. This distinctive material—a metamorphosed clay, mostly black but also in various grays—occurs in bedrock outcrops around the flanks of the Chisos and Rosillos mountains. In these locations, volcanic magmas and pyroclastic flows came into contact with compacted clays to produce hornfels. One particularly large outcrop of black hornfels occurs at Banta Shut-in along Tornillo Creek in the northeast-central part of the park. This location and other bedrock outcrops evidence quarrying activities, although much of this material was likely procured in downslope settings where eroded and re-deposited hornfels cobbles are broadly scattered. It occurs in a range of textures, from quite coarse to extremely fine-grained, and is a common lithic material at archeological sites in the park (Mallouf 1985:12). The OSA/THC research efforts with hornfels consisted of detailed recording and instrument mapping of several sites in the northern portion of the park. Their efforts were concentrated at quarries along Tornillo Creek and in areas on or peripheral to Rough Mountain, Roy's Peak, the Grapevine Hills, and the Rosillos Mountains.

Las Haciendas Burial—Robert J. Mallouf

In the 1980s, Robert Mallouf, then-Texas State Archeologist, conducted an intensive analysis of a Late Prehistoric cairn-burial assemblage possibly related to the Cielo complex. It was recovered in ca. 1984 by relic hunters from about 20 km (12.4 mi) south of Santa Elena Canyon, just north of the small village of Las Haciendas (Ejido Paso de San Antonio), Chihuahua. Although the cairn and burial had been destroyed, Mallouf was able to piece the story together through interviews with the excavators and a visit to the site. He eventually was able to reassemble and analyze the mortuary collection (195 arrow points, 1 small pendant, and 1 small discoidal bead) and complete a detailed report on the find (Mallouf 1987; Figure 3.19). This study has provided invaluable metric and other data for the Perdiz arrow point type (the dominant type in the assemblage; n=180), one of the most common arrow points found in BBNP and across the region.

The cairn was positioned high (ca. 15 m [49.2 ft] above the basin floor) on an eroded bench along the gentle southwestern backslope of a cuesta. Mallouf (1987:15), using information from the excavators, reported that the human remains were found within a shallow pit with a north-south orientation (head to the south). While the actual juxtaposition of the body was unknown, the informants thought the corpse had been lying on the back in an extended position. Almost all of the grave goods were recovered below and on either side of skull fragments and teeth, suggesting that they had been originally encased in one or more perishable containers. The burial was subsequently covered with a low, oval mound of variously sized limestone fragments which appeared to have been procured from the immediate vicinity of the interment. The mound had been covered in tent-like fashion with two large, tabular rhyolite boulders, which also seemed to have

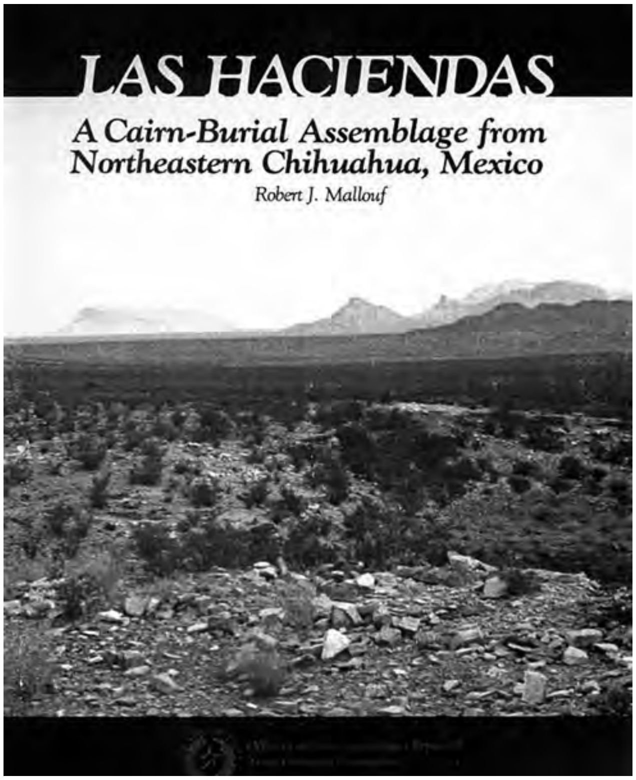


Figure 3.19 Cover of the 1987 report on the Las Haciendas cairn burial in Chihuahua Mexico.

been gathered from the surface in the area surrounding the burial. The skeletal material from the interment was that of an adolescent of undetermined sex. However, the six recovered teeth contained variable crown wear and coloration suggestive of two individuals although the cairn excavators were emphatic that they had found only one skeleton (Mallouf 1987:15, 44). The presence of numerous arrow points as grave goods was thought to be potential evidence of a male interment (Mallouf 1987:15).

Mallouf (1987) performed an extensive analysis of the grave goods, with an emphasis on the 180 Perdiz arrow points within the assemblage. Based on inspectional sorting, he was able to separate these specimens into 10 morphological groupings containing 26 varieties, as well as 2 miscellaneous groups. While this sorting indicated a high degree of morphological variability within the Perdiz assemblage, Mallouf (1987:60) attempted to identify the parameters of the variability through a combined attribute analysis using simple two- and three-element (blade, barb, and stem configurations) plottings. Based on these and other findings from the analysis, Mallouf suggested the likelihood of multiple knappers of the cairn arrow points, and the possibility that the assemblage had been selectively curated with the intent of refurbishing damaged specimens. His specimen analysis contains an impressive body of data that should help guide future studies. Using radiocarbon data for Perdiz points from West, South, and Central Texas, as well as postulated dating ranges for the non-Perdiz points within the assemblage, a temporal span from A.D. 1500–1750 was suggested for the burial (Mallouf 1987:63). Thorough data on the widespread occurrence of Perdiz points in the Big Bend area and surrounding regions and the possible association of the Perdiz type with several different cultural groups was discussed in the report. However, Mallouf (1987:64) cautioned against a speculative link until further associations could be confirmed.

Black Willow Burials—Robert J. Mallouf

In 1983, OSA archeologists salvaged two burials in BBNP just west of middle Tornillo Creek (Figure 3.20). The eroding interments, several hundred meters apart at opposing ends of a north-south trending sandstone ridgeline (and recorded separately as sites BIBE100

Figure 3.20 Robert J. Mallouf documenting an eroded human burial (#2) near Black Willow Spring in December of 1983. Photo by M. Denton.

and BIBE1007), had been originally reported to park officials by Margaret Stephens, a geological researcher from Lamar State University. Robert J. Mallouf, who supervised the excavations, theorized that both had been originally placed in shallow pits and buried under small overhangs that had subsequently collapsed (Mallouf n.d. a). Each burial contained the partial remains of an adult, and the interment at BIBE100 was accompanied by poorly preserved fiber and cordage, suggesting the inclusion of matting. Preliminary skeletal analysis of the remains was conducted by Lynne A. Biesaart (n.d.), with a focus on the BIBE100 interment. They were recently re-analyzed by Jennifer C. Piehl of the CBBS and subjected to stable isotopic analyses by Geochron Laboratories, the results published in a synthesis of known eastern Trans-Pecos interments (Piehl 2009).

The burial at the south end of the ridgeline (site BIBE100) was situated within a collapsed talus slope niche, about one quarter of the way up the steep slope. These adult remains were identified as probably female by Biesaart (n.d.) based on the mastoid process, while Piehl (2009) classified them as male. Biesaart (n.d.) further suggested an age of 45+ years at the time of interment. The remains were in a flexed supine position with the head facing the northeast. Erosion had apparently weathered, relocated, or destroyed portions of the individual's left side, the mandible, and a few other skeletal elements. The right femur was submitted to The University of Texas at Austin (UT-Austin) radiocarbon laboratory for an assay shortly after the excavation and a bone collagen date of 920±560 B.C. or 2870±560 B.P. (Tx-No. 5294) was returned. While this indicates the interment dates from the Middle to Late Archaic, the wide range offers little help in narrowing down its actual age. These remains later underwent stable isotope analysis and Piehl (2009:78) reported the following values were obtained: $\delta^{13}C$ collagen (-9.9); $\delta^{13}C$ apatite (-3.6); and $\delta^{15}N$ collagen (6.6). The values indicated that a large proportion of the diet was composed of Crassulacean acid metabolism, or CAM plants (includes desert succulents), moderate consumption of terrestrial animals—who were eating primarily C_4 (includes maize and some amaranths) or CAM plants—and a lack of freshwater or riverine protein sources. When comparing these data to similar-aged coprolites from Culberson County, Piehl (2009:79) noted some discrepancies in dietary preferences, and suggested eastern Trans-Pecos groups at that time may have been reliant upon considerable amounts of grasses along with succulents such as *Opuntia*.

The site BIBE1007 burial was located in a small, knoll-like erosional remnant at the north end of the ridgeline. Positioned near the base of the slope, this location is surrounded by low, erosional ridges covered with cobbles. Approximately half of this fragile interment had been destroyed by erosion prior to removal and most of the other half was exposed, so very little excavation was involved. Juxtaposition of the remains suggested the interment was placed in a flexed supine position (like the site 41BS695 burial) with the head to the west. Piehl's analysis indicated the interment was an adult of indeterminate sex (Piehl 2009: Table 3).

Rough Run Burial—William A. Cloud

The Rough Run site (BIBE80) is an extensive open campsite in western BBNP that spans a ca. 320 x 320 m area on eroded benches above Rough Run, a major tributary to Terlingua Creek. The site was initially discovered during emergency work along an extant powerline by park archeologist Thomas C. Alex in 1983, and then formally recorded by seasonal archeologist William A. Cloud in 1987 during in-house clearance for a pole replacement project. Among over 100 exposed cultural features (mostly hearths or small ovens) was one on an upper bench that differed from the others, having a core of embedded stones surrounded by a loose ring of stones on the surface—all essentially unburned. Importantly, two broken and unburned Perdiz arrow points were discovered within the surficial stones, suggesting the feature represented either a cache of Perdiz points or a burial that had its upper portion disturbed.

Given the feature's uniqueness, its location at the edge of the project's right-of-way, and documented evidence of systematic and unlawful artifact collecting along Rough Run, the feature was bisected in 1988 under the direction of Alex. The excavation uncovered an additional 37 Perdiz arrow points and fragments intermingled with buried, tightly positioned stones that formed an underground cairn. Due to time restraints, the test excavation was suspended until 1990 when it was resumed through a cooperative effort between personnel of the OSA (Robert J. Mallouf and William A. Cloud) and BBNP (Thomas C. Alex) (Figure 3.21). Ultimately, the investigation revealed the cairn overlaid a secondary adult interment (although lacking most torso elements), and two radiocarbon assays of charcoal recovered from the pit provided corrected and calibrated (2-Sigma) dates of A.D. 1520±120 or 440± 70 B.P. (Beta-056189) and A.D. 1530±110 or 400±60 B.P. (Beta-063769). In all, a total of 73 arrow point specimens—all but one adhering to the Perdiz type (the other specimen was a Harrell point)—and three pieces of debitage were recovered from what was classified as a semi-subterranean cairn burial (Cloud 1990, 2002, 2013a).

With positioning of the skeletal material, cairn stones, and arrow points indicating numerous deliberate placements, the burial appeared to have been executed according to a mental template and proved to be unlike any other known burials in the region. The partial remains (all four limbs were intact, flexed, and articulated; the mandible and skull were present, but separate; and torso elements consisted of both clavicles, the manubrium, the atlas vertebrae, and the right first rib) were placed in the pit first. The arms were placed horizontally in the bottom of the pit and the legs were vertically oriented on its opposing sides. The skull, mandible, and other skeletal elements were positioned between the legs. The facial portion of the skull was pointing upward at a slight angle, facing the north-northwest. Although abundant rocks of various

Figure 3.21 Excavation of the Rough Run burial in BBNP by William A. Cloud (left) and Thomas C. Alex with Betty A. Alex taking notes. Note the many tabular cairn stones already removed from the burial. Photo by R. Mallouf.

sizes occur on site, the majority of cairn stones had been secured from a dike outcrop about 700 m away. These stones were very carefully placed within the pit to provide support and protection from subsidence. The arrow points and fragments, all separate from one another, appear to have been randomly placed within the cairn during its construction (Cloud 2002, 2013a).

A preliminary skeletal analysis was undertaken by Alex, who discovered tiny cut marks on the necks of both femora. The remains were then analyzed by Gail R. Colby and D. Gentry Steele of Texas A&M University's Physical Anthropology Laboratory. While definitive determinations of age and sex were not possible given the lack of the thoracic and pelvic regions, other elements suggested the remains were from a male, 35+ years old at the time of death. There were no chronic health problems detected, but evidence of mild to moderate degenerative joint disease was present throughout the remains, and minor osteoporosis was evident in the long bones. Although no biological affinity could be determined, skeletal data proved to be typical of prehistoric Trans-Pecos populations (Colby and Steele 1995).

Cloud (2002, 2013a) analyzed the arrow point assemblage and discovered that seven specimens had conjoining pieces. This finding, coupled with their respective locations within the cairn (no conjoining pieces were in close proximity to one another), strongly suggested they had been ritually broken and somewhat haphazardly placed or tossed into the cairn. Only one of the Perdiz points appeared to have been intentionally placed, a finely made, long and thin specimen placed within the cairn's interior pointing straight down at the skull. Unlike what was found at Las Haciendas, the Perdiz points recovered from the Rough Run burial contain a number of similarities, including cross section, stem shape, stem edge treatment, blade flaking, and maximum thickness. When examined as a whole and compared to other Perdiz assemblages, the points appear to have been made by a single, or perhaps only a few, knappers (Cloud 2002, 2013a).

Although Perdiz points occur across much of the State of Texas and into northern Mexico, Rough Run and Las Haciendas represent the only reported interments with classic or definitive Perdiz points as grave goods. Similar to Mallouf's interpretation of the Las Haciendas burial, and given that Perdiz points are a hallmark of the regionally ubiquitous Cielo complex, Cloud (2002, 2013a) suggested the Rough Run burial may also have been constructed by this group.

In-House and NPS-Sponsored Investigations: 1982–Present

Thomas C. Alex

Since hiring a full-time archeologist at BBNP in 1982, management-related archeological projects have been conducted either in-house or through contracts with independent cultural resources management firms. These projects include surveys of highway rights-of-way, powerline routes, prescribed burns, boundary fencing surveys, and other projects involving ground-disturbing endeavors (T. Alex 1988). These various projects, as well as a number of independent reconnaissance efforts by the park archeologist, have resulted in the addition of hundreds of sites to the park's archeological database. Because a number of these projects were conducted by the CBBS, a brief discussion is provided in Appendix 7.

This section covers archeological work conducted by park staff that was funded in part or wholly by park base funding—the vast majority of which were driven by compliance with §106 of the National Historic Preservation Act (NHPA) of 1966 for projects related to the construction, repair, or maintenance of park infrastructure (see table in Appendix 6). Because of this one-sided focus on federal compliance, very little academic archeological research has been conducted in BBNP and the little that has been done was either part of field schools (led by Kristen Sobolik) or conducted under contract with cultural resources management firms.

Between 1982 and 1994, archeological investigation in BBNP was driven by two major projects: a powerline pole replacement and repair project and a series of road upgrade projects. In addition to these, a variety of smaller infrastructure-related projects requiring §106 compliance were also conducted including a boundary survey, well drilling, utility line installation and repair, and a host of other ground-disturbing activities. Most of this work was performed by the park archeologist. Due to the workload, reporting was limited to internal short reports to fulfill minimum federal requirements. It was not until 1990 when Federal Highway Administration (FHWA) project funds became available that the park had sufficient staffing to produce full reports.

Powerline Rehabilitation and Repair

Approximately 60 miles of powerline serves five developed areas within BBNP. Most of this line was constructed in the 1950s and, by 1982, years of weathering prompted the need to replace deteriorated structures. Because this line was built prior to laws requiring cultural resource surveys, powerlines had been installed through many archeological sites.

In 1982, archeologist Thomas C. Alex was hired to facilitate vehicle access to the project areas, to locate cultural sites along the right-of-way, and to determine ways to avoid adverse impacts. The surveyed area roughly paralleled the powerline but due to difficult terrain, deviated from the line at times as much as a quarter mile or more. To reach and repair these powerlines, access roads had to be found and reopened, and new access roads constructed.

Occasional shovel tests were made to determine the presence of buried deposits in alluvium, but since the majority of landforms crossed by the powerline were deflated Pleistocene pediment surfaces having little or no deposition, very few shovel tests were conducted in the uplands. Where the powerline was found to cross a site and where pole structures were located within a site, the strategy focused on avoidance of impacts to archeological features.

The bulk of survey was done between 1983 and 1989 on the main powerline segments serving the Panther Junction, Rio Grande Village, Chisos Basin, and Castolon developed areas. The survey of 97 km (60 mi) of powerline and associated access routes accumulated data on 512 ha (1,266 ac) of park land and the recording of 169 prehistoric, 10 historic, and 3 multicomponent historic/prehistoric sites. Due to poor planning and coordination on the part of the power company, advance notice was rarely given and, due to resulting time constraints, reporting on this project was abbreviated.

Federal Highway Administration Projects

The park contains over 160 km (100 mi) of paved roads which the FHWA is responsible for, including major road rehabilitation and repair work. Although the original paved roads were constructed prior to the NHPA, all subsequent work, including rehabilitation, realignment, and road structure repair/replacement, requires §106 compliance except in rare cases where sufficient archeological data was already available to determine potential adverse effects.

Beginning about 1990, the park was able to obtain funds to conduct an archeological survey along Park Route 15 (Ross Maxwell Scenic Drive) and Route 16 (Santa Elena Canyon Road) whereas surveys along other paved roads (Route 11, Route 12, Route 13, and Route 14) utilized park base funding. These surveys were designed to document all cultural resources within a 200-foot-wide corridor, assess their significance, and determine potential impacts of construction.

A corridor 30 m (100 ft) wide on either side of each highway centerline was surveyed. Artifact collection was generally limited to items that were temporally diagnostic, that had other research potential, or that were at risk of unauthorized collecting. Features found in the road corridor were mapped, photographed, measured, and described. Subsurface testing was limited to collection of charcoal samples for radiocarbon dating. A total of 1,306 ha (3,227 ac) were surveyed along the park roadways, resulting in the documentation of 50 prehistoric campsites, 3 historic sites, and 2 multicomponent prehistoric/historic sites. An excavation that was conducted by park archeologist Thomas C. Alex and seasonal archeologist Donald W. Corrick at BIBE371 sampled a thermal feature eroding from an arroyo bank that contained carbon deposits in direct association with Toyah arrow points. This places the Toyah point in an averaged temporal range clustering around A.D. 1300 (Corrick 2000).

Backcountry Improved and Unimproved Roads

There has been no systematic survey of backcountry dirt roads by NPS except for work done by volunteers (see volunteer section below). However, road maintenance projects, casual observations, one road re-route, and a general "windshield survey" in 2010 (described in more detail below) have been conducted along the park's backcountry roads, resulting in the survey of some 1,222 ha (3,019 ac). Since much of the park terrain is very open with sparse vegetation cover, it was possible to conduct windshield surveys along road segments where visibility was adequate. However, in cases where visibility was poor or if road maintenance required the use of machinery (such as re-establishing drainage ditches or constructing new drainage structures), pedestrian survey was conducted.

Over the years, casual observations and site recordings not associated with formal surveys or NPS projects have been made along several backcountry roads in BBNP. Much of this was conducted by Thomas C. Alex during off hours, weekends, and recreational trips. In the process, a number of sites have been recorded along road sections in the park (see Table 3.1).

In 1984, a new approach to Reed Camp along a pediment above the floodplain was required due to damage to the existing road by floodwaters of the Rio Grande. The resulting survey covered 43 ha (105 ac) and created a new road segment 2.48 km (1.54 mi) long (Figure 3.22). The project resulted in the documentation of four prehistoric open campsites and avoided impacts to site features through selective routing of the new road.

Park Boundary Fencing Projects

Beginning in 1984, about 20 miles of the park boundary fence required repair or replacement. Because most of this area was not near park roads, much of it had to be accessed from private land adjacent to the park. In many cases, the fencing material had to be hauled by mule and installed by hand.

The project was preceded by a land survey to ensure that the new fencing was installed on the actual section lines that defined the park boundary. Unfortunately, most early surveys were inaccurate and in the northern area of the park the surveyors found that the existing fence was off by as much as 183 m (600 feet) from the actual section line. Because the fence had to be relocated, a new access road was required, which was constructed on private lands adjacent to the park.

Table 3.1 Park Backcountry Road Project Data by Segment.

Dagger Flat Road	1 historic site and 2 prehistoric open campsites
Old Ore Road	2 prehistoric quarry sites, 12 prehistoric open campsites, 3 historic sites, and 1 boulder shelter site
Glenn Spring Road	7 prehistoric open campsites and 1 boulder shelter site
Juniper Canyon Road	5 prehistoric open campsites
River Road east end to Black Dike	5 prehistoric open campsites

Figure 3.22 Re-route of River Road approach to Reed Camp.

Boundary projects were done in consultation with adjacent landowners due to the fact that most access to the boundary had to be carried out over private property and public roads outside the park. The contracted fence installer was responsible for arranging access with each adjacent landowner. However, the archeological survey for each segment accessed the boundary segments from both inside and outside the park, which in some cases required landowner permission.

The archeological survey involved pedestrian coverage of an area wide enough to permit vehicle access and allow installation of fencing. The survey transect width (generally 30 m on either side of the boundary line) was similar to that employed along trails or powerline rights-of-way. New road blading was also inspected for presence of cultural resources and routed to avoid impacting significant sites.

Between December 1983 and late November 1984, Thomas C. Alex surveyed a total of 370 ha (914 ac), recording 23 prehistoric open campsites, 2 rockshelters, and 1 multicomponent prehistoric/historic ranching site. In a few cases, these sites spanned the boundary and portions fell onto private land. The individual segments and number of prehistoric sites are shown in Table 3.2.

Trails

Trail surveys in BBNP have been conducted sporadically and on an ad-hoc basis. In cases where trail maintenance or repair was pre-planned, archeological surveys were conducted in advance of ground-disturbing activities. In emergency situations, however, archeological field work accompanied the repair work and any mitigation was conducted on the spot. Trail surveys typically covered a 60-m-wide survey area (30 m on either side of the trail), and included inspections of adjacent landforms that might contain archeological sites. Brief descriptions of 18 of these surveys are provided below, all of which occurred between 1989 and 1995.

In 1989, William A. Cloud was hired as a seasonal archeological technician to survey four trails in the

Table 3.2 Park Boundary Project Data by Segment.

Segment A	Tornillo Creek adjacent to Pitcock Ranch	74 ha (182 ac)	7 prehistoric open campsites
Segment B	Mesa de Anguila	23 ha (58 ac)	2 prehistoric open campsites
Segment C	Mesa de Anguila	15 ha (38 ac)	1 historic/prehistoric site
Segment D	Dog Canyon area adjacent to Persimmon Gap Ranch	22 ha (54 ac)	1 prehistoric open campsite
Segment E	North of Dogie Mountain	20 ha (50 ac)	1 prehistoric open campsite
Segment F	Between Indian Head and Dogie mountains	23 ha (57 ac)	1 prehistoric open campsite
Segment G	Between Maverick and Indian Head mountains	9 ha (22 ac)	1 prehistoric open campsite
Segment H	Cub Spring area	30 ha (74 ac)	2 prehistoric open campsites
Segment I	Dropped from contract, not surveyed		
Segment J	Mesa de Anguila/Sierra Aguja	36 ha (89 ac)	2 prehistoric open campsites
Segment K	South of Persimmon Gap adjacent to Harte Ranch	55 ha (135 ac)	3 prehistoric open campsites and 1 historic scatter
Segment L	Maverick Entrance area	20 ha (50 ac)	2 prehistoric open campsites
Segment M	Mesa de Anguila	36 ha (88 ac)	1 prehistoric open campsite and 2 rockshelters
Segment N	Mesa de Anguila	9ha (22 ac)	0 sites

Chisos Mountains prior to a trail reconstruction project: the Window Trail, Window View Trail, Laguna Meadow Trail, and a short trail linking the Basin Campground with the upper Basin developed area. The survey covered 62 ha (154 ac) and resulted in the documentation of 5 prehistoric open sites, one of which was a boulder containing petroglyphs (Cloud 1989).

In 1992–1993, archeological technicians Donald W. Corrick and Francisco Garcia conducted several surveys of trail segments prior to trail reconstruction projects, including the east end of Dodson Trail between Juniper Canyon and Dodson Ranch in the fall of 1992 and the west end of Dodson Trail from Blue Creek to Dodson Spring in the spring of 1993. Their survey covered a total of 123 ha (304 ac) and resulted in the documentation of 5 prehistoric open campsites, 2 prehistoric sites with historic overlay, and 1 historic ranch site.

In the spring of 1993, Corrick surveyed Mule Ears Trail from the Route 15 trailhead to Smoky Creek. This survey covered 70 ha (174 ac) and resulted in the documentation of 5 sites that had been previously recorded by Campbell in 1966–1967. These sites consisted of 4 prehistoric open campsites and 1 prehistoric site with extensive historic ranching overlay.

In the summer of 1993, Garcia surveyed Emory Peak Trail, covering 9 ha (23 ac) and recording 2 prehistoric sites. Garcia also surveyed about 200 m of trail on the South Rim that was scheduled for reconstruction work, covering about 1 ha (3 ac) and recording 2 prehistoric open campsites. Garcia then surveyed a segment of lower Blue Creek Trail, covering 30 ha (75 ac) and recording 19 sites, 4 of which were adjacent to the proposed trail work. The survey revisited several sites recorded by Cook (1936–1937) and again by Campbell (1966–1967). Garcia and Corrick also surveyed upper Juniper Canyon Trail, covering 25 ha (62 ac) and recording 4 prehistoric open campsites and 1 historic ranching watering site.

In the fall of 1993, Garcia and Corrick surveyed the Marufo Vega Trail, including a loop that passes deep into Boquillas Canyon. The two covered 52 ha (129 ac) and recorded information on 12 sites: the Ore Tramway, 1 rockshelter, 1 cliff shelter, 1 prehistoric open campsite, and 8 lithic procurement sites. Garcia also surveyed the Ore Tramway Trail system covering 67 ha (166 ac) and recorded 1 lithic procurement site and 1 rockshelter in addition to historic features along the Ore Tramway.

In the late fall of 1993, Corrick and Thomas C. Alex provided clearance for a project at the Chisos Basin trailhead junction that formalized the trailhead and required installation of sidewalks and a signboard. The project took place on a known open campsite adjacent to another site where previous excavations had revealed great antiquity (BIBE908/J. Charles Kelley Site). Because of this, shovel testing was conducted but no additional archeological remains were recovered.

In 1993, and again in 1994, Garcia and Corrick independently inspected a section of trail between Dodson Trail and Smoky Creek—an old ranching trail whose use stretched back into prehistory. Thomas C. and Betty L. Alex had surveyed this trail segment three years earlier in 1990 and recorded eight sites. Garcia and Corrick revisited those sites and a total of 53 ha (132 ac) were surveyed and 8 sites were re-recorded: 1 historic dam, 1 historic ranching corral and watering trough, 1 rockshelter, and 5 prehistoric open campsites.

In the fall of 1994 Corrick surveyed both the Lost Mine Trail, covering a total of 11 ha (27 ac), and the Pinnacles Trail, covering 3 ha (7 ac), although no cultural materials were encountered on either trail. The following spring, Corrick surveyed 2 ha (6 ac) of trail in Santa Elena Canyon, again without observing any cultural sites.

In addition to those mentioned above, numerous other minor trail repair projects were conducted that required archeological inspection to fulfill §106 requirements but none resulted in significant archeological findings. One additional project conducted by the CBBS in 2008 surveyed a proposed multi-use trail around Lone Mountain, covering 106 ha (262 ac) and resulting in the documentation of 9 sites: 5 prehistoric open campsites, 2 prehistoric open campsites with historic overlay, and 2 historic sites (Keller and Cloud 2008; see also Appendix 7).

Developed Area Construction and Maintenance

A significant amount of archeological work has been focused on the developed areas within the park, including Panther Junction headquarters, Rio Grande Village, the Chisos Basin, Castolon, and Persimmon Gap. The first NPS-developed area in BBNP was constructed in 1933—a CCC camp in the Chisos Basin which served as their base of operations; when the national park was established in 1944, the park service took over the abandoned camp. In 1952, BBNP headquarters was moved from the dilapidated CCC structures to the new location at Panther Junction, which continues to serve as the main park headquarters.

Between 1955 and 1966, the NPS began a nationwide program to revitalize the aging park infrastructure under the Mission 66 program. Big Bend was among the first parks to benefit, resulting in the bulk of the existing housing and other facilities at Panther Junction, Rio Grande Village, and the Basin. The completion of Mission 66 development in the park coincided with the establishment of the NHPA. Significantly, in 2013, the Panther Junction developed area was designated a Mission 66 Cultural Landscape.

Between 1982 and the present, each year the park has undertaken between 25 and 35 projects which require some level of §106 compliance. Most projects take place in previously disturbed areas but in cases where new disturbance will occur, on-site monitoring is required. Over this ca. 30-year period, all developed areas have been surveyed including a substantial number of subsurface inspections due to the multitude of trenches that were dug as part of construction activities.

In 1984, during the Santa Elena raft takeout project, Tom Alex recorded BIBE146—a prehistoric open campsite and historic farm where he collected a Paisano (Late Archaic) dart point and a pendant preform from the surface and identified buried deposits. Although he recommended avoidance, when the project was underway a year and a half later, construction revealed the site to be larger than previously thought. Jim Bradford tested the site with five backhoe trenches and 15 hand-excavated 1x1 m units and documented eight features. Soon after, a crew led by Don Clifton of Human Systems Research Inc. (Tularosa, NM) completed the testing by excavating 38 additional 1x1 m units. Two features were documented and the upper component was found to contain arrow points (Perdiz and Scallorn) as well as several brownware sherds—one of only two sites in the vicinity bearing prehistoric ceramics (Clifton 1986).

The other prehistoric ceramic-bearing site, BIBE149, was initially recorded by Alex in 1984 during a reroute of the Santa Elena Canyon loop road. The surface exposure consisted of FCR and lithic debris. The subsurface was explored using a series of shovel tests revealing a cultural component ca. 30 cm thick. In October of 1985, the site was further explored with a series of backhoe trenches and additional shovel tests were conducted in June of 1986. During the latter efforts, several sherds of El Paso Polychrome were discovered, becoming the second site in the park to produce prehistoric ceramics—in this case, exotic wares from the Jornada Mogollon area.

A thrust to improve visitor facilities in the Chisos Basin occurred in the late 1980s when National Park Concessions, Inc. proposed construction of additional motel units and a store at the same time the NPS was planning a new visitor center and ranger station. The ground surface throughout this area was previously disturbed and preliminary survey revealed no intact archeological features.

In 1991 a project was initiated to remediate damage to these new structures from water infiltration beneath their foundations, which were underlain with expansive clay with high shrink-swell capacity. During archeological monitoring, a major discovery was made—the site now known as the J. Charles Kelley Site (BIBE908). Prehistoric features were exposed in trenches that had been excavated deeper than previous construction disturbances (Figure 3.23). For a period of six weeks, archeological investigations revealed the presence of well-stratified prehistoric components, the lowest strata of which yielded a calibrated (2-Sigma) median radiocarbon date of 10,014 B.P. (Beta-70865)—becoming the first known subsurface Paleoindian site in the region (Alex 1999; Figure 3.24).

In 2008, plans were formalized for the rehabilitation of the Chisos Basin wastewater treatment system. Testing began in January on one site (BIBE2240) located within the Area of Potential Effect (APE). Shovel tests and one excavation unit were opened on this site, and by March 2008, field work was completed. A burned rock midden less than a meter in depth that was partially buried by colluvium from an adjacent slope was tested. However, radiocarbon samples yielded dates indicating stratigraphic relationships were mixed. Although the report from this project remains a work in progress, radiocarbon results are listed in Appendix 11.

In 2006 and 2007 a project was undertaken to rehabilitate and replace the aging water system at Rio Grande Village (RGV). The project involved drilling a new well east of the RGV developed area, piping water to existing storage tanks, and building a new water treatment system. A total of 4 ha (10 ac) were surveyed but no new cultural sites were recorded.

At Panther Junction, much of the maintenance facilities were built upon prehistoric open campsite BIBE878. Documentation of this site occurred over a 30-year time span that began with a volunteer effort involving park staff and residents to establish a measured grid system over the remaining portion that had survived the Mission 66 era construction. Over 30 thermal features were identified at that time.

New facilities have progressively encroached upon the site and with each additional structure, mitigative data collection was required. These developed area projects involved utility trenches for water, sewer, electrical and telephone communication lines, as well as construction of operational facilities.

Figure 3.23 Thomas C. Alex during mitigation of 9,000-year-old site, 41BS908, in the Chisos Basin prior to construction activities. Photo by D. Corrick. Courtesy of National Park Service, BBNP.

Two of these construction projects at the site were contracted out to DMG Four Corners Research, Inc. In 2004 DMG Four Corners performed data recovery related to construction of a new Fire Management office building. Prehistoric artifacts suggested Middle and Late Archaic components. Two thermal features were excavated yielding three radiocarbon dates. Feature 14 returned two dates that suggested its use between A.D. 1515 and 1590. The second feature (F30) returned a calibrated date suggesting its use sometime between A.D. 1525 and 1800 (Purcell 2004).

In 2010 DMG Four Corners was again contracted to perform data collection related to proposed construction of law enforcement and emergency services operations facilities at site BIBE878. The archeologists tested and excavated 21 features including 11 shallow-basin hearths. A number of paleobotanical and radiocarbon samples were collected, the latter yielding calibrated dates primarily between A.D. 1420 and A.D. 1680, although one deeply buried feature produced a calibrated date interval of A.D. 780–1000 ±40 and several Late Archaic projectiles were recovered from the surface (Greenwald 2010).

The paleobotanical data was of equal interest, yielding evidence of grass seeds, wild potato, prickly pear, agave, and sotol among others. While the agave and sotol were suspected as being food items, some of the other botanical materials were believed to have been used as tinder, to buffer primary food items from flames, or to introduce moisture. Significantly, one feature (F20) contained sycamore charcoal—a species

Figure 3.24 Thomas C. Alex collecting a charcoal sample from a hearth later dated to 8,890 B.P. at 41BS908 in the Chisos Basin with help from volunteer Howard Newman. Photo by D. Corrick. Courtesy of National Park Service, BBNP.

that is no longer part of the local flora (Greenwald 2010). Although the site is clearly multi-component, this work provided substantive environmental and ethnobotanical data regarding the Late Prehistoric/Contact Period and has been the most intensive archeological work conducted within developed areas in the park.

Prescribed Fire and Wildland Urban Interface Surveys

Prescribed fire within the Wildland/Urban Interface (WUI) has driven much of the archeological work associated with developed areas in the park. Fire program officials coordinate all their treatment projects with the Science and Resource Management staff and each project has received archeological clearance.

Surveys completed in association with WUI activity consist of: Chisos Basin (183 ha/451 ac), Panther Junction (597 ha/1,476 acres), and Rio Grande Village (4 ha/9 ac). These projects did not result in discovery of any additional sites that had not been previously recorded during other developed area project surveys.

Surveys associated with prescribed burns in backcountry settings or along roadways include 399 ha (986 ac) along Route 14; 286 ha (706 ac) between Sublett Farm and Santa Elena Canyon; and 201 ha (497 ac) in the South Rim area.

Surveys at Sublett Farm/Santa Elena Canyon (Keller and Cloud 2007; Figure 3.25); the South Rim (Cloud 1999; Cloud and Walter 2006); Route 13-Route 14 juncture, 216 ha (534 ac) (Cloud 2000; Figure 3.26); and the Hannold Draw portion of the WUI for Panther Junction, 240 ha (592 ac) (Kent et al. 2008) were done under contract with the Center for Big Bend Studies, Sul Ross State University. Results from these projects

Figure 3.25 CBBS crew recording a prehistoric site during the pre-burn survey of Sublett Farm/Santa Elena Canyon in 2005. From left: Roger Boren, Rachel Freer, Monroe Elms, and Ashley Baker. Photo by D. Keller.

have been individually reported and are summarized in Appendix 7.

Disturbed Land Restoration Projects

Beginning in 2008 the natural resources staff began a long-term project to restore grasslands in areas of the park that had been seriously overgrazed—much of it in the Tornillo Flats where the surface is essentially barren soil with scattered shrubs and grasses. Early attempts at soil stabilization were made in this area between 1951 and 1964, prior to NHPA mandates, which resulted in significant disturbance to the land.

Using Geographical Information Systems (GIS), Thomas C. Alex has been able to document these previous disturbances through historic reports, maps, and photographs, which have revealed that up to 1,012 ha (2,500 ac) of Tornillo Flats were disc-plowed, contour plowed, or rip-plowed to a depth of up to 24 inches. This knowledge aids in determining past impacts to shallowly buried archeological remains in that portion of the park.

The more recent grassland restoration project involves shallow scarification of the soil surface, applying seeds and mulch in a wet slurry, and then covering

Figure 3.26 CBBS crew recording a site during the Route 13-Route 14 archeological survey. William A. Cloud (left), Andrea J. Ohl, and Samuel S. Cason (seated). Photo by S. Schooler.

the mix with brush. These brush piles are laid in rows across the slope to slow sheetwash and prevent loss of moisture through runoff. To date, Thomas C. Alex has surveyed a total of 68 ha (169 ac) in Tornillo Flats but found no significant sites that would be impacted by the project.

Border Protection Surveys

Impacts from illegal immigration and smuggling activities along the U.S. border with Mexico have become a major issue in national parks in southern California, Arizona, and New Mexico. Undocumented aliens (UDA) entering the U.S. have had significant impacts on park resources through their trails, camps, and refuse disposal. Concern that this activity could increase along the Texas-Mexico border prompted the NPS to fund a project in 2010 to determine the extent and effects of UDA activities in BBNP.

This project has employed three methods of reconnaissance and formal survey: pedestrian and vehicular surveys along park roads and suspected UDA corridors in the backcountry, helicopter reconnaissance in remote areas of the park, and the placement of monitoring transects within known or suspected UDA corridors. The 2010 pedestrian survey was conducted in many backcountry areas, on numerous established trails, and along suspected UDA routes such as power line right-of-ways and historic (abandoned) roadways. The vehicular survey was conducted along most of the undeveloped roads within BBNP as well as areas along paved roads in which UDA activity may have occurred (e.g., bridges, culverts, and park structures).

Aerial reconnaissance was conducted by helicopter over a week-long period, for a total of over 16 flight hours covering some 36,422 ha (90,000 ac) and allowing numerous remote areas to be inspected by air that would otherwise have remained inaccessible (e.g., Dead Horse Mountains, Mariscal Mountain, and Mesa de Anguila). Especially significant were approximately 235 rockshelters that 1) were in reasonable proximity to suspected or known UDA ingress corridors, and 2) were deemed good candidates for the potential presence of archeological resources. Included in this total were several rockshelters along suspected UDA routes with confirmed cultural deposits.

Unlike the arbitrary transects established in other border parks (e.g., Coronado National Forest) where UDA impacts can be expected in almost all areas, transects within BBNP were placed in 5 out of 30 areas identified by law enforcement personnel and/or resource managers as having a moderate to high probability for current or future UDA impacts. No UDA-related impacts have yet been observed within the transects although this effort is still ongoing. In 2013, the focus was intensified on the trespass livestock problem due to the severity of impacts to sites clustered along the Rio Grande.

To date, nearly 209 km (130 mi) of backcountry roads have been surveyed for archeological resources and associated UDA impacts. Approximately 5,261 ha (13,000 ac) have been surveyed by ground crews, resulting in the discovery of 75 sites: 27 historic sites, 23 prehistoric sites; and 25 cave, rockshelter, or boulder shelter sites. In addition, approximately 50 possible UDA sites have been recorded with 11 having measurable impacts upon cultural resources. A few UDA sites were within historic structures (e.g., Bone Spring house, Ore Terminal) where apparent UDA activities have caused notable impacts such as the presence of trash, campfire debris, and trampling around water sources.

Campbell Site Relocation and Documentation Project

The 1966–1967 survey by T.N. Campbell was a major contribution to archeological inquiry within BBNP. Unfortunately, the field notes and site plottings from this project have not been located. However, Campbell's 1970 report provides descriptive data on the sites recorded and includes a set of aerial photographs used to plot some sites. These sources have proved valuable in locating a number of the sites he recorded. However, in many cases the small scale of the aerial imagery is insufficient to accurately locate sites.

Each site description in the Campbell manuscript references a site location on the aerial imagery. The Texas Archeological Research Laboratory (TARL) attempted to plot Campbell's site locations onto 7.5 minute (1:24,000 scale) U.S. Geological Survey (USGS) topographic maps with limited success. In fact, the imprecision introduced during the process of replotting these sites produced errors on the scale of hundreds of meters. The additional fact that multiple maps with different plottings reside at TARL and THC data repositories in Austin (the main site map file and OSA map file, respectively) compounded the confusion. Yet another complicating factor is that Campbell often used one site location as a spatial reference point for locating other sites. Thus, if the first site cannot be located, neither can the others.

Since 1982, over 2,023 ha (5,000 ac) have been surveyed specifically to find sites described in the Campbell manuscript. This work has often been assigned to skilled volunteers although most of the effort has been carried out by Thomas C. Alex and spouse Betty L. Alex during non-work hours. Their hikes (amounting to more than 10,000 miles in the park backcountry over the past 30 years) have resulted in the rediscovery of at least 140 sites from the Campbell and other early surveys.

In 2003, the Big Bend Natural History Association provided a grant to cover one season of work on the

Campbell site relocation project. Seasonal Archeological Technician Steve Wick was hired to perform cursory reconnaissance, much of which was directed at revisiting Campbell sites to obtain current condition updates. Documentation consisted primarily of obtaining a GPS boundary for each site but unfortunately did not include detailed mapping of intrasite features. Consequently, many of these sites need to be revisited. In all, Wick reconnoitered a total of 1,480 ha (3,656 ac) and visited 145 (mostly Campbell), sites although many of these had already been relocated by Alex or by volunteers.

Chihuahuan Desert Network Inventory and Monitoring Project

The Chihuahuan Desert Network (CHDN)—comprised of seven national park units—is one of 32 National Park Service Inventory and Monitoring networks nationwide designed to assess the condition of park natural resources to develop a scientific foundation for stewardship. In BBNP, CHDN plans to monitor 20 upland plots per year on a rotating schedule. Plot locations were determined randomly using ArcGIS and were stratified by elevation. The uplands protocol establishes permanent, 20 x 50 m sampling plots—roughly 3.13 ha (7.75 ac) each—where crews will collect soil samples and other data (Figure 3.27). Because ground-disturbing activities will take place, archeological clearance is required. The archeological component requires inspection of a sufficient number of both primary and alternate plots in order for CHDN to have a sufficient number of locations. If any significant sites or archeological resources are located within a 100-m buffer around the proposed plot, that plot is thrown out and alternate plots are inspected.

In 2012–2013, Archeological Technician Kira Mullen conducted these surveys. In 2012, all 20 primary plots and 23 of the alternate plots were surveyed, for 43 out of a total of 64 plots. Out of the 135 ha (333 ac) surveyed, one prehistoric open campsite was recorded. In 2013 an additional 23 plots were surveyed—11 "priority level 1" plots and 12 "priority level 2" plots. A total of 72 ha (178 ac) were surveyed although no cultural resources were discovered.

In 2013–2014, volunteer archeologist Joan Spalding conducted most of the CHDN plot field survey with occasional assistance from others. Eleven "priority level 1" plots and 18 "priority level 2" plots were surveyed, for a total of 91 ha (225 ac). One of the 29 plots was eliminated due to cultural resources and 4 archeological sites were recorded.

Figure 3.27 Soil sampling and classification study by USDA Alpine Field Office staff soil scientists at Laguna Meadow. Photo by T. Alex. Courtesy of National Park Service, BBNP.

In 2014, the NPS funded a rock art recording project to conduct documentation and training in field methods at Big Bend, Guadalupe Mountains, and Carlsbad Caverns national parks. The project contracted with Rupestrian Cyber Services and one week of field recording was conducted by Evelyn Billo and Robert Marks at the Indian Head site (BIBE974). Following this, Thomas C. Alex and Archeological Technician Dawnella Petrey conducted pole aerial photography of groundstone features, primarily boulders containing mortars, metates, cupules, and other ground stone features at the site. A total of 109 boulders were recorded using GPS and pole aerial photography.

Across the Rio Grande, Ore Tramway Survey and Heritage Education

This project was an international cooperative endeavor involving BBNP and sister park, Maderas del Carmen Protected Area, in Coahuila, Mexico. The project involved cooperation between the NPS and corollary land management agencies, INAH (Instituto Nacional de Antroplogía e Historia), and CONANP (Comisión Nacional de Áreas Naturales Protegidas) in Mexico. The fieldwork for the project was initiated in 2014 and continued sporadically through 2015 to 2018 and involved documentation of the tramway using photography and GPS mapping. The initial 2014 field crew was comprised of the park archeologist, one seasonal archeology technician, one Student Conservation Corps technician, and one volunteer archeologist. Subsequent fieldwork was completed by the now retired park archeologist and two volunteers. Composite photogrammetry coupled with scaled sketches was used to create CAD drawings of typical towers and tower features. The remains of 45 aerial tramway towers and associated structures were recorded. Field work at the Puerto Rico Mine site in Coahuila consisted of retaking photographs of locations that appear in historic images from the period when the ore tramway was in active operation. Field work also involved photography and GPS data collection of the Boquilla Viejo town site. In 2016 and 2017 an attempt was made to locate and record tramway structures on the Mexico side of the Rio Grande. Aerial remote sensing revealed 22 tower locations on the extremely steep slope of the Sierra Terminal in Mexico. Geographic data collected from surveys on the ground and digitized from aerial remote imagery were compiled and are maintained within the GIS platform.

Work by Volunteers

The park on occasion has benefited from the services of highly competent volunteers. Those who come without skills are employed in simple assistant positions. However, some volunteers are sufficiently skilled to qualify as "para-archeologists" and are capable of working independently with minimal direct supervision. These volunteers are mentioned below.

James Morgan, retired from Los Alamos National Laboratory, was an avid explorer of Anasazi and Puebloan sites in New Mexico and came to BBNP with extensive mapping skills and a meticulous nature. His first project assignment was to inspect the route of the powerline that serves Castolon. Morgan then conducted a wide-area general survey in which he hiked every landform parallel to the river floodplain, starting at Santa Elena Canyon, the eight-mile distance to Castolon Historic District, then continued for another mile to the east of Castolon. Over the course of several years, Morgan covered a total of about 3,108 ha (7,680 ac).

In the spring of 1984, Morgan inspected the powerline route from Castolon northward for a distance of about eight miles as well as the hills surrounding the community of La Coyota and two other locations toward Santa Elena Canyon—a reconnaissance totaling about 1,036 ha (2,560 ac). In the spring of 1991, Morgan returned and made a reconnaissance of the area from Alamo Creek eastward to Castolon and from Route 16 northward for a distance of about 3 km (2 mi), an area of about 1,554 ha (3,840 ac).

In the spring of 1993, Morgan returned and covered the area from Castolon eastward, generally paralleling

Route 16 and the west end of River Road, covering an area of about 259 ha (640 ac); he also covered the abandoned section of old River Road that leads eastward from Castolon, an area of about 259 ha (640 ac). For all the above activities conducted by James Morgan, the documentation consists of a set of topographic maps with observations noted by sequential number correlating to handwritten narratives for each location. These observations include such things as fence lines, rock piles, "geomantic lines and forces" deduced by dowsing rod, old abandoned roads, and upon occasion a ruin or prehistoric "observation" was noted. No site forms were produced and these locations are being progressively revisited by other volunteers or staff when the notations suggest that a site worth recording exists at Morgan's numbered locations.

Howard Newman, a volunteer on numerous National Forest Service projects including area surveys and site excavations, volunteered at BBNP in 1987 and again between 1991 and 1994. Newman was tasked with survey in areas where Campbell had recorded clusters of sites that often occurred around major water sources. In 1993 and 1994, assisted by volunteer Steve McAllister, Newman focused his attention on the Paint Gap area where they recorded nine sites.

Steve Harper, a retired Forest Service area supervisor with archeological field experience, began volunteering at BBNP in 2001 with a focus on the Persimmon Gap area of the park (Figure 3.28). Harper intensively surveyed 206 ha (510 ac) and recorded 22 sites, most of which were previously recorded by Campbell. In 2002

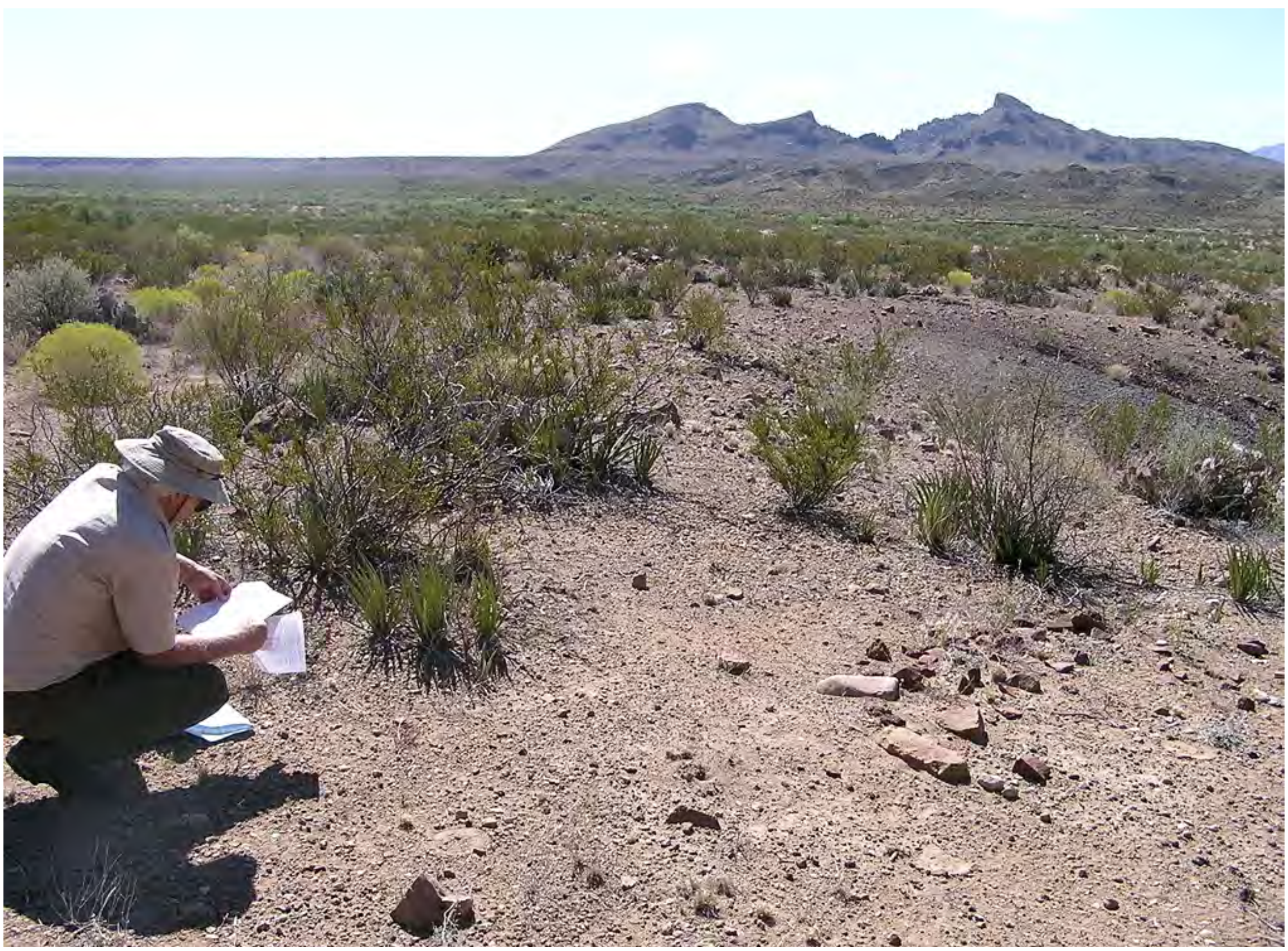


Figure 3.28 Volunteer Steve Harper recording a site during a powerline survey. Photo by T. Alex. Courtesy of National Park Service, BBNP.

and 2003, Harper made a reconnaissance of Maverick Road, covering about 478 ha (1,180 ac) and recorded 16 sites, including 7 new prehistoric sites. In 2003, he also focused on the Terlingua Abajo area, surveying 315 ha (778 ac) and recording 17 mostly new sites. In 2004, Harper made a reconnaissance of about 16 km (10 mi) along the west end of the River Road, covering about 575 ha (1,422 ac). From 2005 to 2006 Harper surveyed in the Croton Spring area covering 100 ha (247 ac), recording 25 prehistoric campsites and 5 historic sites. In 2007 Harper reconnoitered the Hannold Draw area and revisited three of Campbell's sites. In addition to gathering site data, site maps were produced using GPS units equipped with Environmental Systems Research Institute (ESRI) ArcPad data collection software.

In 2013 and 2014, Joan Spalding volunteered on several survey projects including revisits with Harper to sites along an abandoned powerline section that had been surveyed by William A. Cloud between 1986 and 1988. The goal was to determine the impacts from the subsequent removal of the power line poles. Harper and Spalding also conducted the 2013–2014 survey of proposed vegetation monitoring projects mentioned in the previous section. Following the retirement of park archeologist Thomas Alex in 2014, Spalding has returned each Fall-Spring season and assisted with much management related archeological work and GIS data maintenance.

Casual Reconnaissance by Thomas C. and Betty L. Alex

In addition to the formal and informal surveys and reconnaissances described above, a great many sites have been documented through casual reconnaissance into the backcountry (T. Alex 1990; Figure 3.29).

Figure 3.29 Thomas C. Alex recording a cairn feature in 1989. Photo by B. Alex. Courtesy of Tom and Betty Alex.

Over the last 30 years, Thomas C. Alex and Betty L. Alex, have gone on many extended backpacking trips to remote areas of the park such as Mesa de Anguila, the Sierra Quemada, and the Dead Horse Mountains. These jaunts covered 738 ha (1,823 ac) cumulatively and resulted in the recording of 119 sites, including of lithic procurement sites, open campsites, cliff shelters, boulder shelters, rockshelters, and historic ranching and farming sites, and others. In addition, at least another 145 sites were recorded during day hikes in the backcountry. All of these sites are documented in almost 20 personal field books. The conclusion of the present sampling survey covered in this report also marks the conclusion of the official NPS career of Thomas C. Alex. His remaining retirement years will be spent reporting on many of these excursions and the cultural resources documented as a result.

Other Archeological Studies

Few archeological research projects in the park have been conducted by academic researchers, although three projects were conducted that required Federal Antiquities Permits. In 1997, Douglas Drake, a graduate student from Texas A&M University, was granted a permit to conduct excavations at site BIBE4, which occurred in March of that year. Although, no report was produced, and attempts to contact him failed, some information—including 14 photographs—from the excavations was recovered in 2014. From these photographs it appears that a baseline was extended across the length of the rockshelter and a 1 m^2 unit was excavated. At least one temporal diagnostic was recovered.

During the summers of 1993 and 1994, Kristin D. Sobolik from the University of Maine in Orono, led archeological field schools in the park. In the summer of 1993, survey and excavations were conducted in a large rockshelter (part of the Apartimento Site Cluster [BIBE252]) and its talus deposit southeast of Burro Mesa. Nine charcoal samples were obtained, producing radiocarbon dates ranging from 550±70–1,150±90 B.P., indicating the site was occupied mainly during the Late Prehistoric period (A.D. 900–1500) with a possible terminal Late Archaic occupation preceding it. Over 90 complete and fragmentary projectile points were recovered, all but two indicative of the Late Prehistoric period. Other cultural artifacts recovered from the site include shell pendants and one burned kaolinite fragment. A smaller rockshelter named Owl Cave, located across the canyon, was also inspected but did not exhibit signs of human occupation.

In the summer of 1994, Sobolik's excavations took place at the Boot Vista Shelter (BIBE882) in the Chisos Mountains—a site previously noted in 1937 by Robert Redfield (see above). The goal was to test the site using modern excavation techniques and to backfill the large hole suspected to have been left by Redfield. The walls of the existing hole were cut back to expose the stratigraphy before it was excavated further down to sterile deposits; the cultural deposit proved to be 2 m deep. In addition to debitage, cores, projectile points, and tools that were recovered, macrobotanical samples and nine charcoal samples were collected that revealed occupations from Middle Archaic to Late Archaic times.

In 1989, the park was approached by Stephen E. Glass, director of the Wilderness Studies Institute (WSI), in Durango, Colorado, to conduct archeological field work in the park. The approach was similar to other institutes that enlist paying customers to participate in an archeological training session focused on field methods. By 1990 a set of parameters was established under which WSI personnel and customers could work. Field work was to consist of non-destructive site survey and mapping, artifact identification and documentation, and photographic recording.

Through this program, WSI conducted one two-week field session in the McKinney Springs area in 1990 where a number of sites had been originally documented by T.N. Campbell in his 1966–1967 survey. Campbell's notations were particularly vague in this area and the exact location and extent of each site was unknown. The WSI group was to resurvey and locate Campbell's sites and conduct thorough site documentation. However, no field notes or site maps were turned over to the park and no report was ever produced.

In 2002, Brandon Young completed a master's thesis on the results of the survey of Block A, the first 5,000-acre survey block investigated in 1995 and 1996 during the present project. Offering a preliminary interpretation of the data, he noted prehistoric use from the Early Archaic through the Late Prehistoric periods and analyzed site distribution patterns providing insights into human-environmental interactions in the North Rosillos Mountains during prehistory (Young 2002).

In 2002 and 2003, SRSU fine arts graduate student Andrew Tegarden conducted research in BBNP and other locales in the region, focusing on stylistic interpretations of rock imagery. Tegarden visited eight sites within the park containing rock imagery and produced a set of photographic records along with sketched reproductions. The results of this work were presented in his master's thesis (Tegarden 2005).

Legacy Data Integrity and Management: GIS, ASMIS, and TexSite

Although the NPS has conducted numerous minor reconnaissances and some intensive surveys of the park over the past 36 years, much of the focus has been on relocating and rerecording sites documented early in the park's history—data that varies significantly in quality. The 1936–1937 work by Erik Reed and Ruel Cook and the later 1966–1967 survey by T.N. Campbell for many years constituted the entire body of knowledge about the park's cultural resources. For the next 15 years, archeological data was collected in an unsystematic and random fashion from casual reports and observations by research biologists, park staff, and park visitors. Similarly, early §106 compliance in the 1980s, such as powerline repair work, commonly produced only sketchy documentation, often due to the fact that the data was literally collected "in front of the bulldozer." Because these early efforts produced data that is insufficient by modern standards, the character and location of many BBNP sites in the Archeological Sites Management Information System (ASMIS)—the NPS's database for registration and management of park archeological resources—remain unconfirmed.

The critical data most useful for daily cultural site management is maintained within the park's Geographic Information System files. ESRI GIS shapefiles are maintained for Confirmed Sites, Unconfirmed Sites, Historic Buildings, Historic Structures, National Register properties, and Areas Surveyed in the park. The most accurate accounting of the number of known sites having a reliable location is in the Confirmed Sites shapefile. As of 2021, the park has 2,755 confirmed sites with known locations. The Unconfirmed Sites shapefile is essentially a set of records that serve as placeholders for data needing confirmation. As such, they do not necessarily represent actual sites. There are 289 records in this unconfirmed category. The National Park Service Cultural Resource Spatial Data Transfer Standards: Guidelines for Use and Implementation guides how cultural resource legacy data are maintained and used. All cultural resource datasets of all resource types are now managed within an ESRI Geodatabase.

As of 2020, the ASMIS database for BBNP contained a total of 2,878 records, of which 125 are categorized as "Local Resource Types"—a category in ASMIS that indicates records that are not to be used in the annual summary report for accountability within the NPS. Records flagged as "LRT" may not actually be valid sites. Of these Local Resource Types, 3 sites are listed as "Destroyed"; 1 is listed as a district containing other sites included in the total count; 3 are isolated finds; 3 are not on NPS land; 85 are "Not Relocated"; 9 are "Other"; and 21 are "Unsubstantiated."

Excluding Local Resource Types leaves a total of 2,755 sites, 11% (n=301) of which are considered to have "Good" documentation, meaning there is most likely a state site form (which may or may not be completely filled out), a site sketch map, a narrative feature description or at least a count of site feature types, and a location that "should" be sufficiently accurate to allow someone to revisit the site without difficulty. Fourteen percent (n=392) are considered to have "Poor" documentation, meaning site data are marginal but its location is reasonably well-established. Seventy-four percent (n=2005) of sites are considered to have "Fair" documentation, meaning the locational data are mostly reliable and there is sufficient descriptive information to determine the site type although a revisit is needed to assess site condition. Finally, 2% (n=43) are unknown, and less than 1% (n=12) have no data.

Sites recorded within BBNP have been inconsistently entered into the Texas Archeological Sites Atlas (TASA) although this issue is slowly being rectified. For example, all site data compiled during the present project was entered in TASA and, in 2011, an additional 473 BBNP sites were registered by the CBBS under a separate cooperative agreement. Presently, a total of 330 BBNP sites on the confirmed sites list remain to be entered. In addition, some 333 sites that are unconfirmed remain to be ground-truthed and either registered or eliminated from the database.

In summary, with the exception of the present project, work conducted by or sponsored by NPS since 1983 has been dominated by §106 compliance as well as various efforts to organize, confirm, and clarify earlier investigations and to collect and maintain viable records of newly collected data while maintaining ASMIS and addressing the backlog of BBNP sites that remain unregistered with the state.

4

Culture History

Much of the following culture history is applicable to the wider Big Bend region and represents a significant update and refinement of previous culture histories of the region.[1] In 2004, the Center for Big Bend Studies (CBBS) began an ambitious project, the Trans-Pecos Archaeological Program (TAP), designed to bring the archeological understanding of the Big Bend region up to the level that exists in other parts of the state and to address the need for a sustained archeological and historical research effort in the region. Seven thematic domains were developed to address broad areas of research spanning the full spectrum of human presence, from Paleoindian times to the historic period, and to examine topics ranging from human adaptation to ritualism and rock art. In the fifteen years since its inception, significant inroads have been made within each of the research domains. While a number of articles, monographs, theses, and dissertations had been produced addressing topics within these domains, this is the first document in which this information has been summarized as a whole.

Fortunately, TAP's greatest strides have been for time periods we know the least about—namely, the Paleoindian, Early Archaic, and Middle Archaic periods. Notable progress has also been made for the other periods, especially the Late Prehistoric and Historic Euro-American periods, while more modest progress has been made in the Late Archaic and Protohistoric periods. Ironically (because it is more recent), one of the periods we know the least about archeologically is the Historic Indian period. There are a number of reasons for this, but two of the most important are that it was a relatively brief period of time, and—due to extremely dynamic cultural interactions during this period—the remains of these sites are typically cryptic.

The following discussion details the present state of our knowledge for the region and, for reasons stated above, reflects much more than a synthesis of existing publications.

Big Bend Chronology

Regional prehistory is divided into major and minor time periods. The major time periods are the Paleoindian, Archaic, and Late Prehistoric periods. The Paleoindian period is often divided between Early and Late. The Archaic period is subdivided into Early, Middle, and Late. The Late Prehistoric period is sometimes divided into different phases, although most of these are only strictly relevant to the prehistoric villages at

1. The two most comprehensive culture histories are Robert J. Mallouf's A Synthesis of Eastern Trans-Pecos Prehistory, unpublished Master's thesis, Department of Anthropology, The University of Texas at Austin (1985) and William S. Marmaduke's Prehistoric Culture in Trans-Pecos Texas: An Ecological Explanation, unpublished Ph.D. dissertation, The University of Texas at Austin (1978).

La Junta (present-day Presidio, Texas). Table 4.1 shows the corresponding date range for each major period.

Because of the paucity of sound stratigraphic data for the Big Bend, this chronology was largely derived from adjacent regions, particularly the Lower Pecos. Similarities between projectile point styles initially led to a cultural-historical construct based on data derived from excavations outside the region. In recent years, this deficiency has been partially resolved through survey and controlled excavations by the CBBS. This new data has allowed refinement of the chronology and its associated time frame.

Table 4.1 Big Bend Cultural Chronology

Paleoindian Period	11,500–6500 B.C.
Early Archaic	6500–2500 B.C.
Middle Archaic	2500–1000 B.C.
Late Archaic	1000 B.C.–A.D. 700
Late Prehistoric	A.D. 700–1535
Protohistoric	A.D. 1535–1700
Historic	A.D. 1700–present

Native American History in the Lower Big Bend

Paleoindian Period (11,500–6500 B.C.)

Evidence of Paleoindian occupation of the Big Bend remains sparse. Until recently, human presence during this period was inferred based almost entirely upon isolated finds of Paleoindian projectile points. Due to the near absence of excavated Paleoindian sites in the region, much of our understanding of Paleoindian culture and chronology has depended upon a limited number of artifacts recovered from surficial contexts as well as work conducted in adjacent regions.

Several hypotheses have been proposed in an attempt to explain this conspicuous absence. One argues that the loss of early prehistoric sites may be due to erosional processes that have long prevailed in the region. Another argues, conversely, that Paleoindian sites are buried in alluvial deposits that prevent their discovery, or limit their exposure to brief periods following severe erosional episodes (Miller and Kenmotsu 2004). Once exposed, subsequent erosion may destroy sites or obscure their cultural affiliation. Other factors that have been posited include limited archeological access due to large private landholdings and a scarcity of cultural resource management (CRM) projects in the region (Bever and Meltzer 2007; Meltzer and Bever 1995).

However, the continued discovery of Paleoindian projectiles from surficial contexts, coupled with recent finds of buried Late Paleoindian sites in the Big Bend, provides solid evidence that the area was, in fact, occupied by Late Paleoindian peoples, even if in limited numbers. There remains, however, a notable absence of buried Early Paleoindian sites in the region. The corresponding limited number of isolated finds of Early Paleoindian projectile points may suggest that these few artifacts were carried by non-residents simply passing through the area or seeking specific resources. The abundance of high-quality lithic resources in the region is thought to be one such resource that may have been targeted. However, it has also been postulated that a low density of game animals, as well as a scarcity of other resources, may have been contributing factors that rendered the Big Bend peripheral to Early Paleoindian adaptation (Seebach 2011).

Only four buried sites are known in the Big Bend that date to the Paleoindian period. The first discovered was the J. Charles Kelley site (BIBE908), recorded in 1992 during construction activities in the Chisos Basin in Big Bend National Park (BBNP) (Figure 4.1). Diagnostic artifacts were not encountered but the excavation revealed two Late Paleoindian thermal features

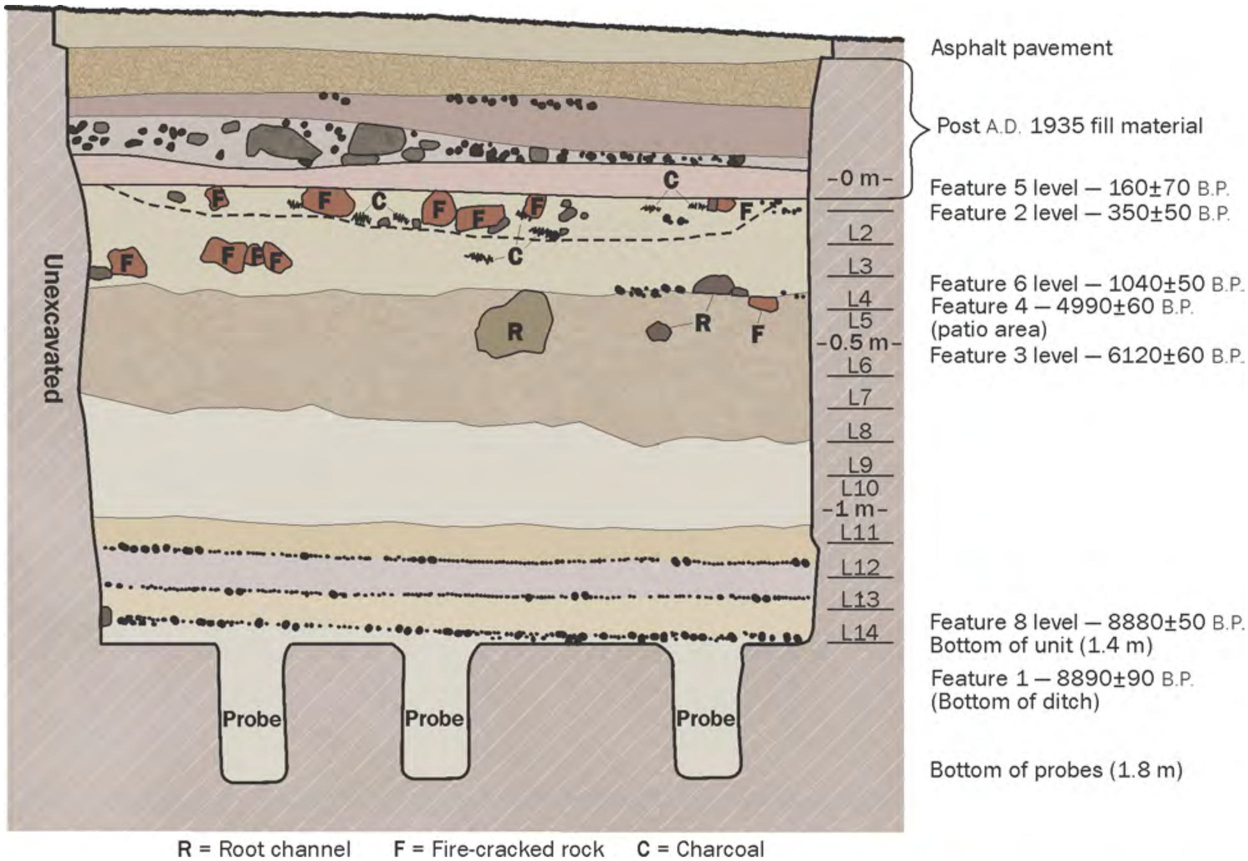


Figure 4.1 Profile of excavation at the J. Charles Kelley site (41BS908) by T. Alex. Illustration by L. Wetterauer.

that constitute the first regional Paleoindian site verified through radiocarbon dating (T. Alex 1999).

Recently, three additional buried sites have been discovered in the region dating to the Late Paleoindian period: Genevieve Lykes Duncan (41BS2615), Searcher (02-387), and Juncture (02-390). Two of the sites have undergone partial excavation and a significant amount of data has been gleaned from this preliminary work. Notably, one Clovis preform was discovered in a backdirt pile and an untyped, stemmed side-notched projectile was recovered *in situ* near a thermal feature dating to ca. 8000 radiocarbon years before present (RCYBP) at the Genevieve Lykes Duncan site.[2]

Early Paleoindian Period (11,500–10,200 B.C.)

There are currently no Clovis or Folsom kill sites, processing sites, or campsites recorded in the Big Bend. Yet isolated finds of Clovis and Folsom projectile points indicate that Early Paleoindian peoples were at least occasionally present in the region, although the low density of these artifacts likely reflects sparse populations (Bever and Meltzer 2007). However, the occurrence of Clovis and Folsom points suggests that campsites may eventually be located buried within the deep alluvial basins near the headwaters of arroyo systems, or perhaps near the headwaters of tributaries to the Rio Grande in areas that have not experienced the intensive

2. Radiometric dates presented in this section are "conventional radiocarbon dates" that have not been calibrated to tree ring data that accounts for fluctuations in atmospheric ^{14}C. The actual date of occupation would be around 1,000–1,500 years older.

erosional events common to the more southerly areas of the region (Campbell 1970; Mallouf 1999).

To date, in addition to the recently discovered Clovis preform, seven Clovis projectile points have been recovered in the Big Bend region, six of which were found in Brewster County. Four of the five were recorded in or near BBNP (Campbell 1970; Mallouf and Seebach 2006). The recovery of Folsom projectile points in the area has been equally meager, consisting of a total of seven points and preforms recovered as isolates in Brewster, Presidio, and Jeff Davis counties north of BBNP (Mallouf and Seebach 2006). The present survey recovered one Midland point that represents the only artifact collected during the project definitively attributable to the Early Paleoindian period.

Despite the absence of buried Early Paleoindian sites in the Big Bend, two significant sites have been recorded adjacent to the region that produced a substantial number of Folsom projectile points. The Chispa Creek Folsom site (Lone Wolf site), located in Wild Horse Draw in Culberson County, was first discovered and investigated by the late Joe Ben Wheat in 1947. Ten years later, Wheat found additional Paleoindian presence in the area and recovered several Folsom projectiles and additional tools (Amick and Hofman 1999). Wheat eventually recorded and numbered 22 separate Paleoindian localities under the Chispa Creek site name. The site (41CU315/locality 45A5-6) and adjacent localities eventually yielded more than 150 diagnostic Folsom projectile points (Amick and Hofman 1999; Seebach 2011). However, the site also contained many diagnostic artifacts from later cultural periods suggesting the area represents a large palimpsest site that spans some 12,000 years of occupation (Seebach 2004:22–23).

Bone bed 2 at Bonfire Shelter (41VV218), located near Langtry, Texas, is believed to be a jump-kill site and/or a kill-processing site dating to ca. 10,080 RCYBP that contains a large number of extinct *Bison antiquus*. Several different projectile point types including Folsom, Midland, Milnesand, and Plainview points have been recovered among the faunal remains (Byerly et al. 2007; Dibble and Lorrain 1968).

Late Paleoindian Period (10,200–6500 B.C.)

Eight Late Paleoindian sites have been recorded outside BBNP in Brewster and Presidio counties based upon surficial projectile points. Three of the eight sites are located in Brewster County: 38 Hill (41BS602) just west of Terlingua Ghost Town, and Duff Creek (41BS1515) and Angostura Flats (41BS1516), both in Green Valley in central Brewster County. In Presidio County, 41PS452, 41PS542, and 41PS937 are all located within Big Bend Ranch State Park (BBRSP) (Seebach 2011).

Of the two remaining Presidio County sites, 41PS816 is located in the Alamito Creek basin on the Marfa Plain, and the Sullivan Site (PCR197) is located in the Sierra Vieja Breaks in the far western part of the county (Seebach 2011). All eight sites also include cultural components dating to the Archaic and/or Late Prehistoric periods and, in several cases, include artifacts from the Historic period. Seven of the sites are located near springs and/or intermittent streams (Seebach 2011).

Thirty-two Late Paleoindian projectile points and fragments were recovered from these eight surficial sites. This collection of points is dominated by the Angostura type, 15 of which have been recovered, followed by 5 Plainview, 4 untyped lanceolate points, 4 Golondrina, and 1 each of Lerma, Cody, Milnesand, and Big Sandy-like types. Significantly, all eight sites contained at least two Late Paleoindian point types and two of the sites (both in central Brewster County) contained three or more types (Seebach 2011).

The survey in BBNP reported here resulted in the recovery of 20 additional surficial Late Paleoindian projectile points and diagnostic point fragments. Eighteen of these were collected from 13 sites: BIBE415, BIBE604, BIBE970, BIBE1185, BIBE1215, BIBE1257, BIBE1381, BIBE1655, BIBE1656, BIBE1850, BIBE2254, BIBE2492, and BIBE2527.

Significantly, four of these 13 sites may be single-component Paleoindian sites. The remaining two Paleoindian projectile points recovered during the project were isolated finds.

In addition to the previously mentioned Midland projectile point recovered during the project, 9 of the 20 points are Angostura, 6 of which display grinding on the lateral stem edges. Two additional untyped lanceolate projectiles, 1 with similarities to Angostura and 1 resembling the Golondrina type, as well as a stemmed projectile with affinities to the Wilson type, were also attributed to the Late Paleoindian period. Seven untyped lanceolate points were also collected that exhibit attributes commonly associated with Paleoindian period projectile points but could not be definitively placed in either the Early or Late periods (see Prehistoric Material Culture, this volume).

Three buried sites dating to the Late Paleoindian period, all located in central Brewster County, have been recorded by the CBBS. The Searcher site (41BS2621) and the Juncture site (02-390) were both discovered in 2012. Although the Juncture site has yet to be subjected to analyses other than dating of wood charcoal, excavation of Feature 1 at the Searcher site suggested it was a lightly used earth oven. Although starch grains were not found, significant quantities of High-spine Asteraceae, Cheno-Am, and Poaceae pollen were recovered. However, definitive proof of either animal or plant processing in the feature was lacking (Cummings 2012).

Additional processing of matrix from Feature 1 resulted in the identification of four different types of fuelwood: mesquite (*Prosopis* sp.), creosotebush (*Larrea tridentata*), desert olive (*Forestieria* sp.), and desert willow (*Chilopsis* sp.). Raphide crystals, representing phytoliths of calcium oxalate normally found in plants such as agave and yucca, were also recovered from the matrix suggesting the feature represents a Late Paleoindian earth oven utilized to process such evergreen rosette plants (Dering 2013:3). Feature 2, another rock-lined thermal feature at the Searcher site, has been radiocarbon dated but awaits excavation.

The Genevieve Lykes Duncan site (41BS2615), located on an interfluve between Terlingua Creek and a lesser drainage to the east, presently holds the greatest promise for understanding regional Late Paleoindian lifeways. The site investigation led to the discovery of 13 thermal features containing fire-cracked rock. Nine of these features date to the Late Paleoindian period. Feature 1, the oldest feature found so far at the site, has three radiocarbon dates that range from 9420 to 9545 RCYBP. Feature 10, the second-oldest thermal feature encountered, has a single date of 9411 RCYBP. The remaining seven Late Paleoindian thermal features date between 7900 to 8400 RCYBP (Cloud et al. 2016).

Twenty-seven pieces of woody charcoal from the nine Late Paleoindian thermal features at 41BS2615 have been identified. In order of abundance, these consisted of 44 percent mesquite (*Prosopis* sp.), 33 percent saltbush (*Atriplex* sp.), 7 percent pecan (*Carya illinoinensis*), 7 percent creosotebush (*Larrea tridentata*), 4 percent acacia (*Acacia* sp.), and 4 percent cholla (*Cylindropuntia* syn. *Opuntia*) (Puseman et al. 2013).

Pollen recovery from Feature 1, provides some data on the Late Paleoindian environment as it existed 11,000 years ago. Because pollen is destroyed by high temperatures, it is presumed to have been deposited shortly after the feature's abandonment. The pollen recovery is dominated by Cheno-Am (goosefoot family and amaranth), reflecting the local growth of plants such as saltbush. Small amounts of juniper and pine pollen were also found as well as lower quantities of pollen from sagebrush, thistle, members of the sunflower family, two species of ephedra, wild buckwheat, grasses, and a member of the rose family (Puseman et al. 2013:11).

Two conjoining pieces of ground-stone collected from within Feature 1 failed to yield starch grains although several phytoliths were recovered suggesting the processing of grass seeds, members of the spiderwort genus *Tradescantia,* and seeds from a member of the sunflower family (Asteraceae) (Puseman et al. 2013:11–12).

Tools recovered from the site were primarily expedient although several bifaces were recovered, including one that may be a dart point preform. An additional finely worked, long, thin, and narrow biface fragment was initially thought to represent a punch or awl, but is now believed to have functioned as a knife. A corner-notched dart point with an expanding stem and concave base was recovered adjacent to and at the same elevation as Feature 2—a thermal feature that dates between 7934 and 8180 RCYBP (Cloud et al. 2016). Significantly, this specimen represents the first Late Paleoindian projectile point recovered from a buried *in-situ* context in the greater Big Bend region. The biface and dart point both await use wear and protein residue analyses. In addition to these finds, a Clovis preform was found in the backdirt of a backhoe trench at the site indicating the presence of an Early Paleoindian component. Research at the site is ongoing.

In summary, a limited number of Early Paleoindian projectiles have been recovered from surficial contexts in the Big Bend, but stratigraphic evidence for occupation of the region during this early period is currently absent. These early surficial projectile points may represent small groups or individuals conducting exploratory ventures into the region that left but scant evidence of their passing. The greater recovery of Late Paleoindian projectile points and the recent discovery of a number of buried Late Paleoindian sites suggests a more intensive occupation of the region during this period.

While a range of Late Paleoindian projectile point types are found in the region, the most abundant is the Angostura point which generally dates from ca. 8000 to 8800 B.P. (Holliday 2000:271). The relative abundance of these points may suggest the beginning of a desert-adapted hunting-gathering lifeway. At the Wilson-Leonard site in Central Texas, Angostura points were found along with stemmed projectile points characteristic of the Early Archaic in deposits that suggest a significant reliance on plant gathering and processing and on the hunting of small and mid-sized fauna (Collins 1998:214–239; Holliday 1997:157).

In this context, the presence of a Late Paleoindian rock-lined hearth containing ground-stone at the Genevieve Lykes Duncan site is suggestive. In addition, the fact that all of the Late Paleoindian thermal features at each of the three newly discovered buried sites are rock-lined supports the idea that an Archaic lifeway based partly upon the gathering and processing of plant materials was already in place in the region by ca. 11,000 years ago. Based upon data gathered thus far at these three new sites, the term "Paleo-archaic," or perhaps "Proto-archaic," may best describe the Late Paleoindian occupation of the Big Bend region as presently understood.

Early Archaic Period (6500–2500 B.C.)

Despite its 4,000–year duration, the Early Archaic period in the Big Bend is poorly understood and generally has been recognized based upon the cross-correlation of projectile point types from adjacent regions (Mallouf 1985). As with the Paleoindian period, the great majority of Early Archaic artifacts recovered from the region have been surface finds.

Most of the Early Archaic period coincides with the Holocene Climatic Optimum that occurred between roughly 9,000 and 5,000 years ago—a time when summer temperatures in the northern hemisphere tended to be higher. This warming trend also likely correlated with the contraction of early Holocene woodlands and the expansion of desert grasslands and more xeric vegetation. Analysis of ancient packrat middens and botanical evidence from thermal features from this period indicate that many components of the modern desert plant community had become well established. These changes appear to have had far-reaching impacts on human adaptation (Puseman and Cummings 2008; Van Devender 1986; Van Devender and Spaulding 1979:706, 707).

During the early part of the Early Archaic, a region-wide shift from lanceolate projectile point forms to corner- and side-notched stemmed forms appears to have occurred (Mallouf 1985:101). The influences that may have prompted this shift are not fully understood, but it is evident that the change from lanceolate to notched and stemmed forms had its beginnings prior to the Early Archaic. Stemmed and notched projectile points, with ground lateral and basal stem edges, were recovered from Paleoindian contexts at the Wilson-Leonard site (Bousman 1998) in central Texas, at the Devil's Mouth site in southwest Texas (Johnson 1961, 1964; Sorrow 1968), and at a handful of additional sites in the southern part of the state. Many of these sites, however, offer imprecise chronologies due to undifferentiated or mixed cultural strata (Bousman et al. 2002).

Projectile point forms diagnostic of the Early Archaic period in the greater Big Bend region include Andice, Bell, Baker, Bandy, Uvalde, Early Triangular, Early Barbed, Martindale, Gower, and Pandale, with the latter dominating the regional Early Archaic assemblage. For example, over half of the Early Archaic projectile points recovered during the BBNP project were Pandale points (Gray, 2013:32; Mallouf 1985:101; Native American Archeological Findings, this volume). Although more common to the western Trans-Pecos, the Jay and Bajada projectile point types are also occasionally found in the region (Robert Mallouf, personal communication 2011).

Only four Early Archaic projectile points have been recovered from dated contexts in the region. Three of these from Phantom Lake Spring (41JD63) in Jeff Davis County consist of one Uvalde-series type, one Bell/Andice type, and one untyped point (Suhm et al. 1954; Turner and Hester 1985; Charles et al. 1994). The fourth, a stemmed, corner-notched projectile point fragment, was recovered *in situ* adjacent to a hearth dated to the Early Archaic period at the Genevieve Lykes Duncan site (41BS2615) in Brewster County northwest of BBNP. This projectile was missing the distal portion of its blade and, although the projectile point is not definitively typed, it has certain morphological attributes of the Bandy type (Robert Gray, personal communication 2011).

For years, Phantom Lake Spring represented the only site in the region with a firmly dated Early Archaic component. Recent investigations have resulted in Early Archaic radiocarbon dates from eight newly discovered sites in the region, all of which are located north or northwest of BBNP. In addition to the Early Archaic locale at the Genevieve Lykes Duncan site are the David Williams site (41PS1020) on the Marfa Plain and the Calendar (41BS1517), Birthday (41BS1914), Buckhorn (02-251), Curtain (02-252), Paradise Draw (02-04), and Hackberry Creek (02-51) sites located in and around Green Valley, northwest of BBNP. Limited excavations have been undertaken at five of these nine sites.

As predicted by Mallouf (1985:102), these new sites are located in the alluvial-filled basins and foothill zones of the region. Each site is located near a modern-day source of water that was probably present at these locations, to a greater or lesser degree, when the sites were occupied. Phantom Lake Spring is located at the site of a major natural spring and David Williams sits on the west bank of Alamito Creek. The seven additional sites northwest of the park are located within the deep soils of alluvial fans or on the interfluves between drainages. The terrain at these sites is deeply cut with arroyos and tributaries that feed into the headwaters of Terlingua Creek.

One characteristic that traditionally has distinguished Archaic from Paleoindian lifeways is the extensive utilization of ground-stone during the Archaic period. A broad range of ground-stone tools appear to have been integral to the daily activities of Early Archaic and later hunter-gatherers in the preparation of wild vegetal materials for food, medicines, and other purposes. Ground-stone artifacts, in the form of cylindrical pestles, slab or small boulder-type metates and manos, are common at Early Archaic sites in the greater Big Bend. Ground-stone fragments are frequently recycled as heating elements in Archaic hearths.

An increase in the utilization of rocks as heating elements in thermal features is also characteristic of Archaic lifeways, and has been observed in all Early Archaic hearths recorded in the region to date. Thoms notes that this practice began in western North America as early as 11,000 years ago, and a continent-wide increase in the utilization of rocks as heating elements occurred during the Holocene. The intensification of broad-spectrum foraging, increasing regional specialization, and increasing aridity necessitated new cooking methods in order to facilitate the processing of plants that were formerly considered low-ranking food resources (Thoms 2008a, 2008b, 2009). Such processing renders plants less toxic, more digestible, and more nutritious, while eliminating parasites. Cooking also reduces moisture content, which is required for bacterial growth, thereby extending the storage life of the prepared food (Wandsnider 1997:2).

Although earth ovens—the penultimate prehistoric burned rock feature—are not believed to have been utilized extensively until late in the Archaic, at least one site suggests their use during the Early Archaic. At the Birthday site in central Brewster County, a 10m^2 area of fire-cracked rock appears to represent the remnants of an earth oven. Based upon charcoal recovered from an adjacent hearth, this earth oven may date to roughly 6800 B.P. Research at the Birthday site and at a few Middle Archaic sites in the region, indicates that earth oven use increased beginning in the Early Archaic period (Ohl 2011).

Pollen and macrofloral analyses conducted at the Phantom Lake Spring and David Williams sites are indicative of a wide variety of plant species from desert grassland and shrubland environments. Flora represented from pollen recovery includes high-spine Asteraceae (aster, rabbitbush, snakeweed, sunflower family), low-spine Asteraceae (ragweed, cocklebur, sumpweed), Cheno-am (goosefoot family and amaranth), *Prosopis* (mesquite), *Salix* (willow), a small amount of *Pinus* (pine), *Ephedrea torryeana* (Mormon tea), *Poaceae* (grasses), *Sphaeralcea* (globe mallow), *Vitis* (grape), and Trilete-smooth (fern) (Puseman and Cummings 2008). In addition, *Quercus* (oak) pollen was identified from Phantom Lake Spring (Charles 1994). The recovery of a small amount of *Vitis* pollen suggests that grapes were processed within or near a hearth at the David Williams site and charred Cactaceae spines recovered from hearth matrix indicate that cacti were processed in at least one of the hearths at the same site (Puseman and Cummings 2008).

Other plant species recognized through wood charcoal identification indicate that a desert scrub environment had fully developed in the region by ca. 7,000 years ago. Six types of wood charcoal were identified from the Early Archaic hearths, including Asteraceae, *Atriplex* (saltbush, shadscale), *Prosopis*, *Acacia*, *Cylindropuntia* (cholla cactus), and *Larrea tridentata* (creosotebush). Not surprisingly, *Prosopis*, a preferred fuelwood historically, was identified in every Early Archaic hearth in the study except one and was most often identified in combination with other types of fuelwood (Puseman and Cummings 2008, 2009; Puseman 2009, 2010).

Limited faunal analyses conducted at Phantom Lake Spring and the David Williams site identified a preponderance of arid adapted species still present in the region today. Faunal recovery from an Early Archaic stratigraphic context at Phantom Lake Spring consists of 89 fragmentary bones from small, medium, and large mammals (Charles 1994). Eight bone fragments identified as deer/pronghorn were intensely burned and two unburned bone fragments were identified as cottontail rabbit. However, the fact that only 11 bones of the total 89 evidenced any degree of burning (Schniebes 1994) places the cultural association of the majority of the recovered bone from Early Archaic strata at the site in question.

Bone recovered from excavations at the David Williams site consists of a total of 266 specimens. More than 90 percent of this total was highly fragmented and 65 percent (173 pieces) evidenced various degrees of burning. Although only a small portion of the fragmentary bone is identifiable, the bones of deer or antelope are present, as well as those of jackrabbit and cottontail, in addition to one possible bison astragalus (Willett 2011).

While the data acquired thus far from these Early Archaic sites is insufficient to allow for more than cursory observations, a few generalizations can be made. Pollen and macrofloral analyses, along with the identification of wood charcoal, reveal that many of the plant species common to the northeastern Chihuahuan Desert environment were already present ca. 7,000 years ago. The utilization of ground-stone tools was ubiquitous, suggesting a significant reliance upon plant foods. Likewise, abundant evidence of hot rock cooking suggests that wild plant materials became increasingly important. The relative importance of animal resources to the Early Archaic diet is not fully understood though sites examined to date indicate a heavy reliance on plant foods and a more limited reliance on small-and medium-sized game.

Our very limited knowledge of the Early Archaic period in the Big Bend requires a cautious and qualified interpretation. However, ongoing excavations at these newly discovered sites, along with the continued search for additional sites, should shed further light on the Early Archaic period in the region.

Middle Archaic Period (2500–1000 B.C.)

By at least 4,500 years ago, desert conditions were widespread in the vast basin-and-range country of the greater Big Bend. At this time, marking the very beginnings of the Middle Archaic period, movements of indigenous people appear to have become less fluid. A period of relative entrenchment began as different groups throughout central and western Texas adapted more fully to environmental change and to regional peculiarities (Mallouf 1985; Marmaduke 1978b; Ohl 2014).

Environmental data from sites radiocarbon-dated to the Middle Archaic period suggest a land in transition. The xerification process that began as early as the Paleoindian period was turning grasslands to desert, but with intra-regional variations. Pollen analyses in portions of the region north of BBNP, close to Guadalupe Mountains National Park, indicate that different environmental conditions prevailed within these two subregions during the Middle Archaic.

At Rounsavalle Ridge (41CU681) in northeastern Culberson County, pollen dated to about 3,500 years ago (1620–1410 B.C.) indicates a steppe prairie environment (Turpin 2005). While no pollen analyses have been conducted on Middle Archaic sites within the park, pollen and macrobotanicals from the Paradise site (41PS914) in eastern Presidio County, about 80 km (50 mi) northwest of the park, and 2 degrees of latitude south of Rounsavalle Ridge, indicate that climatic conditions 4,000 years ago were similar to the Chihuahuan Desert climate of today (Ohl 2006).

Probably in response to increasing aridity, indigenous people appear to have adopted new technologies, including a succulent processing method and changes to their projectile point technology. The processing of succulents in earth ovens was a technological innovation that appears to have flourished in Central Texas during the Early Archaic period (Decker et al. 2000:301). Essentially, this processing allowed inedible, complex carbohydrates in the hearts of the plants to be broken down into more nutritionally available simple sugars. Processing involved excavating a shallow pit that was then filled with fuel and rocks to be used as heating elements. After the fuel was reduced to coals, succulent hearts or bulbs were sandwiched between layers of protective vegetation on top of the heated rocks, sealed with a mound of earth, and baked for as long as two or three days (Figure 4.2). The oven was then at least partially dismantled to retrieve the baked contents. For a more detailed description of the construction and baking process, see Woltz (1998) and Dering (1999, 2003). Because these baking locations were often utilized repeatedly, with much recycling of usable rocks, what archeologists find today are extensive deposits of burned rock mixed with ash- and charcoal-laden soils. These heaps of waste are termed burned rock middens. In cases where the feature has a central depression, they are called ring middens.

Most researchers in the region, past and present, hypothesize that the use of earth oven technology

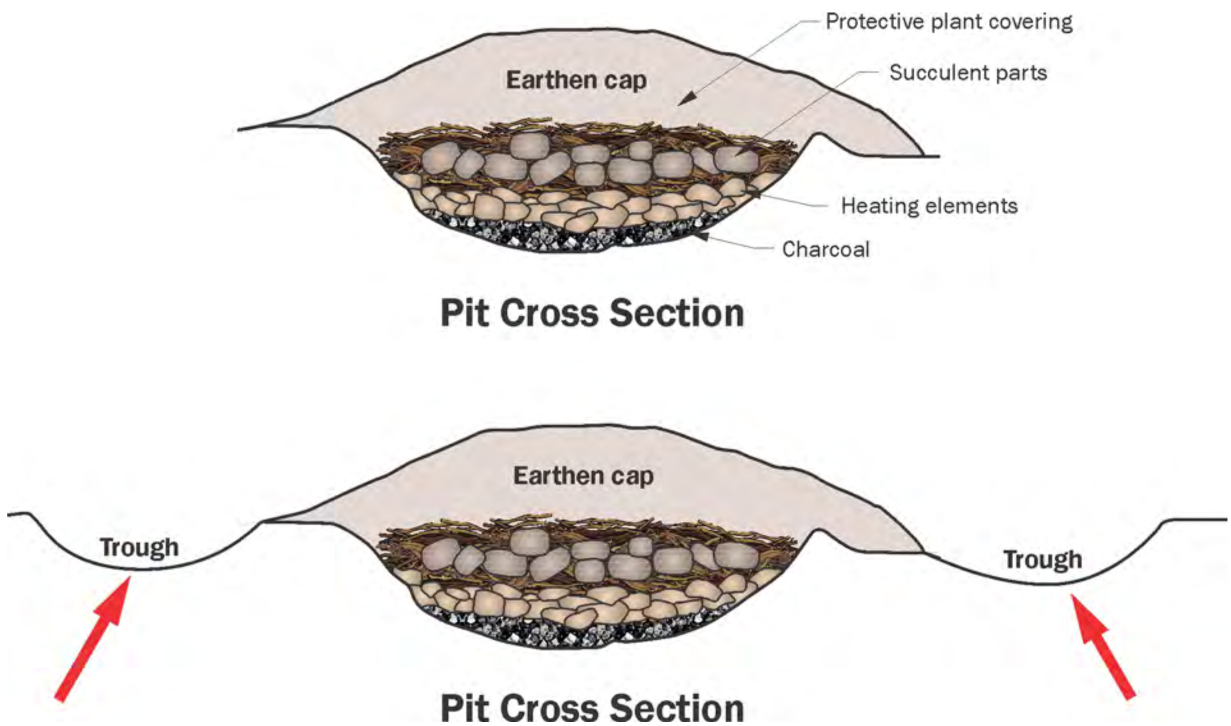


Figure 4.2 Idealized cross section of an earth oven. Illustration by D. Hart and L. Wetterauer.

gradually increased here during Archaic times, perhaps because succulents had become more plentiful as the environment reached a level of stasis. It was a revolutionary change in subsistence that involved greater preparation and intensive processing. Large quantities of an inedible product had to be harvested through a complex time- and labor-intensive procedure before it was rendered edible, allowing it to become an important component to their diet (Gonzalez Arratía 1989:13–14).

Evidence of the use of earth ovens are present at only about 30 percent of sites in the park that contain Middle Archaic materials and, even with these few sites (n=20), a cultural association cannot be assumed since these middens could be residue of earlier or later peoples. These limited findings suggest that within the park, succulent processing during Middle Archaic times may not have been an important part of the subsistence strategy, or at least may have been less important than in other parts of the region (Ohl in press).

Technological changes also came in the form of the adoption of contracting stem dart point styles. Like succulent processing, contracting stem technology evolved earlier outside the region, most likely in the Valley of Mexico (MacNeish et al. 1967; Marmaduke 1978b:248–249). In the Big Bend, contracting stem dart points are the primary indicators of Middle Archaic occupations. No other specific artifact or feature types are known to be diagnostic for this cultural period. Contracting stem dart points have been recorded at over 200 sites in BBNP (including sites documented prior to the current project) (Ohl in press).

Technologically speaking, contracting stems are believed to have provided an advantage by bearing the brunt of the impact, thus lessening wear and tear on the wooden shaft to which it is affixed. Several researchers have pointed out that the shaft actually requires more time to craft than stone points and should be considered the most valuable part of the weapon (Keeley 1982:800; Musil 1988:373–375). Since finding suitable wood for spear shafts may have been a persistent concern in the desert, any innovation that would have lengthened the life of this component might have been embraced. Regardless of its theorized advantages, the apparent longevity of the contracting stem tradition in the Big Bend seems to attest to its utility.

The most recognized and prominent of contracting stem point types believed to date to the Middle Archaic period are Almagre, Langtry, Arenosa, and Jora. Three other point types—Val Verde, Pedernales, and Gobernadora—are also considered to be part of this tradition although they do not exhibit classic contracting stems.

Almost 600 Middle Archaic dart points were identified from the 200 sites in BBNP although a full one-third of these could not be definitively typed. Of those remaining, almost half were Almagre and Langtry points, with another 20 percent typed as Arenosa and Jora. Val Verde, Pedernales, and Gobernadora points represented less than 10 percent each.

Gobernadora points, which are prevalent in northern Mexico, are rare in this region. However, seven specimens have been identified, three of which were recovered from BBNP. Of those from the park, one was found on top of Rosillo Peak and another high in the Chisos Mountains. Similarly, of those recovered from the greater Big Bend region, one was from Nine Point Mesa north of the park and one high in the Chinati Mountains in far western Presidio County. The fact that so many of these points are found in mountaintop settings, along with their unique morphology, suggest they may have been used for special purposes. There are exceptions, however. The third Gobernadora point from BBNP was found at a habitation site along the Rio Grande (BIBE1520). Used heavily through time, this site contained 88 hearths, several pecked pebbles, and a few points from other cultural periods. Even so, 10 contracting stem points dominate the collected artifacts from the site (Robert Gray, personal communication 2013).

Regional populations during the Middle Archaic appear to have concentrated where desertification was complete—most notably in the lowlands of the Big Bend (Ohl in press). This suggests that specific resources were being targeted here that did not occur in other settings. Succulents, for example, especially lechuguilla in the late winter and sotol in the early spring, likely formed an important component of the diet. Nevertheless, processed succulents probably did not dominate their subsistence system. Instead, the variety of life forms and the attendant variety in seasonality (Nabhan 1989:8–9), the overproduction of seeds in plants adapted to xeric conditions, and the efficiency of succulents in storing water and nutrients (Niethammer 1974:xxi) would have offered a broad-spectrum diet that obviated the need for such specialization.

Data suggest that Middle Archaic groups in the Big Bend tended to cluster around springs and the occasional rockshelter, but may have spent their winters along the Rio Grande. The extensively occupied sites along the Rio Grande occur among a cluster of special-use sites that contain features indicative of ceremonial or ritual activities. The most conspicuous, a cache of 13 Middle Archaic dart points consisting of 11 Almagre and 2 Langtry points, was recovered at the Lizard Hill site (BIBE1853) in the southernmost portion of the park (Ohl 2007). This cache was located on the side of a low hill, marked by a cairn of small boulders. Seven points were found on the ground surface (probably a result of rodents carrying them up) and two were recovered between the partially intact cache and the surface. At 20 cm (8 in) below the surface, the *in situ* portion of the cache was discovered, consisting of four projectile points that appear to have been nested within two mussel shells and capped by a river cobble "capstone."

These shells, of the Unionidae family, probably represent yellow sandshells (*Lampsilis teres*), currently known to be native to the central and lower Rio Grande (Howells et al. 1996:69; Robert Howells, Kevin Cummings, and Lyubov Burlakova, personal communication 2006, 2007). Both shells exhibit one or two drilled holes, indicating they may have been personal or ritual ornaments. One of the shells displays use-wear along one edge.

In addition to the projectile cache, the Lizard Hill site contains four non-thermal stone features of unknown function—a broad V-shaped rock alignment/petroform and three circular cobble clusters, or "pavements" made from local limestone cobbles. Notably, the apex of the V-shaped alignment "points" towards the cache, located some 90 m (295 ft) to the north. Several other sites along the river containing Middle Archaic materials also have variously shaped rock alignments/petroforms, all of which are equally enigmatic but are suggestive of a well-developed spiritual tradition.

Since areas along the river in this lowland setting are uncomfortably hot during much of the year, it is likely that Middle Archaic occupations occurred there during the more temperate winter months. Possible support for such seasonality occurs in the form of certain burned rock features at a number of sites along the river. These features consist of extensive burned rock concentrations that lack the more distinct (and deliberate) morphology of earth oven remnants. It may be that these burned rock concentrations represent coalesced hearths used to process locally abundant lechuguilla that, for several reasons (such as responsiveness to winter precipitation and less potent laxative effects), was more likely to be harvested in the winter, and in fact was considered a cold-season staple (Woltz 1998:46–48). These data, taken as a whole, may indicate that Middle Archaic groups were rendezvousing along the Rio Grande during the winter months where the abundance of lechuguilla, as well as river fauna such as fish and turtles, allowed for larger aggregations.

In contrast to the lowland settings near the Rio Grande, the elevated setting of the Rosillo Peak site (41BS762) may suggest some sort of summertime gathering. A CBBS excavation conducted there in 2005 (Mallouf et al. 2006) revealed an unusual combination of features and artifacts in this majestic mountaintop setting. A dearth of FCR at the site—both on the surface and in the test units—seems to support the seasonality hypothesis. In spite of this, a piece of charcoal recovered from the subsurface yielded a terminal Middle Archaic radiocarbon date of 2880 +/- 50 RCYBP or 1210-920 cal. B.C. (Mallouf et al. 2006:93). Although not recovered from a thermal feature, this date aligns temporally with the 21 contracting stem dart points recovered from the surface and subsurface of the site, including 1 of the 7 Gobernadora points found north of the Rio Grande. In addition, numerous grinding slicks were recorded, though at a considerable distance from any known resource that would have required grinding (with the possible exception of grass seeds). Equally anomalous, the nearest present water source is a seep spring ca. 300 m (984 ft) below the site. While the artifact assemblage consisted of projectile points and tool manufacturing and maintenance debris (including 3,808 pieces of chipping debris), there was no solid evidence for either hide working or meat preparation. These site characteristics, along with the addition of a rare Gobernadora point, suggest this site, like the Lizard Hill site, also may have served a ritual purpose during the Middle Archaic.

The inferred emphasis on hunting, in conjunction with possible ceremonial functions, at Rosillo Peak and Lizard Hill suggests a type of ritualism that embraced utilitarian aspects of the material culture—namely, projectile points. Based on known trends in regional prehistory, it may be that such ceremonial activities served to bolster the status of hunters whose importance was otherwise declining as subsistence increasingly relied on vegetable foods.

Two burials excavated by J. Charles Kelley in the 1930s (Kelley et al. 1940:97–101) comprise the only known examples of mortuary practices among Middle Archaic people in the greater Big Bend. Eroding out of a cutbank of Sheep Creek, a tributary to Calamity Creek in northern Brewster County, the burials were covered with hearthstones, stone slabs, metate fragments, and crude stone tools although no formal grave goods were noted. Despite the absence of ritual objects, these utilitarian materials capping the burials nevertheless suggest a belief in the afterlife. Interestingly, these practices appear to contrast with the shamanistic belief system of the neighboring Lower Pecos during the Middle Archaic, where it is thought that a dependence on succulents and apparent population pressures required a unifying system demonstrated through the repetitive rock art of the period (Turpin 1995:547–548).

Unfortunately, what little we know about the material culture of Middle Archaic people in the Big Bend comes from looted rockshelters, where direct associations are lacking, or from neighboring regions. Excavations in caves and rockshelters in Coahuila, Mexico, and the Lower Pecos have revealed a rich material culture with an immense variety of wood, bone, leather, shell, and fiber artifacts, including ornamental objects, sandals, mats, baskets, packs, pouches, ropes and other cordage, much of which was found in direct association with Middle Archaic points. Similar artifacts from looted shelters in the greater Big Bend that were found in very loose association with contracting stem dart points suggest that Middle Archaic people in the Big Bend had a similar suite of materials. Empirical evidence for such association consists of a single "twined" mat of sedge recovered from Cueva Encantada across the Rio Grande from BBNP that yielded a radiocarbon date of 2500–2030 cal B.C. Sotol leaves from a "mattress" in this shelter produced a later radiocarbon age of 1675–1595 cal B.C. (Turpin 1997:9–10), still well within the Middle Archaic period.

Interactions with neighboring regions seem to have gained in strength by the end of the period, along with the advent of more mesic climatic conditions. Pedernales points, common in the Lower Pecos and Central Texas, were recovered from sites that yielded radiocarbon dates from later portions of the Middle Archaic period (i.e., Crystal Creek Rockshelter and the Meander site, both on the upper reaches of Terlingua Creek north of the park). The presence of these points may suggest the beginning of interaction with groups from other areas of Texas, as the apparent entrenchment of Middle Archaic lifeways gave way to increased trade and the exchange of ideas.

Late Archaic Period (1000 B.C.–A.D. 700)

The beginning of the Late Archaic period in the Big Bend correlates with the onset of mesic conditions as indicated by elevated levels of arboreal and grass pollen in the adjacent Lower Pecos region between 1050 and 550 B.C. (Dering 2005:248). Other evidence, such as pine pollen from both the Lower Pecos and Southern Plains, further supports an increase in moisture around 1050 B.C., about the same time that cultigens begin to appear in parts of the greater Southwest (Bryant 1974:18–19; Bryant and Holloway 1985:60; Matson 2005:289). A study of the staged development of carbonates in sediment within the Tularosa and Hueco basins also supports a general increase of moisture in the northern Chihuahuan Desert, although for a longer span of time—between 2050 and 250 B.C. (Buck and Monger 1999:368).

This approximately 500-year mesic interval is believed to have improved range conditions, increased the availability of edible plants, and facilitated the growth and expansion of both resident and migratory animal populations such as deer, antelope, and bison. Higher numbers of these larger prey animals likely allowed an adaptive shift towards hunting. Such a shift may explain the greater number of Late Archaic campsites relative to earlier periods as well as their occurrence in all ecological zones across the region. Late Archaic components are commonly found in caves, rockshelters, and open campsites. These sites often contain one or more stone-lined hearths and incipient burned rock middens indicative of a continuation of communal processing of desert succulents. Such processing appears to have increased in prominence during the latter half of the Late Archaic as more xeric conditions returned (Mallouf 1985:116–128, 1999:60–61, 2005:222–224).

In conjunction with the proliferation of Late Archaic sites and their spread into almost every ecological niche is the sudden appearance of a bewildering suite of dart point styles that contrast sharply with the limited number of contracting stem forms from the preceding

Middle Archaic (Mallouf 1985:116). These corner- and side-notched forms, characterized by expanding and parallel-sided stems, are morphologically similar to those found in adjacent regions and include Charcos, Conejo, Ensor, Fairland, Frio, Lange, Marcos, Marshall, Montell, Paisano, Palmillas, Shumla, San Pedro, and Durango types (Justice 2002:195–211; Turner et al. 2011: 74, 78, 94–96, 99, 106, 127, 130–131, 137, 143, 145, 162;). Additional types such as Carlsbad, Hueco, and Van Horn points have only recently been recognized as belonging to the region or were previously undefined (Mallouf 2013b:205–210; Turner et al. 2011:68, 116, 169). The dramatic increase in morphological variability most likely represents the influx of an array of hafting technologies introduced by various hunter-gatherer groups from adjacent regions (Mallouf 2005:228; Miller and Kenmotsu 2004:222–223).

Despite the proliferation of sites, there have been an insufficient number of controlled excavations in Late Archaic deposits in the Big Bend. Until recently, the most substantive took place between 1920 and 1940, focused more on recovering perishable museum specimens than attempting to understand cultural chronology. As a result, much of what we know about the period results from cultural resource surveys conducted within the last 30 years (Mallouf 2005:225–226). Although dry rockshelters and caves are our richest sources of information for this and other time periods, a great many of the larger rockshelters and caves that contained the most robust cultural deposits have either been pot-hunted or were excavated by professional archeologists in the early part of the twentieth century using outdated techniques. A few of these early efforts are discussed below.

Excavations in the early 1920s at Ceremonial Cave in the adjacent western Trans-Pecos region produced perishable materials such as prayer sticks, hafted dart points, and various items made of fiber including hundreds of sandals. The hafted points were determined to be of the Carlsbad and Hueco types. Subsequent AMS radiocarbon dating of the foreshafts indicated an earlier date of 1690–1530 B.C. for the Hueco point while dates ranged from 400 B.C. to A.D. 220 for the Carlsbad types (Creel and Dial 2011:1). These dates support a model of repetitive use of this cave during the Late Archaic.

Large-scale excavations in the late 1920s at Bee Cave, some 5 km (3.1 mi) north of BBNP, produced an array of both perishable and non-perishable items although materials representing occupations spanning the Middle Archaic to the Late Prehistoric periods occurred in mixed deposits (Coffin 1932:61). Even so, the preponderance of projectile points recovered were Late Archaic or suspected Late Archaic forms. Much of this collection has yet to be examined using modern analytical techniques and has potential to provide a wealth of data about the Late Archaic foragers of the Big Bend.

In the 1930s, Victor Smith, a professor at Sul Ross State Teachers college, excavated Carved Rockshelter located in Sunny Glen Canyon west of Alpine. There he found both dart and arrow points representing multiple occupations from the Late Archaic to Late Prehistoric times. However, little is known about the depositional context of the artifacts because they were provenienced from the surface rather than from an elevation datum. Five storage pits lined with prickly pear pads, grasses, sticks, branches, mat fragments, and sandals were exposed. Also, corn, cordage, perforated skins, sandals, foreshafts, fire sticks, basketry, and quids were recovered (Smith 1938:222–223).

In addition to these early efforts, a couple of recent investigations are helping us to better understand the Late Archaic period. Although Spirit Eye Cave in the far western portion of the Big Bend was severely impacted by pot-hunters, the discovery of intact deposits has made the cave a focus of research in the past few years. Previous collections from the cave as well as data from new excavations in intact deposits are providing important information about this period, especially regarding perishable materials and the early use of maize in the region. Parching trays and fragments of coiled baskets recovered from the cave that date to the Late

Archaic are indicative of long-lived textile traditions that extend across the greater Southwestern U.S. In addition, maize recovered from the cave returned a date of ca. 2,000 B.P. indicating a much longer horticultural tradition in the region than previously known (Schroeder 2018:1–2).

Not far from Spirit Eye, an open campsite known as the Deep End site, has also produced important contextual information about the Late Archaic. Two radiocarbon dates indicate occupations of the site around A.D. 300 and an earlier one around 350 B.C. Significantly, both dates came from features within spring-side or pond-like deposits that may suggest a longer mesic interval than is indicated by models from adjacent regions. Just downstream, nine Late Archaic dates from buried thermal features at the Second Gate site—most clustered around 350 B.C.—indicate a lengthy period of occupation that, with further analysis, may reveal greater insights into the many unknowns of this period (Cason 2018:6–7).

Hints about Late Archaic mortuary practices are revealed at Granado Cave, located in the Rustler Hills in eastern Culberson County. Out of 10 burials excavated there, 3 were children or infants dating to the Late Archaic period. One of these contained a fascinating array of grave offerings including a large carrying basket with a tumpline and four support rods in addition to a smaller carrying basket made of red-dyed cordage. Both baskets were found “killed” (intentionally damaged) over the infant. The body was wrapped in a tanned deerskin, then enveloped in a beargrass mat, followed by a dropseed grass mat. Various artifacts were found inside the burial wrapping including a rattlesnake rattle, a deer-hoof tinkler, two agave knives, two bone awls, two olive shell beads, one small piece of mica, three small pieces of limonite, one bird-head skin, crushed cotton seeds, and numerous pieces of cordage. The presence of olive shell suggests trade links with people from the Gulf of California (Hamilton 2001:53–71).

The second burial was that of a child about 16 months old, possibly a female, whose body was flexed tightly with the head drawn down between the knees facing the opening of the burial bag in which she was placed. The bag consisted of a twined grass mat inside a twined rabbit skin robe, both wrapped inside a twined rush mat. The burial bag was then placed in the grave with two mats folded over it. Knotted cords with feathers and a skein of red-dyed cotton yarn had been placed inside the burial bag, the presence of which suggests direct or indirect trade with agriculturalists. The third burial was yet another infant less than six months old that was laid on a twined mat of split beargrass. A fragmented woven cotton belt and numerous seed beads made from common gromwell or stone seed were placed in the burial. A large coiled basket was inverted over the burial while a juniper branch was placed adjacent to and south of the basket. Rocks were then piled on top (Hamilton 2001:53–71).

In recent archeological and osteological studies of 127 human burials from the region, only 5 dated to the Late Archaic (Piehl 2009:26–35). Analyses of stable isotope signatures of collagen and apatite (the organic and inorganic components of human bone) from one of the Late Archaic Black Willow burials in BBNP were conducted and compared with previous results from two Late Archaic individuals from the ELCOR burial cave in Culberson County (Bousman and Quigg 2006:133–134). Although derived from a very small sample, the results suggest Late Archaic individuals from the Big Bend region relied primarily on grasses and succulents for much of their food, more so than was revealed in samples from the Lower Pecos region (Piehl 2009:79).

Although most Late Archaic burials have been documented from caves and rockshelters, some also occur in open campsites. One such burial, the Burr Cairn burial located in Green Valley in west-central Brewster County, was excavated in the spring of 2008. It was discovered that the burial had been previously looted. Only part of one hand and wrist were still articulated—the remaining bone was fragmentary and had been scattered both within and outside the burial pit. Around the radius and ulna were several thin, discoidal mussel shell beads, indicating the individual was wearing a shell bracelet. Skeletal analyses indicated the individual was an adult female and bone collagen revealed a Late Archaic radiocarbon date of ca. 220-50 B.C. (Cason et al. 2009: 14–15).

Although prehistoric caches are uncommon in the Big Bend, two have been discovered with attributes strongly suggesting a Late Archaic cultural affiliation. One is the McHam Cache, located on an open campsite in central Brewster County. Atypical of most caches which are commonly hidden, this cache was located in a shallow pit inside the most intensively used portion of the campsite (Mallouf 2013a:142). Excavated in 1996, the utilitarian cache consists of 15 late-stage bifaces and 2 large flakes. All of the bifaces and flakes were made of a gray chert derived from limestone sources in the neighboring Del Norte Mountains (Mallouf 2013a:129, 138–139). The homogeneity of the bifaces suggest the intention of a common end-product—their basal edge and basal corner configurations appear as if they were intended for the production of corner-notched, expanding- and/or straight-stemmed dart points, most commonly found in Late Archaic tool assemblages (Mallouf 2013a:143–144). Another utilitarian cache bearing similar attributes was recovered during the 1933 excavation of Meriwether Rockshelter C (41BS809). The cache consisted of 11 late-stage subtriangular and ovate bifaces. The cache was encountered within the same general stratum as the Late Archaic materials. Its provenience, coupled with the morphological attributes of the bifaces, suggests the cache represents Late Archaic dart point preforms (Smith and Kelley 1933:7).

Various styles of rock imagery have been identified in the region (Roberts 2010:81; Schaafsma 1992:46–48) although no chronological constructs have been formalized, mostly due to the problem of obtaining reliable radiocarbon dates. However, some researchers believe that certain regional motifs resemble the Late Archaic Shumla dart point (Sutherland and Steed 1974:16, 25), often found in association with hunting scenes. In adjacent Lower Pecos and northern Coahuila, Turpin (2004:274) has tentatively correlated pictographs depicting bison hunts and atlatls in the miniature Red Linear style pictographs to the intrusion of Late Archaic bison hunters. Pigment produced a date of cal A.D. 540–1020, placing the event sometime from the latter part of the Late Archaic to the beginning of the Late Prehistoric period (Ilger et al. 1994:344). Figures documented at several pictograph sites in the Guadalupe Mountains are strikingly similar to the Lower Pecos Red Linear style, but their temporal relationship remains unknown (Billo et al. 2011:68). Similar imagery exists at Tablecloth Rockshelter in the western portion of the greater Big Bend where a single panel includes both atlatls and darts as well as bows and arrows. If the panel was created in a single event, it suggests a date of around A.D. 1000. On more solid temporal footing is an example of Late Archaic use of "portable art" in a painted pebble recovered from a buried Late Archaic deposit at the Fulcher site in southern Brewster County in 2006. Charcoal exposed directly under the stone produced a date of cal A.D. 630–710 falling at the terminus of the Late Archaic period (Walter and Keller in prep:128).

The cultures of the Big Bend were undoubtedly influenced by trends in adjacent regions. In the Lower Pecos region, the presence of a bison bone bed and broad-bladed dart points, such as the Castroville type, at Bonfire Shelter dating between 950 and 550 B.C. provides strong evidence that these mesic conditions resulted in vegetative changes, allowing the range of bison to extend southward (Turpin 2004:272–274). Although little evidence exists for a similar expansion into the Big Bend, it seems plausible. In the adjacent western Trans-Pecos region, the Late Archaic period is additionally marked by the arrival of domesticates—specifically corn and pumpkins—probably between 1200 B.C. and A.D. 600 (MacNeish 1993:396; Miller and Kenmotsu 2004:227). During the latter part of the period there appears to be an increase in trade/interaction with groups from other regions, the development of new races of corn (Maize de Ocho and Pima-Papago), and the introduction of beans and perhaps amaranth from Mexico (MacNeish 1993:398, 400).

Although the recent maize date from Spirit Eye supports the use of cultigens during the Late Archaic in the Big Bend and some corncobs in museum collections are supposedly derived from Late Archaic sites in the region, a clearer understanding of horticulture at this early date in the region must await additional excavations of intact Late Archaic deposits in rockshelters (Mallouf 2005:238).

Late Prehistoric Period (A.D. 700–1535)

The beginning date for the Late Prehistoric period across Texas and much of North America has been associated with important technological innovations (i.e., the bow and arrow and the use of ceramics), the development of agriculture, and the establishment of villages; however, in the eastern Trans-Pecos these behavioral shifts did not occur at a single point in time nor were all adapted by every native group. Throughout the majority of the region, the bow and arrow was the only one of these advancements that was universally embraced. Since the earliest radiocarbon date associated with an arrow point—a Livermore point at the Arroyo de la Presa site (41PS800)—is around A.D. 700 (Cloud 2004:Table 1), that date is used here for the beginning of the Late Prehistoric period. The ending date for the period, A.D. 1535, marks the time of the first-known Europeans in the region, Cabeza de Vaca and his three companions.

While the atlatl and spear—hallmarks of the lengthy Archaic period—were ultimately replaced by the bow and arrow as the primary weapon across the entire region, it appears both technologies were in use for a considerable period of time during the early centuries of the Late Prehistoric period. Unpublished chronometric data from Tall Rockshelter in the Davis Mountains and the Homer Mills site in the Glass Mountains indicate Paisano dart points were still in use as late as A.D. 1100 (Mallouf 2005:226), at least four centuries after the appearance of the bow and arrow. Further possible evidence of the co-occurrence of these two weapon systems comes from a rock art panel at Tablecloth Rockshelter in the Sierra Vieja Breaks in the western portion of the region. Depicted on the panel amongst a wide array of quadrupeds and a number of anthropomorphs are about 10 images of bows and/or arrows, a single probable atlatl, and 6 images that likely represent spears. However, since portions of the panel may have been completed at different times in the past, this evidence of co-occurrence remains tentative.

Although ceramics, agriculture, and villages were mainstays of prehistoric groups in the western Trans-Pecos and adjacent areas of New Mexico during latter portions of the Late Archaic period (Miller and Kenmotsu 2004:236–238, 252), these innovations were only slowly adopted in the greater Big Bend region. In fact, outside of the La Junta district (area centered on the juncture of the Río Conchos and Rio Grande; Figure 4.3), the available evidence suggests agricultural efforts were limited and sporadic, ceramics were used sparingly, and sedentary villages did not exist.

The transitional period across the region during which the weaponry system evolved is characterized by select dart points (Paisano, Figueroa, and small untyped specimens) and the aforementioned Livermore arrow points. While a few other arrow points may have been in use at this time as well, securely dated associations have yet to be found. Subsequent arrow point types in the regional archeological record for the period include Toyah, Perdiz, Cliffton, Fresno, Harrell, Garza, and Soto. In addition, there are three newly defined arrow point types from specimens found across the region: Alazan, Means, and Diablo (Mallouf 2013b). Despite this appreciable listing, there are also a number of untyped specimens, as well as others in relatively low numbers, that adhere to established types from adjacent regions (e.g., Bonham, Lott, Scallorn, Sabinal, and Washita). This wide diversity of types suggests there were numerous discrete groups in the region during this time.

Despite the importance of the bow and arrow, there was very little change in the region to the long-

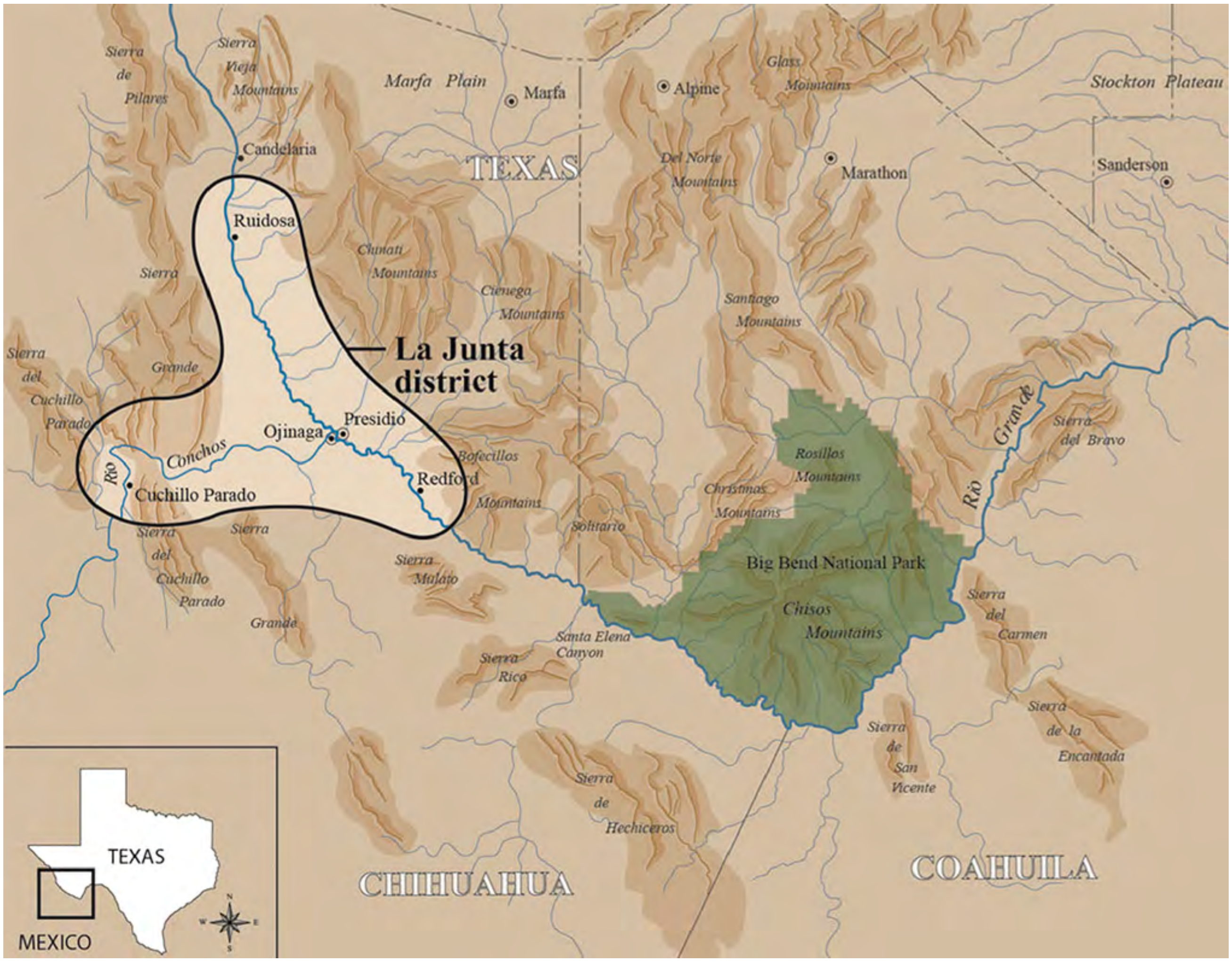


Figure 4.3 Map of La Junta District within the greater Big Bend by D. Hart.

standing and well-established nomadic lifeways of the Archaic period. Earth oven technologies refined over millennia allowed higher population levels and radiocarbon data suggests these cooking facilities saw greater use at this time, likely in response to an increasing population. Like the previous period, Late Prehistoric sites occur on a wide range of landforms, with both open sites and various sheltered locations used for habitation.

It is noteworthy that two interesting Late Prehistoric behavioral trends have recently come to light from CBBS rockshelter investigations: 1) peoples of the period often "cleaned out" Archaic-aged residue and tossed the deposits onto the talus below and 2) they occasionally constructed structures with stone-based foundations within the shelters. Both behaviors have been documented at Tranquil (41BS1513), Rough Cut (41BS1507), and Surprise (PCR-282) rockshelters, perhaps responses to space and warmth needs. All three of these rockshelters have relatively low ceilings, and the removal of earlier deposits would have enhanced their livability; however, it is also possible that cultural values or taboos might have played a role in the deposit removals. On the other hand, the structural foundations at these sites were constructed and used during a climatic period known as the "Little Ice Age," a period between ca. A.D. 1300/1400 and 1850/1900 in North

America and Europe when winters were appreciably colder than preceding or succeeding times (Cronin 1999; Fagan 2000). Thus, the interior structures documented in the region from this time may have been in response to the colder winter temperatures of this period.

Further insights into the Late Prehistoric period have been provided through several recent publications, a synthesis of eastern Trans-Pecos mortuary data by Jennifer C. Piehl (2009) and an article on a crevice burial by Piehl and Robert J. Mallouf (2013). Of the 123 aboriginal human interments documented in the region prior to Piehl's 2009 study, 40 have been dated or, based on a variety of data, are thought to be from the Late Prehistoric period. Of these, 9 were discovered in caves/sinkholes, 5 in crevices, 2 in open sites, and 24 in La Junta villages. Piehl (2009:26–35, 40–41) indicated the interments from the period conform to known practices in the region and in adjacent regions, with pit contexts, sometimes covered with stone, the most common form of burial.

For cave/sinkhole contexts during the Late Prehistoric, Piehl concluded that wrapped/bundled burials were common, extending a Late Archaic tradition in the region (Piehl 2009:40). She indicated crevice interments from the period contained multiple stones (cairns) positioned over bodies that had been placed between boulders or in bedrock fissures, and included more than one individual (Piehl 2009:39–40). The lone exception to the latter (which was not part of Piehl's 2009 study) is a single cremated individual, a probable female based on the presence of a metate on top of the cairn and adjacent boulder metate grinding surfaces; this interment (Fire Spirit Crevice Burial at site 41BS413) yielded a bone collagen date of cal A.D. 1480–1640, placing it in the terminal Late Prehistoric/early Protohistoric period (Gray n.d.; Piehl and Mallouf 2013:11). Two crevice burials, both recovered from Ghost Ridge (41BS2618) and included in Piehl's study, have been dated to the Late Prehistoric period. The remains were from an adult male and an adolescent female and yielded respective bone collagen dates of cal A.D. 880–1010 and cal A.D. 1170–1280, indicating long-term use of the crevice (Piehl and Mallouf 2013:60). Both sets of remains were also subjected to stable isotope analysis and provided congruous results, which "indicate that mobile lifeways in the Late Prehistoric eastern Trans-Pecos continued reliance on C_4 [includes maize and some amaranth] and CAM [includes desert succulents] plants, with increased exploitation of terrestrial fauna in comparison with the Late Archaic in this region" (Piehl 2009:81).

Both open-site burials in Piehl's 2009 study occurred within well-occupied archeological sites and involved stone coverings over pits containing single interments. One of these, the Palo Blanco burial, was a female covered by four large maroon-colored tabular cobbles and four rounded cobbles, and charcoal from the pit provided a date of cal A.D. 1220–1300 (Piehl 2009:110). The other, the Rough Run burial (from the Rough Run site/41BS844), consisted of a secondary interment of a male covered by a semi-subterranean cairn, with 73 arrow points and point fragments (all but one of the Perdiz type) included as grave goods; charcoal within the pit yielded dates of cal A.D. 1420–1640 and A.D. 1400–1640 (Cloud 2002, 2013a; Piehl 2009:20, 38). Similarly, a burial not part of Piehl's synthesis located nearby in northeastern Chihuahua—the Las Haciendas interment—was male and contained 194 arrow points, including 180 of the Perdiz type (Mallouf 1987). It has been suggested by the respective authors (Cloud 2002 and Mallouf 1987) that these interments may have been executed by Cielo complex peoples, and perhaps are representative of the Jumano Indians as well; however, no such definitive linkage has yet been established for either. La Junta village burials comprise the majority of Late Prehistoric burials and are summarized below. The reader is referred to Piehl (2009) for further patterns in the mortuary data from the period.

As mentioned previously, Kelley et al. (1940:23–41) developed a scheme to subdivide the regional cultural manifestations from the Archaic to the present using the terms *aspect* and *focus*, with the former encompassing the latter. They suggested use of the phrase "Livermore focus" (now referred to as the "Livermore phase") for the hunting-gathering cultural group in the region that used the well-known Livermore arrow point. This classification was not contained within either earlier or later aspects due to a lack of data. A more recent construct for a unique hunter-gatherer archaeological manifestation in the region that followed the Livermore phase—the Cielo complex—has been offered by Mallouf (1985, 1992, 1993, 1995, 1999).

Beginning in the Late Prehistoric period and ending in the Early Historic period, sedentary villages arose at La Junta, marking the beginning of agriculture in the region. Kelley et al. (1940) termed this cultural manifestation the "Bravo Valley aspect" which consisted of three distinct and sequential phases discussed below (Figure 4.4). The following discussion is organized more or less chronologically by these constructs: the Livermore phase, the Cielo complex, and the Bravo Valley aspect.

Livermore Phase

The Livermore phase construct is based largely on work conducted in the region by J. Charles Kelley and Victor J. Smith. The phase is characterized by the consistent presence of three arrow point types—originally named Livermore Barbed, Toyah Triple Notched, and Fresno Triangular—and a hunting-gathering toolkit, including double-beveled "Plains" knives, small snub-nosed scrapers, and distinctive gravers (Kelley 1957, Kelley et al. 1940:30–31). Livermore points were first discovered in 1895 by local residents beneath a cairn on the summit of Mount Livermore, the highest peak in the Davis Mountains. Over 1,500 of the distinctively shaped arrow points, an unidentified dart point, and a few flat stone beads were clustered together in a small pit beneath the cairn (Janes 1930:8). The find became known as the "Livermore Cache," and the small points were later given the abbreviated type name "Livermore."

The Livermore phase was concentrated in the Davis Mountains and Lobo Valley within the central and western portions of the region. Mallouf (1999:62) has suggested a distribution for the phase which essentially encompasses the entire eastern Trans-Pecos and extends beyond those boundaries relatively short distances: a western boundary along the Sierra Vieja, Van Horn, and Sierra Diablo mountain ranges; a northern boundary in southeastern New Mexico; an eastern boundary east of the Pecos River; and a southern boundary in northern Coahuila and northeastern Chihuahua, ca. 30–50 km (19-31 mi) south of the Rio Grande.

Kelley et al. (1940:39–41) indicated the Livermore phase had been found in consistent association with the Chisos phase of the Late Archaic, suggesting a degree of contemporaneity with foragers of that construct. Furthermore, Kelley has stated that the phase was "associated quite clearly with the erosional disconformity separating the Calamity and Kokernot Formations" (Kelley 1957:49) and accordingly predated the Bravo Valley aspect that is within the upper strata of the Kokernot deposition. Livermore points have been reportedly found in association with El Paso Polychrome ceramics in southeastern New Mexico, but Kelley et al. (1940: 30–31, 40) thought this occurrence was relatively late and isolated for the phase. It is noteworthy that recent investigations have failed to uncover additional evidence of the use of ceramics by Livermore phase peoples. Based on stratigraphic relations and a tree ring date from southern New Mexico, Kelley et al. (1940:163) thought the Livermore phase began around A.D. 800 and ended by ca. A.D. 1200. Kelley (1957:51) later revised the suggested dates for the phase to A.D. 900–1200, noting that it may have appeared somewhat earlier and persisted a little later.

Kelley et al. (1940:162–163) originally hypothesized that the Livermore phase represented an influx of new peoples into the region, and Kelley (1952a:359, 1986:143) later suggested this group may have originally been Plains Indians. Mallouf (1999:62) has cautioned that the group could also have been indigenous

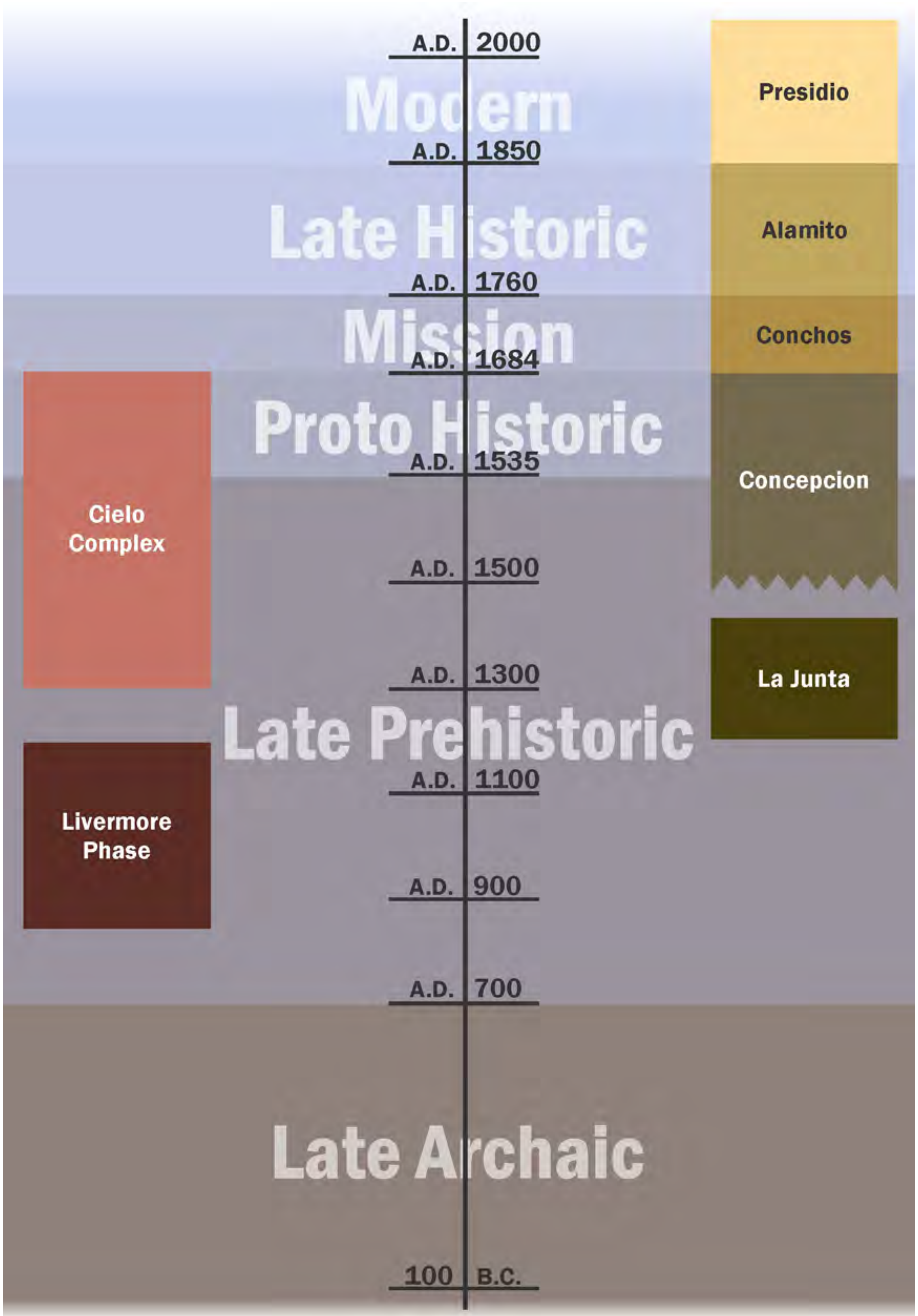


Figure 4.4 Timeline of the Late Prehistoric Bravo Valley Aspect.

to the Trans-Pecos region, noting that neither hypothesis has been seriously investigated. Regardless of its origins, Kelley et al. (1940:40) indicated the phase "is the typological ancestor of the Bravo Valley aspect, and modified Livermore focus [phase] types of projectile points occasionally occur in La Junta focus [phase] sites." Later, Kelley (1957:50) softened this conclusion, stating "there is some evidence that the Livermore Focus [phase] may have been one of the cultural elements that entered into the development of the La Junta Focus [phase] of the Bravo Valley Aspect."

Several recent investigations by the CBBS—within the La Junta district (Arroyo de la Presa/site 41PS800) and in the Davis Mountains (Tall Rockshelter/site 41JD10; Wolf Den Cave/site 41JD191; and the Means Cache/site (Field No. Y-6-1)—have supplied additional data concerning the Livermore phase. While Livermore points are somewhat rare along the Rio Grande, several were found in 2002 within deposits at the Arroyo de la Presa site located downstream of Presidio, Texas. Notably, one of the points was in contact with charcoal that yielded a date of cal A.D. 690–890 (Cloud 2004), which roughly corresponds to Kelley's estimated beginning date for the Livermore phase.

More robust findings have been recovered from CBBS projects in the Davis Mountains, the heartland of the Livermore phase. At Tall Rockshelter (Mallouf 2001) and Wolf Den Cave (Mallouf 2002, 2007), both subsurface deposits and ritualistic rock art have been linked to the phase. Test excavations and rock art recording occurred in 1999 and 2000 at Tall Rockshelter, a site known for an impressive ca. 17-foot-tall, multicolored rock art panel characterized by horizontal and vertical stripes and capped with oval head-like depictions. Testing revealed the main panel at the site extended below the surface, roughly corresponding to the stratigraphic positioning of probable Livermore phase deposits—scattered charcoal from this approximate level yielded a date of cal A.D. 880–1050 (Jensen et al. 2004:35). In 2003, six pigment samples were obtained from the panel for study by Dr. Marvin Rowe, and one of these, a red ochre pigment, was submitted for radiocarbon analysis. It yielded a date of cal A.D. 620–960 (Jensen et al. 2004:40) and, coupled with the subsurface radiocarbon date, suggests the image was painted during early portions of the Livermore phase. Another of the samples—a green pigment rare in regional rock art—was analyzed through synchrontron X-ray diffraction and determined to be principally the mineral celadonite, of which the closest known source is several hundred miles away in Mexico (Jensen et al. 2004:42).

CBBS investigations at Wolf Den Cave occurred in 2001 and 2006 and revealed well-stratified floor deposits, including Livermore phase features and material culture in the uppermost layers (Mallouf 2002, 2007). Findings in these strata included grass "bedding" and/or floor linings, substantive ash deposits, small unusual hearths, and a number of perishable items—e.g., fiber sandals, cordage, basketry, fragmentary matting, and a possible snare (Mallouf 2002:6, 2007:2). Importantly, work at the site included documentation of "a prehistoric painted shrine in Mt. Livermore's likeness in the shelter's interior" (Mallouf 2007:2). The shrine, positioned along the back wall, was apparently carved into the distinctive shape of the mountain that is visible from the mouth of the cave and then painted with multi-colored vertical stripes. The striped paintings on the three-dimensional shrine are reminiscent of the imagery at Tall Rockshelter and, coupled with the other unusual features at the site (i.e., extensive ash deposits from the burning of muhly grasses, and small hearths capped with unburned plant material), strongly suggest the site had a ritual function (Mallouf 2007).

In 2002, on a mountaintop in the far western reaches of the Davis Mountains, another ritual cache containing Livermore arrow points was discovered—the John Z. and Exa Means Cache—and, importantly, the CBBS participated in a portion of its recovery. Containing over 1,250 arrow points dominated by those of the Livermore type, the cache included a wider variety of point styles than the more famous Livermore Cache, including three varieties that were recently given type names—Diablo, Means, and Alazan (Mallouf 2013b).

"Placed ceremonially, the hundreds of complete, but mostly fragmentary, arrow points were intentionally grouped in niches among the rocks and inside cracks in the bedrock below the stacked rock cairn" (Mallouf 2009:2). The cache, the first scientifically documented find of a mountaintop cache in the Big Bend, is currently under study by Mallouf.

The recent investigations at Tall Rockshelter, Wolf Den Cave, and the Means Cache site have helped to enhance and refine our understanding of Livermore peoples, and a comprehensive summary of the phase is now under preparation by Mallouf (in prep.). Yet it is clear more work will be needed to flesh out origins and other details related to this enigmatic hunting and gathering group of the region.

Cielo Complex

Based upon extensive archeological work in the region, Mallouf (1985, 1992, 1993, 1995, 1999) identified a unique cultural phenomenon that he has termed "the Cielo complex." It is described as "a Late Prehistoric to Contact period (ca. A.D. 1250–1680) aceramic manifestation that is found across most of the Texas Big Bend and for an undetermined distance southward into northeastern Chihuahua and northwestern Coahuila" (Mallouf 1999:65). In the La Junta district, Cielo complex sites, such as Cielo Bravo and Arroyo de las Burras, occur on "elevated pediments that overlook the river basin terraces that were used for farming and habitation by coeval La Junta phase agriculturalists" (Mallouf 1999:67). Mallouf feels the complex consists of a range of individual site types across the landscape, including base camps, short-term campsites, specialized resource procurement sites, and ritual locales (Mallouf 1999:65). Base camps and short-term campsites of the complex are characterized by above-ground, circular-to-oval stacked stone wickiup foundations with narrow entranceway gaps and a variety of constructions related to various special functions (Mallouf 1992, 1999). Significantly, virtually all Cielo complex sites with wickiup foundations are in elevated settings, with many of these suggestive of defensive positioning.

Material culture associated with earlier occupations of the complex at one of the type sites (Cielo Bravo) includes:

> Perdiz arrow points and preforms, flake drills, unifacial end scrapers and side scrapers, occasional fragments of beveled bifacial knives, a host of expediency tools fashioned on both flakes and blades, occasional oval pestles, a variety of manos, end-notched sinker stones, fragments of bone rasps, fragments of deer-ulna awls, small bone and stone beads, tiny turquoise beads, and a few *Olivella* shell beads (Mallouf 1999:69).

Artifactual materials from the final occupation at Cielo Bravo (dated to the latter portion of the seventeenth century) were very similar to the earlier assemblages, with some notable differences: the addition of Garza/Soto-like arrow points, a lower incidence of ground-stone, the lack of end-notched sinker stones, a higher incidence of triangular end-scrapers and beveled-knife fragments, and the addition of small trianguloid shell (freshwater) pendants (Mallouf 1999:71).

Mallouf (1992, 1999) has theorized that both the La Junta phase and the Cielo complex are ancestral manifestations of the sixteenth century group identified in Spanish documents as "Jumano Indians." He further suggests that these related groups had shared identities dating back as far as A.D. 1250 and that both had non-Athapaskan ethnic origins among hunter-gatherers indigenous to the Southern Plains or northwestern Chihuahuan Desert region. His model suggests that the La Junta phase and Cielo complex peoples were interacting somewhat like genetically-linked "cousins," with the La Junta folks practicing a semi-sedentary, agricultural-based (supplemented by hunting and gathering) lifestyle and Cielo complex groups relying on a hunting and gathering lifeway. The two groups interacted through seasonal trading where unknown goods were exchanged. After the collapse of the Casas Grandes interaction sphere, Mallouf (1992, 1999) has suggested that the La Junta phase peoples joined their cousins in the hunting and gathering lifeway, archeologically manifested as the Cielo complex. Furthermore, using data from the final occupation at Cielo Bravo, he has suggested a linkage between early Apachean groups and Cielo complex peoples (Jumano-Apache) by approximately A.D. 1650, or perhaps a little earlier (Mallouf 1999:85).

Bravo Valley Aspect

As stated above, the cultural continuum in the La Junta district referred to as the Bravo Valley aspect forms the cornerstone of the cultural classificatory scheme developed by Kelley et al. (1940:39). This aspect was subdivided into the La Junta, Concepcion, and Conchos phases (Figure 4.4). The La Junta phase (ca. A.D. 1200–1450) is confined to the Late Prehistoric period and the Concepcion phase (ca. A.D. 1450–1684) crosscuts what is now the Late Prehistoric-Protohistoric temporal boundary. The Conchos phase (ca. A.D. 1684–1760) or "Mission period" (Kelley 1990:39) straddles the Protohistoric and Early Historic periods, and has been characterized as "the period of Spanish acculturation of the Indian villages" (Kelley et al. 1940:39). Important aspects of the theoretical continuum were the use of pithouses within village settings, consistent attempts at agriculture, and the use of various pottery types (Kelley et al. 1940:31–33). Each of the three phases are summarized below.

La Junta Phase (A.D. 1200–1450)

The La Junta phase represents the first cultural manifestation in the La Junta district representative of sedentary or semi-sedentary occupations. Inhabitants of the phase lived in *jacal* structures placed in pits on terraces along the Rio Grande and lower Río Conchos and used non-local pottery. They derived their sustenance from agriculture, hunting, fishing, and from the gathering of plant foodstuffs (Kelley et al. 1940:31–34). Most of the recovered data from the Bravo Valley aspect, especially architectural and mortuary remains, are attributable to this phase. Whether this is due to sampling bias, or perhaps evidence of a greater population, remains in question at this time. While the impetus responsible for the relatively sudden appearance of the La Junta phase is also still open to conjecture, Kelley et al. (1940), Kelley (1957, 1990), and Mallouf (1992, 1999) have offered possible explanations.

Kelley et al. (1940:40) originally proposed that the Livermore phase was ancestral to the La Junta phase; later Kelley (1957:50) slightly altered this suggestion, saying it may have played a role in development of that phase. Years later, Kelley (1990:38) offered a revised concept, postulating the La Junta phase "essentially represents an isolated colony of the El Paso phase of the Jornada Branch of the Mogollon" and that La Junta peoples were involved in a symbiotic trade relationship with Casas Grandes, an important redistribution center in northern Mexico. Mallouf (1999:82–83) has offered an alternative hypothesis suggesting that the La Junta phase could have origins in a hunting and gathering society, either indigenous to the region or intrusive from the Southern Plains, rather than from a direct linkage with sedentary peoples of the Jornada Branch of the Mogollon. He has argued that differences in both architecture and material culture between the Jornada Mogollon and La Junta phase support such a conclusion. He has further offered that material assemblages of the phase "reflect semisedentary lifeways with continued strong reliance on hunting and gathering as a means of supplementing their agricultural stores" (Mallouf 1999:83).

Houses of the phase had various shapes and forms, entranceways, and roof supports, with most all of these having *jacal* wattle-and-daub superstructures. During this phase, three types of houses built in pits of varying depth have been identified: 1) a single example of a multi-roomed structure constructed in a relatively shallow pit, 2) rectangular structures, and 3) circular structures. The rectangular variety was dominant, built within or over pits. Floors were of prepared adobe or tramped gravel, occasionally with low adobe curbs around their peripheries. The *jacal* superstructures were anchored by both large and smaller interior posts; walls were of a pole framework often plastered with mud/

daub. The circular structures were relatively small (diameters of <3 m), and had tramped gravel floors, interior framework posts around their edges, and were built over pits with pole walls starting at ground level.

La Junta phase artifacts present a conundrum of sorts, as they are represented by items manufactured both locally and nonlocally. Ceramics from the phase are predominantly Southwestern trade wares, with El Paso (Jornada branch) and Chihuahua (Casas Grandes) polychromes consistently present (Kelley et al. 1940:34). In sheer numbers, El Paso Polychrome sherds are dominant, and both Shackelford (1955) and Hilton (1986) have suggested some of the El Paso variant sherds at La Junta may have been locally produced (other possible threads of evidence for the colony theory). While recent petrographic and instrumental neutron activation analyses of select El Paso Polychrome sherds from the Millington site indicate manufacture in the El Paso area (Kenmotsu 2005; Robinson 2004; Rodríguez-Alegría et al. 2004;), data from a larger sample is needed to refute or support this hypothesis. Chihuahua polychromes identified include the Ramos, Babicora, and Villa Ahumada types. Other established types represented include Tusayan Polychrome, Playas Red, and Chupadero Black-on-White (Kelley et al. 1940:34). On the other hand, La Junta phase arrow points suggest affiliation or some type of relationship with local hunter-gatherers. The primary points found with the phase include Piedras Triple Notched, Perdiz Stemmed, and Fresno Triangular (Shackelford 1951)—now called Toyah, Perdiz, and Fresno (Turner and Hester 1985)—all types uncommon or nonexistent in the El Paso phase assemblages but regularly seen in hunter-gatherer settings across the Big Bend.

Compared to other burial contexts during the Late Prehistoric period, there is a relative abundance of mortuary data from the La Junta phase, with a total of 23 known burials from 5 sites (radiocarbon dates for one burial included here straddles the La Junta phase-Concepcion phase temporal boundary): Millington/41PS14 (n=14), Polvo/41PS21 (n=5), Loma Alta/41PS15 (n=2), Shiner/no site number (n=1), and Williams/41PS53 (n=1). Most of these interments were excavated or documented in the 1930s and 1940s by Kelley and/or his subordinates. Exceptions are four recently salvaged burials at the Millington site (Cloud and Piehl 2008). Consisting of 13 adults and 10 subadults, these burials were placed in pits, often beneath house floors or other structures, or within midden deposits, and rarely contained grave goods. About 75 percent were tightly or partially flexed in a supine position. Two, one adult male and one adult female—both uncovered at Millington during CBBS investigations in 2006—had marking stones and a loose cobble cairn positioned over their respective pits. Piehl recognized an interesting pattern amongst the head orientations of the interments when intercardinal directions were considered, with 69 percent of the burials with known orientations falling into either north or south directions. Furthermore, using these data, she recognized a distinct pattern amongst the genders "whereby all sexed adults interred with head in the northern quadrant are male and all those in the southern quadrant are female" (Piehl 2009:36).

Stable isotope analysis was performed on six of the La Junta phase burials from Millington, three from the earlier excavations and three from the 2006 investigation, and Piehl (2009) reported the values obtained were indicative of a mixed diet rather than one concentrated on agricultural produce. The data indicated "a greater contribution from C_3 plants than the mobile groups from the Late Archaic or Late Prehistoric, and greater terrestrial meat consumption than Late Archaic mobile groups in the region" (Piehl 2009:79). Moreover, maize contributed less than 25 percent to the diet of these individuals, and neither desert succulents nor riverine resources provided dietary staples, an indication that these villagers had more complex subsistence strategies than typical agriculturalists.

Kelley (1990) has pointed out that the end of the La Junta phase coincides with the collapse of both the El Paso phase of the Jornada Mogollon and the Casas Grandes interaction sphere. As a result of these coeval occurrences, he further suggested that the La

Junta area "may have been almost entirely abandoned by pottery-making agriculturalists, leaving the area occupied only by semi-sedentary hunters and gatherers living in simple structures" (Kelley 1990:39). Alternatively, Mallouf (1999:84) has offered that La Junta phase peoples were practicing a semi-sedentary rather than sedentary existence to begin with and that, upon collapse of the phase, reverted fully to a hunting-gathering lifeway.

Concepcion Phase (A.D. 1450–1684)

Kelley et al. (1940:35–36) used the Concepcion phase to distinguish changes in architecture and material culture within the La Junta district and later came to believe this shift followed the collapse of the Jornada Mogollon culture and the Casas Grandes interaction sphere. Following what may have been a century-long hiatus in sedentary occupation, the La Junta region is believed to have been recolonized. Material culture changes followed this demographic turnover. Pithouses were similar to those of the La Junta phase but were larger, with both rectangular and circular-to-oval varieties represented. Rectangular houses were dominant, either isolated or in east-west tiers, and about twice the size of those of the preceding phase—averaging 8.5 x 9.1 m (27.9 x 29.9 ft). These houses also differed from those of the La Junta phase by the absence of adobe. Instead of prepared adobe floors, tramped gravel or packed refuse served as floors within the pits, and adobe was not used at all. Circular houses had diameters of about 3.7–5.5 m (12.1–18 ft) and had numerous supporting posts compared to those of the La Junta phase (Kelley 1985, 1986).

The Concepcion phase is further distinguished from the La Junta phase by the associated ceramic assemblage, although virtually all stone, bone, and shell artifacts remain quite similar (Kelley 1986:82). With intrusive Southwestern types no longer present, the assemblage is comprised almost completely of new wares—Chinati Plainware, Capote Red-on-Brown, and Paloma Red-on-Gray—thought to have been locally produced (Kelley et al. 1940:35–36). However, some trade wares were apparently being brought into the area at this time as indicated by the presence of two sherds of Patton Engraved, an East Texas Caddoan type, which were found in the deposits at Loma Alta (Kelley 1986:83, 90). This may be a small clue linking the La Junta villagers with the ubiquitous Jumano Indians, who are reported to have ranged as far east as the Caddo settlements in eastern Texas (Hickerson 1994:24; Kelley 1947a, 1986).

Mortuary data for the Concepcion phase is sparse, with only one excavated burial thought to have been interred during this span of time, and one other that crosscuts the La Junta phase-Concepcion phase boundary (Piehl 2009). Since the latter was discussed above, only information on the former is provided here. Kelley (1939) excavated the Concepcion phase interment from beneath a cairn on the floor of a circular pithouse at the Millington site. It was "that of an old male, was tightly flexed, on its right side, skull to northeast, and face to the west. There was no mortuary furniture within the grave, which was merely an unlined pit cut into the gravel" (Kelley 1939:228). Despite the lack of appreciable data on the subject, this information suggests several aspects of mortuary behavior displayed in the La Junta phase continued into the subsequent Concepcion phase: burial in a pit beneath the house floor, the presence of an overlying cairn, the flexed positioning of the body, the head orientation (for a male), and the lack of grave goods.

The arrival of the first Europeans occurred during the Concepcion phase when Alvar Núñez Cabeza de Vaca and his three companions apparently traveled through La Junta in A.D. 1535. Although their exact route has long been debated (Chipman 1987), evidence for their passing through La Junta was suggested by chronicles of an A.D. 1582–1583 expedition led by Antonio de Espejo:

> They made us understand, through interpreters, that three Christians and one Negro had passed through there [La Junta], and by means of signs that they gave, it seemed that

> these had been Alvaro Núñez Cabeza de Vaca, and Dorantes, and Castillo Maldonado, and a negro (Espejo 1871:107 [in Kenmotsu 1994b:17]).

Núñez's description of La Junta includes brief references about the environment, the people who lived there, their economy, and dress. He described the settlements as being spread out along a "river that flows between mountains" and noted the people grew crops of beans, squash, and corn and wore buffalo robes (Bandelier 1905:149–151).

La Junta's next encounter with Europeans was not that of shipwreck survivors or Spanish *entradas*, but of slave-raiding parties that reportedly visited La Junta as early as A.D. 1563 to enslave native villagers to work the silver mines in north-central Nueva Vizcaya. Slaving raids occurred intermittently thereafter, peaking in intensity between A.D. 1575 and 1585 (Applegate and Hanselka 1974:51; Hammond and Rey 1929:60; Scholes and Mera 1940:271). These raids—which continued until the mid-eighteenth century—made the La Junta natives hostile toward all Spanish intruders.

The next historical account of La Junta comes from the Rodríguez-Chamuscado *entrada* of A.D. 1581–1582. Although several reports from the expedition were produced, the Gallegos *Relación* supplied the best information on La Junta (Kelley 1952b). Gallegos described the individual pueblos and gave detailed descriptions of some of the houses and the manner in which they were constructed—details that correlate well with archeological evidence from the district. Groups of Indians referred to as "Conchos," "Patarabueyes," and "Amotomancos" were described as living at La Junta, but Gallegos gave no references as to the number of pueblos nor the size of the population (Kelley 1952b:264–265). However, a later historian, Obregón, indicated the expedition observed more than 2,000 Indians in the Rio Grande Valley, which was named "Valle de Nuestra Señora de la Concepción" (Kelley 1952b:265).

The Rodríguez-Chamuscado expedition was soon followed by the *entrada* of Antonio de Espejo in A.D. 1582–1583, as documented in the journal of Diego Pérez de Luxán (Hammond and Rey 1929). Additional information was produced on the villages and inhabitants of La Junta, with "Omotomoacos" and "Abriaches" Indians identified and collectively referred to as "Patarabueyes," who apparently had different languages than their neighbors to the south (Hammond and Rey 1929:57–64; Kenmotsu 1994b:17). Descriptions of the houses indicated they were flat-topped and constructed in pits. Material goods mentioned include corn, beans, mescal, gourds, buffalo skins, blankets, and bows and arrows (Hammond and Rey 1929:57–63; Kenmotsu 1994b:17). Significantly, Luxán also recounted that "Jumanos" Indians encountered along the Pecos River brought the group back to La Junta after the expedition's foray into present-day New Mexico (Hammond and Rey 1929:124–126; Kelley 1986:14). This is the first mention of Jumano Indians in the regional record, which some researchers have associated or linked with the Patarabueyes (Bandelier 1890; Hickerson 1994; Hodge 1911; Sauer 1934); however, the preponderance of archeological and historical evidence suggests they were a separate group of nomadic hunters and traders (Kelley 1947a, 1986; Kenmotsu 1994a, 2001; Mallouf 1992, 1999; Scholes and Mera 1940).

Archival data provides conflicting evidence on the presence of Jumano Indians at La Junta. Kenmotsu (1994a, 2001), noting the Jumano were not mentioned in the Spanish records of La Junta at the Archivo del Hildalgo del Parral for a 100-year period (A.D. 1583–1682), suggests they were only sporadically present at this time. However, some records from the late seventeenth century indicate they spent the winter months at La Junta and much of the remainder of their time in Central, East, and West Texas on hunting and trading forays (Kelley 1986:30–31, 112). Even so, the Jumano remain one of the least understood groups of the region during Protohistoric times.

After the Spaniards found a more direct route through present-day El Paso to the pueblos of northern New

Mexico in A.D. 1599, they abandoned the difficult passage through La Junta de los Ríos. During the second half of the seventeenth century, Indian unrest in New Mexico, culminating with the Pueblo Revolt of A.D. 1680, shifted the Spanish focus towards maintaining control of their northern frontier. They established a presidio at El Paso in A.D. 1681 to protect the four missions in that area (Ing et al. 1996:28) while a 20-year war ensued between the Spanish and practically all major Indian groups in New Mexico and northern Nueva Vizcaya (the Spanish province that included most of the modern state of Chihuahua) (Jones 1988:99–110).

It was also during the Concepcion phase that Apache Indian tribes began migrating to the region from the Southern Plains, constituting a new and more dangerous threat to both the northeastern Spanish provinces and existing native tribes (Jones 1988:115). It was during this social upheaval, in A.D. 1683, that several delegations of Indians from La Junta traveled to the El Paso missions to request missionaries be sent to the valley and to a vast area of Central Texas. One of these delegations was led by Juan Sabeata, a Jumano Indian, who sought Christian baptisms for the Jumanos and other tribes (Castañeda 1976:II:312; Kelley 1986:24). Many scholars believe that Sabeata's motives were at least partly driven by hope that the Spanish would push the invading Apache out of Jumano territory (Ing et al. 1996:29; Kelley 1986:26). In response to Sabeata's request, the Mendoza-López expedition (A.D. 1683–1684) was dispatched from El Paso and worked its way down the Rio Grande to La Junta where they left a *padre* in late December A.D. 1683 before continuing eastward into Central Texas (Kelley 1952b:266). It was reported that Indian *rancherías* of the "Julimes" displayed crosses and had fields of maize and wheat along both sides of the Rio Grande at La Junta (Kelley 1952b:266–267). Spanish documents indicate that between 6 and 9 grass and/or wood missions were eventually established and over 500 Indians from 9 separate nations were baptized (Kelley 1952b:267).

Conchos Phase (A.D. 1684–1760)

Just as Kelley's Concepcion phase straddles the Late Prehistoric-Protohistoric divide, the Conchos phase straddles the Protohistoric and Early Historic periods. Also called the "Mission period," it began with the establishment of missions at La Junta and ended with the siting of a Presidio there in 1760 (Kelley et al. 1940:39, 1990:39). Although Kelley suggested a beginning date for the phase of ca. A.D. 1700 (Kelley 1947a, 1986), since archival sources indicate the first missions at La Junta were established in ca. A.D. 1684, that date is used here to divide the Concepcion and Conchos phases.

During the Conchos phase, large rectangular pithouses remained the predominant architectural style and lithic assemblages remained unchanged from the previous period. The primary archeological distinction is the presence of artifacts of European or Mexican origin such as Spanish majolica pottery, and utility wares in addition to metal items (Kelley et al. 1940:37). Indigenous pottery styles associated with the phase include Conchos Red-on Brown and Pulicos Red-on-Brown, with some Capote Red-on-Brown and Chinati Plain, Striated-Neck, and Neck-Banded (Kelley 1986:85; Kelley et al. 1940:37).

In the first half of the eighteenth century, the Jumano are believed to have been assimilated by their former enemies, the invading Apaches. Between A.D. 1720 and 1750, many historical accounts refer to these nomadic horse Indians as "los Apaches Jumanes" or "Apache Jumanos" (Kelley 1986:41–42; Hickerson 1994:202; Kenmotsu 1994a:328; Kenmotsu and Wade 2002:50; Newcomb 1990:233). By ca. A.D. 1775, the Jumano name had disappeared entirely from the written record as the Apaches replaced the Jumanos as the predominant traders with the La Junta villagers, exchanging deer and bison hides and dried meat for agricultural products such as corn and beans (Kelley 1952a:380).

In 1715, the Traviña Retis *entrada* brought two priests to La Junta to re-establish missions there.

They found the existing missions still standing but in poor repair. Significantly, they also found that European traits had already spread throughout the native population including clothing, tools, agricultural products, and use of the Spanish language (Kelley 1952b:270). Additional priests were dispatched to La Junta in 1716 but their work was interrupted when the missions were episodically abandoned over the next 15 years due to Indian uprisings, notably in 1718, 1725, and 1732–1733 (Kelley 1992:xiii–xiv).

Euro-American History in the Lower Big Bend(A.D. 1684–ca. 1950)

The Euro-American period in the Big Bend is most easily divided into three subperiods: the Spanish Colonial period (A.D. 1684–1821), the Mexican period (A.D. 1821–1845), and the Texas Statehood period (A.D. 1846–1950).[3]

Spanish Colonial Period (A.D. 1684–1821)

The Spanish Colonial period began with attempts by the Spanish to establish missions at La Junta and ended with Mexico's independence from Spain. Although the first missions at La Junta were built between 1683 and 1684, and re-established in 1715, they were not maintained continuously until around 1750 due to recurrent Indian rebellions. During the early 1700s, pressure from encroaching Spanish settlements coupled with the slave trade set the stage for Indian uprisings, and not just at La Junta. The Chisos Indians were involved in the 1704–1707 and 1715–1716 rebellions in northern Nueva Vizcaya. The Apaches, Sumas, Cholomes, Cibolos, and Chinarras were likewise involved in various rebellions between 1720 and 1746, both at La Junta as well as across the greater Big Bend (Kenmotsu 1994a: 251–253).

Between 1715 and 1747, raiding by the Apaches and Sumas, crop failures, and susceptibility to disease caused a dramatic decrease in population at La Junta—many villagers abandoning the pueblos for fear of more plagues (Kenmotsu 1994a:260). Even as disease winnowed the population, the La Juntans were also becoming acculturated (Castañeda 1976:III:198–202; Kelley 1986:59, 61). Working as servants and laborers for the priests, these "mission Indians" were increasingly exposed to Spanish culture. Some foraging groups, such as the Conchos, even began to adopt small-scale agriculture (Kenmotsu 1994:253–254). For many of the nomadic groups beyond La Junta, however, acculturation took on a more opportunistic form as raiding Spanish settlements—often deep in Spanish territory—became increasingly integral to their economy (Daniel 1955:48).

Isolated Spanish settlements and *rancherías* in Nueva Vizcaya became easy targets for raiding nomads such as the Sumas and the Apaches. The pueblos and missions at La Junta were no exception. Spanish authorities tried to resolve the problem of Apache raiding by issuing the *Reglamento de 1729*, which discouraged peaceful Indians from congregating at La Junta—a policy that remained in effect until 1772. In addition, the various groups at La Junta began to band together to better protect themselves from outside threats. As Apaches continued to spread southward into the Big Bend, many indigenous nomadic tribes began to ally with or assimilate into the Apache tribe. As early as 1734 the Jumano Indians were considered allies of the Apaches, and by A.D. 1750 they ceased to be recognized as an identifiable group (Ing et al. 1996:35). By the 1740s, Apaches were reported to be trading at La Junta, including the occasional trade of captive children (Bancroft Library 1746).

3. The following section only provides a brief outline of the history of the Big Bend, with a focus on the area contained within the present-day park boundaries. For more comprehensive treatments, the reader is referred to Ronnie C. Tyler, *The Big Bend: A History of the Last Texas Frontier* (1975) and Arthur R. Gomez, *A Most Singular Country: A History of Occupation in the Big Bend* (1990).

In 1729, the viceroy ordered Captain José Berroterán to explore the territory south of the Rio Grande, from San Juan Bautista to La Junta—an area that was known to be a refuge for hostile Indians who preyed upon frontier settlements of Nueva Vizcaya and Coahuila. The purpose of the expedition was to note characteristics of the geography, areas suitable for colonization, potential for valuable mineral deposits, and, significantly, to gain knowledge of the location of and routes taken by hostile Indians (Casteñeda 1976:336). Berroterán and his party reached the Rio Grande near present Villa Acuña. After following the Rio Grande on the south side of the river, Berroterán crossed over to the north side somewhere in the vicinity of present-day Langtry. But after following the river a short distance farther, Berroterán decided to halt due to impassable terrain and inadequate provisions. He crossed back over to the south side of the river and back tracked to the Presidio of Conchos. In all, only around 100 miles of the Rio Grande had been explored (Casteñeda 1976:341–343).

Because of the ever-increasing number of depredations, particularly by Apaches, three expeditions were launched to explore areas both north and south of La Junta in hope of establishing a chain of presidios for protection. In addition, while scouting locations for presidios, the expeditions were to note mineral deposits and areas suitable for Spanish colonization. The three expeditions were to set out from San Francisco de los Conchos, Monclova, and Mapimí and were to converge at La Junta (Madrid 1992, 2007a, 2007b).

On November 12, 1747, the first of these expeditions, headed by Captain Joseph de Ydoiaga, left the Julimes pueblo and led a reconnaissance party down the Río Conchos to its juncture with the Rio Grande (Madrid 1992:25). Ydoiaga's report of the expedition is, by far, the most important contribution to our understanding of the Indians who lived along the Río Conchos south of La Junta. Ydoiaga also provided notes on the physical and cultural geography of the area surrounding La Junta—as far as the Eagle Mountains to the northwest and the edge of the Redford Bolson to the southeast. He discovered that many tribes and / or bands of Indians had assembled in order to defend themselves from Apache depredations and, as a result, many of the pueblos had been abandoned. Along the Río Conchos, the Cholomes Indians from pueblos of La Ciénega del Coyame and El Cuchillo Parado, and the Tecolotes upstream from La Junta had all banded together (Madrid 1992:26–31). The Cacalotes, Conexos, Cholomes, and Indians from the pueblo of El Mesquite had also joined together for protection and were congregated at the pueblo of San Juan Bautista. When the expedition arrived at La Junta, the party found the Púliques, Síbolos (Cibolos), and Pescados Indians settled at the pueblo of San Antonio de los Púliques (Madrid 1992:36–40, 50–53).

The expedition continued south to the ruins of an adobe church along the Rio Grande, in the vicinity of present-day Redford. The Indians called this place Tapacolmes (Madrid 1992:57). The party learned that the Pescados had once lived in huts near this church. After reaching a place called "La Boca" (possibly near the junction of Tapado Canyon), the party turned back and reached the San Christóbal pueblo. It was noted that these villagers planted on plots of land once owned by their ancestors. No specific tribal or band affiliation was mentioned at this pueblo (Madrid 1992:59–61). From San Christóbal, Ydoiaga set off to investigate a large spring where the Cibolos once lived. The party encountered a stream boxed in on either side by rugged mountains and lined with thick vegetation—probably near present-day Shafter (Casteñeda 1976:226; Madrid 1992:64).

The second of the three expeditions was led by Don Pedro de Rábago y Therán, governor of Coahuila, who became the first to explore what is now BBNP. Therán was to pick up where the Berroterán expedition left off in 1729 (Casteñeda 1976:342). Therán left from Monclova, Coahuila with 20 soldiers and marched to the Presidio of Sacramento where he picked up an additional 30 soldiers, then to San Juan Bautista where he gained 15 more. From there, the party traveled north and northeast and crossed the Rio Grande at or near San Vicente crossing in present-day BBNP. The banks of the Rio Grande were described to be populated with cottonwoods and willow with minor veins of mineral loads that transected the river (Madrid 2007a:52). From Therán's camp, he sent Indian auxiliaries northward towards the Chisos Mountains to find a pass across the rough terrain. These scouts encountered various old *rancherías* of the "enemies" with many hoof tracks, indicating the movement of sizable horse herds and trails made by dragging travois. Despite their efforts, no easy passage was found (Madrid 2007a:52–54). From another camp, possibly near the modern ruins of Casa de Piedra, Therán and his party headed northwest through a "harsh land of hills and arroyos." He then camped within a waterless grassy area, likely southwest of present-day Glenn Spring. The next day the party continued a short distance northwest, but had to turn south because of rugged terrain. They continued south, parallel to Mariscal Mountain, until they reached the Rio Grande, possibly near the Talley Camp. There, along the river and surrounding hills, they found many *rancherías*, including one with two dead horses bearing Spanish brands (Madrid 2007a:54–60).

The expedition continued northwestward, roughly following the Rio Grande, until they reached an abandoned *ranchería* on the banks of the Rio Grande where several pumpkins were found. This place, probably south of Pettis ruins in BBNP, was consequently named "The Royal Camp of the Pumpkins." The party continued along the north bank of the Rio Grande, through the vicinity of present-day Castolon, continuing to the confluence of Terlingua Creek and the Rio Grande at the mouth of Santa Elena Canyon (Madrid 2007a:54–60). Therán describes the lowest reaches of Terlingua Creek as surrounded by cottonwoods and desert willows, and a spring that issued into a pond held by beaver dams (Madrid 2007a:60). Therán turned north along Terlingua Creek, discovering a heavily-trafficked Indian trail that led to the northeast towards the plains. Turning west, he arrived at or near the vicinity of present-day Lajitas before continuing west across the Rio Grande then north through the Sierra Rica Pass to La Junta. Therán noted that during the course of his journey through the Big Bend he had encountered, on average, abandoned campsites every two to four leagues (roughly 8 to 16 km or 5 to 10 miles) (Madrid 2007a:52–54, 61).

While visiting the missions at La Junta, Therán noticed herds of horses and mules bearing Spanish brands and reported that the villagers sporadically conducted illicit trade with the Apaches, Natajes, Cholomes, "and others who preyed upon the frontier outposts" (Casteñeda 1976:220; Madrid 2007a:70). He also reported that the villagers had become dependent on trade with the Apaches, writing that "the skins and hides secured in this manner sold regularly in Chihuahua in exchange for supplies and other necessities." In addition, two captives, one each from the missions San Juan Bautista and San Juan Bernardo, had been sold by the Apaches to the Indians of the Mission of San Francisco (Madrid 2007a:71).

Therán learned from a missionary that Ydoiaga had arrived several days before, but had left to explore El Cajón, north of La Junta. Corresponding by way of messengers, the two men disagreed as to the suitability of farmland at La Junta to sustain a military unit and colonists. Therán believed that the farmland at La Junta could support both Spanish soldiers and colonists and recommended that a new presidio be constructed on either side of the Rio Grande at La Junta (Casteñeda 1976:219, 220; Madrid 1992:78–85). Although Ydoiaga disagreed, he investigated several possible locations for a presidio. Father Lorenzo, the oldest missionary at La Junta, suggested that the most plausible location (chosen several years before by Fray Andrés Varo) should be at the abandoned pueblo of San Bernardino, previous home of the Tecolote (Owls), seven leagues above the San Francisco mission (Castañeda 1976:227–228).

On his return journey, Therán noted a small area near a spring where Apaches held trade fairs just outside of La Junta, possibly near the mouth of Alamito Creek. Therán's party proceeded to Terlingua Creek and from there headed northeast around the Chisos Mountains, eventually arriving at a place downstream from San Vicente, before returning to Monclova (Madrid 2007a: 76–81).

The third expedition, led by Fermín de Vidaurre, left the Presidio de Mapimí and traveled northeast to Sardinas Pass, which joins the Sierra de Baján where there was water and grazing land. There he was joined by 15 citizens and their corporal from Santa María de las Parras pueblo and another 15 men from the Villa de Saltillo (Madrid 2007b:46, 47). The party then traveled north until they arrived at an arroyo with running water called Berroterán. From this point the mountainous land to the west was of the Tobosos. The party followed the trail that Therán had previously followed and stopped at the Presidio de Santa Rosa where they were informed that Therán had passed through some 22 days earlier (Madrid 2007b:53, 54). Finally, on January 4, 1748, Vidaurre arrived at the Rio Grande to witness a "fast waterfall in a precipice formed by the confinement of the river flow between the mountains" (Madrid 2007b:66).

The party rested while Bentura, a Sisimbles Indian, left in search of a way out of what he called the Sierra de las Animas (Mountain of Souls). Later, Bentura reported to have found a way to leave this range and informed Vidaurre that he had found a large Apache *ranchería*. They were able to establish peaceful relations and their chief, El Ligero, ate supper with the party and stayed until the next morning. The party traveled west through rough country to the Apache *ranchería*, only to find their camp abandoned. The Apaches had moved on top of the mountains with the women and children. Re-establishing contact with El Ligero, Vidaurre was able to convince the old chief to give him two Indian guides (Madrid 2007b:69–70).

Nevertheless, Vidaurre did not completely trust the Apache guides, who sent smoke signals ahead of the group, not wanting to seem affiliated with the party. On January 23 they traveled west and stopped at the juncture of an arroyo and the Rio Grande where there were many *jacales* of recently abandoned *rancherias* on either side of the bank—likely the junction of Terlingua Creek and the Rio Grande. Vidaurre proceeded north along Terlingua Creek before turning west. En route, Vidaurre encountered the Sargeant of the Presidio del Valle de San Bartholomé, Manuel Gruciaga, with a squad of soldiers and Indians. The party crossed to the south bank of the Rio Grande, likely at present-day Lajitas, thence westward, before finally reaching La Junta in late January 1748 (Madrid 2007b:71–77).

Despite recommendations by de Rábago y Therán and others to construct a presidio at La Junta, another decade would pass before plans were put in place. In 1757 the Viceroy Marques de las Amarillas accepted recommendations for the establishment of two new presidios, one to be located at Carrizal in northern Chihuahua and the other at La Junta. In 1759 Captain Alonso Rubín de Celis, Lieutenant Manuel Villaverde, Alférez Juan Hidalgo, and a force of soldiers left Chihuahua City to establish the new presidio at La Junta. However, because of opposition from Franciscan missionaries and leaders of various pueblos, Celis failed to complete his task. As a result, he was suspended by the governor, and Captain Manuel Munoz was chosen to carry out the orders (Jones 1991:50). Under the direction of Munoz, the presidio, as well as housing for the soldiers and a stockade, was completed on July 22, 1760, in less than eight months. The new presidio was officially called El Presidio de Nuestra Señora de Belén y Santiago de las Amarillas de La Junta, but later shortened to Presidio de Belén (Moorhead 1975:50).

During the inauguration of the new presidio in 1760, the Cholomes leader, General Francisco Arroyo, and 200 natives, along with the Mescalero chief El Venado and his band, attacked the stockade, but were held off by Spanish soldiers (Morgenthaler 2007:123). Reinforcements were sent in during early September, and Spanish soldiers defeated the Apache offenders and their allies (many of whom were Cibolos) at strongholds along Ruidosa Creek. Nine Indians were killed whereas 47 warriors in addition to over 100 women and children were taken prisoner. Those who surrendered brought in Chief José Manuel, who they blamed for starting the revolt (Casteñeda 1976:229–231).

That same year, the population at the pueblo of Nuestra Señora de Guadalupe was declining and, by the next year, all of the pueblos in La Junta had been virtually abandoned due to abuses committed by the Spanish soldiers (Castañeda 1976:III:229–231; Kelley 1986:65). During the presidio's first six years of service, the area between El Paso and La Junta was still largely populated by hostile Apaches. Apache depredations, coupled with the depopulation of the pueblos, led to the abandonment of the presidio at La Junta. The garrison relocated up the Río Conchos to the pueblo of Julimes in 1767, after which the natives destroyed much of the La Junta presidio, using the timber for firewood (Castañeda 1976:III:230–231; Kelley 1986:65;). Meanwhile, the six pueblos at La Junta lay in ruin (Castañeda 1976:IV:235–236).

In 1766, the Marqués de Rubí was sent to inspect the conditions at the presidios along the frontier border, including the Presidio de Belén, but delayed his visit when he learned that the garrison was in the process of relocating to Julimes. In his 1768 report, Rubí recommended that the presidio be relocated back to La Junta in compliance with the new *Reglamento de 1772* (Jones 1991:52; Morgenthaler 2007:126). The newly appointed Commandant Inspector Hugo O'Conor was assigned to relocate the presidios as Rubí had recommended. In 1773 O'Conor re-stationed the Julimes garrison back at La Junta with 50 soldiers. The relocated presidio would be known as El Presidio de los Rios del Norte y Conchos and soon after shortened to Presidio del Norte. The new presidio was built at the abandoned pueblo of Guadalupe, located some two miles from the site of the old Presidio de Belén (Morgenthaler 2007:128).

In addition to Presidio del Norte, O'Conor relocated the garrison at Cerro Gordo to the spring of San Carlos, while the garrison at San Sabá relocated to a ford on the Rio Grande called San Vicente along the Comanche Trail. In addition, a new presidio named El Príncipe was built about a quarter of a mile southeast of the present-day village of Pilares, Chihuahua (Ivey 1990:1; Jones 1991:52; Moorhead 1975:70). The presidios at San Carlos and San Vicente each contained 57 men, which consisted of "forty soldiers, two *cabos* (corporals), one sergeant, ten Indian scouts and four officers including a chaplain" (Ivey 1990:2). The presidial soldiers were outfitted with leather armor, a shield, a musket with case, two pistols, a sword, and eight lances. The Native scouts were issued far less, their gear limited to a pistol, a shield, a lance, and bows and arrows (Moorhead 1975:189–191; Ivey 1990:2). The Comandante General encouraged civilian settlement at or near the presidios, creating "support communities" such as San Carlos, Ojinaga, Carrizal, and Janos (Ivey 1990:2; Jones 1991:54; Moorhead 1975:90). San Carlos, just south of present-day Lajitas, had an abundant water supply, good soils for cultivating crops, and available timber for construction and fuel. Due to its remoteness, San Vicente likely never had a support community, or at least not one that lasted beyond the life of the presidio itself (Willeford 1999: 17).

In response to continued Apache depredations, in 1775 and 1777 Hugo O'Conor launched two offensive military campaigns against the Apaches. The first campaign involved 15 engagements that left hundreds of Apache warriors dead and resulted in the capture of many Apache men, women, and children, as well as the recovery of over a thousand horses and mules. The outcome of the second campaign is less clear, but supposedly O'Conor pushed many Apaches east as far as the Colorado River where Comanches were reported to have killed more than 300 Apache families. In 1777 O'Conor retired due to ill health, and the recently appointed Commandant General Teodoro de Croix selected Colonel José Rubio to fill O'Conor's vacancy (Gomez 1990:34; Morgenthaler 2007:129). In the winter of 1778–1779, Croix and his subordinates held a series of military conferences to discuss the Apache problem. One strategy that came out of the meetings was to forge an alliance with the Comanches. If the Apaches did not accept peace under Spanish conditions, they would be pursued not only by the Spanish military, but also by their dreaded and powerful Comanche enemies as well (Nelson 1940:459).

In 1779 Croix traveled across Nueva Vizcaya to evaluate the strategic location of the presidios, the ethics and standards of Spanish soldiers operating the presidios, and to assess the severity of Apache depredations. Croix soon learned that, although the placement of presidios along the Rio Grande looked good on paper, it was not very practical. Too many miles of unprotected and rugged country allowed nomadic groups to slip between the presidios and left many of the *colonias*, *haciendas*, and *ranchos* vulnerable to attack. Consequently, Croix reorganized the presidio line and established a new resettlement policy. Among other changes, the presidios of San Vicente, San Carlos, and Principe were abandoned because they were at the end of the presidial supply line and too expensive to maintain in addition to being largely ineffective (Morgenthaler 2007:130–131).

Spanish frontier policy changed once again in 1779 when Spain allied with the French to defend Florida and the Spanish Gulf Coast against the British. Because no funds could be directed towards improving the defense of Nueva Vizcaya, King Charles III ordered a more conciliatory approach to the Apache problem. At Presidio del Norte, a new pueblo named Nuestra Señora de la Buena Esperanza was built specifically for the Apache leader named "Alonso" and his band of 45 Mescaleros. In addition, the abandoned Pueblo of San Francisco, which included a small planting of wheat, was offered to an additional 80 Mescaleros, which was declined since the band needed to go hunt buffalo. When the Mescaleros returned from the hunt, they requested to live in one single pueblo (Jones 1991:55; Moorhead 1975:247).

Although Mescalero and Lipan raiding persisted, by 1783 a substantial number of Apaches had settled into a more or less semi-sedentary life near Spanish presidios. Nevertheless, during this relatively peaceful time, Apache spies collected information at various Spanish *colonias* to aid in conducting successful raids (Daniel 1955:269–273). Bernardo de Gálvez's *Instrucción of 1786* initiated a pacification program that established reservation-like villages near existing presidios (Moorhead 1968:284). This long-term policy "with its carrot-and-stick approach of search-and-destroy missions on the one hand and peace negotiations, settlement, and government support for those who submitted on the other, continued unbroken, albeit weakened, for forty years—ten years past Mexican independence in 1821" (Griffen 1988:3). It is estimated that around 3,000 Mescaleros had settled on a reservation-like encampment near Presidio del Norte by 1787 (Moorhead 1975:109).

Juan de Ugalde became the governor of Coahuila in 1777 and served for seven years before losing his position. But by the fall of 1786, Ugalde returned to the frontier provinces only to find the entire country, as far as Guadalajara, torn apart by Apache depredations. Because of Ugalde's frontier experience, Jacobo Ugarte, who had just been appointed Commandante General of the western provinces, promoted Ugalde to second in command. On March 24, 1787, Ugalde and his force camped at the abandoned presidio of San Vicente before sending a detachment northward across the Rio Grande following the trail of a band of Mescaleros leading into the Chisos Mountains. The Spanish located the Apache *ranchería* in a wide arroyo that ran between the wooded slopes of two hills. Four squads dismounted their horses and climbed up the slopes of the mountain to surround the *ranchería* while three mounted squads were to initiate the attack. The Spanish troop attacked at dawn, surprising the awakening Apaches. While Apache women and children ran in retreat, the Spanish soldiers quickly surrounded the remaining warriors, bringing the battle to a decisive end. Four Apaches were killed and 12 more were captured. Horses, mules, tents, food, and personal items were confiscated and one Spanish captive was released. Because the action had taken place on the morning of the Friday of Sorrows, or Good Friday, the battle site was named the "Aguaje de Dolores." Soon after the battle ended, Chief also surrendered in order to be with his wife and two sons. Much to their dismay, the chief, Quijiequsyá, known by Spanish soldiers as Zapato Tuerto (Twisted Shoes), told the Spanish officers that the band had just concluded a peace treaty with the commander at Presidio del Norte. Many Apaches had already moved to the protection of the presidio. Zapato Tuerto also informed Ugalde that other Apache bands had moved to La Junta and had been allowed to keep all captives and plunder while being rewarded with gifts for seeking peace (Nelson 1936:201, 207–213).

The troops returned to find the camp had been moved a short distance east of the presidio of San Vicente. The soldiers remaining in camp had discovered yet another nearby *ranchería* and given chase. The surprised Apaches ran, leaving all of their possessions including a "safe conduct" note that had been issued the preceding February by one of the officers at Presidio del Norte. Although the note was only intended to allow them safe passage to their hunting grounds, the band decided it would be more profitable to raid the Saltillo district. The Spanish found horses and mules bearing a suite of different Spanish brands. Although these Apache bands enjoyed good reputations with the officers at Presidio del Norte, it was obvious that the officers failed to keep watch over the band's actual movements (Nelson 1936:207–213).

The expedition traveled west to the abandoned Presidio of San Carlos and onward probably to the western edge of the Bofecillos Mountains where they found many signs of Apache activity. Some of the soldiers climbed a peak from which smoke signals from La Junta were visible, with another column of smoke farther north where Apaches were assumed to be baking mescal. In the distance, clouds of dust indicated the return of other Apache bands to the protection of the presidio, probably in response to news about the battle at Aguaje de Dolores. Outraged, Ugalde ordered his troops forward in the direction of the column of smoke in hopes of attacking an Apache encampment outside the confines of the presidial district. Ugalde's troops attacked but the Apaches were able to escape. At the *ranchería*, the soldiers found all of the Apaches' possessions including 23 large tents, a number of wickiups, personal belongings, 83 horses and mules wearing 22 different brands, and 6 captives. On April 26, Ugalde and his troops set off for the Sierra del Movano, traveling at night in an attempt to avoid detection. They were discovered, nonetheless, by a band of Mescaleros who warned others in the Sierra de Guadalupe by smoke signals. The Spaniards pursued the Indians but were only able to capture two Apache stragglers who informed Ugalde that their band was called the *Nit-agende*, or Seed Sowers and that a large number of Cendés and Mescaleros were camped at the waterhole called Aguaje del Tobaco near El Paso del Norte. The troops finally arrived at the waterhole only to find that the Comanches had wiped out the entire *ranchería*. On their return trip the force was divided. Lieutenant Bustamante and his men reconnoitered the Sierra del Guadalupe and encountered a small war party. The troop took 6 prisoners and recovered 1 Spaniard who had been in captivity for 14 years (Nelson 1936:216, 219–220, 224–225).

Ugalde's attack on the Apaches in the Chisos Mountains was only the first of many violations of Spanish good faith. And since Ugalde had not received any official notification of the truce, he persisted in his mission by attacking the *rancherías* of Cuerno Verde's Zendé band at the Sierra de la Pendencia. The Mescaleros at Presidio del Norte, of course, believed that they had been deceived (Moorhead 1968:214–217). Meanwhile, Commandant-Inspector Rengel recognized that the environs at La Junta were unsuitable for "fixed" Mescalero *rancherías*. Because there was only a limited area suitable for farming, the presidio simply could not afford to provision so many Apache families. The site was also too close to Comanche territory to afford decent protection. Orders were given to persuade the Mescalero chieftains to take up permanent residence near El Paso del Norte, at the abandoned town of Los Tiburcios, some 15 miles outside El Paso. But the bands were divided in their decision to move. The bands of Patule and El Quemado wanted to remain at Presidio del Norte while the other leaders—Cuerno Verde, Bigotes El Bermejo, Zapato Tuerto, and Montera Blanca—considered moving to the vicinity of El

Paso since it was in their traditional range (Moorhead 1968:217–219).

Shortly after, four of the eight bands of Mescaleros that had come to Presidio del Norte in peace abandoned their pueblos and joined other bands in the sand dunes and the Guadalupe Mountains before retreating to the Sierra del Movano. The remaining bands at Presidio del Norte grew increasingly upset over Ugalde's military campaign and failures to return Apache prisoners, leading the Spaniards to fear an Apache revolt. Ugarte made a last attempt to ratify the original peace agreement with the Mescaleros, but to no avail, and was ultimately relieved of his command and replaced by Ugalde under direct orders from Viceroy Flores (Moorhead 1968:219–232; Nelson 1940:446–447).

During the latter half of the eighteenth century, Spain faced political unrest at home. The French invasion in 1808 left the Spanish Empire vulnerable and, by 1810, New Spain was in a revolution. As resources were focused internally, the border was left completely unprotected from attacks by Apaches and Comanches (Fehrenbach 1994:82). Most Spanish settlers abandoned the borderlands of the Big Bend and retreated to more populated areas although some—taking considerable risk—made alliances with the Comanches in order to keep their homesteads, particularly around the villages of San Carlos and Presidio del Norte (Willeford 1999:19, 21). Meanwhile, the cultural division between the Spanish and the Indians became increasingly blurred. By 1820, a population census at Presidio del Norte reported that intermarriage between Spanish soldiers and Indian women was commonplace and that the remaining Native population was becoming increasingly acculturated (Jones 1991:52–53).

A diary that was written by Don Francisco Colomo mentions births, deaths, baptisms, political appointments, and—significantly—Indian attacks in the community of Presidio del Norte from 1775 to 1895. Although the entries are sporadic, brief, and limited in scope, they provide a glimpse into life along the Spanish frontier during the waning years of Spain's hold on the territory and the early years of Mexican Independence. As evidenced by the diary, life changed little although Indian attacks increased dramatically in frequency. Both Apaches and Comanches are mentioned, although the latter dominate the entries with skirmishes, killings, kidnappings, and attacks logged for every year between 1829 and 1842 (de Levario 2012).

Mexican Period (A.D. 1821–1845)

Following Mexican Independence from Spain, newly liberated Mexico was faced with serious economic shortfalls that limited their ability to address problems along the northern border. The Mexican government continued the Spanish policy of enticing Apache bands to settle peacefully with the promise of rations. However, because of dwindling funds, rations were reduced at a constant rate and by 1831 the program had dissolved. This, coupled with an outbreak of smallpox, forced the Apaches from their settlements and their raiding activities resumed (Ing et al. 1996:39, 40).

Poorly equipped Mexican militias became Mexico's main line of defense—one that was largely ineffective. San Carlos, which was described by a visitor in 1828 as a "half-wild Indian and Mexican settlement on the Rio Grande," had only 25 militiamen stationed there (Gomez 1990:40). At the same time, conditions for civilian settlement around the old presidio were restrictive. For example, an 1837 document found in the *Trabajo Monografico Del Municipio*, granted a parcel of land to colonist Pablo Anaya and his sons with the stipulation that he reside on the property, raise horses and donkeys for the militia, and cultivate various crops including fruit trees for at least two years. Although compliance would result in receiving title to the land, it also placed him at risk of Indian attack. To deal with these limitations, colonists found themselves making uneasy truces and agreements with the Indians to avoid becoming a target for their raids (Fehrenbach 1994:213; Willeford 1999:45–47).

By the 1830s, Apache and Comanche raiding began to take on epic proportions. Many *rancherias* and small settlements were abandoned. The frontier, instead of advancing, beat a hasty retreat. In 1832 the State of Chihuahua responded by declaring war against the Apaches. However, as the government could no longer offer rations or other enticements to settle peacefully, Apache raiding intensified. As a result, by 1838 the State of Chihuahua was reported to be in a ruinous condition. In 1842 several peace negotiations were made with a number of Apache groups. However, such truces were localized and by 1845 all peace accords had collapsed. Worse still, the Lipans had allied with the Mescaleros and the Comanches. In desperation, Mexican state governments began employing scalp hunters to pursue and destroy Indian bands—at one point paying as much as $200 per scalp. One (unverified) account mentions a company of scalp hunters attacking a large encampment of Mescalero Apaches below Santa Elena Canyon in 1850, reportedly making off with some 250 scalps before being repelled (Griffen 1988:92–93, 130, 191–193; Ing et al. 1996:43; McGaw 1972:136, 150–152; Smith 1964:12).

Raiding expeditions into Mexico had become part of the mounted nomad's adaptation, an integral part of their lifeway. For many, the Comanche Trail was the highway to plunder, one that cut a swath through the heart of the Big Bend. Sometime after the late 1770s (and climaxing in the 1850s), a number of Plains Indian tribes, primarily Comanche, came from as far away as the High Plains of Texas, Oklahoma, New Mexico, Colorado, and Kansas to raid vulnerable and isolated Mexican settlements in northern Coahuila and Chihuahua. By the early 1840s, Comanche raids extended as far as San Luis Potosi, some 400 miles south of the Big Bend (DeLay 2007:107). These raids were annual affairs timed to late summer or early autumn when forage was abundant and horses and mules were in prime condition. The raiding lasted several months and was operated out of temporary bases in Mexico. The dreaded full moons during the fall months provided light for night raids and were referred to as the "Mexican Moon" by the Comanches, and the "Comanche Moon" by the Mexicans (Cox 1997:44). The return trip back to Texas usually took place during the winter or following spring. The repetitive use of these routes to and from the southern High Plains and northern Mexico resulted in well-beaten trails (Campbell and Field 1968:129). Colonel Langberg, during his 1851 military expedition, noted, "The road that the Comanches have opened gives an idea of the immense plunder that they have taken out of the Republic, because besides being wider than any highway, it is so well-worn that it seems as though engineers purposefully built it" (Langberg and Flores 2009:9).

The Comanche Trail entered the region at Horsehead Crossing, a major ford of the quicksand-laden Pecos River in northwestern Pecos County. The trail trended southwestward to Comanche Spring, then southward to Peña Colorado Springs. From there, it branched. The first branch, called the Chisos Trail, continued south, passing through Persimmon Gap, skirting the eastern slopes of the Chisos Mountains to Glenn Springs. From there, the trail likely branched again—one branch crossing near the old Presidio San Vicente and the other closer to Mariscal Mountain. After the presidio at San Vicente was decommissioned, the former became a popular ford for groups coming from Comanche camps in the Laguna de Jaco. The second branch out of Peña Colorado, known as the San Carlos Crossing, passed westward through the Santiago Range and south down Terlingua Creek before veering westward again to cross the Rio Grande at presen-day Lajitas (Casey 1969:18–19; Langberg and Flores 2009:11).

Because of the effectiveness of the mounted raiders, their intimate knowledge of the harsh terrain of the Big Bend, and the new republic's anemic response, Mexico was never able to effectively protect its northern frontier. It would take many years, another war, and the persistent efforts of the U.S. military before peace would finally come to the borderlands.

Texas Statehood Period (A.D. 1846–present)

Long-standing political and cultural clashes between the Mexican government and Anglo settlers in Texas came to a head in 1835 when conservative forces took control and the Seven Laws of 1835 were approved. The resulting revolution created a brief Republic of Texas, but its days as an independent entity were numbered. The republic was annexed by the United States on February 28, 1845. Within months, the United States Congress declared war against Mexico, a move that was highly controversial. After three years, the Mexican government conceded defeat and gave to the U.S. the land between the Nueces River and the Rio Grande (Fehrenbach 1994:174–267; Ing et al. 1996:43, 44).

Chihuahua Trail

Economic interests had spurred a successful freighting expedition from Chihuahua City to New Orleans as early as 1839, but the great distance and other difficulties delayed further efforts for almost another decade. A renewed pursuit to establish a commerce trail was set in action by Major John Polk Campbell and 39 Mexican War veterans in 1847. The trip—from Chihuahua city to Fort Towson, Oklahoma via Presidio del Norte—was successful with no apparent sign of hostile Natives. This led various business entrepreneurs in Texas towards efforts to bring commerce from Chihuahua to Presidio del Norte and eastward to San Antonio on to port cities along the Gulf Coast (Tyler 1975:53).

In 1848, former Texas Ranger, John Coffee Hays formed a party to scout out a route from San Antonio to El Paso—a widely publicized expedition that generated a great deal of interest, both among merchants as well as the U.S. government. But being unfamiliar with the geography of the Big Bend country, coupled with a largely inaccurate map, made their westbound journey perilous. Their route took them across the torturous southern reaches of the Big Bend, finally crossing the Rio Grande near the abandoned Presidio San Vicente, then to San Carlos, before finally reaching Fort Leaton at La Junta. Although they were too exhausted to press farther to El Paso (their original destination), the eastward journey back to San Antonio led them on a much easier northerly course. In his report to San Antonio supporters and the Federal government, Hays recommended the northern route as an easy passage for wagon trains (Tyler 1975:54–56).

Beginning in 1850, freighters began hauling goods across the Hays' northern route on the "Chihuahua Trail" that extended from Chihuahua City to Indianola, Texas. From that time until 1877, the trail carried more traffic and commerce than even the Santa Fe Trail (Swift and Corning 1988:x). Freighters on the Chihuahua Trail hauled an assortment of goods and were easy targets for Apaches and Comanches—the two main tribes that resided, at least seasonally, in the Big Bend. Mescalero Apache, Chief Gomez, and his band claimed the Davis Mountains and the upper Big Bend as their domain while Comanche Chief Arriba el Sol and his band roamed across the lower Big Bend much of the year. Livestock, miscellaneous goods, and ransom for captives were their primary currency. Stolen goods were later traded for rifles and ammunition, swords, tobacco, whiskey, and other goods from Anglo traders (Gomez 1990:40).

Ben Leaton and Milton Faver were the first individuals to settle successfully in the Big Bend region following the Mexican-American War. Leaton acquired an old adobe complex on the American side of the Rio Grande, just downstream from present-day Presidio, Texas. El Fortín, more commonly known as Fort Leaton, was thought by some scholars originally to have been the location of the 1684 mission El Apostol Santiago, later reestablished as El Fortín de San Jose (Corning 1967:20). However, archeological investigations carried out in 1969 at the fort suggested it was neither, and had not been occupied earlier the 1830s (Ing and Kegley 1971:58).

Fort Leaton served as a private fortress and trading post for travelers and freighters along the Chihuahua Trail as well as the unofficial headquarters of the U.S. Army, with troops from Fort Davis using the structure as a command post during scouting expeditions along the Rio Grande. Despite his military ties, Ben Leaton was also suspected to have traded guns and ammunitions to the Apaches and Comanches in return for stolen cattle, a cause of persistent complaints by the Mexican government (Corning 1967:27–31). Milton Faver was the first Anglo-American to settle beyond the relative safety of La Junta, establishing ranches along Cibolo Creek at the base of the Chinati Mountains. Faver's success was made possible by a ready market for his produce and cattle at Fort Davis. He also carried other items such as silver ornaments, horse trappings, and other trade goods although he was probably best known for his famous peach brandy which was consumed by soldiers and civilians alike (Thompson 1985:80, 82, 84).

Meanwhile, traffic through the region was on the rise. In addition to commerce along the Chihuahua Trail, gold seekers began crossing the region in 1849 en route to the gold fields of California. The following year a mail route between San Antonio and El Paso was established. To protect freighters, mail carriers, and travelers, Fort Davis was established in 1854 at Painted Comanche Camp in the heart of the Davis Mountains. Although affording some localized protection, the fort was ineffective at stopping Indian depredations (Tyler 1975:101–103). Part of the reason was that Indians were offered a safe haven in Mexico and had forged alliances with many of the small settlements, and even the state government. W.H. Emory, supervisor of the U.S.-Mexican Boundary Survey, reported in 1857:

> The relations between the Indians of this region and several of the Mexican towns, particularly San Carlos, a small town twenty miles below, are peculiar, and well worth the attention of both the United States and the Mexican governments. The Apaches are usually at war with the people of both countries, but have friendly leagues with certain towns, where they trade with the people of San Carlos, who also have amicable relations with the Comanches, who make San Carlos a depot of arms in their annual excursions into Mexico. While at the Presidio we had authentic accounts of the unmolested march through Chihuahua, towards Durango, of four hundred Comanches under Bajo Sol. It seems that Chihuahua, not receiving the protection it was entitled to from the central government of Mexico, made an independent treaty with the Comanches, the practical effect of which was to aid and abet the Indians in their war upon Durango (Emory 1857:86).

Camel Expeditions

In spite of the increased traffic through the Big Bend, most of the vast region was still poorly known. To help address this problem, two expeditions were launched, in 1859 and 1860, to reconnoiter the region and map the infamous Comanche Trail. They were to do this while also testing the efficacy of using camels as pack animals in arid regions. The idea had been floating around for some two decades before it was employed. But in 1855 the project was authorized and two shiploads of camels were imported from the Middle East, Africa, and southeast Europe. Setting out from Camp Verde near San Antonio in 1859, the first expedition under command of Lt. Edward L. Hartz proceeded to Fort Stockton before turning south along the Comanche Trail. The expedition took the east fork of the trail where it diverged near Peña Colorado, and continued southward, passing through Persimmon Gap, entering what is now BBNP. The party proceeded to Tornillo Creek, which it followed down to the Rio Grande before turning back (Casey 1972:16–19; Smith 1928:5–6).

The following year, a second expedition was launched, this time under the command of Lt. William H. Echols of the Topographical Engineers, who had also been on the first expedition. Once across the Pecos River, Echols continued on to Fort Davis before turning south into the Big Bend. The expedition followed the Chihuahua Trail southward to Fort Leaton, thence northeastward in hopes of crossing the western branch of the Comanche Trail. After an arduous journey through the Bofecillos Mountains, the party camped at Agua Fria springs before striking the Comanche Trail near Terlingua Creek. Echols reconnoitered the San Carlos crossing on the Rio Grande, then turned east until he arrived at the mouth of Santa Elena Canyon which he dubbed the "Gran Puerta." Four miles further east, the party discovered a good location for a post, likely near present-day Castolon. Having achieved their goals, the expedition returned via the San Carlos branch of the Comanche Trail, following Terlingua Creek northward before veering northeastward to Peña Colorado. Despite the relative success of the camel expeditions in having met their goals, the Civil War brought the project to a halt and, following the war, the experiment was never resumed (Echols 1860; Tyler 1975:109).

Indian Removal

In 1861 Texas seceded from the Union to become part of the Confederate States of America. As a result, Fort Davis was abandoned by U.S. troops in the summer of 1861 and replaced with an under-manned Confederate garrison that only occupied the fort until the following spring leaving local settlers and freighters without military protection. Within days, Apaches under Chief Nicolás destroyed the fort, triggering the abandonment of almost all of the homesteads, stage stops, and small settlements in the region due to the dramatic increase in Indian depredations (Scobee 1963:42).

In 1867, two years after the Civil War had ended, the U.S. military reoccupied and rebuilt Fort Davis. Lt. Col. Wesley Merritt oversaw the reconstruction of the fort—this time using stone rather than adobe. In addition to the twenty-fourth and twenty-fifth Infantry, the fort was manned by the U.S. Cavalry's Ninth and Tenth Regiments—black soldiers popularly known as "buffalo soldiers." Although the soldiers were quick to show their worth as Indian fighters, the vast distances and intensely rugged terrain of the Big Bend limited their effectiveness (Tyler 1975:114).

As late as 1870, both Apaches and Comanches still reigned supreme across the Big Bend and Davis Mountains. One well-known band was the Chisos Apaches, so named because they frequented the Chisos Mountains. The band was led by Chief Alsate, who was reportedly the son of an Apache woman and a Mexican captive from the town of Santa Rosa, Coahuila, named Miguel Múzquiz (Williams 1968:257). Fluent in Spanish, Alsate frequently traded stolen goods and livestock to Mexicans from the villages of San Carlos and Presidio del Norte. In 1877 Lt. John L. Bullis and his Seminole scouts picked up Alsate's trail and found their village on the Texas side of the Rio Grande. During the pursuit, Alsate's men trapped the detachment on a narrow ledge in a deep canyon. Miraculously, the scouts escaped without a single casualty (Reeve 1950:206–207). Shortly after, Bullis and his men returned to Mexico and attacked Alsate and his band in the Sierra del Carmen where they destroyed their *ranchería*, captured some 30 horses and mules, and killed 2 Indians (U.S. House 1878:195). But Alsate's troubles had just begun. Later that year, Mexican President Diaz ordered Alsate and his band captured and detained. The band, along with Alsate's aging father, Miguel, was seized, shackled, and transported from their *ranchería* near San Carlos, Chihuahua to the dreaded Mexican Prison of Casa de la Acordada in Mexico City (Daugherty and Elizondo 1996:38).

Alsate's Spanish heritage saved him from dying in prison. His uncle was Manuel Múzquiz (who had homesteaded south of Fort Davis before returning to Mexico), a prominent citizen and son of Santa Rosa, Coahuila, (now called Melchor Múzquiz). Alsate's father, Miguel, was able to prove to Manuel that he was his long-lost brother. As a result, the distinguished Manuel secured Miguel's release and eventually that of Alsate and his band. Resettled on a *ranchería* near San Carlos, however, it was not long before Alsate and his band resumed raiding. Again, the Mexican government gave orders to capture the "Chisos Apaches," this time to Col. Ortíz, the commander of troops at Presidio del Norte. Around 1882, Alsate and his band were deceived into attending a peace conference at San Carlos followed by a feast and drinking binge. The Indians awoke the next morning to find themselves surrounded by Mexican soldiers. Some 210 Apache warriors, women, and children were captured. Alsate was summarily executed by a firing squad while his fellow Apaches were sent to southern Mexico to be sold into slavery (Daugherty and Elizondo 1996:47; Miles 1976:45; Williams 1968:259–263).

By 1875 the Red River War forced the last of the Comanches and other Plains Indians to be relocated to Fort Sill in what is now Oklahoma, finally putting an end to their annual raids into Mexico (Fehrenbach 1994:545; Gwynn 2010:286). Nevertheless, the Apaches continued to range across the Big Bend, raiding and killing with relative impunity. But continuous pressure from the troops at Fort Davis and other regional forts finally drove most of the remaining Mescalero Apache to Fort Stanton, New Mexico (Banks 2002:1, 2). Discontent ran high, however, as the land was inferior to their native lands. In 1878, Apache leader Victorio along with 80 of his followers left the reservation and headed west across the San Andres Mountains, turning southwest into the Gila country. The band then circled through Mexico below El Paso and continued northeast into the Big Bend (Sonnichsen 1973:181–182; Tyler 1975:117).

In 1879 Fort Peña Colorado was established as a subpost of Fort Davis at the spring of the same name that lay along the Comanche Trail—part of a larger strategy of manning critical waterholes in an effort to weaken and demoralize the remaining Indians. By this time, Victorio's band had been joined by other discontents until his band numbered between 200-300 Indians. For many months, Victorio artfully evaded U.S. troops to the point of making a mockery of their efforts. Nevertheless, the Cavalry's constant pursuit ultimately forced them into Mexico where Mexican troops laid siege to the band at Tres Castillos in northern Chihuahua in 1880, effectively ending Indian resistance in the region forever (Sonnichsen 1973:210).

By the time Camp Neville Spring became a subpost of Fort Clark in 1885, it was no longer needed. Constructed beside a strong-flowing spring near the Grapevine Hills in present-day BBNP, the camp was established in response to depredations by Mexican bandits as well as the threat of Apaches crossings into Texas during Geronimo's campaign. But the Seminole Scouts who manned the post found nothing on their patrols except cowmen squatting at nearly every spring as far as they could see. After Geronimo's surrender in 1886, the further use of regular patrols became unnecessary and the subpost was abandoned in 1891. Nearby Camp Peña Colorado would face the same fate just two years later (Casey 1969:26–27; Gomez 1990:85–91).

Settlement

With the Indian threat removed, for the first time the greater Big Bend was available for settlement. Presidio County had been organized in 1871 and originally embraced all of what is now Brewster, Jeff Davis, and Presidio counties. In 1882, only two years after the last of the Indian engagements, the Southern Pacific Railroad was completed through the area, creating towns at regular intervals along its length. The railroad caused a rapid influx of people, supplies, and livestock, tying the region to the wider global economy. In 1885 the county seat was moved from Fort Davis to the quickly growing railroad town of Marfa. Yet the vast distances within the county's boundaries caused administrative delays and created discontent with residents. Pressure on the state legislature ultimately resulted in splitting off parts of Presidio County into four additional counties: Brewster, Jeff Davis, Foley, and Buchel counties. In 1887, Murphyville (later renamed Alpine) was designated the county seat of Brewster County and provisionally administered the two smaller counties, Foley and Buchel. In 1897, these two counties were folded into Brewster County, making it the largest county in the state (Casey 1969: 28–29).

Conventional histories of the region generally claim the Big Bend was settled by Anglos and Mexicans, but only after the Indians had been subdued and the railroads had arrived. In fact, the first settlers in the Big Bend were of Spanish and Indian descent—and came from settlements around San Carlos and La Junta. These early settlers would have been subsistence farmers who also hunted and gathered wild plants for food and medicine. Walter Fulcher (1959:3–5) claimed that an old Mexican peddler, locally known simply as "*Tío*," told him there were Spanish-speaking settlers at the mouth of Terlingua Creek as early as 1800 who raised crops of corn and *calabazas*. In a 1950s interview, an old Hispanic woman living in Marfa who claimed to be over a hundred years old, said that when she was a little girl [around 1850], her people were settlers near the mouth of Terlingua Creek. She said the country still belonged to Spain [*sic*], and that they finally had to leave because the Indians and rattlesnakes were so bad (Fulcher 1959:10). Although the specific dates are likely garbled, these anecdotes suggest a plausible model of episodic settlement and abandonment of areas along the border in response to changing conditions—such as drought and relations with nomadic Indians.

Ranching

Texas land laws were established to raise revenue for state schools, promote orderly settlement, and to discourage large landholdings. The laws may have achieved the first goal, but certainly not the others. Over the course of decades the law changed many times, reflecting shifts in policy and the ways in which the land was actually being settled. Beginning in 1879 settlers could purchase only one watered section and three unwatered sections with conditions of settlement and improvement. By 1905, the allowable acreage had doubled to an unprecedented eight sections, setting off a second land rush. A decade later, the long-standing requirement that buyers settle on and improve the land was simply discarded. But the opportunity to acquire lands at attractive prices drew many people to the Big Bend and set the stage for the ranching industry. Most of the largest ranches were established in the Big Bend between 1880 and 1890. The greatest increase occurred between 1884 and 1886, although cattle numbers would continue to rise for years. In 1880 the agricultural census revealed only 2,496 head of cattle in all of Presidio County (which at that time included future Brewster County). A decade later, Brewster County alone had over 33,000 cattle grazing its ranges. Although cattle predominated after 1890, sheep and goats outpaced cattle after 1935—a pattern that held until the early 1970s (Keller 2005:50).

Across much of what is now within BBNP, the G4 Ranch (so named because most of the land was located in Survey Block G4) spanned a vast area from Agua Fria Mountain southward to the Rio Grande, and from Terlingua Creek eastward to the Chisos Mountains. Established in 1885 by John and Clarence Gano, the Estado Land and Cattle Company purchased some 55,000 acres of land and leased other watered sections to create the G4 empire. By the end of the year, a herd of some 6,000 cattle grazed its pastures. By 1891 the herd had increased fivefold but drought and other difficulties forced the company to disband only four years later (Gomez 1990:100–101).

By the 1890s many other cattlemen had become well-established in the Big Bend—including a number of smaller operators. Notable early Mexican pioneers included Martín Solís who established his ranch near Mariscal Mountain, Federico Villalba who ranched at Burro Mesa, and Félix Domínguez who grazed his cattle along the southeastern flanks of the Chisos Mountains. Among the well-known Anglo ranchers were James Dawson, T.J. Miller, J.M. Talley, "Det" Walker, Pink Taylor, Jim Reed, William Pulliam, Joseph Moss, T.D. McKinney, "Newt" Gourley, J.L. Sublett, Clyde Buttrill, Joe Humphries, and H.G. Wigzell (Casas 2008; Gomez 1990:101; Willeford 1999:76–77).

Farming

Prior to the construction of upstream reservoirs, the Rio Grande and Río Conchos provided a tremendous flow of water through the Big Bend, allowing for irrigated farms. A number of tributaries to the Rio Grande such as Alamito, Alamo, Capote, Cibolo, Contrabando, Smoky, Terneros, Terlingua, and Tornillo creeks also provided modest flows sufficient for small-scale irrigation. Historical documentation indicates that some of these creeks were mostly perennial during the late 1800s to early in the twentieth century (Willeford 1999:63, 64, 67–69).

The earliest farming effort in the region outside La Junta was around Presidio San Carlos where, in 1851, Colonel Emilio Langberg of the Mexican Army found a community of more than 800 people farming in the floodplain. With the Indian threat removed, however, farming began to spread beyond the safety of the settlements. Within what is now BBNP, most of the early settlements were farming-based including San Vicente, Terlingua Abajo, El Ojito, La Coyota, and Santa Helena. More dispersed settlements, often little more than a collection of widely spaced homesteads such as those along Alamo Creek, combined farming with small livestock operations. Individual ranches and homesteads always had a garden, if not a field, to meet the family's needs for produce. Dugout Wells, originally homesteaded during the early 1900s by J.C. Avery, was purchased in 1917 by W.A. Green, who remained there with his family until 1937. The spring supplied enough water to support the ranch headquarters, a garden, and a number of fruit trees. Because of its central location, ease of access, and abundant water, Dugout Wells served as one of the cultural centers of the eastern Big Bend where dances, meetings, and social events took place. It also served as the location for a wood-framed schoolhouse that remained in service until 1936 (Madison and Stillwell 1997:49; Maxwell 1968:39; VandenBerg 2003:10).

Terlingua Abajo, a small farming community located along Terlingua Creek, some 3.5 km (2.2 mi) north of its confluence with the Rio Grande, was likely one of the earliest communities north of Mexico. It was probably occupied intermittently from as early as the early to mid-1800s, although permanent occupation would not take place until after 1880 when the threat of Indian depredations had passed. Several lines of evidence indicate that the community was well established by 1901, and by the early 1920s some 300 or more people were reported to be living in the small village (ruins of at least 70 structures have been identified). The first inhabitants were mostly Mexican subsistence farmers but as the quicksilver mining industry developed, farmers began growing produce for the mining camps and villages. To supplement their farming income, they also cut wood for fueling the massive cinnabar furnaces. At its peak, Terlingua Abajo boasted not only a sizable population, but also a village store and cantina (Wirt 2011).

In 1903, Cipriano Hernández purchased three sections of land several miles downstream from the mouth of Santa Elena Canyon and began to raise cereal grains that he sold as feed for freighting mules, and fresh vegetables that he sold in the mining camps. He also built what came to be known as the "Alvino house" (after a later owner), the first permanent structure in the area, and opened a small store on the east side of his home. In 1914 Hernández sold his property to Clyde Buttrill, who ranched in the Rosillos Mountains. In order to grow feed crops for his cattle, Buttrill contracted with James L. Sublett to run his farming operation. It was Sublett who introduced mechanized irrigated farming to the area, installing the first steam-powered irrigation pump. The property later sold to Wayne Cartledge who worked for Howard E. Perry, owner of the Chisos Mining Company. Cartledge moved from the Chisos Mine to the Rio Grande in 1919 and began farming portions of the floodplains in a partnership with Perry called the La Harmonia Company that consisted of a farming operation and a general merchandise store (Gomez 1990:157–158).

Between 1918 and 1922 the primary crop in the Santa Elena area was wheat although, starting in 1923, Cartledge began growing cotton in keeping with trends across the state. That same year Cartledge and Perry purchased a ginning machine to avoid excessive freighting charges. Cartledge also rotated crops, adding such products as grapes, corn, cantaloupes, peanuts, maize, alfalfa, and Rhodes grass for pasturing cattle. In addition, Cartledge planted orchards containing pecan, peach, apricot, and pear trees (Willeford 1999:125, 135–136). In 1926, a post office was established, leading to a change in the community's name from Santa Helena to Castolon (the name derived from nearby peak, Cerro Castellan) since there was already a post office in Texas called Santa Helena. Between 1923 and 1942 the La Harmonia gin produced more than 2,000 cotton bales and became a steady source of employment for the local Mexican population. La Harmonia also operated a frontier trading post that dealt in such commodities as fruit, feed, vegetables, hogs, turkeys, honey, candelilla wax, and furs (Willeford 1999:135). The Cartledge family continued to operate the store in Castolon until 1961 (Willeford 1999:101–102).

The La Harmonia store, in addition to the Sublett store operating a short distance upstream, helped support several budding hamlets in the area that sprang up soon after Cipriano Hernández purchased his three sections. Agapito Carrasco founded the village of El Ojito with a half dozen Mexican families, around one mile downstream from Santa Elena. Ruperto Chavarria led a larger group of immigrant families sometime between 1903 and 1911 to found the village of La Coyota—located about five miles downstream from the mouth of Santa Elena Canyon on the west bank of Alamo Creek. Within a few years the community had grown to around 10–15 houses (Elam 2000:71; Gomez 1990:157). According to an interview with former La Coyota resident, Mrs. Ramirez Rivera, the community was named after an incident involving a man who shot a coyote trying to get into a hen house. Like other small villages along the Rio Grande, La Coyota residents were primarily subsistence farmers who relied on hand-dug irrigation ditches to water their vegetables and grains. In addition to crops, the farmers also raised hogs and chickens. What little surplus remained was sold to miners in Terlingua (Hay 2003:7).

Although the farms around Castolon were the largest and most successful in the lower Big Bend, there were others. Farther downstream, the community of San Vicente was founded around 1896 by Mexican immigrants from Comanche, Coahuila, who were employed at the Boquillas mines, and who devoted their fields primarily to subsistence crops. Across the Rio Grande from Boquillas, Coahuila, at present-day Rio Grande village, fields were cleared by John O. Wedin around 1918 who grew wheat. The farm was purchased by rancher Joe H. Graham in 1926 who converted it to alfalfa and grains to feed his livestock. During the Great Depression, he sold his land to John Daniels who maintained the farm primarily for subsistence (Gomez 1990:160-61).

Despite a few good years, commercial farming in the Big Bend was plagued with insurmountable problems. Among the greatest were market fluctuations coupled with drought that caused annual farm income to be undependable and erratic. In the case of cotton farming, the pink bollworm also took a heavy toll, most notably in 1927. And although inexpensive labor provided by Mexican nationals had long been an asset, after the U.S. Government began strictly enforcing immigration laws in 1928, the labor force dwindled. Farming limped along, however, through the Great Depression and into the 1940s, largely due to continued local demand, especially that of the mining communities (Gomez 1990:166–67; Willeford 1999:82–83).

Mining

The mining industry played a major role in the early economic development of the Big Bend. Although the first mining in the region was reportedly conducted by the Spanish (or, alternatively, by Spanish convicts or slaves), most of the evidence is anecdotal. One legend holds that Spanish soldiers forced Indian slaves held at Presidio San Vicente to mine silver from what is now called Lost Mine Peak. Physical evidence of such mining, however, has never been found. Colonel Emilio Langberg, reconnoitering the Chisos Mountains in 1851, claimed he found several mines that had been in operation there at one time. Regardless, the first large-scale mining enterprise in the Big Bend was the Shafter silver mine established in 1883 in central Presidio County. The Boquillas silver mines were established in the Sierra del Carmen shortly thereafter in the early 1890s, and the community of Boquillas was declared an official village in 1897. In 1914 a tramway was constructed to transport the silver ore to the U.S. side for smelting but was in operation for only five years (Gomez 1990:114–115).

As early as 1884 cinnabar—or quicksilver—began to be mined west of Terlingua Creek. The earliest mining was conducted by small operators, but began on a larger commercial scale around 1910. In 1903 Chicago industrialist, Howard E. Perry, incorporated the Chisos Mining Company. Destined to become the most successful of a handful of cinnabar mining operations in the Big Bend, within two years of opening, the mine supplied 20 percent of the nation's quicksilver output. In 1900, U.S. Custom's Officer Ed Lindsey filed a mining claim at Mariscal Mountain in the far southern tip of the Big Bend. But to ship the ore to be processed was cost prohibitive and Lindsey sold the mine less than five years later. The mine changed hands several times before installing a much-needed 45-ton Scott furnace in 1919, but in the process was overextended and the mine closed for good in 1923, having produced a total of only around 1,300 flasks of mercury (by contrast, the Chisos Mine produced 5,029 flasks in its first year alone) (Gomez 1990:126–27).

The mercury mines allowed some, like Howard Perry, to amass considerable wealth. For the actual miners, however, the wages were barely enough to survive on and, because paychecks were issued as company-store scrip, the largely Mexican workforce was little more than indentured servants. The truck farmers, wood haulers, chino grass gatherers, brick makers, and freighters, on the other hand, were independent contractors and stood to make good money. The freighting industry was largely controlled by Mexican American entrepreneurs who served the critical function of hauling mercury from the mines and supplies back to the mines. Common names in the freighting business were Felix Valenzuela, Rafael Carrasco, Cleofas Acosta, Valentine Rodríguez, Paz Molinar, Antonio Franco, and the Ben Gallegos family (Gomez 1990:123; Willeford 1999:151–152).

Candelilla Wax

The candelilla wax industry played a significant role in the economy of the lower Big Bend from around 1910 to modern times, with booms corresponding with greater demand during the first and second world wars. Used by traditional Mexican folk healers (*curranderos)* for kidney ailments and venereal disease, candelilla wax has been used in more recent decades to produce many end-products, including candles, crayons, lipstick, and chewing gum. During wartime it was used extensively as a waterproofing agent for tarps and tents (Casey 1972:184).

The first lease contracts to gather and process the candelilla plant in Texas were issued to W.W. Willet and G.E. Brashear in 1908 for Brewster and Terrell counties, and later that same year to J.H. Smith for El Paso, Presidio, and Jeff Davis counties. Commercial exploitation began in the interior of Mexico before 1910, but was interrupted by the Mexican Revolution. In 1911, a chemist from Monterey, Mexico, developed a more effective and efficient processing method about the same time the wax industry was launched in the Big Bend (Pospisil 1994:62–70; Tunnell 1981:6–7).

In 1911 Edgar D. Lowe built the first wax factory in the Big Bend at Double Mills, around 30 miles south of Marathon on Maravillas Creek. In 1912 E.M. Ellis established another wax factory at McKinney Springs, but sold it the following year. In 1913 W.K. Ellis and partner C.D. Wood acquired the factory as well as the lease to the water and candelilla plants within the immediate area. The factory operated successfully for over two years, but as candelilla supplies dwindled, the operation was relocated to Glenn Springs amidst thousands of acres of candelilla plants. The Glenn Springs factory was considerably larger and consisted of a water storage system, a boiler room with tall smoke stacks, six large extracting vats, a well-stocked general store, a large house for the foreman, and several dozen huts for the workers and their families. The market for candelilla wax remained strong throughout World War I, but prices plummeted once the war ended. As a result, the Glenn Springs factory was closed and, in 1919, sold to W.D. Burcham, manager of the Mariscal Mine, who operated it for another decade (Casey 1972:181; Tunnell 1981:7).

Although Glenn Springs was the largest of the early wax factories, other smaller operations were soon to follow. As early as 1921 at least six factories were operating between Fresno Canyon to the West and Reagan Canyon to the east. One such factory was established at Cerro Chino about 12 km (7.5 mi) southeast of Castolon around 1922. Known as the Mex-Tex Wax Company, it was run by general proprietor R.W. Coffey in Alpine with Lee Harrington serving as field manager. Wax production began at least by January of 1923, sending regular shipments out of Castolon. Most, if not all, of the company's transactions between 1922 and 1924 were made through Wayne Cartledge at his La Harmonia store, totaling nearly $5,000 in purchases of equipment for the wax factory as well as food and clothing for the workers. Records from the Terlingua Truck Line records (that shipped all Mex-Tex wax at least during 1924) indicate steadily declining production of candelilla wax between March and September of 1924. Although the company averaged over 7,000 pounds of wax per month, production declined rapidly from a high in March of 13,082 pounds to a low in September of 1,800 pounds. The total for the 7-month period was 49,177 pounds (worth approximately $9,835 at 20 cents per pound). By comparison, the Glenn Springs operation produced up to 10,500 pounds a month when operating at full capacity. Correspondence during this period from Harrington to Cartledge often expressed urgency reflecting the continued struggle to keep the operation productive. Among the most requested items were food, clothing, and special equipment such as water gauge glasses, metal pipe, valves, fittings, and heavy gauge wire. Clothing orders suggest a workforce of around 24 families (clothing for 2 dozen men and a dozen boys in one order), most likely all of Mexican national origin (common names in La Harmonia ledgers related to the Mex-Tex company include Viscaina, Baldez, Ybarra, Avalon, and others). Although candelilla was harvested locally and refined at the company factory, it was also purchased by the company (either as raw candelilla or finished wax) out of Mexico (Casey 1972:182; Keller 2012).

Because the entire candelilla plant is harvested, gathering areas were quickly depleted, forcing workers to go farther afield to harvest. It was likely due to such declining production that the Mex-Tex Wax Company moved the operation downriver in 1924, probably to the village site of Pantera. Although documentary evidence of their subsequent location is lacking, among artifacts recovered at Pantera were several Mex-Tex Wax Company tokens, apparently used by workmen in exchange for goods at the company store. The company continued operations for an unknown period of time at this (and possibly other) locations, probably using Glenn Springs for their post office and shipping needs (Keller 2012).

By 1935 candelilla wax production had expanded across the Big Bend region, encompassing nearly every area where it grew. This was made possible largely by the introduction of newer methods and equipment that allowed operations to be much smaller and more portable. Early vats used to process the candelilla wax were made of wood and required the addition of a broiler to make steam. Once these were replaced by metal vats that could be buried in the ground and fired directly, the operations became much more portable. Thus, when the candelilla supply was exhausted in one area, the entire operation was simply loaded onto a truck and moved to another location. In this way, smaller operations proliferated. The industry fluctuated with the changing tide of the candelilla market and in response to drought or market stresses that lured ranchers towards such supplemental income. In 1942 Jim Casner of Alpine built the largest processing plant in the area at Presidio and a decade later built a refining plant in Alpine, essentially dominating the regional market, which persisted for another 40 years (Casey 1972:182–83).

The erratic nature of the candelilla market, affected by climate, economic conditions, Mexican export restrictions, and U.S. tariffs, forced major industrial consumers to develop synthetic substitutes for candelilla which significantly decreased demand. Meanwhile, the

North American Free Trade Agreement of the 1990s largely privatized the industry, causing it to become more centralized and under the control of large commercial interests. After the closing of Class B border crossings following the terrorist attacks of September 11, 2001, tourist dollars ceased to support the small border communities south of the Big Bend and many turned to candelilla wax production to survive. Today, most candelilla wax is sold to Mexican buyers who then sell large lots to U.S. buyers and brokers through the ports of Presidio or Del Rio. Despite candelilla's uncertain future, U.S. prices have increased steadily since around 1975, and it continues to be an important source of income for border communities (Texas Beyond History website, Wax Camps: The Industry Today).

Mexican Revolution

In 1910 Francisco Madero declared his *Plan de San Luis Potosí,* marking the beginning of the Mexican Revolution. For the next decade Mexico would be in turmoil and the Big Bend would be the staging area for military activities and bandit raids that persisted into the 1920s (Elam 2001:187). The effects of unrest were first felt in the Big Bend on December 10, 1910 when it was feared that revolutionaries were to attack Ojinaga, Chihuahua (Thompson 1985:77). Although that attack failed to materialize, U.S. troops were called to the border to monitor the situation. Meanwhile, Madero briefly assumed leadership in May of 1911, but by 1913 General Victoriano Huerta of the Mexican army took power and had Madero executed. The following year, Madero's followers, led by Venustiano Carranza, occupied Mexico and Huerta fled the city. By that time revolutionary uprisings were occurring all over Mexico. Emiliano Zapata and Francisco "Pancho" Villa broke from Carranza and the revolution continued, creating a renewed wave of tension along the border (Keil 2002:3, 4).

After Mexico nationalized American properties, resentment soared and many Texans working in Mexico turned to banditry, joining with Mexican gangs that held contempt for both the Carranza and Villa regimes, taking advantage of the chaos to prey on citizens. People living on both sides of the border now feared not only the revolutionaries and the federales, but also the bandit gangs and the *Rurales,* groups paid by Carranza to kill bandits along the border (Keil 2002:7, 8).

As the revolution gained momentum, there was an ever-increasing need for federal troops along the border. Consequently, Troop M of the Third Cavalry and Troop H of the Fourteenth Cavalry were the first companies stationed at Marfa in 1911 to patrol the border and enforce neutrality laws. Known as Camp Marfa, the central headquarters supplied 12 border outposts by 1913, some as far as 100 miles away. In 1914 Camp Marfa expanded to include state and National Guard troops following the onset of World War I. That same year Pancho Villa led an assault on Ojinaga. Some 2,000 refugees fled to Presidio, most of whom were marched to Camp Marfa to be shipped by train to Fort Bliss. It was estimated that the column of refugees was 12 miles long (Justice 2001:101; Keil 2002:*xii,* Thompson 1985:Vol. II, 79–82, 104, 123; Tillapaugh 1996:167).

Meanwhile, as early as 1912, rumors circulated that bandits were planning a raid on San Vicente, Texas. In response, 25 cavalrymen were transferred to the lower Big Bend in March, although the military was concerned less about San Vicente than the mining interests at Boquillas. Consequently, the cavalry was stationed at La Noria, the American terminus for the cable tram used to transport ore from Mexico into the U.S. But the raid did not materialize, and after a few months the cavalry unit returned to Marathon. Despite repeated pleas for additional military protection, the federal government resisted committing more than a token force. For its part, the U.S. military was more interested in maintaining neutrality and to prevent the war from spilling over onto U.S. soil. Bandit raids, it was argued, were a state issue, not a federal one. That all changed in 1916 due to a string of events that forced the U.S. to respond. In January, Villistas executed 18 American mining engineers near Santa Ysabel, Chihuahua.

Three months later, Villistas attacked the border town of Columbus, New Mexico, leaving 17 Americans dead. The Army promptly sent Brigadier General John "Black Jack" Pershing into Mexico to punish the offenders. While Pershing pursued Villa across northern Mexico, Mexican bandits attacked the village of Glenn Springs in May where three U.S. soldiers and one boy were killed. A second group of bandits raided the store at Boquillas, taking two men hostage. In response, troops from the Eighth and Fourteenth cavalries converged at Marathon before marching south in pursuit of the raiders. Penetrating some 200 miles into the interior of Mexico, the troops were able to engage a small party of bandits, wounding several. They also recovered some of the stolen goods and both hostages before returning (Gomez 1990:131–136).

The raid on Glenn Springs forced the military to more actively defend the border. During the next two years, thousands of troops were dispatched to the Big Bend. Among those were National Guard units from Texas, Arizona, New Mexico, Pennsylvania, and New York. The newly established Big Bend Military District consisted of 10 isolated outposts with the headquarters in Marfa—from east to west, troops were stationed at La Noria, Glenn Springs, Castolon, Lajitas, Polvo, Presidio, Indio, Ruidosa, Candelaria, and Porvenir. In what is now the national park, the most substantial of the military outposts was Camp Santa Helena, located at present Castolon. Among other things, this strategic location allowed protection of the Chisos Mining Company stores and payroll. Between 1916 and 1917 several wooden buildings were constructed and troops of the Fifth, Sixth, and Cavalry were stationed there. Then, in 1919, a fully modern post was built consisting of officer's quarters, barracks with a mess hall, lavatory, recreation hall, canteen, grain shed, stables, a water tower, and a storage tank. But the modernized post was never fully utilized. The military response to the Glenn Springs raid seemed to quell additional raids in the lower Big Bend, and the commitment of American troops to France in 1917 had already reduced manpower along the border. Then, as the situation in Mexico began to stabilize, orders were issued in April of 1920 that closed down many of the border outposts, including Camp Santa Helena, and began the withdrawal of troops from the Big Bend (Casey 1969:51–52; Gomez 1990:146–154).

Commerce

The first retail operations in the Big Bend were established in what would become Presidio, Texas. Around 1848 Ben Leaton opened a classic frontier trading post on the north side of the Rio Grande. Once the threat of Indian attack subsided and the railroad penetrated the northern part of the Big Bend, such frontier trading posts proliferated. By 1930 some 15 trading posts were known to exist between Presidio and Boquillas. Among these were the Lajitas Trading Post, the Chisos Mining Company store, La Harmonia Company store, Johnson's Ranch Trading Post, Langford's store and post office, Deemer's store, Chata's store, and the stores at Glenn Springs, San Vicente, La Noria, La Coyota, and Terlingua Abajo. Whereas the trading posts provided basic necessities to people of lower socioeconomic status, for others the posts served more as a place to socialize than as a critical source for goods. Such trading posts supplied items that could not be obtained locally, such as coffee, sugar, salt, cinnamon, Karo syrup, sardines, American cheese, fruits, tobacco, shoes, and bolts of cloth. Because money was scarce—and not particularly useful along the frontier—much of the commerce was carried out by bartering rather than cash sales. Among other things, trading posts were actively engaged in the fur trade; beaver, wolf, grey fox, lynx, badger, skunk, and ringtail pelts were accepted in lieu of payment. The pelts were later sent to such buyers as the Funston Brothers Company of St. Louis (Willeford 1999:92–95, 136–138).

Although there was not much in the way of the service industry in the lower Big Bend, there were a few minor exceptions. For example, one of the favored destinations of early travelers in the 1920s and 1930s was "Chata's" place in Boquillas, Mexico, where homemade meals were cooked on a wood-fired stove. Just a few miles away, J.O. Langford built a large stone bathhouse at his hot springs around 1910, marking one of the first tourism efforts in the Big Bend. Although Langford left during the Mexican Revolution, he returned in 1927 and expanded his resort by building a new store and cabins for overnight guests. Due to reported medicinal powers the hot springs possessed, they became a destination not only for local residents, but for health seekers all across Texas and northern Coahuila. Langford continued to operate the hot springs until he sold it to the State of Texas in 1942 (Casey 1972:116–122).

During the drought and Great Depression of the 1930s, many people sought additional sources of income. Some turned to manufacturing candelilla wax, others to prospecting for precious minerals, and still others to offering hunting leases or guiding services. Deer leases in particular became an important source of income to many Big Bend area ranchers, one that continues to grow in importance even today. These leases also helped launch the larger tourist industry and the sales of ice, gasoline, beer, and liquor to deer hunters, in turn, helped local storeowners through tough times. At least as early as 1929 some Big Bend residents also began to supplement their income by raising honeybees—another industry that persists to the present day. Although much was consumed locally, some of the honey was freighted to the Chisos Mine or shipped by railway for government-subsidized school lunch programs (Willeford 1999:115–117, 150).

Aftermath

By the time the lower Big Bend was set aside as a national park, the mountains, grasslands, and desert that surround the Chisos Mountains had undergone a vast array of changes. Cottonwoods along the Rio Grande and tributaries (such as Terlingua Creek) as well as pines in the Chisos Mountains had been harvested to fuel furnaces at the quicksilver mines. Mining itself left indelible scars on the land, now littered with mineshafts and adits, roads and pads, abandoned furnaces and toxic tailings piles. Fields in the Rio Grande floodplain, once cleared of vegetation and plowed for row crops, became thickets of mesquite and salt cedar. The Rio Grande, depleted from upstream diversions and impoundments and choked with vegetation, no longer lived up to its name. But no change has been as dramatic as the loss of the grasslands in the Big Bend. Before livestock were brought in, the desert grasslands were significantly more widespread and productive than they are today. In 1909 J.O. Langford claimed that the land between Alpine and the eastern flanks of the Chisos Mountains contained grasses knee-deep to a horse (Langford and Gipson 1955:20).

Such grasslands could not last long amidst the abuses that attended the early ranching days. When the vast G4 Ranch disbanded a scarce 12 years after it started, some 15,000 head of cattle were driven north to market (Gillett 1933:82–83). Such intensive grazing coupled with recurrent drought led to the loss of topsoil. And once the grasses were gone, shrubs and other woody vegetation increased in a process known as "desertification." Fire suppression, climate change, increases in atmospheric carbon dioxide and a host of other factors have also contributed. But due to the excesses of the early days, much of the area once dominated by grasses is now dominated by desert shrubs and cacti (Powell 1994:20–25).

The National Park

Efforts to establish a national park in the Big Bend extend back to 1933, when the country was steeped in the Great Depression. Inspired by Robert T. Hill's 1899 article in Century Magazine about the first documented boat trip through the canyons of the Big Bend, junior congressman Robert M. Wagstaff approached E.E. Townsend about co-sponsoring a bill to create a "Texas Canyons State Park." Townsend, who had served as a U.S. customs agent in Presidio as well as sheriff of Brewster County, knew the country well and was enthusiastic about the prospect of making it a park. The bill passed on March 2, 1933, setting aside some 15 sections of land for a "Texas Canyons State Park" along the canyons of the lower Big Bend. Several months later, a second bill was passed that added another 150,000 acres of public school land and redubbed the park "Big Bend State Park" (Gomez 1990:175–76).

Meanwhile, President Roosevelt approved a proposal to locate one of his New Deal Civilian Conservation Corps (CCC) camps at the new park. After finding the required water in 1934, a camp was established in the Chisos Basin. As the young men of the CCC began building roads and trails for the new state park, Townsend and local promoters started an aggressive campaign to have the park added to the National Park system. After considerable effort was expended writing letters and courting NPS dignitaries, a bill passed Congress authorizing Big Bend National Park that was signed into law by Roosevelt the same day. However, there was one major stipulation: the State of Texas must acquire all the needed acreage before deeding it to the federal government. This proved problematic. Several bills were introduced to the state legislature during the 1930s, but none passed, due largely to the national economic crisis. However, at Roosevelt's urging, the new governor W. Lee "Pappy" O'Daniel personally oversaw legislation that ultimately passed in 1941, allocating the $1.5 million required to purchase the remaining land. Despite some local resistance, almost all of the land was purchased within a year, and on September 5, 1943, the State of Texas transferred the holdings to the Regional Director Tillotson of the NPS. On June 12, 1944, Big Bend National Park officially came under the jurisdiction of Region III in Santa Fe, becoming the 27th park to be added to the National Park System (Gomez 1990:176–189).

5

Project Design

Research Design

The research design for the present project was originally outlined in the project proposal submitted in 1990. A formal research design was completed and submitted in 1998, shortly before the project's funding was terminated. Five years elapsed before the National Park Service reinstated funding to the project. By this time significant advancements in technology, as well as experiences from the first phase of the project, led to the decision to revise the research design. Each component of the project's history is outlined below.

Background on Predictive Modeling in Archeology

Predictive modeling in archeology attempts to predict the location of archeological sites or materials within a prescribed area, usually based on existing knowledge of archeological sites within a sampled portion of that area. Underlying such modeling is the assumption that the location of archeological remains in the landscape is not random, but is related to identifiable characteristics of the natural environment. In essence, it assumes that certain parts of the landscape were more attractive for human activity than others. In practice, predictive modeling is a tool that allows land managers to select areas for survey when time and money do not allow a complete survey of the landscape. Similarly, it can aid in planning efforts when trying to avoid areas containing archeological resources (Verhagen 2007:13).

The archeological application of predictive modeling was an outgrowth of both the growing field of Cultural Resources Management (CRM) and Processual Archeology of the late 1960s that embraced more ecological and quantitative approaches. The burgeoning field of CRM following the passage of the National Historic Preservation Act of 1966 addressed the new requirement that federal land managers identify and document historic properties on the land under their watch. An outgrowth of that effort was the "predictive survey"—the techniques for which were developed by the Southwestern Archaeology Research Group (SARG) that sought to compare expected to observed site distributions. This essentially laid the foundation for predictive modeling in archeology. As Geographic Information Systems (GIS) software became available in the 1980s, computer-based spatial modeling grew increasingly popular with land managers. By the late 1980s and early 1990s, GIS-based modeling was beginning to be employed in the field of archeology, and a large number of publications were devoted to its application. Although such modeling has not been universally embraced by the academic community, it has been widely employed in public archeology and continues to be an important management tool, especially with federal land agencies like the National Park Service (Verhagen 2007:14–17).

The present project was conceived in 1990, at a time when predictive modeling was being increasingly utilized but before widespread use of GIS. Such modeling had been successfully employed by the Texas Office of the State Archeologist, and the sampling format for the Big Bend National Park (BBNP) project was initially modeled after a predictive assessment conducted in 1976–77 in Hidalgo and Willacy Counties, Texas, by Mallouf, Baskin, and Killen (1977). Funded by the U.S. Army Corps of Engineers, the assessment was a pilot project intended to have broader applications in similar undertakings (Mallouf, Cloud, and Alex 1990; Mallouf et al. 1977).

Subsequent intensive surveys and test excavations conducted in the Hidalgo-Willacy project area served to demonstrate the validity and applicability of the pilot predictive assessment. However, as noted by Mallouf et al. in 1990, the relatively homogeneous environmental parameters of the Hidalgo-Willacy project were markedly different than those of BBNP, and it was emphasized that the 60 percent to 80 percent predictive accuracy achieved at Hidalgo-Willacy might not be obtainable in the latter project. As a consequence, ensuing planning sessions for the BBNP project, while drawing heavily from the basic Hidalgo-Willacy methodological format, stressed the need for revised and expanded field procedures that would address the unique environmental complexities of the park.

BBNP Project Proposal

The original project proposal was submitted to the Southwest Division of the National Park Service in 1990 by Robert J. Mallouf and William A. Cloud, both with the Office of the State Archeologist, and Thomas C. Alex, NPS archeologist for BBNP (Figure 5.1). The document outlined the purpose of the proposed study, previous archeological work conducted in the park, and the project's theoretical framework and methodology (Mallouf et al. 1990).

Because previous systematic recording of sites within the park had been small surveys related to development of park infrastructure, the document proposed to conduct a 12% percent environmentally stratified sampling of the entire park, including all environmental zones, using a combination of judgmental and random quadrat sampling units. The approach would consist of four phases. The first phase would focus on gathering background data, creating a project design, and intensive survey of control blocks. During the second phase, judgmentally placed sampling quadrats would be surveyed and phase two site projections would be generated. During the third phase, randomly placed sampling quadrats would be surveyed and phase three site projections would be made. The fourth phase would involve data integration, analysis, and scientific reporting of findings as well as the development of research avenues, additional site projections, a parkwide cultural resources management plan, a parkwide National Register of Historic Places (NRHP) nomination, and public education materials (Mallouf et al. 1990).

Following review of the project proposal by the NPS and the Texas Historical Commission, the project received funding in fiscal year (FY) 1995. Fieldwork began in October of 1995 and continued through the spring of 1998 for a total of 6 seasons and 17 field sessions—each lasting 10 days. Over that span of time, 6,851 ha (16,930 acres) were surveyed and 391 sites were recorded. Status reports were generated in 1996, 1997, and 1998. The project followed the methodology as set out in the original proposal until 1998 when the formal research design was completed and submitted. However, because the NPS did not provide funding for FY 1999, the project was shelved indefinitely.

Research Design

The first BBNP archeological project research design was completed in January of 1998. As originally set out, it was to be a parkwide, environmentally stratified sampling project that would help guide research and management decisions in BBNP. Among other issues, the project was to address a major NPS mandate to inventory and evaluate the significance of cultural properties within the park as set out in section 110

Figure 5.1 BBNP project coordinators discussing landforms. From left: Robert Mallouf, Andy Cloud, Rolfe Mandel (geomorphologist), and Tom Alex. March, 1998. Photo by F. Garcia.

of the National Historic Preservation Act and Executive Order 11593 (See Appendix 17; Mallouf et al. 1998:1).

By sampling each environmental zone within the park, the project was to provide data on the different kinds, densities, distribution patterns, and preservation status of cultural resources in the park. One of the key products from the project would be a predictive model of site occurrence to facilitate management decisions, especially with reference to NPS undertakings, such as construction and maintenance of park infrastructure.

The research design was crafted to be systematic and problem-oriented in order to address various hypotheses concerning regional human adaptations. The project was to be divided into a sequence of complementary stages designed to maximize funding, efficiency, consistency of recording, and validity of results. Significantly, the project design was also "based on the premise that research and management domains go hand-in-hand, and one should not, and cannot, be reasonably separated from the other—either conceptually or in real practice" (Mallouf et al. 1998:1).

Among the purposes of the project were seven management-oriented goals. In addition to the predictive model, the project would generate criteria for determining site significance, identify critical resource zones and natural and artificial impacts to cultural resources, develop guidelines for cultural resource management, outline management needs and procedures, and develop a parkwide multiple resources nomination to the NRHP.

In addition, the original proposal outlined a broad range of research topics the project would help address, including "site function, site configuration, cultural feature type and function, intra-site patterning, material inventory, stone technology, inter-site relationships, human-environmental interactions, settlement patterns, subsistence patterns, dynamics of seasonal rounds, specialized resource-procurement activities, human demography, and inter- and extra-regional influences" (Mallouf et al. 1998:12).

Also included was a list of more regionally specific research questions the data generated by the project could bear on, including the presence or absence of Paleoindian occupation in the Big Bend, emergence of hunter-gatherers in the region, lifeways of Archaic peoples, recognition of indigenous versus intrusive cultures in the archeological record, interaction of nomadic and farming peoples in Late Prehistory, and prehistoric resource procurement systems and techniques (Mallouf et al. 1998:12). Specifics concerning the sampling strategy and phased approach are addressed below.

Sampling Strategy

The sampling strategy as set out in the original research design employed a total of 106 quadrats amounting to a total of 32,375 ha (80,000 ac). The initial fieldwork would involve surveying six 2,023 ha (5,000 ac) "control blocks," 4.5 km (2.8 mi) per side, allowing the project to amass a body of consistently derived and systematic data in targeted environmental zones. These blocks would be judgmentally placed for the purpose of sampling large, homogenous portions of each environmental zone in the park. Several blocks located along the Rio Grande were also to be surveyed, amounting to an additional 6,070 ha (15,000 ac).

Fifty smaller 202 ha (500 ac) quadrats, 1.5 km per side (.93 mi), were to be judgmentally placed in a strategic fashion to capture microenvironments within each of the larger environmental zones. This would guarantee that no significant environmental niche would remain unexamined. Finally, 50 additional 202 ha (500 ac) quadrats were to be *randomly* generated by computer, which would be used to evaluate the effectiveness of (and to further refine) the predictive model (Mallouf et al. 1998:17).

Phased Approach

The original research design called for eight complementary phases by which the predictive model would be created. The first phase consisted of surveying the six 2,023 ha (5,000 ac) judgmental control blocks. The second phase consisted of projections of site type, location, density, and condition—an initial predictive model based on the first phase of fieldwork. The third phase involved surveying fifty 202 ha (500 ac) judgmental blocks. The fourth phase was to evaluate the accuracy of the predictive model based on the results of the survey of the 202 ha (500 ac) blocks. The fifth phase was to refine the model. The sixth phase was to apply the revised model and to test its accuracy with the seventh phase—a survey of 50 randomly selected 202 ha (500 ac) blocks. The eighth and final phase involved refinements and adjustments to the model as needed (Mallouf et al. 1998:20).

Environmental Zonation

Environmental zonation was originally based on geological and geomorphic attributes rather than vegetation due to climatic changes through time. The project universe was split into two broad classifications: mountains and basins. Further delineation was based on slope elements for the mountains and landform-sediment assemblages for the basins. This resulted in a three-part breakdown for the mountain zone: summit, sideslope, and footslope. In the basins, five geomorphic units were identified: alluvial fans, colluvial aprons, alluvial terraces, alluvial plains, and badlands. Following the spring 1998 season, an additional category, bedrock outcrop, was added to the basin zone. Together, these nine environmental zones were to be sampled individually, with considerable attention given to surveying boundaries between such zones as well as microenvironments contained within them (Mallouf et al. 1998:14–16; Cloud and Smith-Savage 1998:2).

Revised Research Design

Following the termination of funding in FY 1999, the BBNP project was shelved for five years until NPS funding was reinstated in FY 2004. At that time, the research design, methodology, and project goals were critically reviewed based on the experience gained during the first three years of the project (Keller et al. 2008).

In the time that had elapsed, significant advances in technology had been made as well as changes in the project staff's understanding of the scope of the project and the practicability of the original goals. It was determined that within the confines of the present budget and time frame, the original research design was unachievable. As a result, crucial modifications were made that reflected these concerns, and the project was scaled back to a more manageable scope.

Although the primary objectives for the project remained the same, several significant changes were made. The most sweeping involved changing the project's focus from the entire park (324,220 ha [801,163 ac]) to an exclusive focus on the Basin Zone (203,874 ha [503,783 ac]), a mostly judgmental sampling strategy, revisions to the phased approach, and specific criteria for nominations to the NRHP. In addition, minor adjustments were made to the methodology, GIS analysis, and the project results. Each of these revisions is detailed below.

During the first three years of the project, problems arose as a result of the parkwide scope of the project. In particular, several concerns arose as sampling began in the Mountain Zone. For one, adequate sampling of this zone posed extreme logistical difficulties—mostly as a result of increasingly remote survey areas, much greater topographical relief, and difficulties in getting crews and gear into the backcountry and keeping them properly supplied. Coupled with these problems were substantially reduced rates of coverage (plummeting from ca. 10 ha [25 ac] per person per day to only 2 ha [5.3 ac] per person per day) and personnel safety issues resulting from injuries sustained due to the rougher terrain.

As a result of these concerns, through a series of meetings among the project staff, a modified sampling strategy was proposed that would limit the project to the Basin Zone; the remaining environmental zones would be excluded. The Basin Zone was chosen over the others for a variety of reasons, among which were its significantly larger size (approximately 60 percent of the park total), relative ease of access, much greater concentration of archeological sites, higher visitor use, and greater development-related impacts (see Setting and Environment chapter for further discussion).

Another aspect of the original research design that was scrutinized was the sampling strategy. As originally conceived, some 30 percent of the surveyed acreage was to be randomly generated, and all survey blocks were to be of a uniform size (202 ha [500 ac] and 2023 ha [5,000 ac]) and shape (square). The revised research design called for an increase in judgmental blocks, and a reduction in random blocks, for two major reasons. For one, judgmental blocks allowed better coverage for areas of special interest as well as those that had been under-sampled. Second, this method allowed blocks to be placed with an eye towards ease of logistics, which would conserve project funds as well as save a considerable amount of time.

Consequently, the revised sampling strategy called for reducing the randomly generated blocks to 6 percent of the total survey area, amounting to 20 blocks, 81 ha (200 ac) in size, for a total of 1,619 ha (4,000 ac) that would be randomly generated (actual random survey area was 1,581 ha [3,906 ac]). It was felt this would maximize project efficiency while still being sufficient to test the predictive capabilities of the model. Further, the revised approach dispensed with uniformly square blocks. Blocks could now be chosen without restrictions as to shape or size.

The phased approach was also revised and simplified, reducing the total number of phases to five. The first phase (already completed at the time the revised research design was written) was to sample a variety of areas within the Basin Zone, for a total of ca. 20,234 ha (50,000 ac) surveyed. The second phase was to survey 10 or more small judgmental blocks strategically placed to sample microniches and ecotones. The third phase was to develop the predictive model based on data derived from the first two phases. The fourth phase was to test the model using 20 randomly generated 81 ha (200 ac) blocks. The fifth and final phase was to evaluate the model and adjust and refine it as necessary to achieve ca. 70–80 percent accuracy.

As set out in the original proposal and research design, all sites documented during the project were evaluated with regard to eligibility for inclusion in the NRHP. However, due to the sheer number of sites documented during the project, the possibility of individual site nominations was deemed impractical. Instead, the revised research design called for a single fully-developed, formal historic context and a parkwide multiple property nomination. Although the parkwide multiple property nomination was ultimately dropped due to funding constraints, a thematic framework for such a nomination was proposed to offer a convenient framework for future site evaluations and nominations. Architectural remains were chosen as the theme for the fully-developed, formal historic context—one that crosscuts temporal boundaries and addresses a broad range of site types. Although such remains are fairly common in BBNP, they are also among the most important and, often, the most endangered of prehistoric and historic features. The proposed provisional heading was "Temporal, Functional, and Social Affinities of Vernacular Architecture in Big Bend National Park" (See Appendix 19).

The field methods of the BBNP project were refined several times over the course of the project. These were made in response to a variety of factors including efforts to increase coverage rates, technological innovations, and field experience. However, changes in methodology were always balanced with the need for consistency in recording throughout the project. The primary adjustments, as outlined in the revised research design, consisted of the use of streamlined site forms and greater reliance on handheld GPS units and digital cameras. Other methodological considerations remained the same. A detailed explanation is presented in the Methodology section below.

When the original research design was developed, GIS was relatively new. At that time the mapping software employed by the NPS was called Geographic Resources Analysis Support System (GRASS). Little digital spatial data was available and the environmental zonation was based on relatively coarse geology and soils maps. By the time the research design was revised, the NPS was using Environmental Systems Research Institute's (ESRI) GIS—the gold standard of spatial data manipulation and analysis. Environmental zonation was reconstructed using recently developed high-resolution soils data from the U.S. Natural Resources Conservation Service (NRCS). Additional data included ease of access to water sources, peak and ridgeline data, and water availability indices. Taken together, these various layers made possible a much more refined product, both in terms of the analyses of findings as well as the predictive model. Details on the various methods employed in each can be found in Analysis of Findings (Chapter 7) and in Appendix 15 (GIS Model).

Few changes were made to the BBNP project deliverables. As outlined in the original research design, the project results would be presented in a well-illustrated technical report comparable to recent publications in the *Intermountain Cultural Resources Management Professional Papers*. A monograph and/or brochure condensing the project's findings for the general public would also be produced. (This component was ultimately fulfilled in a series of public presentations and an article published in *Crossroads in Science* [Keller

2015]). In the interest of time and efficiency, annual status reports were to be replaced by shorter, more concise documents detailing findings within each survey block. In addition, the park archeologist and the project archeologist would collaborate on annual *System-wide Archeological Inventory Program* (SAIP) reporting.

Aside from the change in NRHP nominations, however, the primary management-related goals as outlined in the original research design remained essentially unchanged:

(1) develop a *predictive model* for cultural resources across the entire 203,874 ha (503,783 ac) Basin Zone;
(2) develop criteria for determining and prioritizing *site significance*;
(3) identify critical resource zones and specific areas in need of *protection*;
(4) identify natural and artificial *impacts to cultural resources*;
(5) develop *guidelines for cultural resource management* on specific sites as well as across the entire park; and
(6) identify and prioritize present and future *management needs and procedures*.

Methodology

Although significant changes were made to the methodology when the project was resumed in the spring of 2005, most were a result of technological advances rather than substantive changes in recording procedures. Rather, the project staff strived for consistency in recording between the two major project phases, with a focused effort toward consistent feature and artifact identification and nomenclature. Toward this end, experienced crew members who worked on the first phase of the project were present during the transition to the second phase. Similarly, whenever possible, the same crew personnel were used from field season to field season.

Logistics

Field logistics for the BBNP project were tailored to the climatic and topographic characteristics of the park. To avoid the worst of the summer heat, fieldwork was restricted to two *field seasons* a year—one in early spring and one in late fall. Within each field season were 3 to 5 *field sessions* lasting 10 days each followed by 4 days off.

Using four-wheel drive vehicles, crews utilized existing backcountry park roads to drive as far as possible to the survey areas. Base camps were established, most often within existing roadside park campsites (Figures 5.2 and 5.3). Survey areas were accessed daily by

Figure 5.2 BBNP field crew setting up shade structure. Photo by D. Keller.

Figure 5.3 Front country base camp. From left: David Hart, Sam Cason, Dawnella Petrey, and Bobby Gray. Photo by C. Covington.

vehicle or by walking out from camp—either utilizing park trails or, more often, cross-country. Survey blocks were typically near enough that they could be reached within 15 to 30 minutes. At times, however, access took considerably longer—most notably in Block F where, at one point, more than an hour of fast-paced walking was required to reach the unsurveyed portion of the block's interior.

During sessions where survey blocks were located near the Rio Grande, a "camp guard" was left at camp to deter potential thieves, as the proximity to Mexico had caused periodic problems with theft from unoccupied campsites along the river. This coveted duty was rotated among crew members. While in camp, the guard's duties—aside from posting guard—were to clean the camp, complete any unfinished paperwork, charge batteries, and make any necessary equipment repairs.

When necessary, remote survey areas were accessed by backpacking and setting up base camps within the survey block (Figure 5.4). All crew gear as well as personal gear was carried in, including all food. Water was filtered from tinajas or spring seeps (Figure 5.5). During the 1998 spring season survey within the waterless Dead Horse Mountains, water was initially brought in by NPS pack animals with a subsequent resupply conducted by the crew.

Figure 5.4 Back country base camp. Photo by D. Keller.

During the first three years of the BBNP project, different strategies were employed experimentally to test their applicability. One that was used throughout the first part of the project was to employ a logistical coordinator—a person whose primary responsibility was to address food, water, and camp needs. In addition, during several sessions, camp cooks were hired to feed the crew. This strategy worked well when the crew was camped in the "front country" but, because of the added complications of backcountry camping, this practice was ultimately discontinued.

During the second half of the project, the field crews managed their own logistics and cooking was left to each individual. Typically, crew members cooked in a common area, usually in the center of camp. Otherwise members maintained their own personal camps, and provided their own gear such as backpacks, tents, sleeping pads, canteens, etc. Food and trash were stored in hard-sided vehicles, in a closed utility trailer, or in dedicated bear boxes in accordance with BBNP rules in an effort to deter potential wildlife depredations.

Survey Personnel

Because of the long period of time spanning the project, several key personnel changes were made. During the first half of the project, then-director of CBBS Robert J. Mallouf and park archeologist Thomas C. Alex served as co-principal investigators while William

Figure 5.5 Jesse Nowak (left) and Candace Covington filtering water at a backcountry spring seep. Photo by D. Keller.

A. Cloud served as project archeologist and Joseph M. Sanchez (1995-97) and Steven M. Kotter (1998) served as crew chiefs. In Cloud's absence during a teaching assignment in Spring 1997, those positions were filled by Joseph M. Sanchez. Beginning in the spring of 2005, David W. Keller replaced Cloud as project archeologist, and in 2008 Cloud replaced Mallouf as director of CBBS as well as project co-principal investigator. Throughout Betty L. Alex served as the GIS spatial analyst.

Between 2005 and 2010, David W. Keller served as project archeologist and principal crew chief. For the majority of the project a single crew was utilized, consisting of from 6–9 archeologists (Figure 5.6). However, in the spring and fall seasons of 2007, the crew was split into two smaller crews (3–4 archeologists each) which worked in tandem. In the spring of 2009 and 2010, two to three small crews worked independently in small blocks across the park. During these seasons, additional crew chiefs were employed. Blake E. Cochran served in this capacity in the spring and fall of 2007, Robert W. Gray in the spring of 2009, and Samuel S. Cason in the spring of 2009 and 2010.

Survey Methods

The BBNP survey was an intensive, 100 percent pedestrian survey. Complete coverage was accomplished with transect surveying, where crew members were

Figure 5.6 BBNP archeological field crew, Fall 2007. From left: Blake Cochran, Kate Baer, Candace Covington, John Moretti, Kate Hill, Sarah Loftus, and David Keller. Photo by K. Baer.

spaced at regular intervals (regionally, standard transect widths are typically 30 m [98 ft] apart due to good surface visibility). Crew members then walked in a zigzag pattern within their respective transect lines to further maximize coverage. Whenever possible, transects were surveyed at the same pace to allow a visual accounting of areas covered by neighboring crew members. This also ensured that high probability areas (benches, stream terraces, boulders, and other attractive microenvironments) along the edges of transects were not missed and prevented gaps as well as redundant coverage.

In highly rugged terrain, "landform surveying" replaced regular transects. In these cases, individual landforms were surveyed by one or more crew members to avoid unnecessary repetitive climbing and descending of steep slopes by the entire crew. Also, very steep slopes and other landforms lacking any inhabitable surfaces were not surveyed unless there was a chance of rockshelters being present. Large sites were sometimes systematically surveyed at much closer transect intervals (5–10 m [16–33 ft]) and, in a few cases where artifact density was unusually high, on hands and knees (Figure 5.7).

At the beginning of the project, sighting compasses were used exclusively. During the latter part of the project, both handheld GPS units and sighting compasses were used in tandem to maintain a straight

Figure 5.7 Field crew surveying a dense sheet midden on hands and knees. From left: Brian Dailey, Lisa Weingarten, Chris Smith, John Moretti, Warren Kinney, and Blake Cochran (standing). Photo by D. Keller.

line while transecting. At the beginning of each new transect, a compass was used to sight on a distant landmark to use as a *general* guide. GPS units were then used by the surveyor while transecting to periodically monitor his or her location, keeping either the northing or the easting on the GPS unit constant. When using this combination technique, compass bearings were adjusted to true north. In the Big Bend area, magnetic declination is about 10 degrees east. Thus, if walking a north transect, the compass was sighted on a distant landmark at 350 degrees (mag.) on the forward transect, and 170 degrees on the return transect.

Survey Blocks

A total of 58 blocks were surveyed during the project for a total of 24,996 ha (61,766 ac; see Table 5.1). Blocks ranged in size from 16 ha (40 ac) to 3,078 ha (7,605 ac) although most ranged between 40 ha (100 ac) and 2,023 ha (5,000 ac). The average block size was 432 ha (1,065 ac). Prior to the 2009 season, however, only one block (partially surveyed) was smaller than 202 ha (500 ac), and most were greater than 404 ha (1,000 ac). In the spring of 2009, an array of smaller blocks was employed to cover ecotones and microniches in addition to environments that had been under sampled. During the final project season in spring of

Table 5.1 CBBS/BBNP Survey Blocks by Year and Area Surveyed.

#	Block	Year	Hectares	Acres
1	A	1996	2040.34	5041.78
2	B	1996	2043.51	5049.61
3	C	1998	2025.06	5004.02
4	D	1998	100.5	248.34
5	JQ-1	1997	227.9	563.15
6	JQ-2	1997	230.91	570.59
7	JQ-3	1998	228.26	564.03
8	E	2005	2500.57	6179.03
9	F	2005–07	3078.23	7606.43
10	G	2005–07	876.9	2166.86
11	H	2007	1402.3	3465.13
12	I	2008	1566.91	3871.91
13	J	2008	935.44	2311.51
14	K	2008	535.24	1322.59
15	L	2008	2009.44	4965.41
16	M	2009	199.53	493.06
17	N	2009	65.46	161.76
18	O	2009	56.31	139.15
19	P	2009	144.93	358.12
20	Q	2009	98.08	242.37
21	R	2009	213.07	526.51
22	S	2009	203.04	501.73
23	T	2009	204.34	504.92
24	U	2009	238.79	590.07
25	V	2009	205.26	507.20
26	W	2009	205.2	507.06
27	X	2009	296.31	732.19
28	Y	2009	338.79	837.17
29	Z	2009	302	746.25
31	BB	2009	59.19	146.25
32	CC	2009	77.47	191.44
33	DD	2009	227.72	562.69
34	EE	2009	203.1	501.87
35	FF	2009	92.85	229.43
36	GG	2009	43.71	108.01
37	2010-C	2010	195.63	483.40
38	2010-D	2010	59.76	147.67
39	2010-E	2010	55.49	137.12
40	2010-F	2010	41.33	102.13
41	2010-G	2010	87.3	215.72
42	2010-H	2010	53.55	132.32
43	2010-I	2010	86.58	213.95
44	2010-N	2010	173.39	428.46
45	2010-O	2010	58.16	143.72
46	2010-P	2010	74.3	183.61
47	2010-Q	2010	117.75	290.96
48	2010-U	2010	93.08	230.01
49	2010-V	2010	54.29	134.15
50	2010-W	2010	62.96	155.56
51	2010-X	2010	82.78	204.56
52	2010-Y	2010	15.83	39.11
53	2010-AA	2010	57.33	141.66
54	2010-BB	2010	40.77	100.75
55	2010-FF	2010	45.44	112.28
56	2010-GG	2010	45.44	112.27
57	2010-HH	2010	51.9	128.24
58	2010-II	2010	28.05	69.30
		Total	24996.05	61766.34

2010, 22 blocks were selected out of 40 randomly generated blocks that occurred in a wide variety of shapes and sizes.

As outlined in the original research proposal, blocks generated during the first part of the project were of uniform size and shape. "Control Blocks" 2,023 ha (5,000 ac) in size were to provide the initial body of systematically derived data to create the predictive model. Judgmental blocks, 202 ha (500 ac) in size, were to be placed to target under sampled environmental zones as well as micro-niches and ecotones. All were to be equal-sided polygons (square) in shape. Five blocks (control blocks A, B, and C as well as judgmental blocks 1 and 2) were completely surveyed and two blocks (control block D and judgmental block 3) were partially surveyed following these guidelines.

As discussed above, with the exception of the 22 randomly generated blocks surveyed in the spring of 2010, all blocks were judgmentally positioned with a number of factors considered in their placement. Among these were the environmental zone covered, location within the park (in an attempt to sample many different parts of the park), ease of access, terrain difficulty, and other various logistical concerns.

It should be noted that the results from several CBBS-directed CRM projects in the park were included to develop the GIS model. These survey areas were all different shapes and sizes, reflecting the specific project they addressed. All except one were based on prescribed burns, using natural landforms or roads as containment barriers. The exception was a bike trail project that included both a small block as well as a linear survey area (see Appendix 7).

Data Collection

Sites were recorded using a paper site form in addition to feature forms, artifact descriptions, site maps, photographs, and GPS data. Although these tools were used throughout the survey, significant changes were made as the project advanced, primarily through a heavier reliance on digital data. In addition, the format and length of paper forms were changed in an effort to streamline the methodology and to reduce the amount of time spent recording sites.

During the first part of the project, State of Texas Archeological Site Data Forms were used to record basic site information. Additional forms were employed for feature descriptions, isolated finds, lithic scatters, and locational data. In addition, graph paper was used for hand-drawn sketch and scaled maps as well as feature and artifact drawings. Maps were produced using the compass-and-pace method, supplemented by locational data forms used to enter associated distance and directional information. Aluminum bar-stock datums stamped with the site number were driven into the ground at each site as a reference point for mapping as well as an aid for future investigations. A single GPS location per site was taken at the datum. Sites were hand-plotted on 7.5-minute U.S. Geological Survey quadrangles using GPS coordinates and/or triangulation. Site overviews as well as significant features and artifacts were photographed using Kodachrome color slides. All photographic data was recorded on a photo log.

As the project progressed, efforts were made to increase efficiency and accelerate coverage, largely in response to the size and complexity of sites that were being encountered and the time it took to record them. Consequently, feature forms underwent several revisions, allowing for greater uniformity in recording and greater ease in data analysis. During the spring 1998 season, while surveying blocks C and D where fewer features were encountered, summary feature descriptions largely replaced feature forms, and mapping methods were further streamlined (Cloud et al. 1997:2–3; Cloud and Smith-Savage 1998:21).

During the second part of the project (2005–2010), site forms were revised to exclude excessive and redundant information required on the state forms, and to assume a format that was easier to fill out and significantly easier to review. As a result, the length of the forms was reduced from the original six pages to two pages, requiring much less time to complete. Short forms were also developed for site condition assessments consistent with the format of the Archeological Sites Management Information System (ASMIS)—the NPS database for basic registration and management of cultural resources. Feature forms were further refined and tailored more specifically to thermal features, by far the most common feature type in BBNP. Additional field forms were made for cairns, historic scatters, digital photo logs, and GPS logs.

In addition, digital data took on an increasingly important role as the project advanced. Beginning in 2005, digital cameras were used for photo documentation (initially with analog photographs serving as backup).

Foregoing photographic printing allowed many more photographs to be taken than before, resulting in a more detailed photographic record. Similarly, handheld GPS units now assumed predominance for all locational data. After selective availability was disabled in 2000 (removing intentional error in GPS signals) and the Wide Area Augmentation System (WAAS) was developed, the accuracy of GPS units increased dramatically (from 100 m [328 ft] to better than 5 m [16 ft.] accuracy). During the first part of the project GPS units referenced North American Datum (NAD) 27. After the project resumed in 2005, however, all GPS units referenced NAD 83—now the standard datum for federal agencies and GIS software.

GPS units were issued to crew members at the beginning of each session and were used to facilitate transecting during survey as well as recording the location of all features and formal or diagnostic artifacts. Eventually, GPS completely replaced compass-and-pace mapping except in cases where a signal was unavailable or greater detail was needed. Beginning in the spring of 2007, Thales Mobile Mappers (a GIS-compatible handheld GPS/PDA device with sub-meter accuracy) were used to create all site maps, as well as to record basic site data such as feature type and site condition; (Figure 5.8. In addition to recording points, these units could also record lines and polygons allowing large or linear features and site boundaries to be accurately mapped. Consequently, these units offered substantial time and labor savings while increasing spatial accuracy.

Figure 5.8 Tom Alex training Leeland Jones, Amie Meade, and Candace Covington on Thales Mobile Mappers. Photo by D. Keller.

Two-way radios were also issued to crew members and were used extensively during the second part of the project (Figure 5.9). These greatly facilitated communication between crew members both while transecting (when crew members could be spread as far as 240 m [787 ft]) as well as when recording sites. These units also saved time by allowing for remote communication that otherwise would have required walking (or yelling across) long distances.

With the increased reliance on electronic equipment, batteries became indispensable. Both alkaline and rechargeable batteries were used. The latter were preferred when access to vehicles allowed for nightly charging. In other cases, however, alkaline batteries were used. Because the Mobile Mapper units used proprietary batteries, these had to be recharged, typically each night. When backpacking, and charging was not

Figure 5.9 Blake Cochran using a two-way radio to communicate with crewmembers on a large prehistoric site. Photo by K. Baer.

an option, several fully charged batteries were carried into the field.

Although recording duties were rotated among crew members during the first part of the project, during the latter part, individuals were typically assigned specific tasks for the duration of the season. This allowed for more consistency, fewer errors, and greater speed as each individual gained mastery over his or her task. The primary tasks were divided up into three categories: photography, site mapping, and feature descriptions. In addition, the crew chief was responsible for filling out the site form and conducting the site condition assessment. This breakdown eventually led to the most efficient crew configuration: either three or four people. During the last two seasons, and utilizing multiple crews, this strategy allowed for much faster rates of coverage.

Site Recording

Once a site was located, its boundaries needed to be established in order to determine the most efficient course of action. If the site proved extensive (for example, larger than 10,000 m^2 [107,639 ft^2]), then it might be surveyed methodically by transecting through it, either using flagging tape to mark features and artifacts, or recording them "on the fly" with handheld

GPS units and notebooks. With smaller sites, the crew would congregate near the site's center and fan out to flag cultural materials.

Once the site was flagged, feature and artifact numbers were assigned by the crew chief or the site mapper. On sites with more than a few features, the numbers were typically written on the flagging tape to avoid confusion. Once this was complete, crew members began their respective duties. The crew chief would fill out the site form and ASMIS form, the mapper would map all features and artifacts as well as the site boundary and any other distinguishing features (such as roads or trails), the photographer would photograph all intact features and formal artifacts (those that were not to be collected), and the rest of the crew would work on feature and artifact descriptions and sketches (Figures 5.10 and 5.11).

Features

By far the most common archeological features encountered during the survey were thermal ones. Consequently, feature forms were tailored to this feature type, allowing for quick descriptions and comparable data. Because other feature types were relatively scarce and diverse in type, they were recorded on blank sheets of paper so that the recording could be tailored to the specific feature type. Architectural features, whether prehistoric or historic, received special attention and a higher level of detail than more common feature types. However, any features that were unique or in some

Figure 5.10 David Keller filling out paper site form. Photo by C. Covington.

Figure 5.11 Jesse Nowak photographing a historic artifact. Photo by D. Keller.

way exceptional received more detailed descriptions along with photographs and—in many cases—a sketch. Sketches generally were restricted to instances where a photograph would not properly show critical details (as when obscured by brush, or when some detail was too small, etc.), or to exaggerate certain significant details. Any feature that was described was also given a feature number, waypointed (provenience taken), and represented on the site map.

Typically only thermal features that were relatively intact were described and photographed, although this depended to some degree on the site, the number of features it contained, and its general complexity. With small sites containing only a few such features, they were often all described and photographed. With larger sites, the focus was placed on the more intact, representational, and unusual features. Thus, hearths that were 60 percent or more intact might receive full descriptions, whereas deflated hearths and fire-cracked rock (FCR) concentrations and scatters would only be mapped, counted, and mentioned on the site form.

Artifacts

Generally, only temporal diagnostics and some functional diagnostics in addition to museum-quality artifacts were collected during the project although all projectile points and point bases were retrieved for subsequent analysis. All artifacts were bagged in a 3-mil plastic bag labeled with the site number (or isolate number), artifact number, artifact description, waypoint number, provenience (using the Universal Transverse Mercator system [UTMs]), date, and the initials of the individual who found the item as well as the person who bagged it. The artifact description for each site included the range of artifact types, numbers of each type, their condition, material types, and other formal tools not collected. Areas with greater or lesser artifact density were also noted as were kinds of debitage present. Significant artifacts or artifact clusters that were not collected were waypointed and sketched and/or photographed.

Photography

Photographs were taken of every site, which minimally included two site overviews from opposing directions, preferably with recognizable landforms in the background. In addition, all features that were assigned a number and described were photographed as were the best, most unusual, or most representative features. Similarly, any formal tools not collected or dense artifact concentrations were photo documented.

North arrows and/or photographic scales (typically a retractable stadia rod for features and a cm scale for artifacts) were used for all feature and artifact photos. Photo logs were maintained, noting the season and session, photographer, camera used, photograph number, block and site number, direction the photograph was taken from, and a description of the subject. In addition, within each block, overviews were taken from a location offering an expansive view—preferably a 360-degree panorama. Photographs of characteristic physiographic formations and vegetation within each block were also taken. Finally, crew photos were taken at the end of each 10-day session.

Mapping

Maps were generated for every site. As noted previously, earlier in the project these were sketch maps produced using the compass-and-pace method. During the latter part of the project, reliance on GPS technology grew and from 2007–2010, sites were mapped using Thales Mobile Mappers exclusively. Although only intact features were assigned a number and formally described, maps usually included all features on a site, regardless of condition, as well as FCR concentrations and lithic scatters. Similarly, in addition to collected artifacts, other formal tools were also mapped. Historic and modern features such as trails, roads, fences, campsites, etc. were also included on site maps.

When using the Thales Mobile Mapper, the operators were responsible for a number of associated tasks in addition to mapping the site. They were often required to number and identify the kinds of features present. Basic data such as feature type, dimensions, and condition were entered along with its provenience. Small features, such as hearths, were recorded as points, whereas larger features, such as burned rock middens, were recorded using a polyline. Polylines were also used to map linear features such as roads, micro-drainages, and fences within a site. Polygons were reserved for site boundaries, which were also determined by the mapper. Generally, the site boundary was offset 10 to 15 m (33 to 49 ft) beyond the outermost features and artifacts on the site. Because of the range of decisions required of the mapper, it was important these individuals were proficient at identifying the range of feature types.

Field Notes

In addition to paperwork generated during survey and on sites, field notes were taken at the end of each day by the project archeologist and/or crew chief. These notes detailed the events of the day including weather conditions, the area surveyed, sites recorded, isolates found, and an accounting of who did what. In addition, field notes included environmental characteristics of the block (physiography, geology, vegetation, animals observed) as well as general observations about cultural manifestations—site types, density, patterning, etc. Field notes also provided a forum for less formal observations, speculation, and general impressions of the archeology.

Survey Definitions

Terminology and definitions used during the BBNP project include those that are standard within the field of archeology as well as those specific to the present project. With few exceptions, these terms and definitions were used throughout the project to maintain consistency.

Archeological Site

A site is simply a place where evidence of past human activity has been preserved—typically in the form of features and artifacts. A site is a fundamental archeological unit, providing a method of conceptually organizing feature and material culture data. In most cases, sites were discrete manifestations, distinct from other sites, and had well-defined boundaries. However, there were cases where boundaries were less distinct and sites graded into one another. In these cases, decisions were made that best suited the particular circumstances. Inevitably, some guesswork was involved, and in some cases site boundaries could be somewhat arbitrary.

Nevertheless, guidelines were established to standardize decision-making. In general, if 2 features were more than 50 m (164 ft) apart, they were separated into different sites unless there were artifacts or FCR that could be used to "connect" them. However, sites could sometimes be less than 50 m apart if they were separated by a landform, watercourse, and/or there were clearly distinct differences in site characteristics.

For the purposes of this project, most archeological features were recorded as sites with the exception of commonly encountered isolated features.However, not all sites had to have features. Dense artifact concentrations, for example, especially those containing formal tools and or temporal/functional diagnostics, were also recorded as sites.

Isolated Find (IF)

An isolated find is defined as 1 to 5 formal tools or other cultural item (historic or prehistoric), typically within a diameter of 20 m (66 ft) or less. By definition, these occur outside of sites. In cases where more than five formal tools were encountered within a relatively small area, they were recorded as sites. Documentation included the tool type, material type, and associated artifacts along with the location.

Lithic Scatter (LS)

A lithic scatter is defined as an area containing a small and discrete concentration of debitage, usually with no formal tools, within a defined area. This category was intended for scatters that were spatially discrete, often indicating a single reduction episode. Typically, there were fewer than 20 pieces of debitage typically within a diameter of 20 m (66 ft) or less. However, there were many exceptions. Because of the nearly ubiquitous presence of siliceous stone in the park, debitage is very frequently encountered. In some areas, especially near quarry sources, this results in a "lithic landscape" that may extend far beyond the boundaries of the quarry site itself. In a number of cases where lithic scatters exceeded the defined parameters, or there were formal tools present, they were often recorded as sites. In all cases, however, the level of recording was judgmentally determined. Documentation included the dimension of the scatter, number of pieces of debitage, the material type, the flake type (reduction stage), and associated artifacts along with the location.

Historic Scatter (HS)

A historic scatter is simply defined as a concentration of historic artifacts (typically less than 10) occurring in a relatively small area, usually within a diameter of 20 m (66 ft), outside of a site. This category was developed to address small concentrations of historic artifacts in areas lacking features or other cultural materials. Because these are common in the park, this category proved a useful way of capturing this data without having to do a full site recording. Documentation included the scatter dimension, number and type of materials present, and associated sites or features along with the location.

Archeological Feature

A feature is an object or objects representing some unportable human activity. The most typical prehistoric features include hearths, cairns, mortar holes and middens, although wickiup rings, tipi rings, petroforms, and burials were also encountered. Typical historic features include structural remains (rock, adobe, *jacal*), hearths, lime kilns, and dumps. The level of detail in recording features depended on the type of feature as well as its intactness, significance, and context. Photographic examples of the various feature and artifact types are included in Chapter 6.II.

Isolated Cairn (IC)

An isolated cairn is any stacked rock feature (either historic or prehistoric) that is nonthermal and nonstructural, located outside of a site. Cairns are often of unknown function unless related to a trail (trail marker) or associated with a USGS benchmark or other topographic or cadastral surveys. Depending on the setting, the relative age of cairns could usually be inferred from their intactness. Documentation included the cairn dimensions, number of rocks, number of courses, rock type, size range of rocks, degree of definition, and associated features or artifacts along with the location.

Rock Grouping (RG)

A rock grouping is an arbitrary name for a unique feature type that was discovered during the project and that began to be encountered frequently in some parts of the park. Rock groupings are nonstacked, nonthermal features typically consisting of 3 to 6 rocks, of roughly uniform size (ca. 20-40 cm [8–16 in] maximum diameter), in a loose grouping. Although sometimes the rocks are touching one another, more typically they are spaced apart by 10-20 cm [4–8 in] or so. These features almost always occur outside of sites and are of unknown function. Specific data were taken on dozens of these features (dimension, rock size, rock type, and associated features or artifacts were documented along with the location) before the sheer volume of them (and the degree of similarity) made this impracticable. Subsequently, RG's were simply noted by location.

Rock Cluster (RC)

A rock cluster is another arbitrarily named feature type that served as a catchall category for all other nonstacked, nonthermal rock features of unknown function. This category was meant to address all rock features that were clearly not hearths or cairns, did not fit the definition of a rock grouping, and were not architectural, but were clustered enough to suggest they were cultural. These feature types occurred both within as well as outside sites and almost certainly represent a vast suite of expedient feature types. Documentation included the feature dimensions, number of rocks, size range of rocks, and associated features or artifacts in addition to location.

Rock Alignment (RA)

A rock alignment is a horizontal, linear—or roughly linear—arrangement of rocks upon the ground surface, typically of unknown function or affiliation. Rock alignments addressed a broad range of forms and could be prehistoric or historic, but could not be architectural. These features occurred both within as well as outside of sites. Documentation included the alignment dimensions, number of rocks, size range of rocks, and associated features or artifacts in addition to location.

Petroform

A petroform is a broad feature category indicating an intentional arrangement of stones upon the ground to create abstract or representational figures or patterns. Petroforms encompass a large array of feature types, including medicine wheels, effigies, and abstract geometric shapes. Although petroforms were always recorded as sites, they usually occurred outside of habitation sites and were often not associated with other feature types or artifacts. Petroforms are typically of unknown function but in many cases are presumed to have had ritual significance. These features were always sketched and photographed. Detailed metric data, associations, and location were also systematically recorded.

Effigy

As a special subset of petroforms, effigies are representations of human or animal figures. Although in other regions these are often made of pottery or stone, in the Big Bend, these are more typically made by arranging stones upon the ground, most of which appear to be prehistoric in age. Like petroforms, they most often occur outside of habitation sites, are rarely affiliated with other feature types or artifacts, and are believed to have ritual significance. These features were always sketched and photographed and detailed metric data, associations, and location were documented.

Medicine Wheel

A medicine wheel is a type of petroform that typically consists of a central stone cairn or circle surrounded by one or more concentric stone circles and/or one or more stone lines that radiate outward from the central cairn (Royal Alberta Museum website). These features are common on the Northwestern Plains but are virtually absent further south. Consequently, the medicine wheels that have been documented in BBNP are rare examples that occur nowhere else in the state. These features were always sketched and photographed in addition to collecting detailed metric data, associations, and location.

Linear Historic Features (Fence Lines, Roads, and Telephone Lines)

Because BBNP was established in 1944, with few exceptions most historic features are older than 50 years old—an NRHP guideline for historical significance. Consequently, many ranch and farm-related features such as fence lines (typically barbed wire, sometimes smooth wire or net-wire fencing) or remnants of fence lines (posts lacking wire, or wire lacking posts) were recorded. Similarly, two-track roads not in operation and/or that do not appear on maps, as well as historic telephone lines (generally only poles and glass insulators), were also recorded. With these feature types, a waypoint and direction the road, fence, or telephone line was trending was recorded along with notes on their characteristics.

Processing Field Data

Following each field session, all digital photographs and provenience data were downloaded and backed up onto an external hard drive and/or an archival DVD. GPS waypoints were downloaded using DNR Garmin freeware (produced by the Minnesota Department of Natural Resources) and the data from each GPS unit was saved as a projected shapefile. Files from the mobile mapper were downloaded using Active Sync. Each file was named according to the GPS or mobile mapper unit number. All waypoints and other spatial data were then attributed, using descriptions taken from the waypoint logs (detailing what the point represents). All paperwork was organized and any incomplete sections were completed.

Maps were produced for each site using GIS software including at least one site map showing all features and artifacts as well as the site boundary overlaid upon a background of USGS topographic maps or digital orthophotoquads. In addition, a site location map was created to show the site's position within the larger landscape. These maps were then printed and placed with the other site paperwork. All paperwork, including site forms, feature forms, artifact descriptions, sketches, and maps, were then scanned to a portable document format (PDF). All scanned forms, digital photographs, and provenience data was then provided to the NPS archeologist to serve both as a backup as well as to aid in his annual reporting.

Summary data on each field season was tabulated, including the sites and isolates recorded, the area surveyed, and a narrative detailing both environmental and cultural data on each block surveyed (such block narratives, however, were generally reserved for larger blocks). Collected artifacts were grouped together in a larger bag, labeled by season and session, and prepared for laboratory processing and analysis.

Laboratory Analysis

All artifacts and other samples collected during the project were brought to the CBBS laboratory for processing and analysis. Laboratory procedures conformed to those presented in the project scope of work in accordance with *NPS Management Policies; NPS Museum Handbook;* and *36 CFR 79, Curation of Federally Owned and Administered Archeological Collections*. Once in the lab, non-perishable artifacts were removed from their labeled field bags and washed with water, sometimes with the aid of a small brush to remove all foreign materials. Each specimen was then allowed to air dry. Fragile artifacts or perishable items were cleaned without water or were left in their original state. Each artifact was then labeled with a unique NPS catalog number (i.e., BIBE 00001), typically using India ink between layers of polyvinyl acetate (PVA). On dark-colored specimens, a white base layer (Paraloid B-72 Lacquer) was applied before the ink for better visibility prior to being sealed with PVA. Specimens too small to be labeled, or whose surfaces were too rough, were placed in plastic bags with a labeled paper tag.

Metric data was taken on each artifact. Measurements were obtained, typically in millimeters using handheld calipers (for the length, width, and thickness); weight, in grams, was measured using either a triple-beam balance or electronic scale. These data were entered into a Microsoft Excel spreadsheet that included other descriptive data such as catalog number, site number, object type, and description according to NPS guidelines as established in the Automated National Catalog System (ANCS) maintained by the NPS. Artifacts are typically entered directly into ANCS; however, for the purposes of the present project, it was deemed more efficient to use a spreadsheet which allowed for easier data manipulation and analysis. The spreadsheet data will be subsequently imported into ANCS by the local NPS curator.

Following processing and cataloging, all artifacts were analyzed for temporal and/or functional affiliation. A wide variety of references was consulted, such as projectile point and ceramic typologies, historic artifact identification guides, and many other sources to determine similarities with known forms (see Material Culture sections in chapters 6.II and 6.III). Finally, select artifacts were photographed for use as illustrations in this report. With the aid of blue bulb background lighting, a digital Canon Rebel camera mounted on a stand was used to take individual or group artifact photos with a metric scale.

Data Analysis

Project data was managed in two primary formats. Site content was maintained in Microsoft Excel whereas spatial data was managed in ArcGIS. For analysis, spreadsheets were joined to the spatial data and the resulting combined data was exported. Queries of the data set were performed in Excel using filters and pivot tables as well as GIS intersects and selections based on locations and attributes. In this fashion, tables, charts, graphs, and maps were generated to illustrate relationships between environmental and cultural variables and to allow a descriptive statistical analysis. A more detailed explanation of analytical techniques is discussed in Chapter 7, Analysis of Survey Results.

6-I

Survey Results

Overview of Survey Results

This section lays the foundation for the three sections that follow, which detail the findings from the BBNP project. The section begins with a discussion of the project survey blocks and a brief introduction to the site breakdown which explains how sites were classified based on temporal characteristics. Following this, the prehistoric chronology is briefly discussed, explaining the temporal range of prehistoric occupation represented in the project dataset. Finally, a brief overview of Native American, Euro-American/Mexican-American, and isolated archeological findings is provided.

Survey Blocks and Coverage

Survey coverage for the project consisted of 58 survey blocks spanning 24,996 ha (61,766 acres [ac]). Blocks ranged in size from 16 to 3,078 ha (40 to 7,605 ac), with an average size of 431 ha (1,065 ac) per block. In the first several years of the project, blocks were of uniform size and shape—2,023 ha (5,000 ac) square, 4,500 meters per side, for the "control blocks" and 202 ha (500 ac) square, 1,500 meters per side, for the "judgmental blocks." After the project resumed in the spring of 2005, this convention was dispensed with and blocks took on a range of shapes and sizes. In the spring of 2009, an array of smaller blocks was employed to cover ecotones and micro-niches in addition to environments that had been under-sampled. All blocks were judgmentally sited except for the 22 randomly generated blocks surveyed in the spring of 2010 which were used to test the predictive model.

In placing the blocks, a number of factors were considered, including past archeological work (unknown areas given priority), location within the park (in an attempt to sample many different parts of the park), the environmental zone covered, ease of access, terrain difficulty, and other logistical concerns (see Figure 6-I.1).

The environmental zone(s) within which each block was located was of prime significance. This included the primary basin/mountain breakdown as well as the finer grained environmental zonation developed for the predictive model. Although the basin zone ultimately became the project's focus, many blocks overlapped into the mountain zone and blocks C and D were primarily or wholly contained within the mountain zone. As a result, 4,415 ha (5,455 ac)—18 percent of the total surveyed area—were surveyed in either the igneous or limestone mountain zones and 20,581 ha (50,856 ac)—or 82 percent of the total surveyed area—were located in the basin zone (Figure 6-I.2, Table 6-I.1).

In developing the GIS predictive model, the park was stratified into different *environmental zones* (EZ). The result was 25 distinct zones based on the U.S. Natural Resources Conservation Service (NRCS) soil classifications, ecological descriptions, and field

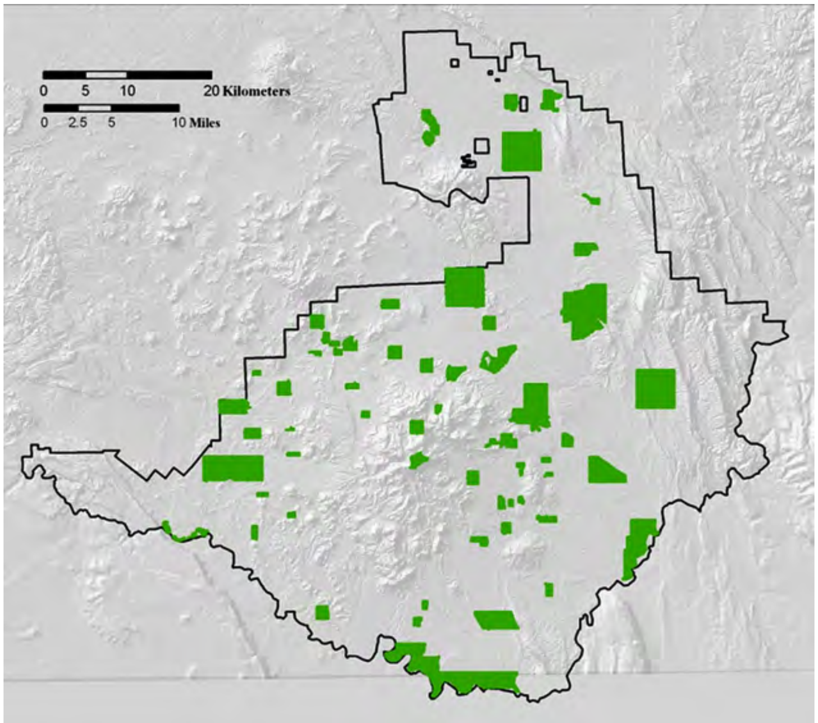


Figure 6-I.1 Overview of survey blocks within BBNP.

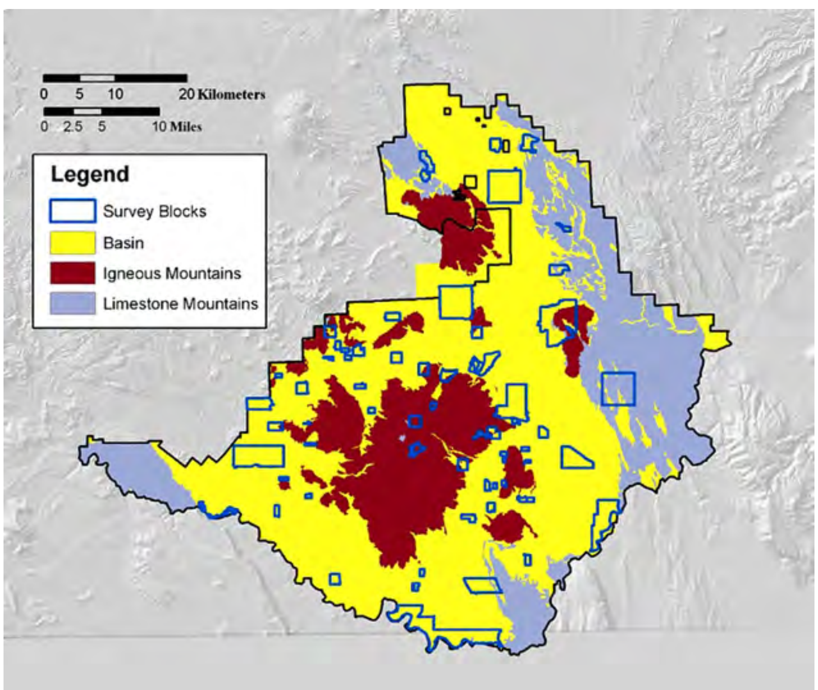


Figure 6-I.2 Survey blocks in BBNP relative to the mountain and basin division. Igneous mountains are shown in red, limestone mountains in blue, and basin in yellow.

observations. Gross attributes of the EZ categories found in the basin are summarized in the Chapter 2 section on *Physiography*. They consist of a variety of physiographic and geomorphologic units including pediments, alluvial fans, erosional remnants, terraces, hill and mountain slopes, and a variety of other landform categories.

Of the 25 environmental zones, survey coverage was achieved in 23 of the zones (Figure 6-I.3). Of the zones that were surveyed, the percentage of each zone surveyed relative to the total survey area was very similar to the percentage of each zone that exists parkwide (indicating that the survey was representative of the range of environmental zones and roughly proportional to their relative size in the park). In fact, only three zones differed by more than 5 percentage points: *mountain slopes* were under-represented in the survey by 9 percentage points, while the *fan remnants on piedmont slopes* and *erosion remnants* were over-represented by just over 6 percentage points.

Although over a thousand ac were surveyed in 14 of the zones, the vast majority of survey coverage occurred in just four zones: *pediments-piedmont slopes*, *fan remnants on piedmont slopes*, *erosion remnants,* and *erodible clay from mudstone*. Together, these four classes account for more than half of the surveyed area (54 percent).

Table 6-I.1 Survey Blocks in Basin or Mountain Settings in Hectares.

Block	Basin	Igeous Mtn	Limestone Mtn	Total
A	2040	0	0	2040
B	2017	26	0	2044
C	254	0	1771	2025
D	0	100	0	100
JQ-1	119	107	2	228
JQ-2	231	0	0	231
JQ-3	0	228	0	228
E	1503	892	106	2501
F	3028	0	50	3078
G	757	0	120	877
H	1364	0	39	1402
I	1532	34	0	1567
J	935	0	0	935
K	535	0	0	535
L	2009	0	0	2009
M	200	0	0	200
N	65	0	0	65
O	56	0	0	56
P	145	0	0	145
Q	98	0	0	98
R	177	36	0	213
S	203	0	0	203
T	100	104	0	204
U	239	0	0	239
V	161	44	0	205
W	205	0	0	205
X	143	0	153	296
Y	258	0	81	339
Z	116	0	186	302
AA	69	0	69	138
BB	54	5	0	59
CC	64	14	0	77
DD	157	71	0	228
EE	121	82	0	203
FF	93	0	0	93
GG	37	6	0	44
2010-C	190	5	0	196
2010-D	60	0	0	60
2010-E	55	0	0	55
2010-F	41	0	0	41
2010-G	87	0	0	87
2010-H	54	0	0	54
2010-I	41	0	46	87
2010-N	173	0	0	173
2010-O	58	0	0	58
2010-P	74	0	0	74
2010-Q	118	0	0	118
2010-U	93	0	0	93
2010-V	51	3	0	54
2010-W	63	0	0	63
2010-X	83	0	0	83
2010-Y	13	2	0	16
2010-AA	30	28	0	57
2010-BB	41	0	0	41
2010-FF	45	0	0	45
2010-GG	45	0	0	45
2010-HH	52	0	0	52
2010-II	26	2	0	28
Total	20581	1792	2623	24996

**Note: Because totals were derived from GIS figures to the millionth decimal place, they may not reflect the sums of the listed whole numbers due to rounding error.*

Site Breakdown

A total of 2,755 sites have been recorded within BBNP as of 2021 (see Legacy Data Integrity and Management in Chapter 3 for a more detailed accounting). More than half of these—1,566 sites—were recorded during the present project (Table 6-I.2). The vast majority of project sites contained prehistoric components—1,506 sites, or 96 percent of the total. Of these, 1,161 were exclusively prehistoric whereas 345 sites also contained historic components. Of these mixed component sites, 278 were predominantly prehistoric with a lessor historic component and the remaining 67 were predominantly historic with a lessor prehistoric component. Only 60 sites were exclusively historic. The preponderance of prehistoric artifacts reflects that the vast majority of cultural material in the park predates European contact.

Table 6-I.2 Overview of Historic and Prehistoric Sites Recorded During the Project.

Exclusively Prehistoric Sites	**1,161**
Exclusively Historic Sites	60
Mixed/Predominantly Prehistoric Sites	278
Mixed/Predominantly Historic Sites	67
Total Sites	**1,566**

Prehistoric Chronology

Prehistoric chronology in the region relies largely on the use of projectile points for relative dating of sites. Although other diagnostic materials—such as ceramics—exist, they are rare and of limited utility in establishing temporal control outside of the La Junta district. For this reason, projectiles assume considerable significance in framing discussions and analyses.

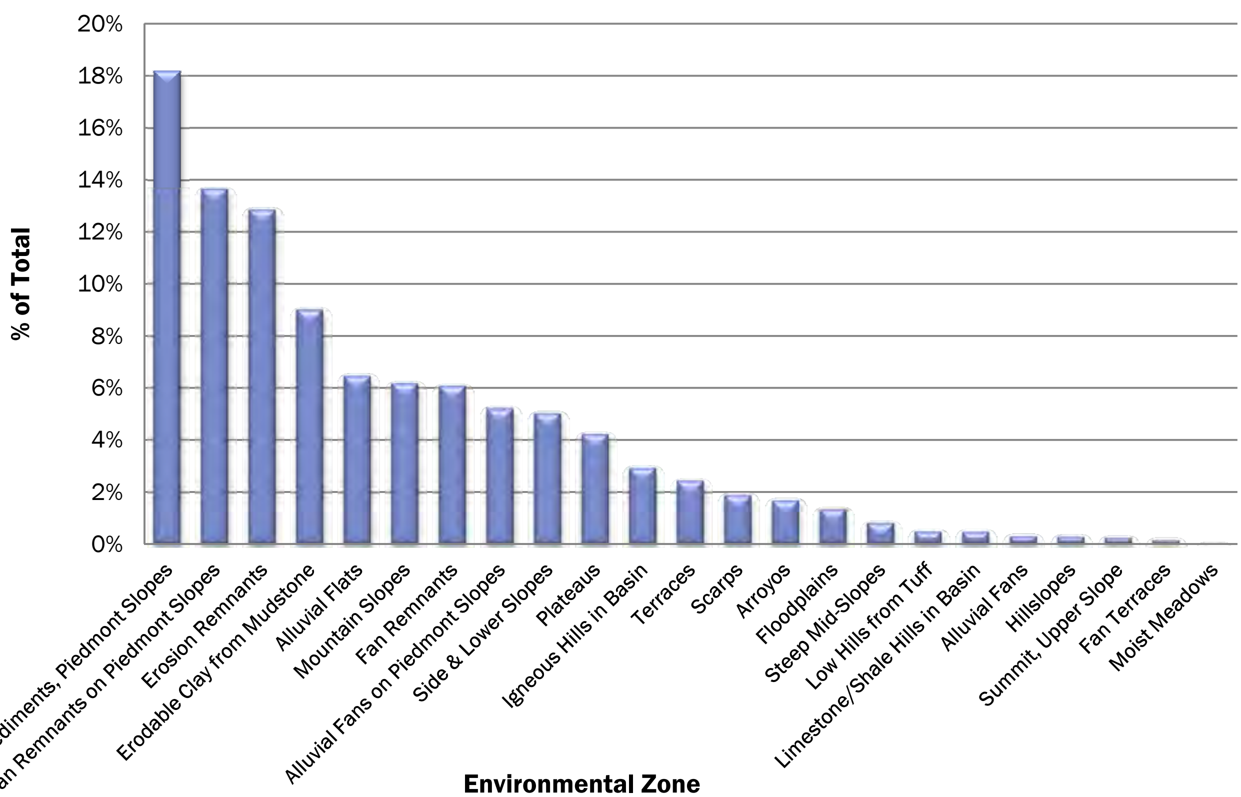


Figure 6-I.3 Area surveyed by environmental zone (EZ) shown as percent of total.

As the basis of the chronological framework, they serve as perhaps the most significant single metric for classifying and analyzing sites. By arraying sites with certain temporal affiliations against other data, such as site distribution, size, and content, we are able to infer behavioral changes through time.

Projectile points collected during the survey represent some 12,000 years of human occupation in the region—from the Paleoindian period to the Late Prehistoric. Based on one Midland-like projectile point recovered, there is a demonstrated Paleoindian presence in the park as early as ca. 10,000 B.C. (Turner and Hester 1985:124). However, subsequent periods are much better represented with as many as 19 Late Paleoindian projectiles, 73 Early Archaic projectiles, 225 Middle Archaic projectiles, 320 Late Archaic projectiles, and 376 Late Prehistoric projectiles recovered during the project (see Figure 6-I.4).[1]

Protohistoric/Historic Native American artifacts were virtually absent, represented during the survey by a single metal tinkler. (However, it should be noted that both an Apache earthenware vessel as well as a Spanish Majolica sherd collected prior to the present project attests to activity during these later periods.) Other artifacts, such as Perdiz arrow points and prehistoric ceramic sherds may also date to this period, but are difficult to assign without additional evidence. Due to such scant representation, in the following discussion, the term "prehistoric" is used synonymously with "Native American."

Summary of Findings

The following sections provide brief summaries of Native American and Euro-American/Mexican-American archeological findings as well as isolates documented during the BBNP survey. These summaries provide a broad overview of the detailed sections that follow.

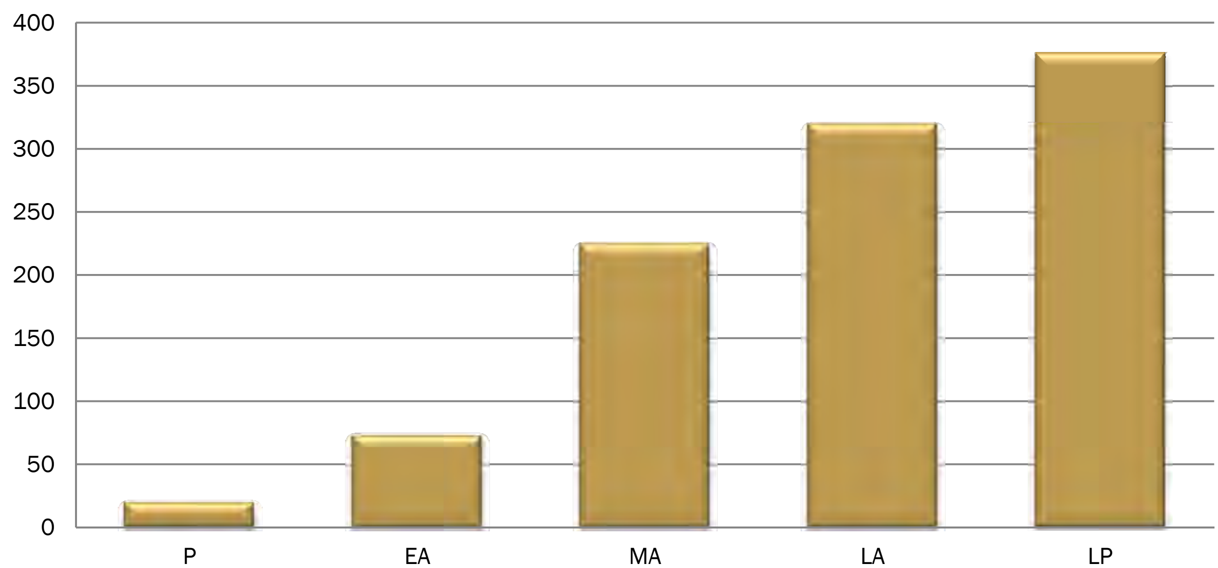


Figure 6-I.4 Projectiles collected during the survey by time period.

1. These numbers to not count the 222 unspecified Archaic projectiles—those that could not be definitively placed in a temporal category. Of these, 105 are fragments and one is a preform but the remaining 116 retain some stem morphology, most of which suggest Late Archaic affiliation. If these are provisionally added to the Late Archaic total (n=437), then they exceed the number of Late Prehistoric projectiles by 61. See Chapter 7 for further discussion.

Native American Archeology

Of the 1,566 sites recorded during the project, 1,439 were exclusively or predominantly prehistoric. An additional 34 sites that were predominantly historic but that had substantial prehistoric components were included in the prehistoric site tally, bringing the total "substantial prehistoric" site count to 1,473.

Prehistoric projectiles collected during the survey attest to human occupation in BBNP from Paleoindian times to the Late Prehistoric, although later periods are much better represented than earlier ones. Of the 1,014 projectiles that could be identified to subperiod, 2 percent were attributed to the Paleoindian period, 7 percent to the Early Archaic, 22 percent to the Middle Archaic, 32 percent to the Late Archaic, and 37 percent to the Late Prehistoric (rounded figures). Aside from the 65 projectiles recovered as isolated finds, all remaining projectiles were collected from 284 sites. Of these sites, more than half had projectiles representing only a single time period, suggesting they may be single component sites.

The data suggests that the Big Bend experienced a gradual increase in human population through time with a significant spike during the Middle Archaic period when the number of projectiles increased by 15 percentage points from the Early Archaic—the highest jump between any two periods. The number of projectiles increased by only another 9 percent in the Late Archaic and another 6 percent in the Late Prehistoric, suggesting the *rate* of population growth began to decline towards later prehistory.

Summary of Sites

The density of prehistoric sites recorded during the project averaged 1 site per 17 ha (42 ac) but ranged significantly between survey blocks—from a high of 1 site per 6 ha (14 ac) to a low of 1 site per 59 ha (145 ac). Although survey coverage in mountainous areas was limited, preliminary data indicate that prehistoric site density is generally higher in the lowland settings although this may be a function of better visibility in the latter zone. Sites density was also shown to be higher in ecotones, where two different environmental zones meet, and along the Rio Grande as well as near springs and other riparian areas. Site patterning around such features, however, varied significantly.

Prehistoric sites ranged in size from 13 m^2 to 1,796,393 m^2 although this significant span was primarily a result of site function; the largest sites tended to be lithic procurement areas rather than habitation sites. By excluding these large lithic procurement sites, average site size was reduced to 10,000 m^2 or 1 ha (2.5 ac) per site.

Prehistoric sites were placed in one of six different site types based primarily on features and artifacts contained within them, or by the setting in which they occur. The vast majority (90 percent) of sites was open campsites, followed by artifact scatters (4 percent), special use sites (3 percent), natural shelter sites (2 percent), food processing sites (1 percent), and stone enclosure sites (0.3 percent). Less than one percent of sites could not be classified.

Summary of Features

A total of 22 specific feature *types* were encountered during the survey that fell within six major feature *classes*. The major classes consist of thermal features, stone enclosures, other rock features, special use, interments, and redoubts and fortifications. The most commonly encountered feature class, constituting roughly 90 percent of all feature classes, was thermal features, followed by stone enclosures (4 percent), and other rock features (3 percent). Special use features, interments, and redoubts and fortifications, each comprised less than 1 percent of the total number of features.

The most common feature type within the thermal feature class was hearths, representing 77 percent of all thermal features. This was followed by FCR concentrations and scatters (19 percent), and middens (3 percent). Four hearth types were identified during the survey although they were tallied individually only during the second half of the project. From this data subset, pavement hearths dominate the assemblage at 74 percent of the total, followed by ring hearths (13 percent), cobble-lined hearths (10 percent), and unspecified (4 percent). Two types of middens were also documented: ring middens, making up 58 percent of all midden features, and sheet middens making up the remaining 42 percent.

Stone enclosures were the second largest feature class, comprised of 254 stone enclosures recorded at 89 sites. Thirty percent of these were classified as unspecified stone enclosures, while another 33 percent were interpreted to be wickiup rings, 23 percent to be Cielo structures, and 11 percent to be tipi rings. "Other rock features" formed the third largest feature class, consisting of cairns, rock alignments, rock groupings, and rock clusters.

Special-use features recorded during the project consisted of probable vision quest and lookout structures as well as a variety of rock imagery. Within the latter category are petroglyphs and pictographs, abraded lines and cupules, and petroforms—which consisted of medicine wheels, linear alignments, and effigies.

Aside from the one confirmed burial documented at BIBE1849, there were six features suspected to be interments but that could not be verified. These consisted of two stacked rock features within rockshelters, four stone-filled boulder crevices, and one cairn on an open site.

In addition, five sites documented during the project contained what were interpreted to be redoubts and fortifications—stone-based prehistoric structures that suggested they were for defensive purposes.

Summary of Artifacts

A total of 1,586 prehistoric artifacts were collected during the project, consisting of chipped stone artifacts, ground-stone artifacts, ceramics, ornamental items, and perishable artifacts. Nearly 80 percent of the collected artifacts are projectiles (n=1,236), of which, 859 are dart points and 360 are arrow points. One dart point preform and 16 arrow point preforms were also collected.

Second in abundance were other chipped stone artifacts (n=242) consisting of perforators/drills, knives, scrapers, adzes/gouges, spokeshaves, net sinkers, choppers, bifaces, pieces of edge-modified debitage, and cores and unmodified debitage. Fifty-six ground- and pecked-stone artifacts were also collected, consisting of manos, shaft abraders, pigment stones, hammerstones, ornaments, a metate, and an incised stone. In addition, forty-three ceramic artifacts known or suspected of being prehistoric as well as six shell items consisting of ornaments and possible ornaments, and 3 perishable artifacts were collected.

Euro-American and Mexican-American Archeology

A total of 405 sites recorded during the project contained historic components, or 26 percent of all project sites. Of these, only 60 were exclusively historic. The remaining 345 sites also contained prehistoric components, only 67 of which were predominantly historic. Taken together, these exclusively historic and predominantly historic sites form the body of 127 historic sites addressed in this and subsequent sections.

Temporal affiliation of historic components documented during the project ranged from the Spanish Colonial period to modern times. Most components, however, tended to cluster between 1880 and 1940, with the majority dating between 1910 and 1940. Material assemblages within sites sometimes allowed cultural affiliation to be inferred but most of the time such affinities could not be determined. Instead, artifact assemblages tended to primarily reflect the limited variety of goods available in the region historically.

Summary of Sites

Historic sites were divided into 23 different site types although more than half of the sites were confined to just three groups: campsites, homesteads, and ranching sites. Within the range of historic sites, some 768 historic features were documented, representing 27 different feature types in six categories.

The spatial distribution of historic sites documented during the project was patterned although much of this was due to the greater abundance of water resources in the southern half of the park in addition to the location of the community of San Vicente. Otherwise, historic site distribution appeared to be largely a function of historical contingencies such as cadastral surveys and state land laws as well as the distribution of economic resources such as mercury and candelilla plants.

Summary of Features

Historic features documented during the project (n=768) were represented by 27 different feature types in six categories. As the most abundant of all features, structures were represented by adobe, rock, *jacal*, dugout, wood-framed, and concrete construction. Ranching-related features consisted of corrals, dipping vats, fences, kid goat shelters, dams, windmills, and water tanks and troughs. Farming-related features were restricted to fields, irrigation features, and threshing circles. Less commonly encountered, mining-related features consisted of mineshafts and a smelting furnace. Candelilla wax processing features were represented solely by wax vat fireboxes. Lime kilns, historic hearths, pebble concentrations, petroforms, tent pads, graves, quarries, and roads made up the miscellaneous category.

Summary of Artifacts

The most frequently encountered historic artifacts were tin cans, glass, bottles, ceramics, milled lumber, cartridge casings, nails, wire, tobacco tins, horseshoes, and buttons. Of the great many that were observed, 896 historic artifacts were collected—867 from within sites and 29 that were isolates. These were classified according to 19 functional categories in 5 different major groups: domestic, personal, structural, activities, and miscellaneous. Because a substantial number of historic ceramics was collected (n=330), the domestic group was by far the largest, comprising half of all collected artifacts. This was followed by personal, (24 percent of all artifacts), activities (19 percent), structural (5 percent) and miscellaneous (2 percent).

Isolates

A total of 5,152 isolates (features and artifacts found outside of archeological sites) were also documented during the project. Of these, 4,025 were features, 858 were artifacts, 237 were lithic scatters, and 32 were historic scatters. A detailed breakdown of categories and definition of terms are offered in section 6-IV.

Summary of Features

Isolated features documented during the project occurred across six categories that embraced the range of materials encountered. Of the 4,025 features recorded, 257 were isolated cairns, 2,612 were rock groupings, 1,074 were rock clusters, 74 were rock alignments, 6 were select pebble concentrations, and 2 were miscellaneous features.

Summary of Artifacts

A total of 858 isolated finds were documented during the project. Of these, 265 were prehistoric and 593 were historic. The prehistoric isolated finds consist of 312 individual artifacts in 15 categories—most of which were bifaces, dart points, or flakes. The historic isolated finds consist of 617 artifacts in 22 categories—over 60 percent of which were tin cans, horseshoes, and cartridge casings.

Summary of Lithic Scatters

Lithic scatters were recorded as a separate category from other isolated artifacts in an effort to document single-episode lithic reductions and scatters containing no formal tools. A total of 237 lithic scatters were recorded during the project, most of which occurred within a 5 m diameter area and contained between 11 and 20 pieces of debitage.

Summary of Historic Scatters

Historic scatters, the historic equivalent of lithic scatters, were also documented as a separate category. A total of 32 historic scatters were recorded during the project representing a concentration of historic artifacts (typically less than ten) that lacked associated features. Almost half were tin cans, followed by glass shards and cartridge casings.

6-II

Native American Archeological Findings

This section provides an overview of Native American archeological artifacts, features, and sites documented during the project. The first part presents the temporal affiliation of projectile points collected during the survey. This is followed by an overview of prehistoric sites, including site distribution and density, site size, and site types. The final two sections present overviews of feature and artifact types that were documented within sites before presenting the classification and analysis of all collected prehistoric artifacts.

Temporal Affiliation of Projectile Points

Archeological time periods are represented by temporally diagnostic artifacts, almost all of which are projectile points. A total of 1,236 projectile points were collected from 285 sites and 65 isolated find localities during the survey. All of the specimens are diagnostic of the major archeological time periods (i.e., Paleoindian, Archaic, and Late Prehistoric), and in most instances, they are also diagnostic of subperiods (e.g., Late Paleoindian and Middle Archaic). These subperiods are hereafter referred to as time periods or simply periods.

During the lithic analysis, one of two levels of confidence in assigning temporal affiliation was recorded for each projectile. Where specimens are tallied under a specific period, such as "Early Archaic," this indicates a very high level of confidence in the temporal assignment (near 100 percent confidence). Where temporal assignments are slightly less certain (still more than 75 percent), the qualifier "likely" has been added [e.g., "Early Archaic (likely)]. In most of these cases, some morphological characteristics or missing elements, such as partial stems, precluded 100 percent confidence. Where dart points were too fragmentary to assign to periods, they were simply relegated to Archaic Unspecified and excluded from tallies by time period. Because of the fairly high level of confidence, the specimens in the "likely" categories are included in the subsequent discussions of time periods. For example, Early Archaic and Early Archaic (likely) are combined in Early Archaic Total. Note that the "likely" specimens amount to only 6 percent of the total, a number that bolsters the overall confidence level of subsequent analyses. Table 6-II.1 provides a summary of the count and relative abundance of all diagnostic projectile points collected during the survey, broken down by confidence level.

Table 6-II.2 and Figure 6-II.1 provide a simplified tally of the diagnostic projectile points (excluding the unspecified Archaic specimens), the percent of total, and the relative proportion of each time period represented, such that for every 1 Paleoindian specimen, there are roughly 4 Early Archaic specimens, 11 Middle Archaic specimens, and so on.

Table 6-II.1 Count of Collected Projectile Points by Time Period (Including Isolated Finds).

Time Period	Count	% of Total
Early Paleoindian Total	1	0.08%
Late Paleoindian	11	0.89%
Late Paleoindian (likely)	8	0.65%
Late Paleoindian Total	19	1.54%
Early Archaic	65	5.26%
Early Archaic (likely)	8	0.65%
Early Archaic Total	73	5.91%
Middle Archaic Total	225	18.20%
Late Archaic	258	20.87%
Late Archaic (likely)	62	5.02%
Late Archaic Total	320	25.89%
Archaic Unspecified	222	17.96%
Archaic Total (combined)	840	67.96%
Late Prehistoric Total	376	30.42%
TOTAL	1236	100.00%

The projectile point breakdown demonstrates a number of notable trends. For one, there are progressively more specimens going forward in time such that Paleoindian and Early Archaic time periods are poorly represented whereas later time periods are increasingly better represented. Second, there is an abundance of Middle Archaic specimens relative to earlier periods indicating a significant spike in the general trajectory of increasing numbers of projectiles through time. Third, Late Prehistoric specimens (arrow points) were recovered with the greatest frequency despite their diminutive size and their relative low visibility in the study area.[1]

Table 6-II.2 Simplified Tabulation of Diagnostic Artifacts by Time Periods.*

Time Period	# Projectiles	% of Total	Proportion
P	20	1.97%	1.0
EA	73	7.20%	3.7
MA	225	22.19%	11.3
LA	320	31.56%	16.0
LP	376	37.08%	18.8
Total	1014	100.00%	50.7

* Isolated finds included, unspecified Archaic excluded.

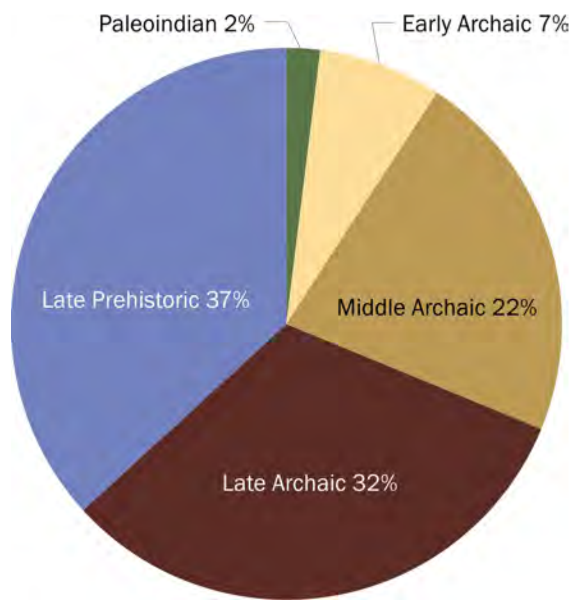


Figure 6-II.1 Archeological time periods represented by collected projectiles (excluding unspecified Archaic).

Temporal Affiliation of Prehistoric Sites

Temporal affiliation of prehistoric sites recorded during the project was almost exclusively derived from relative dating of diagnostic projectile points. However, features from a small handful of sites were dated using soil humate and charcoal samples recovered during the survey. Seven out of a total of 13 samples submitted for analysis dated to the prehistoric period. Of these, four dated to the Late Archaic period (BIBE418, BIBE999, BIBE1030, and BIBE1942) and three dated to the Late Prehistoric period (BIBE1032, BIBE1841, and

1 This observation must be qualified because there are an additional 222 “unspecified Archaic” dart points not included in this tabulation, 116 of which retain some stem morphology and are most likely Late Archaic. If this is correct, then the Late Archaic specimens (n=436) would outnumber the Late Prehistoric ones (n=376). When time is taken into account, however, the “deposition rate” of Late Prehistoric specimens is still significantly higher. See Chapter 7 for measures of deposition rate.

BIBE1891)—two of which were quite late (ca. A.D. 1530). For details on feature contexts and the results of radiometric analyses, see Appendix 8.

Aside from these radiocarbon dates, all remaining sites were dated using diagnostic projectile data. Diagnostic projectiles were collected at a total of 284 sites recorded during the project. However, because 26 of those sites contained points classified as "unspecified Archaic," they are omitted from this discussion. Of the remaining 258 sites, 143 (55 percent) are potentially single time period sites (Table 6-II.3 and Figures 6-II.2 and 6-II.3). For the purposes of this report, a "potentially single time period" site is one that contains projectiles representing only a single time period (though there may be multiple points, and in some instances, multiple styles). These sites are only "potentially" single time period because they may have been occupied during other time periods by people who left no diagnostics. It is also likely that not all diagnostic projectiles on a site were discovered. Consequently, this designation must remain qualified.

Most of the potentially single time period sites are represented by single artifacts. Only a few sites have more than two specimens, and none more than four. A notable exception to this pattern is BIBE1853, the Lizard Hill site, where 13 Middle Archaic projectile points were recovered as part of a cache. When multi-period sites are included in the tabulation (first column in Table 6-II.3), the various periods still tend to be represented by a single specimen, or in fewer instances, two, three, or four specimens.

Because site phenomena on multiple component sites cannot be definitively attributed to any one time period, these single time period sites form the data subset used in some analyses performed in Chapter 7, including site size, and midden and stone enclosure analyses.

Table 6-II.3 Project Sites with Temporally Diagnostic Projectile Points and Those Containing Projectiles from Only One Time Period.

Period	Sites with Diagnostics	Single Time Period Sites
Paleoindian	13	4
Early Archaic	40	5
Middle Archaic	89	24
Late Archaic	145	61
Late Prehistoric	118	49
Total	405	143

Note: Because some sites had diagnostics from several time periods, the total of the first column (n=405) exceeds the actual total (n=284). Unspecified Archaic is excluded.

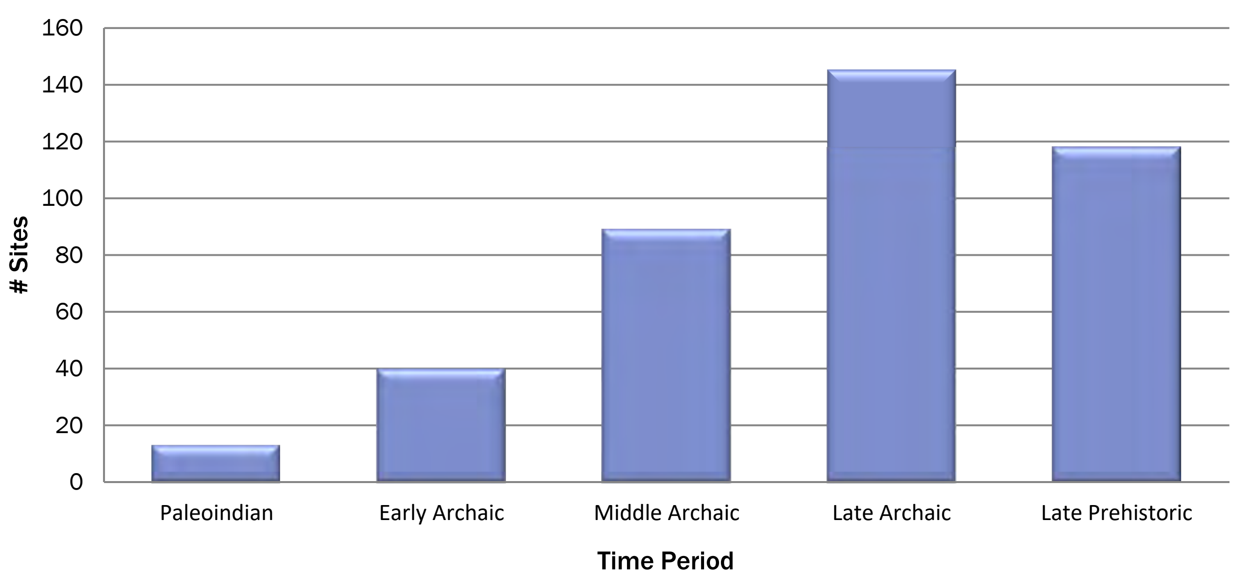


Figure 6-II.2. Project sites that contained diagnostic projectiles (excluding unspecified Archaic).

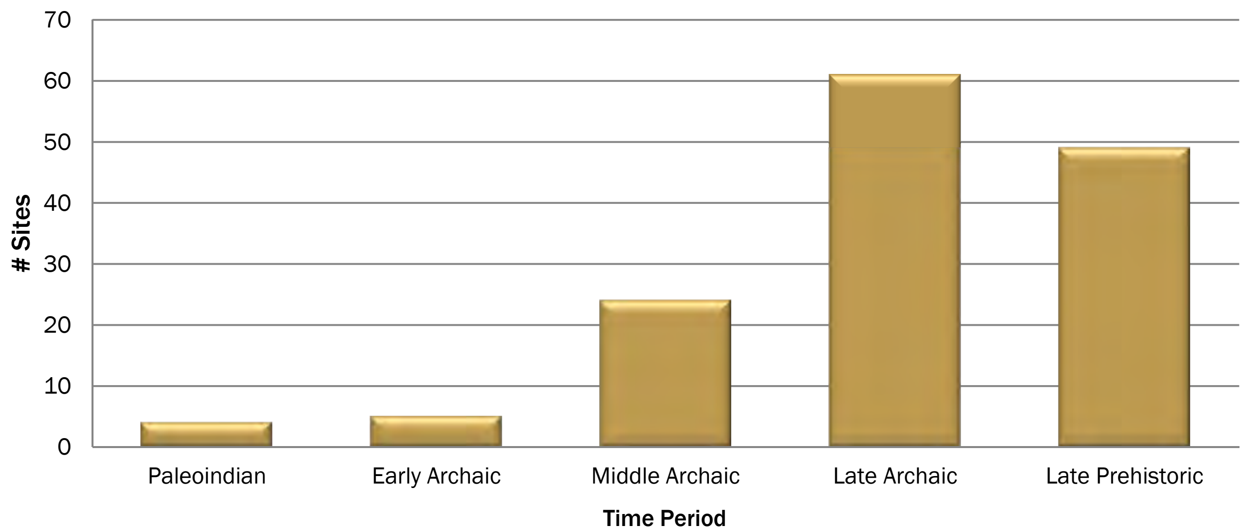


Figure 6-II.3 Project sites that contained diagnostic projectiles from only a single time period.

Prehistoric Site Classification

This section provides an overview of the way in which sites were classified, followed by discussions of site distribution and density, site size, and site types.

Of the 1,506 sites that contained prehistoric components, 1,161 were exclusively prehistoric. An additional 345 sites also contained historic components. Of these mixed component sites, 278 were predominantly prehistoric with a lessor historic component and the remaining 67 were predominantly historic with a lessor prehistoric component.

For purposes of the following discussion, both in the findings and analysis chapters, all sites with a prehistoric component substantial enough to qualify them to be recorded as sites are addressed. This number includes the 1,161 exclusively prehistoric sites plus mixed sites that are predominantly prehistoric (n=278) plus the predominantly historic sites that have a "qualifying" prehistoric component (n=34)—bringing the total number of sites with a substantial prehistoric component to 1,473.[2] Of all sites that contain a prehistoric component, then, only 33 (or 2% of sites with prehistoric components) are excluded here. To avoid confusion, these "substantial prehistoric component" sites are hereafter simply referred to as "prehistoric sites."

Site Distribution and Density

This section presents a brief introduction to the distribution and density of prehistoric sites relative to their locations within the park and between survey blocks. Distribution and density of sites between physiographic and environmental zones are addressed in Chapter 7 as part of the analysis.

Park-Wide

A total of 1,473 prehistoric sites were recorded across some 24,996 ha (61,766 acres [ac]) surveyed within BBNP, for an average park-wide site density of 1 site per 17 ha (42 ac). Prehistoric sites tended to occur

2. Prehistoric site qualifying criteria are explicitly outlined in the methodology section, but in general are limited to archeological manifestations that contain prehistoric features and/or a variety of formal stone tools.

fairly uniformly across BBNP, and in proportion to the area surveyed. Site density was somewhat greater on the west half of the park—averaging 1 site per 15 ha (37 ac) versus 1 site per 18 ha (45 ac) for the east side. Site density was more similar between the north and south halves—averaging 1 site per 18 ha (44 ac) in the north half and 1 site per 16 ha (40 ac) in the south. A more robust pattern is revealed by examining the park's four quadrants. Site density was highest in the northwest quadrant, averaging 1 site per 13 ha (31 ac), followed by the southeast quadrant at 1 site per 16 ha (39 ac) and the southwest quadrant at 1 site per 17 ha (42 ac). Density was least in the northeast quadrant at 1 site per 21 ha (52 ac).

This pattern is probably best explained by the size and arrangement of blocks across the park rather than natural phenomenon, more a sampling error than environmental constraints. The northwest quadrant has the least amount of surveyed acreage (3,771 ha; 9,318 ac) and the fewest large blocks while the northeast quadrant has the most surveyed acreage (9,191 ha; 22,711 ac) and the highest number of large blocks (3 are over 2,023 ha; 5,000 ac). Likely because of the judgmental placement of most of the blocks, smaller blocks—on average—tend to have a slightly higher site density.

By Survey Block

There was much greater variability in the density of prehistoric sites among the 58 survey blocks and all but 1 contained sites with substantial prehistoric components (see Figure 6-II.4 and Table 6-II.4). Site density ranged from 1 site per 6 to 59 ha (14 to 145 ac) except for the 1 block (2010-AA) where no sites were found. Of the 57 blocks that contained prehistoric sites, there was an average of 26 sites per block, with a range between 1 to 207 sites. Twenty-eight blocks contained less than 10 sites, 10 blocks contained between 10 and 20 sites, and 20 blocks contained more than 20 sites.

By Hydrologic Features and Minor Landforms

Although site locations were not systematically examined with regard to hydrological features and minor landforms, there were clear correlations between them. As would be expected in an arid region, site density along the Rio Grande as well as along ephemeral watercourses and springs was significantly higher than areas farther away from such features, and these sites tended to be more complex. Despite this,

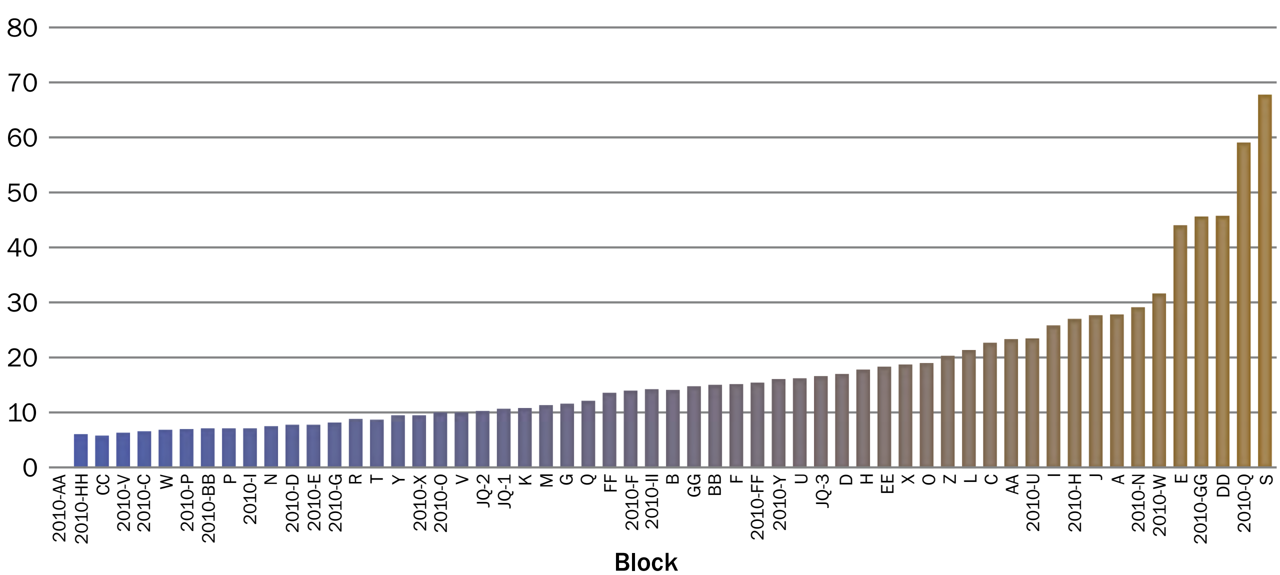


Figure 6-II.4 Site density (hectares per site) by survey block.

Table 6-II.4 Prehistoric Sites by Block.

Block	Hectares Surveyed	Prehistoric Sites	% Of Total	Hectares Per Site
A	2,040	74	5.02%	28
B	2,044	143	9.71%	14
C	2,025	90	6.11%	23
D	100	6	0.41%	17
JQ-1	228	22	1.49%	10
JQ-2	231	23	1.56%	10
JQ-3	228	14	0.95%	16
E	2,501	57	3.87%	44
F	3,078	207	14.05%	15
G	877	77	5.23%	11
H	1,402	80	5.43%	18
I	1,567	61	4.14%	26
J	935	34	2.31%	28
K	535	51	3.46%	10
L	2,009	95	6.45%	21
M	200	18	1.22%	11
N	65	9	0.61%	7
O	56	3	0.20%	19
P	145	21	1.43%	7
Q	98	8	0.54%	12
R	213	25	1.70%	9
S	203	3	0.20%	68
T	204	23	1.56%	9
U	239	15	1.02%	16
V	205	21	1.43%	10
W	205	31	2.10%	7
X	296	16	1.09%	19
Y	339	37	2.51%	9
Z	302	15	1.02%	20
AA	138	6	0.41%	23
BB	59	4	0.27%	15
CC	77	13	0.88%	6
DD	228	5	0.34%	46
EE	203	11	0.75%	18
FF	93	7	0.48%	13
GG	44	3	0.20%	15
2010-C	196	31	2.10%	6
2010-D	60	8	0.54%	7
2010-E	55	7	0.48%	8
2010-F	41	3	0.20%	14
2010-G	87	11	0.75%	8
2010-H	54	2	0.14%	27
2010-I	87	12	0.81%	7
2010-N	173	6	0.41%	29
2010-O	58	6	0.41%	10
2010-P	74	11	0.75%	7
2010-Q	118	2	0.14%	59
2010-U	93	4	0.27%	23
2010-V	54	9	0.61%	6
2010-W	63	2	0.14%	31
2010-X	83	9	0.61%	9
2010-Y	16	1	0.07%	16
2010-AA	57	0	0.00%	0
2010-BB	41	6	0.41%	7
2010-FF	45	3	0.20%	15
2010-GG	45	1	0.07%	45
2010-HH	52	9	0.61%	6
2010-II	28	2	0.14%	14
Total	24,996	1,473	100.00%	17

distribution patterns of sites around water features proved to be highly variable and inconsistent suggesting that factors other than water were also involved. Sites were also found to occur more commonly along ecotones, or where two or more environmental zones meet—areas that typically contain a more diverse suite of resources. Density was also observed to be higher on and around minor landforms in otherwise nondescript landscapes, as when a low hill rises out of an alluvial plain. Similarly, high landforms such as summits and promontories frequently contained sites, especially when they occur among lower elevation landforms or flat terrain. Such sites tend to be more ephemeral, however, typically consisting of singular structures indicative of vision quest sites, lookouts, or redoubts. A more complete discussion of site distribution according to environmental variables is offered in Chapter 7.

Site Size

Site size refers to the spatial extent of an archeological site as defined by its boundaries. However, this is often a problematic site characteristic. Because site boundaries encompass a variety of phenomena, including discrete single-component occupations and mixed debris from numerous overlapping occupations, it is difficult to discern when or if they conform to any single occupation (a discrete behavioral event). Such issues can reduce the interpretive value of this kind of spatial data. However, instances where diagnostic artifacts indicate only a single time period (e.g., limited to the Late Archaic) or cases where artifacts and features appear to be discretely bounded or clustered raise the level of confidence in making behavioral inferences.

The 1,473 prehistoric sites spanned 1,813 ha (4,480 ac), an average of 1.2 ha (3 ac) per site. Sites ranged in size from a low of 13 m^2 to 1,796,393 m^2. However, three of the largest prehistoric sites were lithic procurement areas spanning vast areas (320 ha combined) that skew the total. Removing these sites results in a more accurate figure of 1,493 ha (3,688 ac) total prehistoric site area, for an average of 1 ha (2.5 ac) per site.

Project sites were arbitrarily divided into six size grades (Table 6-II.5).[3] The vast majority of sites (95 percent, n=1397) range between 101 and 100,000 m^2 with an average size of 6992 m^2. However, 78 sites fall on the extreme ends of the spectrum. Fifty of these sites are exceptionally small, ranging from 13 to 100 m^2. The majority of these sites (size grade 1) consist of only 1–3 hearths, but they also include sites with small numbers of stone enclosures or historic features (such as historic pens or "cowboy hearths"). Interestingly, all prehistoric artifact scatters are larger than grade 1.

Conversely, 26 sites are exceptionally large, ranging from 100,001 to 1,766,000 m^2. The largest of these grade 6 sites, BIBE1718 (1,766,000 m^2), is an expansive lithic procurement area where tested cobbles, tools, and debitage abound in a broad scatter that links one landform after another. The remaining class 6 sites range between 110,780 and 964,361 m^2 and are comprised of quarries or secondary procurement locals, prehistoric camp debris, thermal features, a small number of stone enclosures, historic artifact scatters, and a number of other historic and prehistoric features. These sites are difficult to characterize because the expansive boundaries likely encompass numerous overlapping occupations that are difficult to differentiate. No prehistoric diagnostic artifacts were discovered at five of the grade 6 sites, while the rest display evidence of a wide range of time periods from Late Paleoindian to modern times. Because of these challenges, these largest sites are excluded from several analytical discussions in later sections.

Table 6-II.5 Size Classification (Grades) of Sites Recorded During the Survey.

Grade	Size Range (mM2)	# Sites
1	0–100	50
2	101–1000	471
3	1001–5000	504
4	5001–20,000	292
5	20001–100,000	130
6	100,001–2,000,000	26

Prehistoric Site Types

All prehistoric sites were classified according to site type which are broad categories based on the kinds of archeological materials present within each site and, in some cases, their relative abundance. These designations do not address site function or the full range of activities carried out therein, and, as such, have limited

3. Although arbitrary, size grades were tailored to the dataset to approximate a normal distribution and as an aid in simplifying analytical comparisons.

analytical utility. Rather, site types serve simply to place sites within a framework based on observed phenomena rather than conjecture.

Six site types were identified, consisting of open campsites, food processing sites, artifact scatters (including quarries and procurement areas), natural shelters, stone enclosures, and special use sites (Table 6-II.6). The following discussion defines each site type and presents comparative observations concerning their context within the larger body of project data.

Table 6-II.6 Major Prehistoric Site Types.

Open Campsites	Artifact Scatters	Special Use	Natural Shelters	Food Processing	Stone Enclosures	Undetermined	Total
1,327	55	38	32	8	4	9	1,473

Open Campsites

The open campsite is a highly inclusive, "catch-all" category, and the vast majority of prehistoric sites (n=1,327, or 90 percent) were designated as such. In general, sites that did not fit neatly into any of the other site types were typically placed in this category.

In composition, prehistoric open campsites are diverse and consist of a variety of features and artifact types that typically indicate either short or long-term habitation and food preparation (Figure 6-II.5). The most abundant feature types consist of a variety of thermal features such as rock hearths/ovens and fire-cracked rock

Figure 6-II.5 Prehistoric open campsite on an alluvial plain at BIBE1851 (41BS1777). Photo by L. Weingarten.

middens, many of which are remnants of baking "appliances" (earth ovens) used to process foraged foodstuffs. Burned rock or fire-cracked rock (FCR) is nearly ubiquitous in prehistoric sites in the park, and while it is an indicator of prehistoric human subsistence activities, when it occurs as diffuse scatters, it typically offers little or no indication of the original feature's morphology. Because FCR scatters alone or in the company of a lithic scatter can be sufficient criteria for an open campsite, some have no intact features (75 sites fall into this category). Another common feature in campsites is *structures*, which typically consist of stone enclosures composed of single or multiple stacked courses or rock. In some cases natural features such as boulders and bedrock exposures are opportunistically incorporated. Such remains are interpreted as being the stone footings of wickiups, tipi rings, ramadas, and a variety of other structural forms.

Because of the material diversity encompassed by the open campsite category, data concerning the character and content of open campsites are addressed in subsequent sections on feature types, complexity classifications, and the GIS-based site predictive model; the latter two deal exclusively with open campsites.

Artifact Scatters

An isolated lithic scatter is defined as an area containing a small and discrete concentration of debitage, usually with no formal tools, within a defined area (Figure 6-II.6). This category was intended for scatters that

Figure 6-II.6 Artifact scatter / procurement area in Javelina Formation gravels at BIBE2224 (41BS2106). Photo by C. Covington.

were spatially discrete, often indicating a single reduction episode. Artifact scatters were recorded either as isolates or as sites, depending on the number of items present. Typically, these contain fewer than 20 pieces of debitage within a 20 m diameter area. Relative to other site types, artifact scatters appear infrequently in the project dataset. A total 55 artifact scatters were recorded as sites (4 percent of the total number of sites) whereas 130 artifact scatters were recorded as isolates.

When recorded as sites, the prehistoric material assemblage rarely consisted of more than chipped stone artifacts. In only a few instances were features other than discrete lithic scatters present, and in these rare cases, the lithic scatter component dominated. The most frequently encountered type of artifact scatter was a sparse accumulation of debitage with a small number of stone tools (e.g., a hammerstone, scraper, biface, or projectile point). However, cases exist where artifact scatters are comprised of thousands if not tens of thousands of chipped stone artifacts in addition to numerous formal tools. However, if ground-stone was present, the site was usually considered an open campsite instead.

The 55 sites recorded as artifact scatters were further subdivided into sites that contained evidence of lithic quarrying (n=10), of surface procurement (n=15), and sites where the lithic material appears to have been brought in (n=30). Quarry sites displayed evidence of rock removal from in-situ parent material (most often of black hornfels). Procurement sites displayed evidence of surface procurement of siliceous stones, typically in the form of stream-worn rounded cobbles on pediment surfaces or—less frequently—angular and subangular cobbles eroded from nearby parent rock. Although formal tools were absent at the majority of lithic scatters (33 sites, or 59 percent had none), 5 of the sites had projectiles, 4 had scrapers, 8 had hammerstones, and 15 had bifaces.

Special Use Sites

Special use sites contain features that do not fit the expectations of typical domestic or subsistence activities and often imply religious, ceremonial, or defensive functions (Figure 6-II.7). Thirty-eight sites in the dataset are classified primarily as special use sites (3 percent of the total number of sites), but an additional 15 sites have special use features or attributes. Special use features include possible vision quest structures, petroforms, rock art, caches, burials, and sites that appear devoted to defensive activities (i.e., breastworks and redoubts). These sites rarely contain thermal features or other elements common to open campsites. Varieties of special use sites are described below, and details of special use features are discussed in the section on feature types.

Structures interpreted to be related to vision quests are situated in locations that are often high, difficult to access, and that command wide vistas of the surrounding terrain. Functionally they are thought to be related to spiritual or rite-of-passage ceremonies amply documented in ethnographic literature. However, it should be noted that the term is used rather liberally and at least some of these sites may have served other functions, such as lookouts or signaling stations. Nine such sites were documented during the project, most of which contained a single structure. Three of these sites, however, contained between three or four such structures.

Petroforms are intentional arrangements of stones upon the ground to create abstract or representational figures or patterns. These include a number of different forms such as abstract linear figures, effigies, and medicine wheels, all of which are interpreted to have had spiritual or ritualistic meaning. A total of 17 sites containing features identified as petroforms were documented, consisting of 4 probable effigies, 2 probable medicine wheels, and 11 probable abstract petroforms.

Although rock art was infrequently documented on other site types, only one special use site contained rock art. BIBE1428 had a total of 15 pictograph panels containing geometric figures in various shades of red to brown, along with some historic graffiti on a rock bluff.

Figure 6-II.7 Caleb Waters (left) and David Keller recording a special use site on top of a butte at BIBE989 (41BS2285). Photo by D. Hart.

Caches are discrete collections of artifacts purposefully stashed or hidden. They typically fall into one of two categories: utilitarian or ceremonial. In the former case, the materials are interpreted as being stashed for later retrieval. In the latter case, the materials are believed to have been an offering, and may provide rare insights into aspects of prehistoric ritualism. Only one site was documented during the project that contained a ceremonial cache (BIBE1853). Eroding out from an eroded cairn, revealed on the surface and in a subsequent excavation, were 13 contracting stem dart points. Based on the setting as well as other features on the site (including a V-shaped petroform), this cache was interpreted as ceremonial (see Appendix 20). Although no other formal caches were discovered, at least three sites contained what were interpreted as utilitarian "mano caches" where two or more manos were stashed for later use.

Burials can provide similar insights on the ideological, religious, and sociocultural expressions of past peoples. Cairn, crevice, and subterranean burials have all been previously documented in the park. During the present project, only one confirmed prehistoric interment was documented—found eroding out of a short cutbank within a larger open campsite (see Appendix 16). However, eight additional sites contained possible or probable prehistoric burials—most often in the form of isolated cairns or rock-filled crevices. One of these sites (BIBE2704) appeared to contain as many as four separate interments.

Defensive sites are commonly situated in precarious and/or defendable positions (high ground, ridge-tops or cliff-lined buttes) and contain defensive features such as redoubts and fortifications. The frequency of defensive sites in successive time periods (such as Cielo complex sites) can provide information on the changing nature of social interaction during the prehistory. Only two sites were believed to be related to defense—one (BIBE2247) with a curving rock wall, the other (BIBE2479) containing five stone enclosures, both located on defensible landforms.

Natural Shelters

Natural shelter sites are fairly numerous in the park but are underrepresented in the project dataset (n=32, or 2 percent of the total number of sites) because the survey focused on basin rather than mountain settings. Unlike open campsites, natural shelters often provide exceptional conditions for preservation of perishable materials that would typically degrade in open settings (e.g., matting, cordage, wood artifacts, animal and human remains). Because of these qualities, rockshelters across the region have been targeted for uncontrolled excavation and looting for over a century. As a result, most natural shelters have been adversely impacted, evidenced by potholes, backdirt piles, artifact discard piles, and disarticulated features.

Natural shelters are geologically derived features that include rockshelters, boulder shelters, and cave shelters. Rockshelters are defined as rock cavities wider than they are deep as opposed to caves that are defined as being deeper than they are wide (Figure 6-II.4). Boulder shelters are defined simply by the use of a boulder as the primary sheltering element. Table 6-II.7 shows the number of each type documented during the survey. Although 40 project sites contain natural shelters, only 32 were assigned this designation as a site type. The remaining seven were classified primarily as camps, with the shelter being a secondary site type.

Figure 6-II.8 Natural rockshelter with exterior dry laid stone wall at BIBE2394 (41BS2523). Photo by R. Freer.

Table 6-II.8 presents attributes for 46 rockshelters (from 40 sites) recorded during the project. In several instances sites contain multiple shelters, some of which were not always individually recorded. The table provides information for the range of natural shelters where information was available.

The nature of shelters documented during the project proved to be highly variable—in morphology as well as orientation and cultural content. Although ceiling height is perhaps the most significant factor in natural shelters, the long axis is used here as a crude indicator of overall shelter size. In rockshelters, the long axis corresponds to width, whereas in caves it refers to depth (so in this case, these measurements are mixed). Thirty of the natural shelters are between 1–10 m wide, 6 are 11–20 m, and 4 are between 21–45 m. The remaining six shelters lacked this data.

Table 6-II.7 Types of Natural Shelter Sites Documented During the Project.

Type	Count
Rockshelters	30
Boulder shelters	5
Cave shelters	5
Total	**40**

Fifteen of the shelters have a predominantly northern orientation (i.e., north, north-east, northwest), and 13 have a predominantly southern orientation. The remainder has east, west, or unknown orientations. By convention, archaeologists often consider the orientation of the shelter opening (the direction it faces) as a possible indicator of the season it was used. The reasoning is that south-facing shelters (exposed to more direct sunlight) are well suited for cold season occupation, whereas north-facing shelters are more suitable for hot weather but may be too cold for winter use.

Nineteen shelters have talus midden deposits below the mouth of the shelter. These are secondary deposits comprised mostly of FCR, carbon stained sediments, and often artifacts such as debitage and chipped- and ground-stone tools. Diagnostic artifacts on the talus are rough indicators of the temporal depth of the shelter's use, but the processes of site maintenance, clean-out episodes, and debris aggradation make talus deposits difficult to interpret. Talus deposits are often synonymous with debris middens, and the spatial context and association of cultural material therein is frequently questionable.

Twenty-two of the shelters have evidence of interior cultural deposits, though in most cases the depth and integrity of such deposits is unknown. Features were observed in 23 shelters, including rock cairns, rock alignments, rock art, grinding implements (mortars or polished stone), and in two instances, possible evidence of human interments—a projectile point in a rock-filled crevice and basketry/matting in a rock filled crevice. In several cases, circular rock alignments or stone enclosures were documented within or along the opening of the shelter.

Although many of the shelters contained artifacts, perishable materials—such as matting, cordage, or basketry—were found in only three shelters. Eleven sites with shelters (both lone shelters and shelters amidst larger camps) contained diagnostic artifacts, for a total of 43 specimens. Four shelters produced artifacts from a single time period although it is likely that additional periods are represented in buried deposits at these sites.

Even though the Mountain Zone represented only about 18 percent of the surveyed area, it contained 80 percent of the rockshelter sites (32 of 40 sites). Nearly half (n=15) were discovered in Control Block C, where the karst limestone topography of the Dead Horse Mountains is conducive to the formation of rockshelters suitable for prehistoric habitation, a pattern that plays out in other regions of the park as well.

Despite the excellent preservation afforded by natural shelters, shelter deposits are often problematic for research. Because these locations were highly favored by prehistoric peoples, they were often repeatedly occupied, sometimes for thousands of years. This pattern of recurring occupation and attendant site use, site

Table 6-II.8 Attributes of Natural Shelters Recorded During the Project.

BIBE	Type	No. of Shelters	Width (m)	Depth (m)	Orientation	Cultural Talus?	Interior deposits	Groundstone?	Projectiles	Ceramics	Perishables	Component(s)	Looting	Potential	Features
93	SHCA	1	2	3	NE	Y	U	Y	N	N	N	U Pre/Hist	N	U	Hist graffiti
246	SHRO	2	U	U	NW, SSE	U	U	U	N	N	U	U	N	U	U
338	SHRO	5	U	U	SW, NNW	U	U	N	N	N	N	U	N	U	N
449	SHCA	2	U	U	NW, SSE	N	N	N	N	N	N	U	N	Low	N
450	SHRO	1	U	U	SSE	N	N	N	N	N	N	U	N	Low	Polished boulder
497	SHRO	1	4.5	3	NE	Y	Y	U	N	N	N	U Pre	N	Med	Cairn
536	SHRO	1	5	5	N	U	Y	N	N	N	N	U Pre/Hist	Y	Med	Poss. crevice burial; pictographs
609	SHCR	1	U	U	W	N	U	N	N	N	N	U Pre	N	U	Pictographs; polished boulder
749	SHCL	1	30	6	NW	Y	Y	Y	Y	N	N	Archaic	N	Med	Boulder metates; circular stone alignment; pictographs
951	SHRO	1	10	5	NE	Y	Y	Y	N	N	N	U Pre	N	Med	Linear alignments of stone
952	SHRO	1	12	6	E	Y	Y	Y	Y	N	N	U Pre/Hist	N	Med	Petroglyphs and graffiti; boulders with grooves; bedrock metates
953	SHCA	1	4.5	15	W	Y	Y	Y	Y	N	Y	U Pre	N	Med	Storage cist
978A	SHCL	1	4	2	WSW	U	U	U	U	N	N	U	N	U	U
978b	U	1	3	1.5	WSW	U	U	U	U	U	U	U	U	U	U
978c	U	1	12	4	WSW	U	U	U	U	U	U	U	U	U	U
978d	U	1	10	3.5	WSW	U	U	U	U	U	U	U	U	U	U
986	SHRO	1	3.5	0.9	N	U	U	N	N	N	N	U Pre	N	None	N
988	SHBO	1	U	U	U	U	N	N	N	N	N	U	N	None	N
1309	SHBO	1	4	2.8	NE	Y	Y	N	N	N	N	U Pre	N	Med	Rock-filled crevice
1345	SHRO	1	3	5	NW	Y	Y	N	N	N	N	U Pre	N	Med	Oval-shaped stacked stone enclosure
1348	SHCA	1	7	10	S	Y	Y	N	N	N	N	U Pre	N	Med	N
1351A	SHCA	2	1.3	3	SSE	U	U	N	Y	N	Y	LA	N	High	Stone cairns
1351B	SHRO	1	2.5	1.5		U	U	N	U	N	U	U	U	U	N
1353	SHCA	1	5	7	SE	Y	Y	Y	N	N	N	U Pre	N	Med	N

1362	SHCA	1	2.3	4	E	N	Y	N	N	N	N	U Pre	N	Low	N
1363	SHRO	1	7	5	W	Y	Y	N	N	N	N	U Pre	N	Med	N
1364a	SHCA	1	7	10	SE	N	U	N	N	N	N	U Pre	N	Med	Linear alignment of stones
1364b	SHRO	1	5	2.5	SE	U	U	N	N	N	N	U	N	Med	N
1370a	SHCA	1	2.3	4.4	E	N	Y	N	N	N	N	U Pre	N	Low	N
1370b	U	1	3	4	E	N	N	N	N	N	N	N	N	Low	N
1399	SHRO	1	5	2	SSW	Y	Y	N	N	N	N	U Pre	N	Med	N
1425	SHRO	1	8	3	E	N	U	N	N	N	N	U Pre	N	Low	Petroglyph and pictograph; groves on cobble and boulder
1428	SHCL	1	20	2	NNW	N	N	N	N	N	N	U Pre/Hist	N	Med	Pictographs and Hist graffiti
1429	SHRO	1	35	15	SE	U	U	N	N	N	N	U Pre/Hist	N	Low	Stone alignment against back wall; midden; cairn
1444	SHBO	1	10	3	NNE	Y	Y	Y	N	N	N	U Pre	N	Med	N
1454	SHRO	1	5	2	NE	Y	Y	Y	N	N	N	U	N	Med	N
1456	SHBO	1	10	3	WSW	Y	Y	N	N	N	N	U Pre	N	Med	N
1459	SHRO	1	17	5	W	Y	Y	N	N	N	N	U Pre/Hist	N	Low	Hist graffiti
2355	SHRO	1	10	1	E	N	N	N	N	N	N	U	N	Low	Curvilinear stone enclosure
2394	SHRO	1	17	2	NW	Y	Y	Y	Y	N	N	LA/LP Pre/Hist	N	Med	Stone enclosure
2403	SHRO	1	20	3	WSW	U	N	N	N	N	N	Arch	N	Low	N
2471	SHRO	1	10	10	NE	N	Y	N	N	N	Y	U Pre	N	High	Two cairns; one possible burial
2472	SHCA	1	6	10	SE	N	Y	N	N	N	N	U Pre	N	Med	Pictographs and polished boulders
2475	SHBO	1	2	1.9	SSW	N	Y	Y	N	N	N	U Pre	N	Low	N
2575	SHRO	1	40	8	SE	Y	U	Y	Y	N	N	MA	N	Med	Pictographs
2700	SHRO	1	45	14	SE	Y	Y	N	N	N	N	U	N	High	Pictographs

Key:

SHCA=Cave Shelter SHRO=Rock Shelter SHCL=Cliff Shelter U=Unknown Y=Yes
N=None Med=Medium MA=Middle Archaic LA=Late Archaic LP=Late Prehistoric

maintenance, and a host of other taphonomic processes often results in mixed deposits. In addition, shelters are a favored location for animals—especially rodents, javelinas, and modern goats. In addition, natural shelters are often the target of pot hunters. Together, these conditions can conspire to degrade the integrity of cultural deposits in natural shelters, confusing interpretations and making it difficult to assess their research value and archeological potential.

Food Processing

Only 8 sites were documented during the project whose primary function appears to be food processing (0.5 percent of the total number of sites). These sites are typically characterized by the presence of ring middens and/or ground-stone where such features or artifacts overshadow other feature or artifact types (Figure 6-II.9). Five of the sites contained ring and/or sheet middens and six of the sites contained ground-stone. Although usually in the form of manos and metates, 1 site contained 15 mortar holes.

These sites are not numerous, but stand out where they do occur—most typically around springs. The sites themselves suggest specialized food-processing activities, likely a seasonal affair, centered around one or more spring locations. These sites often lack the range of artifact types found in habitation sites. For example, only three of these sites contained projectile points.

Figure 6-II.9 Ring Midden at food processing site BIBE2417 (41BS2546). Photo by D. Keller.

Stone Enclosures

Four sites were designated as stone enclosure sites (0.3 percent of the total number of sites). Like open campsites, this site type does not imply function, only site content. In this case, stone enclosures—usually in the form of wickiup rings—are the primary or sole feature type (Figure 6-II.10). Each site contained between one and five stone enclosures. None contained thermal features and formal tools were virtually absent (one site contained a hammerstone). Based on construction characteristics of the enclosures, these sites are presumed prehistoric. However, because artifacts or other feature types are typically absent, this assumption is difficult to verify. Where sites such as these occur on high promontories, they are usually designated as special use. However, it is possible that some or many of the stone enclosure sites serve similar functions to those theorized for special use sites.

Undetermined

Nine prehistoric sites were recorded during the project whose site type was undetermined. The content of these sites was substantial enough to warrant site status, but site function was not readily apparent—and, in many cases, cultural affiliation was also unclear. None of the sites contained thermal features, which would have placed them in the open campsite category. Most of the sites contained debitage although only one site contained formal tools—in this case, two projectiles. Features within these sites consist of cairns, rock alignments, rock groupings, and rock anomalies believed to be cultural but whose function is unknown.

Figure 6-II.10 Sarah Loftus recording stone enclosure site BIBE284 (no trinomial). Photo by W. Barrick.

Feature Types

This section presents data on archeological features documented during the survey project. Features are defined as bounded, discrete, and non-portable accumulations or arrangements of materials that are the result or focus of human activity. Typically, features cannot be moved without compromising the spatial and scientific integrity of the materials. Examples include thermal features, burials, and structural remnants. Once disarticulated, features lose their interpretive value. In many instances, the most critical information involves the morphology, context, and content of the features, as well as any artifacts that may be associated.

The following discussion is organized according to broad categories (e.g., thermal features, structures, special use, etc.) followed by specific feature types and subtypes, definitions, and morphological characteristics and variability. Analytical discussions addressing major feature types are presented in Chapter 7, Analysis of Survey Results, where temporal associations, environmental distributions, and technological associations are examined.

Thermal Features

Thermal features refer to features that incorporated (or resulted from) the use of fire. They consist of hearths and middens, and their various subtypes. The disarticulated remains of thermal features are discussed as well, though fire-cracked rock concentrations and scatters were not systematically classified as features per se in the project dataset. It is important to note that the thermal feature types discussed represent surficial expressions of these features. Because the scope of work was limited to pedestrian survey, and not excavation, buried thermal features were only rarely encountered. However, a representative sample of those that were are discussed at the end of this section.

Hearths

Hearths, sometimes referred to as rock hearths or cooking hearths, are the remains of a feature where fire was constructed for the purpose of processing or cooking food, as well as providing heat and light. In BBNP and regions abroad, hearths are perhaps *the* quintessential archeological feature and are the most ubiquitous appliance of foraging societies. Ethnographic accounts readily demonstrate that hearths or "camp fires" were and still are a focal point for individual, family, and community activities (Binford 1980, Lee 1979, Yellen 1976). Whether they occur in isolation or, more often, in association with other hearths and feature types, hearths remain the hallmark of an "open campsite."

Based on gross morphological attributes, BBNP hearths are distinguished by three main types: pavement, ring, and cobble lined pavement (CLP). When disarticulated to such an extent they cannot be defined to type, they are referred to as hearth remnants. Despite similarities, hearths recorded during the project displayed marked morphological diversity, even within a particular type. Some variability can be accounted for by stylistic preference, but it is often believed to be related to function.

While hearths can be constructed without rock, rock-less hearths are more ephemeral in the archeological record because they do not preserve as readily, leaving only carbon stains without durable elements. In the vast majority of cases, however, rocks were used as the main construction element, primarily for their thermal qualities. Rocks are able to effectively absorb and retain heat and distribute thermal energy more evenly. As such, in conjunction with fire, rocks were an important tool for cooking—especially the starchy, carbohydrate-rich resources that abound in the desert, making many common food sources more palatable and nutritious.

BBNP is dominated by sedimentary and volcanic geologic features and, as a result, hearth stones are typically limestone, basalt, rhyolite, or some combination thereof. In most cases, stone selection was observed to be expedient, utilizing material close at hand. However, there were cases where stone selection seems idiosyncratic, such as a hearth in a predominantly limestone setting constructed of volcanic rock. Because heating causes rocks to fracture into ever smaller sizes, data regarding the number and size of hearth stones is problematic (and of limited usefulness). But in cases where thermal alteration was limited, and original stones were intact, clear preferences for stone size selection were evident—mostly in the 5–15 cm maximum diameter range.

Of all prehistoric sites (n=1,473), 1,209 sites have hearths and/or hearth remnants—82 percent of the total number of sites. Among sites that contain hearths, the vast majority (n=908; 75 percent) contain less than 5, with an average of 1.4 hearths per site. Although a total of 368 sites (30 percent) contain only a single hearth, at the other end of the spectrum, three sites (BIBE338, BIBE1218, and BIBE418) have more than 100 such features (170, 105, and 101, respectively).

Roughly 6,635 hearths (including hearth remnants) were documented on the 1,209 sites that contained hearths. However, the level of detail recorded varied between the pre-2005 data and the 2005–2010 data. Pre–2005 site recorders less frequently made the distinction between the three hearth types and, in fact, the cobble lined pavement hearth style was not formally defined until the post–2006 period. As a result, subsequent discussions of hearth types deal specifically with the 2005–2010 subset of the project data.

Of the 2005–2010 data subset, 946 out of 1,101 sites have hearths and/or hearth remnants (86 percent of total number of sites), for a sample size of 4,618 features. Of these, 3,208 hearths were classified according to the four specific morphological types, including unspecified or undetermined. The vast majority of this subset, 74 percent, is comprised of pavement style hearths (n=2,373), followed by 13 percent ring style (n=406), 10 percent cobble lined pavement (n=312), and 4 percent unspecified (n=117) (Table 6-II.9 and Figure 6-II.11).

Pavement Hearths

Pavement hearths are by far the most common hearth type in BBNP (n=2,373) accounting for three-quarters of all hearths recorded. These hearths are characterized by a layer of stones arranged fairly uniformly upon the ground—roughly resembling a cobblestone pavement (Figures 6-II.12 to 6-II.15). The layer can vary considerably, sometimes being densely clustered (rock-to-rock with little space between stones) and other times sparsely clustered (space between stones). In some cases, the pavement appears meticulously constructed while at other times it seems hastily made or a fortuitous byproduct of cooking and clean-out episodes. Most seem to have been originally constructed either on the ground surface or in a shallow basin.

Although pavement hearths have distinct characteristics, they can be highly variable in shape and size. Out of a data subset of 487 intact hearths where shape was recorded, the vast majority were circular (60 percent) or oval (25 percent). However, demonstrating the range of diversity, 5 percent were square, 2 percent were arcuate, and 7 percent were amorphous.

Pavement hearths average around 1 m in diameter. However, they can range from 50 cm to more than 3 m in maximum diameter. A subset of the project data are comprised of 484 intact pavement hearths for which there are tabulated maximum size ranges (Table 6-II.10 and Figure 6-II.16). Based on this breakdown, most pavement hearths (25 percent) fall into the 100-125 cm range and 61 percent fall between 76 and 150 cm. Only about 12 percent of hearths are larger than 200 cm.

Among the most intact examples of pavement hearths are those mostly buried or well embedded in the ground surface where, at times, the sediment between the stones is densely packed, carbon stained,

Table 6-II.9 Summary of Hearth Types Recorded During the Project.

All Seasons		
Type	Count	% Of Total
Hearths	4,883	73.59%
Remnants	1,752	26.41%
Total	6,635	100.00%

2005-2010 Subset		
Type	Count	% Of Total
Pavement style	2,373	73.97%
Ring style	406	12.66%
Cobble lined style	312	9.73%
Unspecified	117	3.65%
Total	3,208	100.00%

and replete with charcoal flecks or chunks. More commonly, however, pavement hearths reside on the surface with little or no sediment between rocks. Even in these cases, however, charcoal or carbon stained sediment is often present beneath the hearthstones. Excavation of several features in the Big Bend region indicate they are commonly only one or two courses deep and underlain by a subtle basin lined with oxidized soil.

Feature 1 at BIBE2105 is exemplary of a well-defined pavement hearth (Figure 6-II.17). The feature is exposed along the upper edge of a drainage cutbank, so some of the subsurface portion is visible. While some of the feature has been degraded by stream erosion, the remaining elements are well articulated. It measures 360 cm along the edge of the erosional cut, and there are roughly 300 stones visible and heavily embedded (5–10 cm in depth) in the ground surface. Fire cracked rock is made up of both igneous and sedimentary stones ranging from 5–30 cm in maximum dimension. Approximately 50 percent of the stones are fire cracked, some with in-situ cracking. Charcoal flecks, chunks, and carbon staining are visible amidst the stones. The cutbank exposure shows a slight depression near the center of the feature, suggesting that the fire was constructed in a shallow basin.

Analytical discussions in Chapter 7 address distributions of pavement hearths, inferred temporal ranges, and possible artifact/feature associations. These discussions demonstrate that pavement hearths are among the most ubiquitous prehistoric features documented in the park, attesting to their importance in prehistoric lifeways.

Ring Hearths

Ring hearths, although second in abundance, accounted for only 13 percent of the total recorded (n=406).

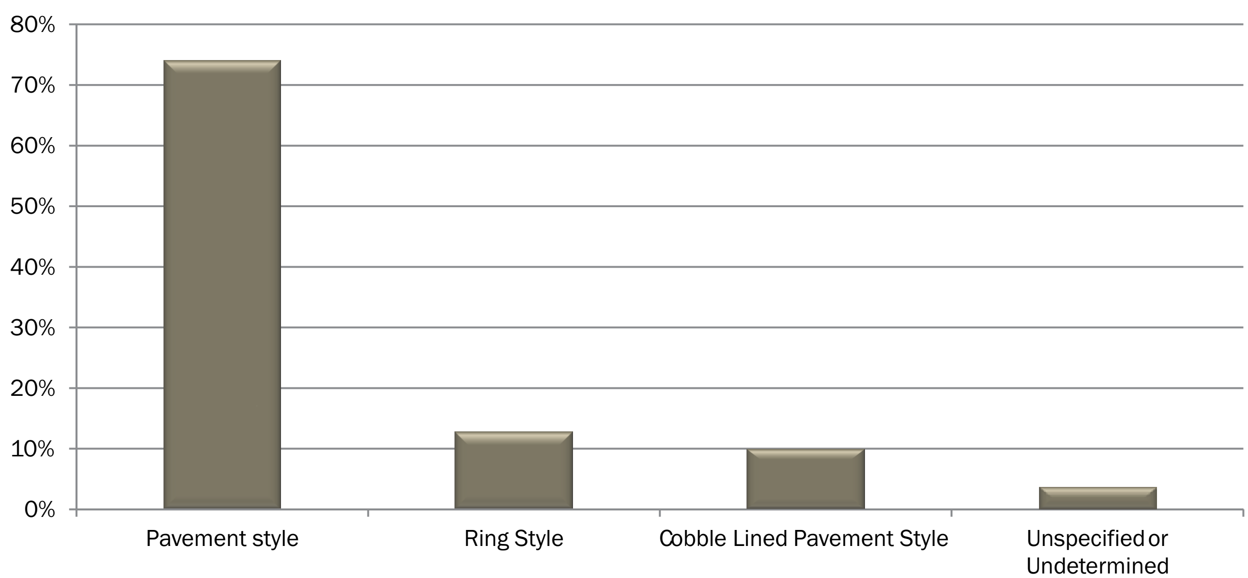


Figure 6-II.11 Percent of total hearths from 2005–2010 data subset.

Figure 6-II.12 Pedestaled pavement hearth at BIBE2203 (41BS2085). Photo by K. Baer.

Figure 6-II.13 Eroding pavement hearth at BIBE1792 (41BS1724). Photo by A. Baker.

Figure 6-II.14 Unique pavement hearth composed solely of limestone at BIBE2203 (41BS2085). Photo by B. Dailey.

These hearths are characterized by an open ring of stones, a circular arrangement around a central void (Figures 6-II.18 and 6-II.19). Significantly, the name refers to their surficial appearance only. Although it is surmised that these are usually basin shaped below ground, lacking excavation data, their subsurface nature remains unknown.

A subset of the project data are comprised of 333 ring hearths for which there are tabulated maximum size ranges (Table 6-II.11 and Figure 6-II.20). Although very similar in dimension to pavement hearths with the highest percentage in the 101–125 cm range (24 percent), there is a higher percentage of ring hearths in the 176–250 cm range (23 percent) compared to pavement hearths in the same range (18 percent). Still, most ring hearths fall within the 101–125 cm range and nearly 60 percent fall between 76 and 150 cm.

Considering that many observations are based on surface manifestations, ring hearths may actually represent several different types of cooking features. At BIBE2358, for example, what normally would have been interpreted as a ring hearth actually appears to be a small earth oven (Figure 6-II.21 and 6-II.22). Very well defined and intact, the feature consists of a 2.5 m diameter ring of stones with a central depression, suggesting it had been emptied of its contents but had not yet silted in. Had the feature been older

Figure 6-II.15 Robust, eroded pavement hearths composed primarily of limestone cobbles at BIBE1859 (41BS1785). Photo by B. Dailey.

Three unusually well-defined and intact ring style hearths were documented at BIBE1942. These features were atypical, however, because their perimeters were formed of tabular stones set on end and tilted slightly outward, suggesting a subsurface pit or basin. Feature 20, the most intact of the three, consists of a ring of embedded cobbles (33 visible) with a central void measuring about 80 cm in maximum diameter (Figure 6-II.23). The stones range in size from 3 to 19 cm maximum diameter, a small number of which are fire cracked. Because of the unique construction characteristics and level of intactness, charcoal from this feature was sent for analysis returning a calibrated radiocarbon date of A.D. 130–260, near the middle portion of the Late Archaic (see Appendix 8, Project Special Studies).

(or deposition had been more pronounced), its appearance would have placed it squarely within the ring hearth category. Consequently, because ring hearths often extend below the surface (out of view), as a formal type it remains problematic.

Cobble-Lined Pavement Hearths

Cobble-lined pavement (CLP) hearths consist of a pavement of stones (typically thermally fractured) surrounded or hemmed in by a ring of larger cobbles that are often unfractured (Figures 6-II.24 to 6.II.26).

Table 6-II.10 Size Range of Pavement Hearths.

Max Diameter	# Hearths	% of Total
0–50 cm	3	0.62%
51–75 cm	18	3.72%
76–100 cm	70	14.46%
101–125 cm	122	25.21%
126–150 cm	101	20.87%
151–175 cm	65	13.43%
176–200 cm	48	9.92%
201–225 cm	35	7.23%
226–250 cm	6	1.24%
251–275 cm	5	1.03%
276–300 cm	4	0.83%
>300 cm	7	1.45%
Total	484	100.00%

Note: Tabulation is derived from a subset of the project data.

In a few cases, the perimeter ring is formed of a different rock type than the interior stones. Cobble-lines pavement hearths were the least common hearth encountered of the three formal types, accounting for only about 10 percent of the total (n=312). However, because they were not recognized as a formal type until late in the project, this number is certainly skewed. First recognized and noted early in 2006, the type was not formalized until later that year with "typesites" BIBE1844 and BIBE1873. After that time, this hearth style was observed fairly regularly. A subset of the project data are comprised of 45 cobble-lined pavement hearths for which there are tabulated maximum size ranges (Table 6-II.12 and Figure 6-II.27).

The data indicates that, with respect to size, CLP hearths display less variability than the other hearth types, with the majority of CLP hearths clustered around the mean. Thus, 36 percent of CLP hearths fall in the 151–175 cm range, demonstrating that—on average—these hearths tend to be slightly larger than pavement or ring style hearths. In fact, a full 78 percent of CLP hearths fall within the 126 cm to 200 cm size range showing only small percentages on the fringes of the size classes.

Feature 2 at typesite BIBE1873 is exemplary (Figure 6-II.28). The hearth is comprised of roughly 50 pieces of FCR and measures 150 cm in diameter. Large, water-rounded cobbles between 15–30 cm in maximum dimension form the outer ring whereas smaller, 6–20 cm stones fill the interior of the ring—some of which appear to be part of the natural desert pavement and

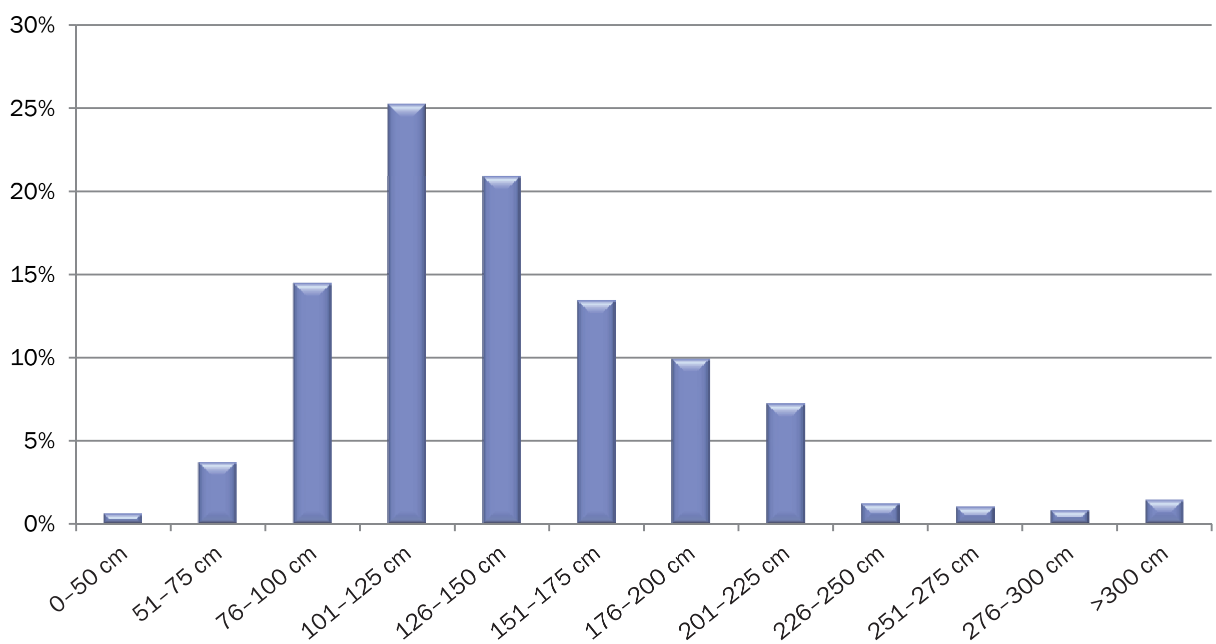


Figure 6-II.16 Size range of pavement hearths.

Figure 6-II.17 Pavement hearth bisected by drainage at BIBE2105 (no trinomial). Photo by K. Baer.

Figure 6-II.18 Ring hearth composed of limestone cobbles at BIBE1647 (41BS1580). Photo by D. Keller.

Figure 6-II.19 Barely exposed ring hearth at BIBE1782 (41BS1714). Photo by C. Covington.

some of which are distinctly FCR. Interior FCR is moderately embedded in the ground surface, but the outer ring of stones is mostly surficial or minimally embedded. No carbon was observed amidst the feature stones.

Because of their distinctive morphology and relative scarcity, CLP hearths are unique in the BBNP archeological record. Possible artifact associations and feature distributions discussed in Chapter 7 suggest that CLPs may be mostly an Early Archaic phenomenon. If so, then CLP hearths may be the only hearth type in BBNP with temporally diagnostic capabilities.

Paired Hearths

Numerous sites recorded during the project contained closely spaced or joined hearth features, often referred

Table 6-II.11 Size Range of Ring Hearths.

Max Diameter	# Hearths	% of Total
0–50 cm	2	0.60%
51–75 cm	20	6.01%
76–100 cm	54	16.22%
101–125 cm	81	24.32%
126–150 cm	57	17.12%
151–175 cm	34	10.21%
176–200 cm	42	12.61%
201–225 cm	26	7.81%
226–250 cm	8	2.40%
251–275 cm	3	0.90%
276–300 cm	4	1.20%
>300 cm	2	0.60%
Total	333	100.00%

Note: Tabulation is derived from a subset of the project data.

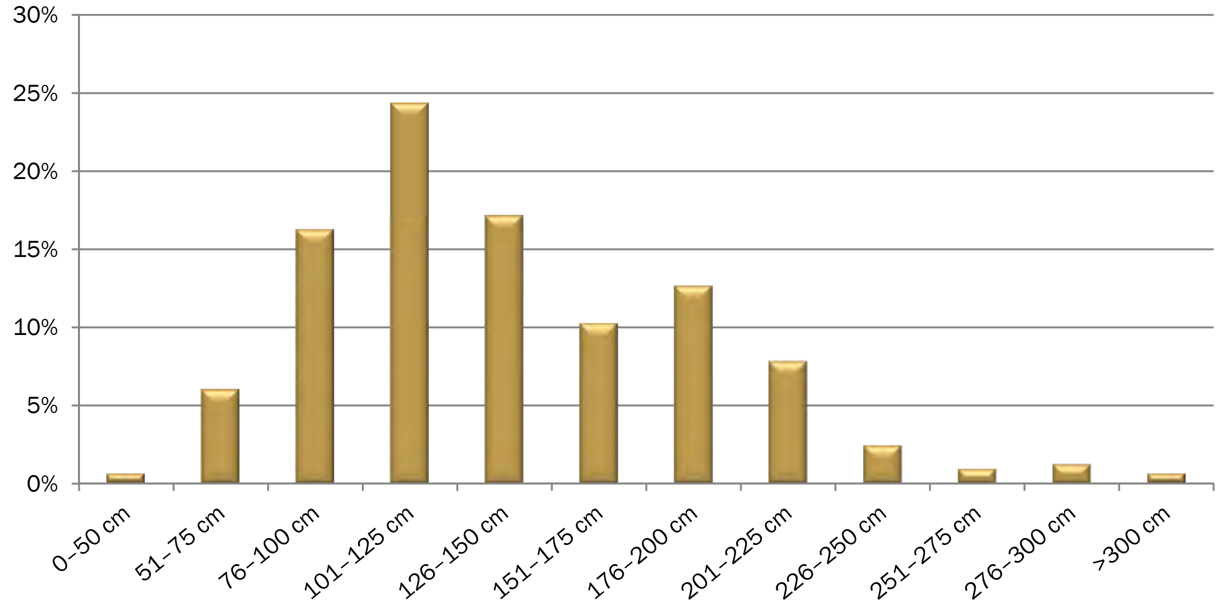


Figure 6-II.20 Size range of ring hearths.

to in the field as compound or paired hearths (Figure 6-II.29). Such features at BIBE1369 are exemplary in this regard. The central focus of the site is a pair of robust pavement hearths, both very intact and nearly joined along their perimeters. The dense and continuous pavement of cobbles in each hearth suggested they may have been used as "roasting platforms." Each measures approximately 300 cm across and each is comprised of a roughly 20 cm thick pavement of stones. BIBE1205 has two compound hearth arrangements. Feature 14 is comprised of two ring hearths joined along their perimeters, one measuring 90 x 170 cm and the second measuring 80 x 90cm. Feature 15 is an arrangement of three ring hearths, measuring 80 cm, 75 cm, and 50 cm across, respectively.

BIBE2567 also contains two sets of paired hearths—one pair consisting of 1 ring style and 1 pavement style hearth, 200 cm and 150 cm in maximum dimension, respectively, set side by side. The second pair consist of two ring style hearths, both measuring 200 cm in maximum diameter. The function of these hearth pairings is poorly understood but is believed to represent different types of food processing—possibly two processes for a single type of food item.

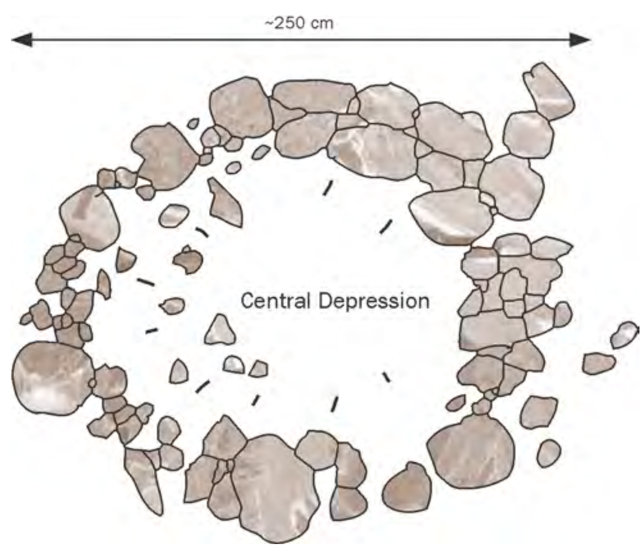


Figure 6-II.21 Field sketch of ring hearth or earth oven at BIBE2358 (no trinomial) by D. Keller. Illustration by L. Wetterauer.

Hearth Remnants

Hearth remnants (n=1,752 out of 6,635 hearths and hearth remnants for the entire project) account for 26 percent of the total number of hearths and remnants recorded. These are usually characterized as accumulations of FCR and (sometimes) carbon staining and

Table 6-II.12 Size Range of Cobble Lined Pavement Hearths.

Max Diameter	# Hearths	% of Total
51–75 cm	1	2.22%
76–100 cm	2	4.44%
101–125 cm	5	11.11%
126–150 cm	9	20.00%
151–175 cm	16	35.56%
176–200 cm	10	22.22%
201–225 cm	0	0.00%
226–250 cm	1	2.22%
251–275 cm	1	2.22%
Total	45	100.00%

Note: Tabulation is derived from a subset of the project data.

charcoal. Hearth remnants retain enough integrity to be identified as hearths, but not enough to justify recording metric attributes. They usually represent disarticulated hearths—most often due to erosion (sheetwash). During the project, these were synonymous with eroded hearths.

Middens

The term "midden" has a variety of meanings and connotations in the archeological literature, but is most often used to describe debris accumulated as a byproduct of cultural activities. As such, middens are the material leftovers from a variety of cultural processes. However,

Figure 6-II.22 Ring hearth or possible earth oven at BIBE2358 (no trinomial). Photo by R. Freer.

Figure 6-II.23 Unique "tilted cobble" ring hearth at BIBE1942 (41BS1868), dated to ca. A.D. 225, the later part of the Late Archaic period. Photo by L. Weingarten.

Figure 6-II.24 Cobble lined pavement hearth at BIBE2350 (41BS2275). Photo by C. Covington.

Figure 6-II.25 Cobble lined pavement hearth at BIBE2271 (41BS2147). Photo by A. Meade.

Figure 6-II.26 Cobble lined pavement hearth at BIBE2215 (41BS2097). Photo by D. Keller.

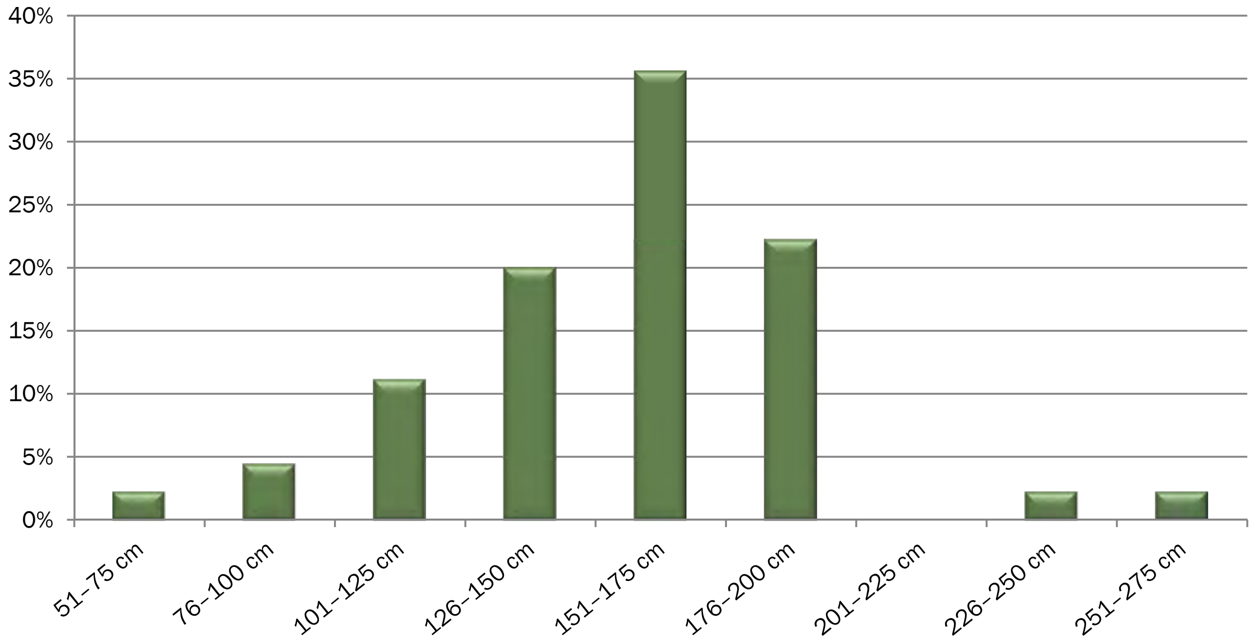


Figure 6-II.27 Size range of cobble lined pavement hearths.

Figure 6-II.28 Cobble lined pavement hearth at type-site BIBE1873 (41BS1799). Photo by J. Moretti.

Figure 6-II.29 Paired hearths at BIBE2674 (41BS2385). Photo by S. Cason.

in the larger West Texas region, two broad categories of middens are relevant, and both are present in BBNP.

The first broad category is the **debris-midden—**an accumulation of diverse cultural materials resulting from prolonged and/or repeated occupation. The contents of these middens typically include FCR, carbon-stained sediment, debitage, tools and tool fragments, and bone. Debris middens are synonymous with refuse piles, either from successive overlapping activities or from cleanout episodes where waste materials are deposited to maintain a habitation area. Debris middens are most common in long-term residential camps, and the diversity of materials and tool forms can be used as proxy measures of the duration of occupation. Robust deposits with a variety of tools are conventionally regarded as hallmarks of long-term base camps although repeated short-term occupations can conceivably produce similar deposits. These kinds of middens are present in BBNP, but they were not tabulated as such in the project dataset. Most often, these were subsumed within the "sheet midden" category. Consequently, the exact number of debris-middens is not known.

The second broad category, the **burned-rock midden**, is comprised of accumulations of FCR often accompanied by carbon stained soil (see Black et. al 1997 and Greer 1965). These are most often the remnants of hearths, earth ovens, and/or roasting pits. Various typologies for these rock middens have been employed (Greer 1965), but not without some difficulty.

Rock middens can be the cumulative aggregation of FCR as activity areas and other features (i.e., hearths) are scattered, mixed, and conflated (also often referred to as "sheet middens" in the dataset). Rock middens may also represent the final expression of a discrete, well ordered activity or process, where, rather than a pile of trash, the midden is itself the remains of a feature or site appliance such as a roasting pit or earth oven.

The term burned rock midden is typically associated with the robust features specific to Central Texas that generally appear as a massive, mounded pile of FCR mixed within a matrix of heavily carbon stained soil. Burned rock middens in Central Texas may measure 5–20 m in diameter and 1–3 m in height, and are the result of repeated subsistence activities that form distinct, robust, and high profile features on the landscape. While the term "burned rock midden" has sometimes been applied to features in BBNP, some consider those inappropriate usages of the term because massive mounded middens without central depressions are not known to exist in the park.

During the present project, debris middens and rock middens were not distinguished as such. Instead, middens were categorized either as "ring middens" or "sheet middens." Because ring middens are the remains of earth ovens, the two terms were used interchangeably in the project, depending on the degree of intactness and, often, the amount of reuse. While ring middens are very specific feature types, sheet middens are not, and can be either debris middens or FCR middens that occur in amorphous "sheet-like" deposits (as opposed to a mounded deposit, or one that displays marked morphology like the ring midden).

Out of the 1,473 prehistoric sites recorded during the project, 129 contained prehistoric middens. Within these 129 sites were a total of 212 midden features, 122 of which were recorded as ring middens and 90 of which were recorded as sheet middens (Table 6-II.13).

Table 6-II.13 Midden Features Documented During the Project.

Ring Middens Total	122
Sheet Middens Total	90
Middens Total	212

Ring Middens

A total of 122 ring middens were recorded at 70 sites during the project. The term "ring midden" is a morphologically based term for a fairly uncommon feature type in the park. Ring middens are comprised of a band of dense FCR encircling a central void or depression (Figure 6-II.30). The central portion of the ring midden may be either devoid of stones and /or appear as a depression.

Archeological investigations in adjoining regions have demonstrated that ring middens are typically the surface expression of a distinct type of earth oven (Black et al. 1997; Roberts 2011), where pits are filled with alternating layers of hot rocks, insulating material, and food items before being capped with a layer of earth. After as much as 48 hours of cooking, the foodstuffs are removed for further processing or consumption. The clean-out debris (fire-cracked rock) accumulates around the perimeter of the pit resulting in the ring-shaped formation. The resulting shape gives rise to the morphological classifications used during the project, such as "ring midden" and "annular midden," as well as "crescent midden" when the ring is only partial.

Elsewhere in the greater Big Bend and adjacent regions—particularly the Stockton Plateau and Guadalupe Mountains—ring middens occur as massive mounds of FCR, at times 10 m across and 1 m high, with a prominent pit depression in its center resembling volcano-like cones. With a few notable exceptions, however, ring middens in BBNP are typically composed of less FCR and are not mounded substantially above the ground surface. Instead of a deep crater in a mound, they are often formed of a band of FCR surrounding a void with fewer stones or no stones at all. Although there are instances where the ring is slightly mounded, rings more than 50 cm above the surface are rare. These more modest rings are sometimes referred to as "incipient" ring middens, meaning "not yet fully formed." However, because locally this form is more the norm than the exception

Figure 6-II.30 Ring midden at BIBE775 (41BS307); crewmember at left standing in central void. Photo by K. Baer.

(and may be the "final product" as opposed to an incomplete one), the term may not be completely accurate.

Features from two sites are exemplary. Feature 1 at BIBE2487 is a ring midden on a gravel terrace (Figure 6-II.31). Its outer diameter measures 8 m, and its inner diameter measures 4 m across. It is formed of hundreds of stones, both igneous and sedimentary, which range between roughly 5 to 17 cm in maximum dimension. The stones appear to be roughly 80–90 percent fractured and are moderately embedded in the ground surface. Carbon staining is evident in the sediment between FCR. Overall, the feature retains strong archeological integrity. At BIBE2433, Feature 1 is a crescent midden with an exterior dimension measuring 14 m north-south by 18 m east-west. The central void of stones measures roughly 6 m north-south by 5 m east-west. It is comprised of thousands of pieces of both igneous and sedimentary FCR that range from 5 to 15 cm in maximum dimension. The stones are heavily fractured and moderately embedded in ashy sediment. Several flakes and a single mano fragment were discovered amidst the feature stones.

Sheet Middens

A total of 90 sheet middens were recorded in 82 sites during the project. Sheet middens, sometimes recorded as "FCR middens" or "midden deposits," are

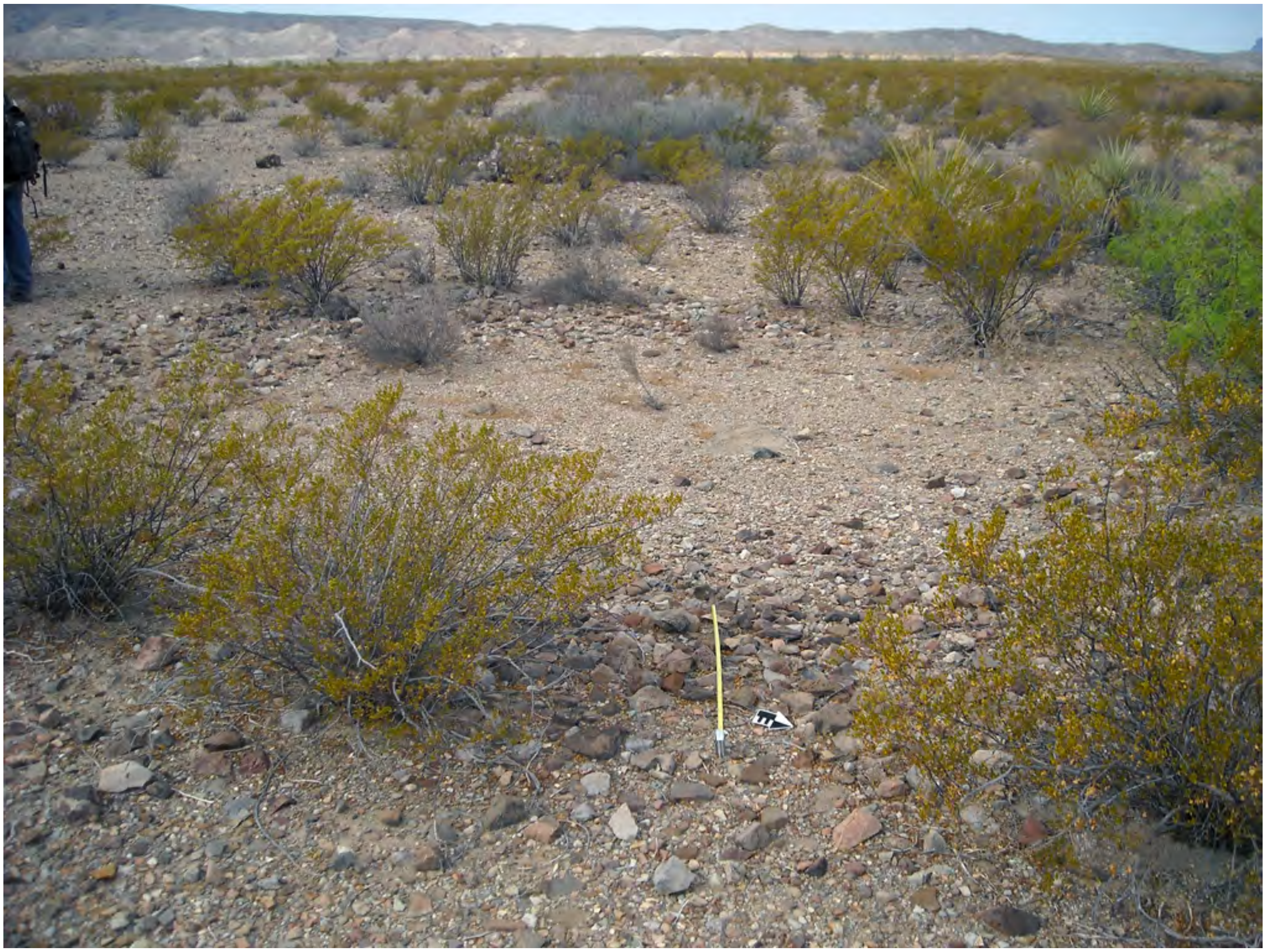


Figure 6-II.31 Ring midden at BIBE2487 (no trinomial). Photo by D. Petrey.

amorphous and poorly defined features comprised of a broad scatter of cultural debris (mostly FCR) that covers the ground surface with varying density—either a rock-to-rock pavement-like coverage, or more dispersed with some spacing between stones (Figure 6-II.32). Such middens may be as small as 3 m across, or they may cover areas totaling several ac encompassing better preserved hearths and other feature types. Carbon stained sediment is a common constituent of these features, though not in every instance.

The formational processes behind sheet middens can be complex and differ from site to site. In many cases one or more thermal features have been displaced and scattered, or multiple features have been scattered and conflated. Regardless, the morphology of the original feature(s) has been obliterated and, as a result, sheet middens often have little research value unto themselves since the cultural material therein retains little spatial integrity. However, sheet middens can provide clues about intensity, duration, or repetitiveness of occupations as well as possibly indicate the temporal range of occupation. They also often provide insight into post-occupational taphonomic processes.

FCR Concentrations and Scatters

Fire-cracked rock concentrations and fire-cracked rock scatters were among the most frequently documented

Figure 6-II.32 Sheet midden at BIBE2684 (41BS2420). Photo by A. Baker.

archeological features during the survey. Some 1,213 concentrations and scatters were recorded at 535 sites. Actually feature remnants rather than intact features, these terms refer the lowest degree of thermal feature integrity. (The hierarchy—from most intact to least—consists of intact hearths, hearth remnants, FCR concentrations, and FCR scatters.) Whereas a hearth remnant retains enough integrity to be distinguished as a hearth, the term "FCR concentration" indicates the feature type is no longer discernible, but the FCR is in a discrete enough pattern to still recognize it as an individual feature. Fire-cracked rock scatters, on the other hand, are no longer discrete and may be merged with other dispersed features; most rocks are more than 10 cm apart. As FCR scatters merge with others, they begin to form sheet middens. Because of their degraded nature, these feature remains have little current research value beyond being indications that prehistoric activities had taken place. Documentation was usually limited to taking a location and noting its spatial extent.

Carbon Stains

Carbon stained sediment refer to stains and smears of carbon and deteriorated charcoal discovered on the surface of sites, predominantly prehistoric, and which represent the residue of features or occupation events. When carbon stains are discrete and bounded, they likely represent rock-less hearths or fires. Unbounded, large, and amorphous examples are more difficult to interpret although in some instances they may be analogous to debris middens but without the rock elements. When discrete, these features were noted, but were not systematically tabulated in the BBNP dataset, largely because of their scarcity.

Buried Thermal Features

Buried thermal features are not a class of thermal feature so much as the context in which they are found. Nevertheless, features in a buried context often have the potential to retain spatial integrity far better than surface sites, and, thus, are worthy of mention. Such features are a product of aggradation and deposition, most often through alluvial, eolian, and to a lesser extent, colluvial geomorphic processes. When buried as a result of slow-moving, low-energy depositional events, the preservation can be outstanding. However, because these same processes can also displace archeological materials and disrupt the patterning of artifacts and features, the mere presence of buried deposits does not necessarily equate with archeological integrity. Consequently, the 27 sites listed in Table 6-II.14 are considered to have the potential to yield useful information based on the presence of subsurface features, but testing is needed to determine if these features are intact and informative. Although more buried features were documented than are presented in the table, these make up a representative majority.

Table 6-II.14 Select Sites with Buried Archeological Features.

Bibe	Description
246	Buried hearths and deposits
415	Six buried hearths in arroyo as deep as 1.6 m
418	Numerous thermal features eroding from low dune slopes
1003	Hearth remnant in cutbank 40 cm below surface
1262	Hearth in cutbank 1 m below surface
1738	Thermal Features eroding from dunes
1841	Buried hearths eroding out of gully
1842	Charcoal bed eroding out of cutbank
1881	Barely exposed hearths; additional shallowly buried features very likely
1891	Hearths exposed in cutbank
1909	Three buried hearths as deep as 2.3 m below surface on river terrace
1910	Buried stratified thermal features on river terrace
1942	Historic and deep, presumed prehistoric, thermal features
1975	Buried hearth
1982	Buried charcoal feature
2433	Fully buried exposures of carbon and charcoal stained sediment, partially buried hearths
2448	FCR and debitage exposed 45 cm below surface on terrace cutbank
2450	Hearth 20 cmbs on terrace cutbank
2458	Buried and eroded thermal features and carbon stains
2486	Partially buried hearth remnant in gully
2494	Possible buried hearth
2531	Hearth on surface with middle archaic dart point and debitage, appears to have been buried and recently exposed
2632	Buried hearth 60 cm below surface on terrace edge
2639	Hearth exposed on cutbank 30 cm below surface
2764	Two buried thermal feature remnants
2765	One buried thermal feature remnant
2768	Two buried hearths exposed in arroyo cuts as deep as 30 cm below surface

Sites not listed in the table include instances where surficial features extend below ground such as where hearths and middens are visible on the surface, but the majority of their mass (FCR, carbon, and feature matrix) is below the surface. As such, they cannot accurately be described as buried. So although these features have strong research potential, the living surface or activity areas around them may be eroded causing materials from successive occupations to be mixed. Nonetheless, such features retain good research potential, allowing the recovery of charcoal and matrix samples, and examination of the relationship between features and associated temporal diagnostics.

Because alluvial processes are frequently the source of deposition, buried features are most often exposed in the walls of gullies and arroyos along drainages. Alluvial deposits range from massive river terraces along the Rio Grande (Figure 6-II.33), to 3–4 m tall vertical arroyo walls along intermittent tributaries (such as Tornillo Creek) and even smaller arroyos and gullies along lesser drainages such as Oak Creek and Cottonwood Creek. These stream channels and adjacent terrace deposits are often situated within larger alluvial plains (e.g., along the Rio Grande floodplain), or they are amidst channel systems on alluvial fans emanating from higher mountain settings (e.g., the Tornillo Creek and Rough Spring blocks).

Figure 6-II.33 Bobby Gray pointing to deeply buried deposits at BIBE1942 (41BS1868). Photo by L. Weingarten.

Although the deepest buried features discovered were roughly 2.3 m below the surface, most tended to be buried no more than 1 m deep. Only in one instance were clearly stratified deposits evident (BIBE1910). In most cases, however, buried thermal features occur singularly, or in discontinuous exposures at various elevations.

Accumulations of windblown silt and sand are much less common in the park than alluvial sediment, although sand and silt dunes do occur in select settings, mostly along the Rio Grande corridor. Where such dunes do occur, they typically contain sites. The Lone Dune site (BIBE418), the Shale Dune site (BIBE1655), and the Rio Grande Dune site (BIBE1738) all contained archeological features and occupation debris eroding from eolian deposits (Figure 6-II.34). In all of these cases, evidence of repeated occupations reveals the preference given these sites by prehistoric people. Despite often abundant features and artifactual remains, however, the ever shifting dunes—constantly burying and re-exposing features and artifacts—often serve to confuse the archeological record, making interpretation of these sites difficult.

Some sites, such as BIBE246, present an interesting combination of depositional processes. In this case, thermal features and occupational debris are buried in

Figure 6-II.34 Archeological deposits eroding out of stabilized sand dunes at BIBE1738 (no trinomial). Photo by C. Covington.

narrow valleys on either side of a long cuesta. Eolian sands are captured on the leeward side of the ridge whereas colluvial debris from the ridge slope is deposited between the slope and the cuesta.

Stone Enclosures

A total of 254 stone enclosures were recorded in 89 sites during the survey (Table 6-II.15). In BBNP, stone enclosure is perhaps the broadest category of prehistoric structures. The term encompasses a great deal of morphological and functional variability, and captures the vast majority of prehistoric structures. Based on ethnographic examples and similar features in surrounding regions, most of the structures are believed to be the basal portion of thatch- or hide-covered structures (wickiups and tipis). The following section addresses subsets of the stone enclosure category, all of which share some important attributes. For one, they are all formed of rocks arranged to create or support a structure either as a foundation element or parts of walls. Second, they occur as one or more courses of stone, but never so high as to form an entire wall; they typically form the base or lower 50–80 cm of a foundation or footing. Twelve stone enclosures were randomly selected from the GIS dataset, and their maximum dimensions tabulated. Among those sampled, the smallest was 87 cm across, the largest was 506 cm across, and the average was 289 cm across.

Stone enclosures documented during the project were typically round or U-shaped in plan view, but there were also examples of square, rectangular, and odd polygon shapes. Many were constructed opportunistically against existing boulders or bedrock exposures. Stone enclosures occur as isolated structures, small groupings of two to four features, or as complexes of village-like arrangements. They are almost always individual stand-alone features although there are examples of adjacent/conjoined enclosures and one rare example of a multi-structure complex with adjoining walls.

Stone enclosures are often situated on the crest of plateaus or elevated landforms with considerable viewsheds, in which case they are often interpreted as "special use" features that could have served as vision quest sites, lookouts, or as defensive structures, (see Special Use below). Stone enclosures are also found amidst boulder fields, on mid-elevation benches, and other settings although they rarely occur on lower alluvial flats.

Table 6-II.15 Count of Stone Enclosures in the BBNP Dataset.

Stone Enclosure	Wickiup	Cielo	Tipi Ring	Total
85	83	58	28	254

Because construction of prehistoric structures requires a considerable investment of energy, they are often thought to represent longer-term encampments or base camps—locations of extended residential activities. Along with rock and boulder shelters, stone enclosures round out examples of prehistoric "houses" in the BBNP dataset. However, these feature types likely represent more complex behavior than is presently understood, and display considerable diversity over time and space (see Mallouf 1999; Seymour 2008; and Seymour and Harlan 2012 for examples of structural diversity in the Trans-Pecos).

The temporal range of stone enclosures in the region is poorly understood. However, based on survey data in the park and excavation data outside it, there is evidence that such structures may have been used since at least the Late Archaic, and most likely long before. Research into the Cielo complex (Mallouf 1999) has demonstrated that at least one variety of stone enclosure was an element of a distinct sociocultural group during the Late Prehistoric period (see earlier discussions in Culture History and Stacked Stone Enclosures below).

Single-Course Enclosures

Single-course or *single-tier* enclosures are a morphological variant where stones are arranged in a single continuous or discontinuous layer, rather than stacked multiple courses high. Single course enclosures may represent tipi rings, wickiups, ramadas, or other forms of aboriginal architecture. Enclosures were typically classified as tipi rings when they exhibited continuous, symmetrical rings, or when the ring was exceedingly large (roughly larger than 4.5 m across; Figure 6-II.35). Smaller enclosures were usually classified as wickiup rings.

In a subset of the project data that tabulated metric data on such enclosures (2007–2010 Mobile Mapper GIS layer), 44 single course features are classified as either tipi rings (n=11) or single tier enclosures (n=33). The features ranged in size (outside to outside edge) from 2.14 m to 9.8 m in maximum diameter. The average size for single tier enclosures was 4.10 m whereas the average for tipi rings was 4.67 m.

Some single-course enclosures recorded during the project are believed to be the remains of crude shade shelters, or ramadas. Typically these are partial rings of stones (often half-rings) rather than complete rings—more crescent shaped than circular (Figures 6-II.36 and 6-II.37). Their morphology suggests a one-sided or partial shelter rather than a fully enclosed structure. In some instances (BIBE2346 and others in Block L), metates were found within these arcs, suggesting that the shelter was arranged around an activity area. Because prehistoric ramadas are not well documented in archeological or ethnohistoric literature in the study area, their nature and character remains speculative. However, a likely rectangular ramada feature was documented during excavations of a Cielo complex village at the Cielo Bravo site outside the national park

Figure 6-II.35 Probable tipi ring at BIBE2112 (41BS1994). Photo by K. Baer.

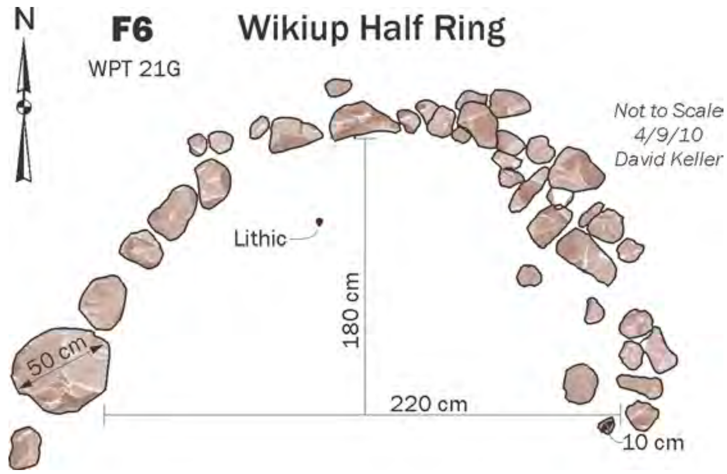


Figure 6-II.36 Field drawing of a half wickiup ring: Feature 6 at BIBE2664. Illustration by L. Wetterauer.

(Mallouf 1999:69). It is also likely that many more exist than have been recorded as they can easily be interpreted as wickiup rings that are simply incomplete.

Although most of these features likely represent prehistoric structures, a small number display unusual precision or symmetry in the placement of stones, suggesting other uses. For example, Feature 4 at BIBE2440 is a single tier enclosure that is atypical since the feature is unusually symmetrical, most of the stones are heavily embedded in the ground surface in an end-to-end arrangement, several of the stones are tilted vertically, and some of the stones ap-

Figure 6-II.37 Single course half circle stone enclosure at BIBE1713 (41BS1646). Photo by C. Covington.

pear too small to serve as structural elements (Figure 6-II.38). Similarly, Feature 1 at BIBE2537 is atypical because most of the tabular stones are embedded and vertically tilted (Figure 6-II.39). Again, the spacing and tilt of the stones suggests a non-utilitarian arrangement.

Stacked Stone Enclosures

The second major category of stone enclosures is the stacked stone enclosure. These features are distinguished by multiple courses of stone as opposed to a single course. They are typically round or oval, but like stone enclosures in general, they can utilize existing boulders or bedrock to create a wide variety of different shapes and configurations. There is considerable morphological diversity in this category, and metric descriptions are often complicated by their various states of preservation. Because the enclosures are almost always wider at the base than at the top, the upper courses often topple over time, making it difficult to record accurate interior-exterior measurements. Based on a sample of feature descriptions in the project dataset, the interior diameter of stacked stone enclosures typically range from 1 to 3 m, and exterior measurements range from 1.5 to 5 m across.

The type and size of stones vary significantly depending on the materials that are locally available. Workmanship can be equally variable. In some cases

Figure 6-II.38 Unusually symmetrical single course stone enclosure at BIBE2440 (no trinomial). Photo by C. Covington.

Figure 6-II.39 Vertically tilted slabs of stone enclosure at BIBE2537 (41BS2588). Photo by A. Baker.

irregular or rounded stones seem carelessly and hastily stacked, whereas at other times tabular or rectangular stones are laid almost like bricks to form neat orderly walls. Similar variation exists in other details—sometimes stones are laid flat on top of one another, at other times they are tilted like flatirons towards the interior space, and at others they are placed on end. While some of these differences may be functionally or culturally prescribed, it is important to note that they may also be products of individual preference.

Feature 3 at BIBE462 is an interesting example of a stacked stone feature that has several key characteristics (Figure 6-II.40). The interior measures roughly 2 m in diameter and the outer measures about 5.5 m across, (though toppled stones makes the latter measurement problematic). Portions of the inner wall are partially intact, and they are formed of tightly stacked and carefully laid tabular stones. Five to six courses remain intact. Stones along the outer ring are larger and more tabular than the interior stones. Several are tilted vertically along the outer wall. Additional large stones are scattered around the periphery of the feature. When the feature was intact, it is suspected the stone walls may have stood as much as 70 cm high. Sediment has accumulated inside the enclosure, and there is some subsurface archeological potential.

In most instances, circular stacked stone enclosures are believed to be wickiup foundations or footings, with the stones supporting poles that form the superstructure, itself covered with thatch, grass, or hides.

Figure 6-II.40 Carefully arranged tabular slabs of stone enclosure at BIBE246 (41BS2277). Photo by D. Petrey.

Photographs and descriptions from ethnological accounts provide ample evidence of the use of wickiups in the larger region (see Seymour 2009), although stacked rocks around the perimeter of such features are not often evident. However, because the construction and configuration of stacked stone structures was often opportunistic, taking advantages of locally available resources, we should expect that construction techniques would vary in different settings.

The Cielo complex is a Late Prehistoric cultural taxonomic unit considered to be a distinct cultural group in which structural remains form a key element. Cielo structures are stacked stone enclosures, typically 2–5 courses high, with well-defined entryways. Like other stone enclosures, these are believed to have formed the foundation for wickiups. Unlike other stone enclosures, however, these structures are the only ones in their class that serve as diagnostic indicators of a particular cultural complex. Although some Cielo sites have been documented where structures share walls in a nested complex or village-like arrangement, most sites attributed to the Cielo complex consist of fewer than three such structures, sometimes associated with hearths, middens, and artifacts scatters.

Despite their interpretive weight, Cielo complex sites and features are difficult to differentiate from the larger suite of structural sites without the unambiguous association of the material correlates of the phase, principally Perdiz arrow points and preforms, flake drills, unifacial end-scrapers and side-scrapers, and beveled bifacial knives (Mallouf 1999:60). Consequently, such sites are likely underrepresented in the project dataset. It is likely, however, that many stone enclosures in the project data set are Cielo complex but were not designated as such for lack of contextual evidence.

BIBE284 is an exception. On a bench overlooking the Rio Grande, this large (160 x 300 m) site consists of some 57 stone enclosures believed to be affiliated with the Cielo complex. Among the many enclosures are a number of morphological variants, including circular, U-shaped, rectilinear, single course, and multi-course stacked examples (Figure 6-II.41). Several features have joined or shared walls and possibly interior entryways between joined enclosures. Despite that many of the features do not fit neatly with classic Cielo complex structures and that some Archaic-aged artifacts were collected, the location along with the presence of Perdiz arrow points and the absence of ceramics suggest its Cielo complex affiliation.

Other Rock Features

Cairns

Rock cairns or simply "cairns" are ubiquitous cultural features consisting of a pile of stacked rocks two or more courses tall (Figure 6-II.42). They are usually roughly pyramidal in profile and round in plan view

Figure 6-II.41 Cielo complex structure at BIBE284 (no trinomial). Photo by W. Barrick.

although a variety of shapes and configurations have been documented.

Cairns are common archeological features worldwide, and their range of uses is similarly broad. Based on modern, historic, and ethnographic accounts we know cairns have been used as place and boundary markers, as navigational aids, to mark caches or memorialize events, to serve as guides in game drives, for use with ritual offerings, to mark or cover burials, and as elements of other larger features such as medicine wheels.

During the present project, cairns were documented in 103 prehistoric sites although they occurred more commonly as isolates (267 isolated cairns were recorded—see Isolates section). These cairns exhibited a wide range of morphological variability, from small piles of three or four small stones, to multi-course, carefully laid constructions over 1 m tall. Although in some cases it was easy to determine if a cairn was historic (NPS trail markers and USGS monuments among them), if historical evidence was lacking, its temporal affiliation could rarely be determined with confidence.

Despite this, many—if not most—of the cairns recorded during the survey were believed to be prehistoric. Although it is difficult to gauge the age of a cairn, a number of indicators were assessed including its level of definition, its degree of integrity, its depth of

Figure 6-II.42 Cairn (IC166). Photo by C. Covington.

embeddedness, its degree of weathering, the presence or absence of carbonate deposits, and, in some cases, the amount of lichen growth.

Rock Alignments, Rock Groupings, and Rock Clusters

Rock alignments, groupings, and clusters are in many ways similar to cairns but differ in some fundamental aspects. For one, these features almost always consist of a single layer of rock rather than multiple layers and exhibit a much broader range of configurations. Additionally, one of these categories (rock clusters) is a "catch all" category meant to embrace a broad array of forms. Although these feature types are abundant in BBNP, like cairns, they were most frequently recorded as isolates rather than within sites. Consequently, these are dealt with in detail—including examples of each—in Chapter 6-IV, devoted to isolates.

Rock alignments are defined as linear, or roughly linear, horizontal arrangement of rocks upon the ground. Alignments were documented on 111 sites during the project, both prehistoric and historic. Except in a few isolated cases, their temporal or functional affiliation remains unknown aside from what could be inferred from their archeological context. However, in some cases, rock alignments appeared to have prehistoric ceremonial or ritual functions; in one of these instances, this interpretation was bolstered by the discovery of a ceremonial dart point cache (see discussion below of petroforms). In other cases, alignments represented partial remains of historic structures, trails, or two track roads. In one case, at San Vicente (BIBE2030), a particular alignment was identified as children's "play corrals" based on an oral interview by the man who, as a child, constructed them. However, such insights are extremely rare and in most cases interpreting rock alignments remain problematic.

A "rock grouping" was a term used during the project to indicate a very specific feature type frequently encountered during the project. They are defined as an arrangement of three to six rocks, typically uniform in size (around 20-40 cm maximum diameter), in a loose grouping (usually within 20 cm of one another) that are not stacked. Although they can occur in a variety of settings, they were encountered most frequently in lowland settings, primarily along the gently sloping to flat surfaces of dissected pediments. They rarely, except by chance, appeared within sites. Consequently, these features were not systematically tallied as part of site inventories. Further discussion of these features is presented in the section on isolates.

A "rock cluster" was a term used during the project as a "catch-all" category for all other non-stacked (and non-thermal) rock features of unknown function. Consequently, rock clusters include a wide range of variability and occur both within and outside of sites. In most cases, they are simply conspicuous accumulations of rock with no other attributes to suggest function or affiliation. They generally appear to be remnants of features that were themselves ephemeral to begin with, such as a tent pole support, toppled cairn, or a disarticulated petroform. Ultimately, these are the most ambiguous features in the dataset. A total of 182 sites were recorded during the present project that contained rock clusters in one form or another. These are discussed further in the isolates section.

Special Use Features

Special use features are those that are associated with activities beyond domestic and subsistence-related tasks. In BBNP special use features include possible vision quest structures, possible lookouts, rock imagery, possible interments, redoubts, and fortifications.

Vision Quest Structures and Lookouts

Special use features suspected of being related to "vision quests," refer to Native American spiritual coming-of-age ceremonies documented in ethnological and contemporary accounts of peoples in North America and abroad. Eight sites recorded during the project have features suspected of being vision quest structures (Table 6-II.16). In all instances they are located on the summits of peaks, promontories, or ridges, and consist of one or more stone enclosures or alignments with minimal or no artifacts in their immediate vicinity and typically no other feature types.

The features at these sites are consistent with the expectations of vision quest activities—situated in high, isolated locations and having relatively small interiors (Figure 6-II.43). The immediate site settings are generally inhospitable yet command a sweeping vista of the surrounding terrain. These conditions, along with the difficult access and general absence of domestic items (such as debitage, FCR, or tools), suggest they may relate to ceremonial activities or observation.

Table 6-II.16 Possible Vision Quest Sites Documented During the Project.

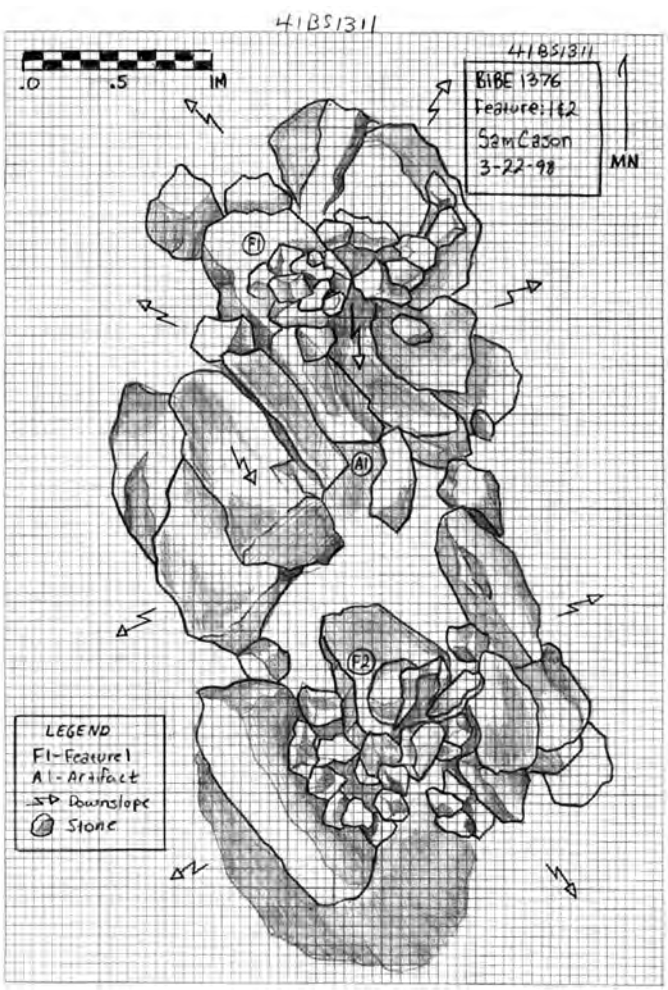
BIBE #	Features
1306	Five stacked stone walls
1344	Three partial stacked stone walls and outlying cairns
1376	Stacked stone wall and outlying cairn
1618	Stacked stone enclosure
2243	Single-course stone enclosure
2247	Stacked stone enclosure
2256	U-shaped stacked stone enclosure
2708	Four stacked stone enclosures

At least some of these features may be lookouts (i.e., for defense, hunting, or weather observations), rather than vision quest structures. In either case, the archeological footprint would be much the same.

Figure 6-II.43 Possible vision quest structure at BIBE989 (41BS2285). Photo by D. Hart.

Similar features in other regions (such as the northern Plains) have been identified by contemporary tribal leaders to be part of vision quest events. Because many of these consisted of several such features, it is plausible that sites containing multiple enclosures in the Big Bend may also be vision quest related, especially where artifacts or FCR indicative of subsistence or domestic activities are lacking.

At two exemplary sites, BIBE1618 and BIBE1376, the feature morphology and site setting is illustrative. Each site has a single structure that is relatively small, with interior diameters less than 1 m. At BIBE1618, the enclosure is roughly three rock courses tall and slightly U-shaped with the opening facing west. BIBE1376 contains a small diameter stonewall-like enclosure about 1.25 m across amidst jumbled boulders (Figure 6-II.44. Left: Illustration of possible vision quest structure at BIBE1376. Right: Topographic setting of structure at BIBE1376.-II.44). No artifacts were encountered at BIBE1618, and only a single flake was discovered amidst the enclosure at BIBE1376.



Rock Imagery

Rock imagery in BBNP is represented in a variety of forms including pictographs and petroglyphs, abraded lines and cupules, and petroforms.

Petroglyphs and Pictographs

Pictographs (rock paintings) and petroglyphs (rock peckings or carvings) in BBNP represent a variety of forms including anthropomorphic, zoomorphic, and abstract geometric designs as well as marks lacking definable patterns. These two main types of rock art are found in various settings across the park, and there are several striking examples including a pictograph

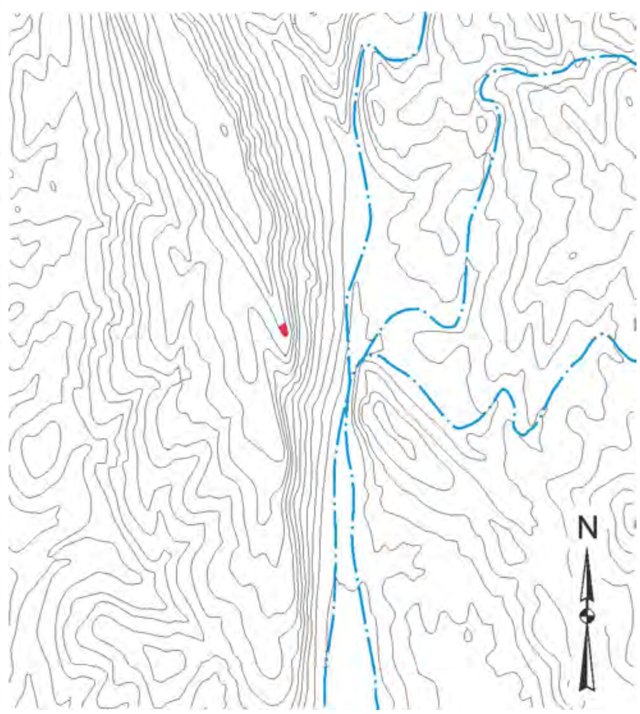


Figure 6-II.44 Left: Illustration of possible vision quest structure at BIBE1376. Top: Topographic setting of structure at BIBE1376.

Table 6-II.17 BBNP Sites Containing Pictographs and Petroglyphs Recorded During the Project.

BIBE	Type	Location	Description
246	Petroglyph	Rockshelter	Vertical incised parallel lines
608	Pictograph and petroglyph	Canyon walls	Vertical abraded lines, painted lines and boxes, painted connected diamonds
749	Pictograph	Rockshelter	Poorly defined painted images (multi-color); possibly images of birds, vulvas, Shumla-like points, feet/hands
952	Petroglyph	Boulder in rockshelter	Abundant curvilinear designs and abraded lines
1425	Pictograph and petroglyph	Rockshelter	Angular red lines (triangular) and abraded grooves
1428	Pictograph	Streamside bench	Numerous painted geometric designs, zig-zags, chained polygons in various colors
1446	Petroglyph	Rockshelter	Three pecked parallel lines
1829	Pictograph and petroglyph	Canyon walls	Black and red painted lines, light scratches
2472	Pictograph	Rockshelter	Handprints, lines and amorphous shapes in red pigment
2623	Petroglyph	Boulder	Etched grooves
2700	Pictograph	Rockshelter	Triangles, rectangles, zigzags, cross hatches in different colors

of a bison, a large boulder covered with hundreds of cupules and numerous vulva shapes, and an array of handprints amidst crowded geometric designs. However, relatively few of these features were observed during the survey, with only 11 sites documented as containing either type (Table 6-II.17). A total of seven sites contained pictographs (Figure 6-II.45) whereas only six sites contained petroglyphs (Figure 6-II.46). Most of these features are located within rockshelters, but they also occur on streamside terraces and canyon walls. Many of the rock art panels contain painted designs in various colors including red, orange, yellow and black. Petroglyphs were either abraded or pecked.

Figure 6-II.45 Pictograph at BIBE2700 (41BS2436). Photo by A. Baker.

Abraded Lines and Cupules

Abraded lines are simply linear grooves scratched into solid rock surfaces that most frequently occur on walls and boulders in rockshelters (Figure 6-II.47). Often many lines occur together in parallel groupings with fewer perpendicular crosscutting grooves (somewhat similar to hatch mark tallies). These are sometimes interpreted as utilitarian rather than symbolic features,

Figure 6-II.46 Petroglyph at BIBE974 (non-project site). Photo by D. Keller.

Figure 6-II.47 Abraded lines at BIBE246 (41BS2277). Photo by J. Nowak.

possibly to have served as a type of abrading surface. However, there are many instances where the vast numbers of grooves argue against such explanations. Consequently, abraded grooves are often classified as petroglyphs. Although abraded lines were documented at a number of sites, they were not systematically tallied.

Cupules are another form of rock imagery present in the national park, though none were observed at sites during the present project. These features consist of ground or pecked concavities, typically 5–10 cm in diameter and roughly symmetrical, resembling incipient mortar holes. Where they do occur, they are often found in abundance and often in the company of abraded lines—a pattern that suggests they may be related to some function beyond tool manufacturing or subsistence related activities. Some believe they may have been used for grinding pigments or seeds and herbs into medicine. The preponderance of evidence, however, suggests both utilitarian as well as ritual functions for these features.

Petroforms

Petroforms—patterns made by arranging stones on the ground surface—are fairly common in BBNP and across the Big Bend region where many examples exist of abstract, geometric, and representational (typically zoomorphic) designs. Strangely, with only one major exception, this feature type went unnoticed by archeologists (both in the park and region-wide) until this survey. Consequently, the formal recording of these features is one of the hallmarks of this project.

Functionally, petroforms are believed to relate to shamanism, ritualism, or for use as navigational aids. Although many sites contained rock alignments that could be considered petroforms, only nine sites are included here, representing those that are the best defined (Table 6-II.18). These petroforms consist of possible medicine wheels, linear alignments, and possible turtle effigies.

Two sites (BIBE1693 and BIBE1984) have features that are interpreted to be medicine wheels. Until the present survey, only one medicine wheel had ever been identified in BBNP. Known as "the spider," (BIBE195) this petroform was first discovered by homesteader J.O. Langford in 1932 and later relocated from an airplane by park archeologist Tom Alex in 1984 (Figure 6-II.48). The two medicine wheels discovered during this survey are distinct from each other and from the one at BIBE195. However, all are formed of multiple lines radiating outward from a central hub. All three features occur in isolation, lacking other feature types or clearly associated formal tools. One (BIBE1984) occurs

Table 6-II.18 Petroforms Recorded During the Project.

BIBE	Type	Description
1693	Possible medicine wheel	15 m maximum diameter, 1.5 m thick central mound with six spokes
1853	Alignment	V-shaped petroform consisting of intersecting serpentine lines
1984	Possible medicine wheel	Central ring with six spokes of irregular length and orientation; ancillary spokes as well; ca. 35 m max length
2294	Possible zoomorph	Stone circle, with alignments and clusters along its perimeter; suggestive of a turtle shape
2351	Possible zoomorph	Single course, crude circle with alignments and clusters along the perimeter; weakly suggests a turtle shape; roughly 250 cm in maximum diameter
2371	Alignment	Rock cluster with two "arms" oriented N–S; 23 m maximum diameter
2392	Possible medicine wheel	Crude circular rock cluster with two, possibly three radiating rock arrangements; 12 m maximum diameter
2399	Clusters and alignments	Series of three 1.5–2.5 m non-thermal rock features with vague morphology; clustering and peripheral linear arrangements suggest non-functional but representational configurations
2404	Alignment	Two linear rock arrangements, each with both disconnected and connected radial projections; 12 m and ca. 20 m maximum diameter

Figure 6-II.48 Medicine wheel known colloquially as "The Spider" (BIBE195). Photo by B. Dailey.

on a prominence overlooking the Rio Grande whereas BIBE1693 and the spider are located on slightly elevated landforms in lower terrain (Figure 6-II.49). Significantly, all three features occur in a 12 km diameter area, perhaps suggestive of similar cultural origins.

These features conform well to known types of medicine wheels, but they are far from other examples. In fact, until these discoveries, the famous Bighorn Medicine Wheel in Wyoming was believed to be the southernmost example of this feature type (Vickers 2005). Most reside on the Northwestern Plains of Montana and southern Alberta and Saskatchewan. To have such features this far south invites many questions, few of which we can answer.

Five project sites contain abstract petroforms, most typically involving linear stone alignments, some of which intersect or incorporate rock clusters. Among these, the petroform at BIBE 1853 stands out (Figure 6-II.50). It consists of a V-shaped rock alignment whose "legs" are formed by serpentine lines approximately 20 m in length. Significantly, the apex of this particular petroform "points" to what turned out to be a cache of 13 Middle Archaic projectiles (See Appendix 20). While the petroform at BIBE1853 is notably robust, sites more typically contain features that are not as well defined. At BIBE2404, for example, two separate features consist of a series of straight to serpentine discontinuous rock alignments that in many places blend into the natural gravels.

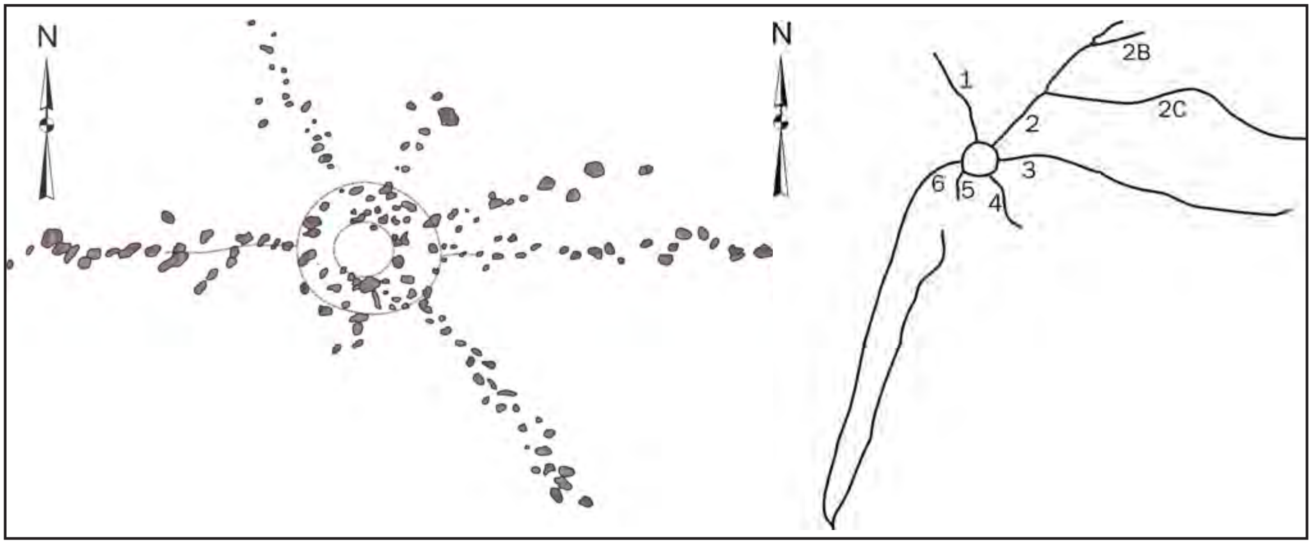


Figure 6-II.49 Field sketches of probable medicine wheels at BIBE1693 (left) and BIBE1984 by D. Keller. Illustrations by L. Wetterauer.

Two sites contain petroforms believed to be effigies, possibly representing turtles. BIBE2294, containing the more robust and better defined of the two petroforms, consists of a stone circle 3.5 m in maximum diameter with several short rock alignments projecting outward along its periphery, including one that extends to the northwest, terminating with a large rectangular stone that roughly resembles a turtle head (Figure 6-II.51). A smaller example has been found in Green Valley north of the park that leaves much less to the imagination (the "head rock" actually resembles a turtlehead). Although these features are only beginning to be recognized, as more are discovered, they will lend additional contextual support for this zoomorphic interpretation.

Figure 6-II.50 Serpentine rock alignment at BIBE1853 (41BS1779), the Lizard Hill site. Photo by B. Dailey.

Figure 6-II.51 Possible turtle effigy at BIBE2294 (41BS2170). Photo by C. Covington.

Interments and Possible Interments

The information in this section is on file at Big Bend National Park in Confidential Appendix 16. (Including Table 6-II.19 and Figures 6-II.52, 6-II.53, and 6-II.54.)

Redoubts and Fortifications

Five sites recorded during the project have features or attributes suggestive of a defensive posture (Table 6-II.20). In most instances, they consist of stone enclosures, stacked rock walls, or rock alignments on the edges of high landforms such as buttes or promontories. Defensive function is inferred in most cases in light of circumstantial or contextual considerations, where the landforms and associated natural features provide both a strategic viewshed and a means to control access. This is consistent with the interpretation of several Late Prehistoric Cielo complex sites documented by Mallouf (1999), where stacked stone features associated with the complex are presumed to be redoubts or fortifications. However, it is also possible that some of these features and sites may have been the result of other activities such as lookouts to spot game or for weather observations.

Both BIBE2528 and BIBE2739 are situated on small isolated buttes surrounded by vertical cliffs and, in both cases, the sole access point is fortified with stacked rock. In the latter site, head-sized boulders are arrayed along the upper edge of the cliff, as if in preparation to repel invaders (Figure 6-II.55). Both of these sites also have architectural features suggestive of Cielo complex wickiup rings, although there are virtually no artifacts on top of these landforms. This lack of domestic debris amidst architectural features suggests that each of these sites may have served as refuges in times of warfare (special use sites), a hypothesis that fits well with the open camps distributed around the base of the landforms. BIBE2479 appears to exemplify this hypothesis because the site is very high and difficult to ascend. Substantial stone enclosures are located on the edge of sheer precipices that look nearly 12 m (40 ft) down on one of the few routes of access. The surrounding landscape is boulder choked, sloped, and generally unsuitable for typical domestic activities. Although confined to Mexican Revolution-era military sites, examples of historic redoubts also exist within the park, such as those at BIBE2686 (Figure 6-II.56).

Table 6-II.20 Sites Containing Features Suggestive of Defensive Posture.

BIBE	Description
2247	Stacked stone wall remnants and partial enclosures atop promontory
2256	Stacked stone enclosure on promontory
2479	Low stacked rock walls and enclosures on cliff edge atop ridge
2528	Low rock alignments along perimeter of isolated butte with cielo complex rock rings
2739	Low rock alignments along perimeter of isolated butte with cielo complex rock rings

Figure 6-II.55 Redoubt at BIBE2739 (41BS2474). Photo by A. Baker.

Prehistoric Material Culture

A wide variety of prehistoric artifact types were documented during the course of the investigation. In order of abundance, the primary artifact types encountered were chipped stone artifacts, ground- and pecked-stone artifacts, ceramics, ornamental items, and perishable artifacts.

Figure 6-II.56 Historic stacked rock redoubt at BIBE2686 (41BS2422). Photo by A. Baker.

Chipped stone artifacts include debitage and a variety of tool forms that are broken down into types by function—where discernible—or morphological attributes where not. Among these categories are projectile points, scrapers, unifaces, bifaces, and edge modified debitage. These tools span the spectrum of refinement, from expedient to highly formalized, with projectile points serving as the foundation of temporal frameworks. Ground- and pecked-stone tool forms documented are mostly represented by manos and metates, although shaft abraders, pigment and incised stones, hammerstones, and stone ornaments are also included in this category.

While prehistoric ceramics are very infrequent components of BBNP assemblages, they were recovered from six sites documented during the project. Some of these were locally manufactured, whereas others represent imported or exotic specimens from coastal Texas, northern Mexico, and the El Paso region of the Jornada Mogollon. Both prehistoric and historic ceramics are addressed in detail in Appendix 13. A number of prehistoric artifacts were classified as ornamental, comprised mostly of beads and pendants manufactured from bone, shell, and stone (primarily kaolinite). Lastly, perishable artifacts such as cordage, matting, basketry, fur, and leather were infrequently encountered in a few of the more sheltered sites such as rockshelters, boulder shelters, and crevice burials.

This section documents only those prehistoric artifacts that were collected during the project, consisting of a total of 1,586 specimens. The vast majority of these (79 percent) are projectile points which were targeted for collection to establish chronology. Otherwise, collections were typically limited to artifacts that were unique or rare. Below, all artifacts of prehistoric aboriginal affinity are placed within 6 major categories: Projectile Points (1,236 specimens), Other Chipped Stone Artifacts (242 specimens), Ground- and Pecked-Stone Artifacts (56 specimens), Ceramics (43 specimens), Perishable Artifacts (3 specimens), and Shell Artifacts (6 specimens).

Projectile Points

One of the major problems faced by projectile point typologists working in the greater Big Bend region is the paucity of data from excavations since the 1930s, which greatly hampers current typological efforts. As a result, typological assignments in the Big Bend must rely heavily on findings in adjacent regions of Texas, such as the Lower Pecos, Southern Plains, and Central Texas, where reliable frameworks have been established through findings from numerous controlled excavations. For these and other reasons, a conservative approach is used here to avoid introducing typological errors into the archaeological database. Thus, projectiles in the collection are only placed within a certain established type when all defining criteria for that type are met. They are otherwise grouped according to morphological attributes.

A total of 1,236 specimens in the BBNP collection are classified as projectile points and are described below in two major groupings: dart points (859 specimens) and arrow points (360 specimens). The only other groupings within this category consist of dart point preform (1 specimen) and arrow point preforms (16 specimens). Metric data for all specimens are presented in Tables 6-II.21 to 6-II.33.

Dart Points

Dart points collected during the BBNP project consist of 859 complete and fragmentary dart points. Of these, 420 specimens conform to established dart point types; however, over half of the assemblage cannot be typed. Among the more recognizable and regionally common dart point types in the collection are Almagre, Angostura, Arenosa, Bandy, Conejo, Ensor, Figueroa, Hueco, Jora, Langtry, Paisano, Pandale, and Shumla.

In this analysis, 746 dart points (of the total 859) are separated into four broad morphological categories: lanceolate, stemmed, triangular, and unidentified fragments. The stemmed points are further divided into four categories based on stem shape: contracting, parallel-sided, expanding, and bulbous. Specimens within all of these categories are separated into discrete forms below; type names are assigned to specific forms when applicable.

Lanceolate Dart Points

Nineteen specimens in the BBNP collection are classified as lanceolate dart points. Within this category are two subcategories (Forms 1 and 2) that conform to established types, while four additional subcategories (Forms 3–6) are also recognized. Specimens too fragmentary to allow confident placement in any of these subcategories are assigned to a miscellaneous group (Form 7). Descriptive and dimensional data for dart points in this category are presented in Table 6-II.21.

Form 1—Angostura *(9 specimens; Figure 6-II.57; Table 6-II.21)*

The Angostura type was originally described and named "Long" by Jack Hughes (1949) from specimens recovered at the Long site in Angostura Reservoir in South Dakota. Because the "Long" name became confused with the length of the points, R.P. Wheeler (1954:1) later renamed them Angostura. These points are characterized by a long and slender leaf shape with the broadest part usually at the mid-section, and they often exhibit parallel-oblique flaking; the stems are narrow and the base is concave or straight, with edge grinding usually present in both of these areas (Hughes 1949; Wheeler 1954; Suhm et al. 1954:402–403; Wormington 1957:138–141; Turner and Hester 1985:66–67). Angostura points have an estimated age of ca. 7800–7000 cal. B.C., falling within the latter part of the Late Paleoindian period (Turner and Hester 1985:66; Turner et al. 2011:59).

Nine specimens in the BBNP collection are classified as Form 1 lanceolate dart points and are assigned to the Angostura type. Three of these are essentially complete but vary in length, a result of the distal blades

Figure 6-II.57 Lanceolate dart points: (a-e) Form 1—Angostura; (f) Form 2—Midland; (g) Form 3; (h) Form 4; (i) Form 5; (j) Form 6.

having been re-sharpened. The other six are fragmentary with broken blades, primarily a result of hinge and impact fractures, although one specimen has a snap fracture. These examples are thin and well made, and flaking varies from parallel to parallel-oblique. Seven specimens have concave basal edges, while the remaining two are straight. Edge grinding on the lateral stem edges is found on six of the nine specimens, while basal grinding occurs on four specimens (all basally ground specimens also have lateral edge grinding). These points are manufactured from a wide array of raw materials, primarily varieties of chert.

***Form 2—Midland** (1 specimen; Figure 6-II.57; Table 6-II.21)*

The Midland type was originally named "unfluted Folsom" by Wendorf et al. (1955) from examples recovered at the Scharbauer site in Midland County, Texas. After additional research, the point was given status as a formal type by Fred Wendorf and Alex D. Krieger (1959), naming it after the nearby town of Midland. Midland points are characterized by their shape, small size, and thinness, as well as distinctive trimming or retouching along the lateral edges of the point; edge grinding is

Table 6-II.21 Dimensions and Descriptions of Dart Points with Lanceolate Stems.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Basal Width (mm)	Weight (g)	Material Type–Color
Form 1–Angostura	IF 021	B	25245	39.4	19.7	5.6	12.6	3.4	Silicified Wood–brown
Form 1–Angostura	BIBE1185	B	25262			5.5		2.2	Unknown–gray
Form 1–Angostura	BIBE1655	E	25353	49.4	21.5	5.9	14	6.6	Chert–gray (w/spots)
Form 1–Angostura	BIBE1850	F	26016			5.4	12.7	2	Chert–dark brown
Form 1–Angostura	BIBE1850	F	26019			5.3	15.6	4.4	Chert–brown
Form 1–Angostura	BIBE2492	T	26937		16.6	5.1	16.1	3.8	Chert–tan (w/inclusions)
Form 1–Angostura	BIBE604	W	27036		25	4.6	14.1	4.7	Jasper–brown (w/patina)
Form 1–Angostura	BIBE2527	U	27122		21.7	5.7		3.7	Chert (fossiliferous)–pinkish purple
Form 1–Angostura	BIBE2254	L	27182	35.8	16.3	5.7	13.6	3.7	Chert–banded dark purple and light gray
Form 2–Midland	BIBE2254	L	27183		15	3.6	15	1.1	Chert-gray
Form 3	BIBE1656	E	25384		21.5	6.9	21.2	6.1	Chert–pinkish gray (w/spots)
Form 4	BIBE1850	F	26018		15.1	4.9	14.6	2.8	Chert–mottled gray and red
Form 5	BIBE1215	B	25567		18.7	5.4		4.1	Chert–brownish purple
Form 6	BIBE1381	C	25777		20.1	4.8	*16.7	3.5	Chert–purple (w/speckles and patina)
Form 7–Miscellaneous	IF 070	B	25716		20.9	5		5.7	Chert–light gray (w/speckles)
Form 7–Miscellaneous	BIBE970	V	27044			3.9		2.9	Chalcedony–light gray (w/patina)
Form 7–Miscellaneous	BIBE2527	U	27111			5.8	16.3	4.5	Agate–dark red
Form 7–Miscellaneous	BIBE2527	U	27114		19.3	6	19	2.8	Chert (fossiliferous)–mottled brown and gray
Form 7–Miscellaneous	BIBE415	U	27137			4.9		2	Chert–tan (w/patina)

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

exhibited along the stem edges as well as the base, which is straight or slightly concave; it resembles the Folsom type, although it is thinner and unfluted (Wendorf et al. 1955; Wormington 1957; Wendorf and Krieger 1959; Turner and Hester 1985:124). Temporally, Midland points fall at the end of the Early Paleoindian period (Turner and Hester 1985:124).

One specimen in the BBNP collection is classified as a Form 2 lanceolate dart point and assigned to the Midland type. This specimen is missing the distal tip, the result of a hinge fracture, yet retains characteristics of being reworked prior to that break. It is uncharacteristically small or diminutive in size for the type, well-thinned and crafted, and fashioned from chert. Edge grinding is heavily expressed on both lateral stem and basal edges. Several small thinning flakes have been removed from each face of the concave base. Flaking on this specimen is parallel, including light retouch along the edges.

Form 3 (1 specimen; Figure 6-II.57; Table 6-II.21)

One specimen is classified as a Form 3 lanceolate dart point. This fragmentary specimen is missing the distal tip from a hinge fracture. The lateral stem edges are recurved and lightly ground, with somewhat flared basal corners. The concave basal edge is thinned on each face and retains smooth remnants from being ground. Made of chert, the specimen exhibits fine parallel flaking and is well-crafted. This specimen is very similar to the Golondrina type (Turner and Hester 1985:103–104) of the Late Paleoindian period, but does not have the distinctive deep basal concavity that characterizes that type.

***Form 4** (1 specimen; Figure 6-II.57; Table 6-II.21)*

One specimen is classified as a Form 4 lanceolate dart point. Missing a tiny piece of its distal tip, this specimen has been severely reworked along the concave base and blade element, resulting in irregular edges and a crude appearance. It has a slender shape, with parallel to random flaking and light edge grinding on the lateral stem edges. Fashioned from chert, it is similar to the Angostura type of the Late Paleoindian period.

***Form 5** (1 specimen; Figure 6-II.57; Table 6-II.21)*

A single dart point fragment is classified as a Form 5 lanceolate dart point. This specimen has snap fractures on both the distal tip and basal edge. The lateral stem edges are recurved, resulting in a slightly flaring base. It is widest near the mid-point of the blade and exhibits crude craftsmanship with a sharp and steep, right-handed, alternately beveled blade. Although this chert projectile does not conform to any formal types, beveling of the blade is known to occur on some Paleoindian projectile points.

***Form 6** (1 specimen; Figure 6-II.57; Table 6-II.21)*

One specimen is classified as a Form 6 lanceolate dart point. This fragmentary chert specimen is missing the distal tip from a snap fracture and the basal edges have slight nicks. It is heavily ground on both lateral stem and basal edges and exhibits retouching along the lateral edges. The base, probably slightly concave when intact, exhibits several small thinning flakes on each face. It is well-made and thin, with parallel flaking on one face; the other face retains large remnants of the original flake scar. It is similar to both the Plainview (Suhm et al. 1954:472–473) and Midland (Turner and Hester 1985:124) types from the Paleoindian period, but cannot be confidently assigned to either.

***Form 7—Miscellaneous** (5 specimens; Table 6-II.21)*

The Form 7 miscellaneous lanceolate dart point category contains five specimens that have attributes common to Paleoindian projectile points but cannot be confidently assigned to a typological or morphological subcategory. These fragmentary specimens consist of three mid-sections and two bases. Two of the mid-sections and one base exhibit distinctive edge grinding on their lateral edges. The other mid-section contains well-executed parallel flaking, which is also found on the remaining basal fragment that could be a late stage preform. These miscellaneous point fragments were manufactured from a wide array of material types.

Stemmed Dart Points

A total of 692 stemmed dart points in the BBNP collection are placed in four categories based on the shape of their stems. These consist of 220 specimens with contracting stems, 100 with parallel-sided stems, 358 with expanding stems, and 14 with bulbous stems.

Contracting Stems

A total of 220 specimens in the BBNP collection are classified as contracting-stem dart points. Within this category, six subcategories (Forms 1–6) conform to established types. Specimens too fragmentary to allow confident placement in any of these subcategories are assigned to a miscellaneous group (Form 7). Descriptive and dimensional data for dart points in this category are presented in Table 6-II.22.

***Form 1—Almagre** (62 specimens; Figure 6-II.58; Table 6-II.22)*

Almagre dart points were originally named by R.S. MacNeish (unpublished manuscript) using examples recovered in southern Tamaulipas, Mexico. The name was then applied to specimens found in Texas and described by Suhm et al. (1954:396–397). Almagre points are characterized by broad triangular blades that have straight to convex lateral edges; shoulders vary from weak-to-strong and the short contracting stem terminates with a pointed or rounded basal edge. These points typically have broad neck widths com-

Figure 6-II.58 Contracting stem dart points: (a-f) Form 1—Almagre; (g-l) Form 2—Arenosa.

pared to other contracting-stem dart points. Almagre points are often thick and crudely flaked, and a number of researchers consider them to be preforms for other styles of contracting-stem points (Suhm et al. 1954:396–397; MacNeish 1958:65; Johnson 1964:30; Turner and Hester 1985:62). In fact, the most recent point typology publication does not list Almagre as a distinctive type, stating they "are clearly preforms for Langtry" (Turner et al. 2011:128). However, it is important to point out that thin and well-crafted Almagre points do occur with some frequency in the greater Big Bend region (e.g., see specimens from the Lizard Hill Cache), suggesting that, at least in some cases, they are finished and distinctive projectiles and represent a viable type (Mallouf et al. 2006:53; Ohl 2011:75–79). Almagre points date to the Middle Archaic period, approximately between 2100–1200 B.C. (Dibble 1967; Turpin 1991).

Sixty-two specimens in the BBNP collection are classified as Form 1 contracting-stem dart points and are assigned to the Almagre type. Lateral blade edges are typically convex, although recurved, concave, and straight blade edges also occur. Shoulder and stem attributes are characteristic of the Almagre type. Twenty-five of these specimens (including 10 of 11 Almagre points from the Lizard Hill Cache—6 of which are exceptionally well-crafted) are thin and well-made, while the other 37 (including 1 Almagre point from the Lizard Hill Cache) are thicker and typically cruder. These points are manufactured from a wide array of material types, primarily cherts, followed in frequency by hornfels.

Table 6-II.22 Dimensions and Descriptions of Dart Points with Contracting Stems.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 1—Almagre	BIBE1853	F	25901	63	34.8	6.1	16.3	21.3	10	Chert–gray
Form 1—Almagre	BIBE1853	F	25902	69.1	38.7	6.1	15.1	25	12.6	Chert–banded gray (w/speckles)
Form 1—Almagre	BIBE1853	F	25903	66	36.9	6.4	16.9	24.7	12	Chert–banded gray (w/speckles)
Form 1—Almagre	BIBE1853	F	25904	63.1	35	6.8	14.9	22.8	12.4	Chert–white (w/speckles)
Form 1—Almagre	BIBE1853	F	25905	50.6	* 31.8	4.6	15.3	20.7	5.4	Jasper–brown
Form 1—Almagre	BIBE1853	F	25906	* 59.3	32.2	5.5	15.9	23.2	7.7	Chert–mottled gray and purple
Form 1—Almagre	BIBE1853	F	25908	64.6	34.5	5	15.3	20.9	8	Chert–pink (w/spots)
Form 1—Almagre	BIBE1853	F	25909		40.2	8.1		24.7	12.8	Chert–mottled gray and tan (w/speckles)
Form 1—Almagre	BIBE1853	F	25910	* 72.2	36.2	5.4	22.2	18.6	9.3	Agate–brown
Form 1—Almagre	BIBE1853	F	25911	* 62.0	37	5.7	16.2	24.7	10.3	Chert–reddish brown (w/speckles)
Form 1—Almagre	BIBE1853	F	25912	76.2		9.9	* 16.2		25	Chert–light gray (w/speckles)
Form 1—Almagre	BIBE0418	A	25018	59.3	43.3	8.1	12	19.9	17.7	Hornfels–black (w/patina)
Form 1—Almagre	BIBE0418	A	25032			5.6	12.5	19.8	4.6	Jasper–mottled brown and red
Form 1—Almagre	BIBE1100	A	25060			4.5	15.8	20.8	3.6	Chert (fossiliferous)–mottled gray
Form 1—Almagre	BIBE1155	A	25194	49.1	29.8	8.8	12.1	17.3	9.9	Chert–light gray (w/patina)
Form 1—Almagre	BIBE1520	F	25404			7.4	8.1	19	7.2	Chert–mottled brown and purple (w/inclusions)
Form 1—Almagre	BIBE1520	F	25409			7.8	15.4	18.8	4.3	Chert–light gray (w/speckles)
Form 1—Almagre	BIBE1520	F	25411			6.1	12.2	16.9	3.5	Chert–gray (w/patina)
Form 1—Almagre	BIBE1520	F	25422		33.8	7.9	16.3	17.9	12.3	Hornfels–gray (w/patina)
Form 1—Almagre	BIBE1682	F	25449			8.9	19.4	20.1	10.9	Hornfels–black (w/patina)
Form 1—Almagre	BIBE1682	F	25451	41.7	26.5	6.5	11.8	15	5	Chert–light gray
Form 1—Almagre	BIBE1688	F	25463		42.8	8.4	10.5	19.3	11.9	Chalcedony–brown (w/patina)
Form 1—Almagre	BIBE1205	B	25545		33.2	5.3	15.2	17	6.8	Hornfels–black (w/patina)
Form 1—Almagre	BIBE1270	B	25671			15.3			23.4	Hornfels–gray (w/patina)
Form 1—Almagre	BIBE0124	B	25678			4.1	11.1		2.5	Chert–banded gray
Form 1—Almagre	BIBE1314	JQ–1	25735		35	10		18.6	13.3	Hornfels–black (w/patina)
Form 1—Almagre	BIBE1594	F	25849		44.4	7	25.2	22.3	11	Rhyolite–purple (w/inclusions)
Form 1—Almagre	BIBE1594	F	25852			6.6	8	13.5	4.7	Chert–light gray (w/speckles)
Form 1—Almagre	BIBE1594	F	25853			11.8	12.8	21.2	14.8	Chert–light gray
Form 1—Almagre	BIBE1594	F	25856		31.4	8	15	22.6	8.6	Silicified Wood (palm)–brown (w/spots)
Form 1—Almagre	BIBE1751	F	25891		28.8	3.7	9	11.6	2.8	Agate–brown
Form 1—Almagre	BIBE1594	F	25918		34.9	8.4	17.8	23.3	10.5	Agate–dark green
Form 1—Almagre	BIBE1594	F	25919			6.7	14.7	26.1	6	Hornfels–black (w/patina)
Form 1—Almagre	BIBE1594	F	25922			5.7	8.7	16.8	9.9	Chert–purple (w/speckles)
Form 1—Almagre	BIBE0537	Y	26075			3.8	10.1	15.1	1.3	Jasper–brown

Form 1—Almagre	BIBE1942	F	26260			6.9	18.6		5.9	Chalcedony–brown (w/speckles)
Form 1—Almagre	BIBE1942	F	26264		35.3	10.3	10.1	17.6	13.4	Hornfels–black (w/patina)
Form 1—Almagre	BIBE1942	F	26268			5.3	24.2	20.4	6.1	Hornfels–black (w/patina)
Form 1—Almagre	BIBE1942	F	26271		37.3	7.7	8.1	16.3	7.6	Chert–gray (w/spots)
Form 1—Almagre	BIBE1942	F	26278			6.9	18.5		5.7	Hornfels–black (w/patina)
Form 1—Almagre	BIBE1942	F	26292			5.8	9.9	20.1	5.8	Unknown–gray (w/inclusions)
Form 1—Almagre	BIBE1942	F	26304		39.1	7.6	11.9	26	8.8	Chert–mottled brown
Form 1—Almagre	BIBE2085	H	26725			10.8	18	22.2	7.5	Chert–light gray (w/speckles)
Form 1—Almagre	BIBE2142	I	26768			6.5	13.5	21.6	6.6	Chert–light gray (w/speckles and patina)
Form 1—Almagre	BIBE2254	L	26808		36.2	8.8	10.2	25.1	11.7	Chert–white (w/speckles)
Form 1—Almagre	BIBE2338	L	26861		34.9	6	10.6	22.1	5.3	Chert–grayish purple (w/patina)
Form 1—Almagre	BIBE2338	L	26862			4.9	11.1	17.7	4.2	Agate–mottled brown and red
Form 1—Almagre	BIBE2338	L	26863		41.3	7.6	15.5	18.7	8.5	Agate–brown (w/patina)
Form 1—Almagre	BIBE2338	L	26864		36.6	8.4	8.9	17.3	9.7	Chert–mottled brown and red (w/patina)
Form 1—Almagre	BIBE2338	L	26867		40.1	6.3	14.5	24	6.7	Agate–brown (w/patina)
Form 1—Almagre	BIBE2338	L	26869			9	16.8	18.6	12	Chert–bluish gray (w/speckles and patina)
Form 1—Almagre	BIBE2338	L	26872	56.6		12.3	16.4	20	14.2	Chert–mottled brown and white
Form 1—Almagre	BIBE2491	T	26931		32.8	5.2	16.1	18.2	5.9	Hornfels–black (w/patina)
Form 1—Almagre	BIBE2497	T	26942		35.6	10.5	9.1	14.9	14.2	Hornfels–black (w/patina)
Form 1—Almagre	BIBE0760	T	26985		42.9	6.4	15.5	20.4	5.9	Hornfels–black (w/patina)
Form 1—Almagre	IF 889	U	27091		35.7	9.1	12	22.2	14.4	Chert–mottled gray (w/inclusions)
Form 1—Almagre	BIBE2519	U	27097		33	5.8	7.5	13.8	6.8	Chert (fossiliferous)–mottled brown and gray
Form 1—Almagre	BIBE2519	U	27099		35.6	5	13.2	19.2	5.7	Chert (fossiliferous)–tan
Form 1—Almagre	BIBE2531	U	27130			7	7.1	18	8.3	Agate–brown
Form 1—Almagre	BIBE2575	EE	27154		36.5	6		11.6	7.3	Hornfels–black (w/patina)
Form 1—Almagre	BIBE2694	2010–I	27271	52.4	40.5	14.2	12	19.9	21.7	Hornfels–black (w/patina)
Form 1—Almagre	BIBE2697	2010–I	27282		39.6	7.9	15.2	24.3	11.4	Hornfels–black (w/patina)
Form 2—Arenosa	BIBE0418	A	25017		38.8	5.9	12.5	12.9	5.4	Chert–gray
Form 2—Arenosa	BIBE0418	A	25046			4.9	17.6	13.6	2.9	Chalcedony–clear
Form 2—Arenosa	BIBE1100	A	25068			4.4		17.8	3.5	Chert (fossiliferous)–tan
Form 2—Arenosa	BIBE1163	A	25220			5.2	17.7	15.7	3.9	Chert–mottled gray (w/spots)
Form 2—Arenosa	BIBE1163	A	25221			4.6	23.5	16.1	3.9	Chert–banded gray
Form 2—Arenosa	IF 015	A	25240		27.7	4.7	13.4	12.4	2.5	Chert–gray (w/spots)
Form 2—Arenosa	IF 028	A	25249		21.6	5.3	12.4	14.1	4	Chert–tan
Form 2—Arenosa	BIBE0338	JQ–2	25295	44.5	19.6	6	16.2	11.2	3.4	Chert–white
Form 2—Arenosa	BIBE1603	E	25299	*47	31.1	6.2	21.9	16.5	5.8	Hornfels–black (w/patina)
Form 2—Arenosa	BIBE1520	F	25405			6.2	18.9	15.5	2.8	Jasper–brown (w/patina)
Form 2—Arenosa	BIBE1520	F	25410			4.6	14.5	14.5	2.8	Chert–mottled brownish red (w/spots and patina)
Form 2—Arenosa	BIBE1520	F	25414			4.3	12.1	12.5	2.8	Chalcedony–light brown (w/spots)

Table 6-II.22 Dimensions and Descriptions of Dart Points with Contracting Stems. *(continued)*

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 2—Arenosa	BIBE1671	F	25429	50.8	26.7	8.6	22.1	16.2	7.4	Chert–white (w/patina)
Form 2—Arenosa	BIBE1688	F	25464		26.1	5.3		15.1	4.5	Chert–light gray (w/patina)
Form 2—Arenosa	BIBE1205	B	25526			4.6	13.9	13	2.1	Claystone–brown
Form 2—Arenosa	BIBE1218	B	25588			3.7	14.8	12.1	1.6	Chert–mottled purple and tan (w/spots)
Form 2—Arenosa	BIBE1218	B	25593			7.6			4	Hornfels–black (w/patina)
Form 2—Arenosa	BIBE0124	B	25677		29.4	6.8		16.1	5.7	Agate–red
Form 2—Arenosa	IF 086	B	25721			4.9	12.8	12.8	3.1	Chert–brown (w/patina)
Form 2—Arenosa	BIBE0284	JQ–2	25763		26.3	5.5	18.1	10.5	5.3	Quartzite (banded)–pink and gray
Form 2—Arenosa	BIBE1361	C	25784			4.7	20.9	16.1	4.9	Hornfels–black (w/patina)
Form 2—Arenosa	BIBE1594	F	25925		32.4	5.5	20.1	17	5.7	Unknown–gray (w/speckles)
Form 2—Arenosa	BIBE1829	G	25939		30.1	4.4	16.8	16.5	4.4	Chert–banded purple and brown (w/inclusions)
Form 2—Arenosa	BIBE1840	G	25948		22.5	4.4	11	12	2.1	Chert–gray (w/inclusions)
Form 2—Arenosa	BIBE1942	F	26277			4.8	14.4	11.5	3	Hornfels–black
Form 2—Arenosa	BIBE1942	F	26295		*27.5	4.8	19.5	15.8	3.6	Hornfels–black (w/patina)
Form 2—Arenosa	BIBE1942	F	26296	47.9	26	4.6	16.5	15.4	3.7	Hornfels–black (w/patina)
Form 2—Arenosa	BIBE1942	F	26297		23.7	4.4	17.2	13.1	3.1	Chert–brownish gray (w/spots)
Form 2—Arenosa	BIBE1942	F	26299			4.8	23.1	16.6	3.2	Chalcedony–light gray (w/speckles and spots)
Form 2—Arenosa	BIBE1942	F	26306			4.8	16.9		1.9	Chalcedony–light gray (w/speckles)
Form 2—Arenosa	BIBE1959	F	26480			4			1	Jasper–brown (w/inclusions)
Form 2—Arenosa	BIBE1959	F	26486			4.5	16.4	12.8	2	Agate–brown
Form 2—Arenosa	BIBE1975	F	26491			6.6	19.7	13.6	4.6	Agate–brown
Form 2—Arenosa	BIBE1976	F	26499	56.1	30.1	5.6	19.5	15.8	5.2	Chalcedony–light gray (w/speckles)
Form 2—Arenosa	BIBE2048	F	26638		26.6	5.4	18.1	15.6	4	Chert–purple (w/patina)
Form 2—Arenosa	BIBE2096	I	26741			6.2	23.1	14.4	5.3	Chert–light gray
Form 2—Arenosa	BIBE2099	I	26743		25.6	6.4	12.5	16.5	4.5	Chert–mottled purple and red (w/spots)
Form 2—Arenosa	BIBE2155	I	26777			4.2	12.1	8.9	2.4	Chert–gray
Form 2—Arenosa	BIBE2257	L	26823			4.7		12	3.6	Chert–banded red (w/patina)
Form 2—Arenosa	BIBE2492	T	26934			6.5	15.5	12.6	5.2	Chert–brownish gray (w/patina)
Form 2—Arenosa	BIBE2495	T	26939			6.5	19.1	12.7	4.8	Jasper–mottled brown and red
Form 2—Arenosa	BIBE2506	T	27017			7.7	16.1	10.8	3.2	Chert–white (w/spots)
Form 2—Arenosa	BIBE0604	W	27032			4.1	12.4	10.6	1.9	Chert–mottled purple and red (w/spots and patina)
Form 2—Arenosa	BIBE2577	EE	27159		27.9	5	10.5	10.9	3.3	Chert–light gray (w/spots)
Form 2—Arenosa	BIBE2588	EE	27162			3.2	12.8	11.1	1.4	Chert–gray (w/spots and patina)
Form 2—Arenosa	BIBE0987	EE	27164			4.2		14	2.8	Chalcedony–gray (w/inclusions)
Form 2—Arenosa	BIBE2763	2010–D	27219			7			3	Agate–brown
Form 2—Arenosa	BIBE2697	2010–I	27277		24.4	4.8	12.4	11.3	2.9	Chert–gray (w/spots)

Form 2—Arenosa	BIBE2697	2010–I	27284			3.7	13.4	10.3	1.2	Chert–dark gray (w/spots)
Form 2—Arenosa	BIBE2719	2010–HH	27307			5.1		11.4	3.7	Chert–tan
Form 2—Arenosa	BIBE2723	2010–X	27308			5.7	20.7	15.6	5.2	Chert–light gray
Form 3—Bell	BIBE1100	A	25057			5.3	11.5	13.5	5.2	Agate–mottled brown and red
Form 3—Bell	IF 128	E	25341	35.5		4	10	11.8	4.4	Chert–gray (w/patina)
Form 4—Gobernadora	BIBE1520	F	25407			6.1	17.5	16.8	4.2	Chalcedony–light gray (w/inclusions)
Form 5—Jora	BIBE0418	A	25007			6		18	3.7	Chert–light pinkish brown (w/spots)
Form 5—Jora	BIBE0418	A	25044			5	12.9	17.3	3	Chert–mottled gray and tan (w/spots)
Form 5—Jora	BIBE0438	A	25051			5.4	13.2	15.6	1.9	Claystone–brown
Form 5—Jora	BIBE1124	A	25160			5.2			3.3	Chert (fossiliferous)–gray
Form 5—Jora	BIBE1152	A	25192	35.1		5.6	14.8	17.4	4.7	Chert–brownish purple (w/spots and patina)
Form 5—Jora	BIBE0338	JQ–2	25296			6.3	9.3	11.5	4.3	Chalcedony–pinkish white
Form 5—Jora	BIBE1520	F	25406			5.5	16.2	16.1	3.2	Rhyolite–brown
Form 5—Jora	BIBE1689	F	25468			4	15.8	14.6	3.2	Chert–banded purple, tan, and white
Form 5—Jora	BIBE1205	B	25530			4.4	12.9	14.6	2.3	Chert (fossiliferous)–brownish gray
Form 5—Jora	BIBE1205	B	25531	38.1	25.2	7.9	15.9	15.5	5.7	Chert–light gray (w/speckles)
Form 5—Jora	BIBE1214	B	25560			4.3	15.7	16	2.3	Chert–mottled gray (w/spots)
Form 5—Jora	BIBE1265	B	25665		30.6	6.7	17	19.6	7.7	Hornfels–black (w/patina)
Form 5—Jora	BIBE1300	B	25708	*44.3	36.2	6	15.4	16	6.2	Chert–mottled brown (w/patina)
Form 5—Jora	BIBE1343	C	25782			5.6	18.3	16.9	4.1	Hornfels–black (w/patina)
Form 5—Jora	BIBE1594	F	25859		29.2	4.2	13	14.6	3.6	Chert–mottled brown
Form 5—Jora	BIBE1594	F	25924			4.6	11.9		3.5	Claystone–brown
Form 5—Jora	BIBE1942	F	26265			5.2	14.2	13.9	1.7	Hornfels–gray (w/patina)
Form 5—Jora	BIBE1942	F	26274		28.5	4.5	15.5	13.8	2.7	Hornfels–black
Form 5—Jora	BIBE1942	F	26305		23.3	6.8	12.2	13.5	3.1	Chalcedony–brown (w/inclusions)
Form 5—Jora	BIBE0284	F	26464	27.9	22	4.4	11.7	14.4	2.4	Chert–banded gray and brown (w/spots)
Form 5—Jora	BIBE0284	F	26466		*30.3	5.4	13.3	13.4	2.7	Chert–light gray (w/inclusions)
Form 5—Jora	BIBE1959	F	26482			6.3	18.3		3.2	Hornfels–black (w/patina)
Form 5—Jora	BIBE1988	F	26525			6.1	14.7	14	3.6	Chalcedony–mottled brown
Form 5—Jora	BIBE2254	L	26810			5.4	18.2	13.8	3.6	Chert–bluish gray (w/spots)
Form 5—Jora	BIBE2364	P	26881	50.5		6.3	13.6	14.2	7.5	Chert–white (w/inclusions)
Form 6—Langtry	BIBE1853	F	25900	* 47.3	32.4	4.7	10	15.5	5.2	Chert (fossiliferous)–brownish gray
Form 6—Langtry	BIBE0418	A	25041			4.2		12.8	1.3	Chert–mottled brown
Form 6—Langtry	BIBE0418	A	25042			3.9	10.7	11.8	1.9	Silicified Wood–dark brown
Form 6—Langtry	BIBE1135	A	25166		20.2	4.1	10.9	10.5	1.9	Claystone–brown
Form 6—Langtry	BIBE1150	A	25183			5.2	11.7	13.6	3.8	Chert–gray (w/spots)
Form 6—Langtry	IF 018	A	25242	62.9	22.6	5.5	18.3	13.8	4.9	Chert–brownish red
Form 6—Langtry	BIBE1640	E	25334			4.9	13.6		3.1	Chert–dark brown
Form 6—Langtry	BIBE1205	B	25544		24.3	5	15.3	15.2	4	Chert (fossiliferous)–tan (w/patina)

Table 6-II.22 Dimensions and Descriptions of Dart Points with Contracting Stems. ***(continued)***

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 6—Langtry	IF 041	B	25711		*27	4.7	17.2	15.4	3.3	Chert (fossiliferous)–gray
Form 6—Langtry	BIBE1594	F	25921				11.6	13.3	1.6	Chert–light grayish brown
Form 6—Langtry	BIBE1913	F	26038	42.2	27.8	5.2	12.9	16.8	5	Chalcedony–mottled white, pink, and black
Form 6—Langtry	BIBE1945	F	26479			5.6	12.9	14.6	4.4	Hornfels–black (w/patina)
Form 6—Langtry	BIBE2257	L	26821	47.1	24.3	6.9	15	13.5	4.9	Chert–brown (w/inclusions)
Form 6—Langtry	IF 706	L	26844			4.7	14.9	14.9	4.7	Chert–mottled light gray and white
Form 6—Langtry	BIBE2338	L	26865			4.1	11.7		2.3	Chert–mottled gray and purple
Form 6—Langtry	BIBE2338	L	26870		26.6	5.1	14.2	16.1	3.9	Hornfels–black (w/patina)
Form 6—Langtry	BIBE2338	L	26871		*30.5	5	18.1	16.8	2.9	Chert–mottled red and tan (w/spots and patina)
Form 6—Langtry	IF 828	T	26916			5.2	12.8	15.2	3.6	Chert–mottled purple
Form 6—Langtry	BIBE2491	T	26924			5.2	14.9	11.9	3.1	Chert–light gray
Form 6—Langtry	BIBE2492	T	26936	52	21.4	4.3	12.6	14.4	4.5	Chert–gray (w/spots and patina)
Form 6—Langtry	BIBE0604	W	27034			4.8	15.9	15.4	2.6	Hornfels–black (w/patina)
Form 6—Langtry	BIBE2527	U	27113		28	5	15.7	14.4	2.3	Chert (fossiliferous)–gray
Form 6—Langtry	BIBE2531	U	27131			4.3	15	13.8	5.1	Chert (fossiliferous)–brownish gray
Form 6—Langtry	BIBE0415	U	27148		33.4	6	15.2	18.9	9.3	Rhyolite–brown
Form 6—Langtry	BIBE2697	2010–I	27279			4.6	13.8		3.2	Chert–light gray
Form 7—Miscellaneous	BIBE1853	F	25907	* 51.0	27.9	4.4	* 9.6	13.5	4.6	Jasper–reddish brown
Form 7—Miscellaneous	BIBE0418	A	25023		23.7	5.7		12.4	3.6	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE0418	A	25038		33.8	6		17.3	4.4	Agate–mottled brown and red
Form 7—Miscellaneous	BIBE0418	A	25040		37.8	8.8		23.7	10.3	Rhyolite–reddish brown
Form 7—Miscellaneous	BIBE1100	A	25059			4.4		12.2	3.1	Chalcedony–mottled brown and gray (w/speckles)
Form 7—Miscellaneous	BIBE1145	A	25179			5		15.6	3.2	Rhyolite–dark brown
Form 7—Miscellaneous	BIBE1149	A	25182		29.7	6.3		16.6	4.7	Chert–tan
Form 7—Miscellaneous	BIBE1163	A	25216			10.6		10.7	2.9	Chert–tan
Form 7—Miscellaneous	BIBE1188	B	25263			5.6	9.6	8.9	2.5	Chert–brown and red
Form 7—Miscellaneous	BIBE1203	B	25271			5.9		15.9	3.8	Chert–light gray (w/spots)
Form 7—Miscellaneous	BIBE0338	JQ–2	25289		23.5	7.3		14.5	4.2	Chert–light gray
Form 7—Miscellaneous	BIBE1520	F	25420			7.1	13.1	12.5	5.6	Chert–light gray (w/patina)
Form 7—Miscellaneous	BIBE1671	F	25428			5	14	19.2	3.8	Chert–mottled gray and purple
Form 7—Miscellaneous	BIBE1682	F	25456		19.1	6.7		13.9	4	Chert–tan (w/speckles)
Form 7—Miscellaneous	IF 175	F	25482		26.4	6.4	7.6	10.5	6.1	Chalcedony–light gray (w/inclusions and patina)
Form 7—Miscellaneous	BIBE1205	B	25528			5.2			2.7	Agate–brown (w/patina)
Form 7—Miscellaneous	BIBE1211	B	25555			4.7		9.8	2.4	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE1218	B	25581			6.7			6.7	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE1218	B	25591			6.3		11.9	5.5	Agate–purple (w/patina)

Form 7—Miscellaneous	BIBE1270	B	25673			7.8		16.4	9.7	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE1278	B	25692			4.9		9.4	2.5	Chert–purple (w/inclusions)
Form 7—Miscellaneous	IF 088	B	25723			7.8		16.1	8.3	Chert–light gray
Form 7—Miscellaneous	IF 091	JQ–1	25758		27.8	6.2		14.8	5.2	Chert–light gray (w/speckles)
Form 7—Miscellaneous	BIBE1594	F	25855		40.3	11.5		27.2	18	Jasper–brown (w/inclusions)
Form 7—Miscellaneous	BIBE1594	F	25920		23	4.7		13.5	3.4	Chert–black
Form 7—Miscellaneous	IF 210	G	25931			6.5		8.9	3.4	Chalcedony–mottled gray and red
Form 7—Miscellaneous	BIBE1849	F	25971			5.7		14.6	2.9	Chert–light gray
Form 7—Miscellaneous	BIBE1849	F	25994		28.7	3.8		11.6	2.3	Chalcedony–brown (w/speckles)
Form 7—Miscellaneous	BIBE1850	F	26021		27	6.3	9.2	11.4	6.1	Jasper–mottled brown
Form 7—Miscellaneous	BIBE0548	Y	26081		26.9	3.5		9.8	1.4	Chert–light gray (w/spots)
Form 7—Miscellaneous	BIBE1942	F	26259			8.6		10	4.2	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE1942	F	26262		36.7	12.8	8.1	16.5	19	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE1942	F	26263		28.1	8.5			8.9	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE1942	F	26267			4.8		12.4	3.6	Rhyolite–dark brown (w/speckles)
Form 7—Miscellaneous	BIBE1942	F	26276		28.7	6.5	9.9	18.2	5.1	Chert–brown (w/spots)
Form 7—Miscellaneous	BIBE1942	F	26287			5.7		12.8	3.4	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE0284	F	26465			4.7		15	3.2	Chalcedony–brown
Form 7—Miscellaneous	BIBE1942	F	26477			5.6		11.7	2.7	Chert–mottled red and white (w/veins)
Form 7—Miscellaneous	BIBE1959	F	26483			5.2		13.3	2.3	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE2126	I	26752		28.5	5.4		15.4	4	Chert–light gray (w/patina)
Form 7—Miscellaneous	BIBE2337	L	26858			4.8	9.8	13.4	1.8	Chert–tan (w/speckles and patina)
Form 7—Miscellaneous	BIBE2337	L	26859		24.5	8.1		14.6	9.3	Chert–light gray (w/inclusions and patina)
Form 7—Miscellaneous	BIBE2338	L	26866		31.9	6.2		17	4.6	Chert–mottled red (w/spots)
Form 7—Miscellaneous	BIBE2338	L	26876			4.9		13.7	4.7	Chalcedony–clear (w/patina)
Form 7—Miscellaneous	BIBE2491	T	26930			6.3			10.9	Chert (fossiliferous)–brownish gray (w/spots)
Form 7—Miscellaneous	BIBE2492	T	26935		30.9	5.7		16.1	4.8	Chert–tan
Form 7—Miscellaneous	BIBE0755	T	26957			3.7		12.5	1.7	Chert–yellowish white
Form 7—Miscellaneous	BIBE2506	T	27019			6.3		15.2	4.4	Jasper–brown (w/spots)
Form 7—Miscellaneous	BIBE2469	Z	27072		26.4	6.5		16.7	4.6	Hornfels–black (w/patina)
Form 7—Miscellaneous	BIBE2567	Y	27081			6.1		14	4.4	Agate–brown
Form 7—Miscellaneous	BIBE2531	U	27125			4			1.2	Chert–light gray
Form 7—Miscellaneous	BIBE2662	2010–E	27258			8.4		12.7	4.4	Chert–tan
Form 7—Miscellaneous	BIBE2662	2010–E	27261			10.1		14.3	6.5	Chert–white
Form 7—Miscellaneous	BIBE2697	2010–I	27274			4.4		13.4	2.6	Chert–light gray (w/patina)

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

Form 2—Arenosa (51 specimens; Figure 6-II.58; Table 6-II.22)

The Arenosa type was originally recognized and described by M.K. Schuetz (1956) as "Variant 3" during an analysis of materials recovered from shelters in Val Verde County, Texas. It was later described and named Arenosa by Leland C. Bement (1991) using examples recovered from Arenosa Shelter (41VV99). The well-crafted Arenosa type is distinguished by long and narrow contracting stems, pointed to rounded basal edges, and short barbs (Schuetz 1956; Bement 1991; Mallouf et al. 2006:55; Turner et al. 2011:60). Arenosa points are chronologically placed in the Middle Archaic period, but lack well-associated radiocarbon dates that could narrow their temporal span (Turner et al. 2011:60).

Fifty-one specimens in the BBNP collection are classified as Form 2 contracting-stem dart points and are assigned to the Arenosa type. Lateral blade edges are typically straight to slightly concave, although two specimens exhibit light-to-extreme serrations on their blade edges. The contracting stems are typically long and narrow, although there is some variation in overall proportions. Thirty-one specimens have pointed bases and the other 20 have slightly rounded basal edges. Many are fragmentary, missing portions of their distal blades or barbs. These thin and well-crafted points are fashioned from a wide array of material types, primarily cherts.

Form 3—Bell (2 specimens; Figure 6-II.58; Table 6-II.22)

The Bell type was originally named and described by Sorrow et al. (1967:12–14) during analysis of specimens recovered from the Landslide Site at Stillhouse Hollow Reservoir in Bell County, Texas. Bell points are typically thin and well-crafted, with wide triangular bodies, expanding stems, and distinctive long and narrow barbs formed by deep basal notching (Sorrow et al. 1967; Turner and Hester 1985:72; Turner et al. 2011:65). Bell points are chronologically placed in the Early Archaic period (Turner and Hester 1985:72; Houk et al. 2008, 2009).

Two specimens in the BBNP collection are classified as Form 3 contracting stem dart points and are assigned to the Bell type. Made of chert and agate, both specimens exhibit contracting stems with rounded basal edges that are atypical of the type; however, both have other notable characteristics that fit the definition. Each has a wide triangular body and is thin and well-crafted. All barbs are missing, a result of breakage. See parallel-sided stem dart points, Form 1, and expanding-stem dart points, Form 4, below for additional specimens classified as Bell.

Form 4—Gobernadora (1 specimen; Figure 6-II.59; Table 6-II.22)

The Gobernadora type was named but not discussed by W.W. Taylor (1966:65–67 and Fig. 3) using specimens recovered from Nopal Rockshelter in central Coahuila, Mexico. Rarely occurring in the Big Bend, the Gobernadora point is distinguished by its distinctive stem. Parallel-sided at the top, the stem then contracts somewhat sharply to a pointed basal edge marked by a distinctively shaped nipple. Gobernadora points are chronologically placed in the Middle Archaic period (Taylor 1966; Mallouf et al. 2006:55–56; Ohl 2011:73–80).

One specimen in the BBNP collection is classified as a Form 4 contracting-stem dart point and is assigned to the Gobernadora type. Fashioned from chalcedony, it is a stem fragment that displays the characteristic attributes of this type—distinctive stem edges and basal nipple.

Form 5—Jora (25 specimens; Figure 6-II.59; Table 6-II.22)

The Jora type was originally defined by W.W. Taylor (1966:67) using examples recovered from the Cuatro Cienegas region of central Coahuila. Taylor's brief description of the type indicates Jora points have large contracting stems with strong barbs and lateral blade edges that are frequently serrated. Some researchers have accepted the Jora type name (Prewitt 1995:112;

Figure 6-II.59 Contracting stem dart points: (a) Form 3—Bell; (b) Form 4—Gobernodora; (c-f) Form 5—Jora; (g-l) Form 6—Langtry.

Zubieta 1999; Ohl 2011:73–79), although there is still much confusion concerning this poorly defined type. Zubieta (1999:30), using examples recovered at Cueva Encantada in northern Coahuila, Mexico, suggests Jora and Arenosa points represent a single type based on comparative metric characteristics. However, her study appears to have a few flaws. For instance, she illustrates (1999:29, Fig.3: 61-B) a distinctive Arenosa point, as defined by Bement (1991), and indicates it is a typical Jora point. Furthermore, Zubieta's description of Jora points (1999:29–30) is practically identical to Bement's (1991) Arenosa type description. Based on Taylor's (1966:Fig. 3) illustrations of Jora points from the Cuatro Cienegas region and Bement's illustrations and his description of Arenosa points, there appear to be real differences between these two types. Arenosa stems are more gracile compared to the blocky Jora stems. Also, Jora stems are often as long as the blades (Ann Ohl personal communication 2012).

Because of Taylor's inadequate description of the Jora type, we here describe the specimens he exhibited, based purely on their appearance in the publication. Taylor's Jora specimens can be described as short to long, broad contracting stems that gradually constrict to a rounded or slightly pointed basal edge; lateral blade edges are straight or concave, but may also be convex, frequently exhibiting light to extreme serrations; small- to medium-sized, well-defined barbs; and fair to excellent craftsmanship. Jora points are chronologically placed in the Middle Archaic period.

Twenty-five specimens in the BBNP collection are classified as Form 5 contracting-stem dart points and are assigned to the Jora type. These Jora specimens are characterized by short to medium length contracting stems that gradually constrict to a rounded basal edge, although some specimens have slightly pointed bases. Most of these examples are moderately thick, although a few specimens are thin and rather well executed. Most of the distal blades are missing, but when intact, lateral edges are straight to convex. Given the prominence afforded serrations in the original definition, it is important to note that only one specimen in the BBNP collection has serrated lateral edges. Well-defined barbs range from short and small to medium-sized. These points were manufactured from a wide array of material types, primarily various cherts.

Form 6—Langtry (25 specimens; Figure 6-II.59; Table 6-II.22)

The Langtry type was originally introduced solely through illustrations as a dominant projectile point of the Pecos River focus by Kelley et al. (1940:Fig. 1, b–c) using specimens recovered from the greater Big Bend region. Kelley (1947b:105) later named this type "Langtry Stemmed." The name was ultimately shortened to Langtry and described by Suhm et al. (1954:438–439). Langtry points are characterized by a long contracting stem that terminates with concave or straight basal edges; they have strong shoulders that slope downwards with random blade morphology and, importantly, are very well crafted (Suhm et al. 1954; Turner and Hester 1985:114–115; Mallouf et al. 2006; Ohl 2011). Langtry points are thought to date between ca. 2150 and 1250 B.C. (Turpin 1991:29–30) during the Middle Archaic period.

Twenty-five specimens in the BBNP collection are classified as Form 6 contracting-stem dart points and are assigned to the Langtry type. Specimens in the collection are generally characterized by slightly concave or straight blade edges (although one specimen stands apart from the rest with a steep, left-hand alternate bevel of the blade), strong shoulders that slope downwards, narrow contracting stems with moderate to long stem lengths, and a high level of craftsmanship. Sixteen specimens have concave to slightly concave basal edges and the other nine have straight basal edges, including five that exhibit steep, left-hand, alternately beveled stems. These thin points were fashioned from a wide array of material types, primarily cherts.

Form 7—Miscellaneous (54 specimens; Table 6-II.22)

The Form 7 miscellaneous contracting-stem dart point category contains 54 specimens that cannot be confidently assigned to a typological or morphological subcategory. Most specimens in this group have general outlines or appearances that are similar to the above contracting-stem types in the BBNP collection. However, they are mostly fragmentary and therefore lack conclusive attributes of a defining type or form. Twenty-eight specimens appear to be either Arenosa or Langtry dart points while two others have similarities to Almagre points, although all are missing the basal edges needed to make these determinations. One specimen has a serrated blade and seven specimens have very short contracting-stems with rounded basal edges, attributes similar to those of Jora points. The remaining 16 specimens could represent any contracting stem type. Form 7 miscellaneous contracting-stem specimens were manufactured from a variety of raw material types, primarily cherts.

Parallel-Sided Stems

A total of 100 dart points in the BBNP collection have parallel-sided stems. Within this category, three subcategories (Forms 1–3) are recognized as conforming to known types, while 12 additional subcategories (Forms 4–15) lack type designations. Specimens too fragmentary to allow confident placement in any of these subcategories are assigned to a miscellaneous group (Form 16). Descriptive and dimensional data for dart points in this category are presented in Table 6-II.23.

Form 1—Bell (1 specimen; Figure 6-II.60; Table 6-II.23)

One specimen in the BBNP collection is classified as a Form 1 parallel-sided stem dart point and is assigned

Figure 6-II.60 Parallel-sided stem dart points: (a) Form 1—Bell; (b-e) Form 2—Pandale; (f-j) Form 3—Shumla; (k-l) Form 4; (m-n) Form 5.

to the Bell type, although other Bell types in the collection have either expanding stems (most typical of the type) or contracting stems. The reader is referred to the contracting-stem category (Form 3) above for background information and a description of the Bell dart point type. Additional specimens adhering to this type are described in the expanding-stem category (Form 4) below.

The BBNP parallel-sided stem Bell point is missing the distal tip as well as the distinctive long barbs that are commonly recognized for the type. The basal edge is nicked along one corner, but was probably straight when intact. This point is very thin, well-crafted, and fashioned from chalcedony. Although the stem is parallel-sided, remaining attributes fall within the Bell type.

***Form 2—Pandale** (9 specimens; Figure 6-II.60; Table 6-II.23)*

The Pandale type was originally named "Pandale Twisted Blade" by J. Charles Kelley from examples found near the community of Pandale in Val Verde County, Texas. The name was ultimately shortened to Pandale and described by Suhm et al. (1954:464). Pandale points are characterized by distinctive beveling of the body, which creates a corkscrew-twist—a result of alternate beveling of the blade and stem in opposite directions, typically executed on the left edge of the blade and right edge of the stem, on each face; shoulders are weakly formed and stems are usually expanding but can be parallel-sided; basal edges can be either concave, convex, or straight (Suhm et al. 1954:464–465; Johnson

Table 6-II.23 Dimensions and Descriptions of Dart Points with Parallel Stems.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 1—Bell	BIBE1520	F	25408			4.2		15	3.9	Chalcedony–brown
Form 2—Pandale	BIBE0418	A	25010	63.9	24.3	7	16.8	17.8	11.5	Silicified Wood–bluish gray
Form 2—Pandale	BIBE1100	A	25061		21.5	5.3	14.6	17.9	4.1	Chert (Maravillas)–black
Form 2—Pandale	BIBE1163	A	25209		16.2	6.2	12.4	10.7	3.2	Chert–brownish gray (w/spots)
Form 2—Pandale	BIBE1682	F	25452	28.2	13.3	4.5	11.1	10.7	1.8	Chert–white
Form 2—Pandale	BIBE1682	F	25458		10	4.7		8.4	1.5	Jasper–brown
Form 2—Pandale	BIBE1251	B	25628			5.4			1.2	Chert–white
Form 2—Pandale	BIBE1942	F	26294	40.4	15.2	7.2	14.3	11.4	4.5	Jasper–brown (w/patina)
Form 2—Pandale	BIBE0760	T	26976	45.5	13.3	5.5	14.7	9.3	3.2	Chalcedony–white (w/speckles)
Form 2—Pandale	BIBE2604	CC	27179		15.3	6.9	11	9.2	4	Agate–mottled red and brown
Form 3—Shumla	BIBE1638	E	25327	*34.2		4.8	14.4	12.7	3.3	Chert (fossiliferous)–mottled gray
Form 3—Shumla	BIBE1657	E	25386			6.2	11.2	10.1	5.7	Chert–brown (w/spots)
Form 3—Shumla	BIBE1520	F	25416			5.2	9.3	14	2.5	Chert–light gray
Form 3—Shumla	BIBE1594	F	25523			5	9.2	12.5	4.2	Agate–mottled red and brown
Form 3—Shumla	BIBE1205	B	25532			5.7	10.8	16.3	2.8	Chert–light brown (w/spots)
Form 3—Shumla	BIBE1214	B	25556			5.5		15.3	2.5	Agate–brown
Form 3—Shumla	BIBE1216	B	25577			5.4		16.9	3	Chert–gray
Form 3—Shumla	BIBE1224	B	25603	35.4		7.1	10.7	16.1	5.7	Chert (fossiliferous)–brown (w/spots)
Form 3—Shumla	BIBE1224	B	25604			4	9.3	12.2	2.4	Chert–light gray
Form 3—Shumla	BIBE1224	B	25605			5.1		10.9	2.8	Chert (fossiliferous)–brown
Form 3—Shumla	BIBE1286	B	25697			5.2	11.1	11.5	2.9	Chert–tan (w/spots)
Form 3—Shumla	BIBE1343	C	25783			5.9	9.2	12.1	3.1	Chert–dark brown (w/speckles)
Form 3—Shumla	BIBE1738	F	25864			4.6	8.2	9.3	2.2	Chert–white (w/speckles)
Form 3—Shumla	BIBE1594	F	25923			5		13	2.3	Chert–brown
Form 3—Shumla	BIBE0284	F	26463			4.8	9.4	14.2	3.3	Chalcedony–white
Form 3—Shumla	BIBE2155	I	26781			4.1	10.4	10.7	1.8	Chert–dark gray (w/spots)
Form 3—Shumla	BIBE2155	I	26786			5.4	9.2	16.5	3.3	Silicified Wood–brownish gray
Form 3—Shumla	BIBE2503	T	26956			5.6	9.7	12.7	2.1	Chert–pink
Form 3—Shumla	BIBE0970	V	27047	27.2	18.6	5	11.6	10.3	2.1	Chert (fossiliferous)–mottled gray and red
Form 3—Shumla	BIBE0987	EE	27163			4.8		13.1	2.5	Agate–mottled red and brown
Form 3—Shumla	BIBE0987	EE	27166			4.2		14.3	1.7	Chalcedony–white
Form 3—Shumla	BIBE0246	2010–D	27198			4.2		11	1.7	Chert–mottled gray and red
Form 3—Shumla	BIBE0246	2010–D	27202			5.7	11.7	13.9	3.5	Chert–tan
Form 3—Shumla	BIBE2665	2010–V	27264			5.2	9.9	11.9	4.1	Chert–white
Form 3—Shumla	BIBE2697	2010–I	27278			4.8	10.8	12.4	2.1	Agate–purple

Form 3—Shumla	BIBE2697	2010–I	27288			6.3	9.9	15.1	3.8	Chert–light gray (w/spots)
Form 4	BIBE1140	A	25172		34	6.2	13.2	11.2	4.6	Chert–mottled brown and light purple
Form 4	BIBE1145	A	25175			7.1		11.5	4.2	Chert–yellowish white (w/spots)
Form 4	BIBE1163	A	25212	*38.4	27.5	5.8	13	10.6	3.6	Chert–gray (w/spots)
Form 4	BIBE1520	F	25421		29.3	4.6		11.4	3	Chert–mottled red and brown
Form 4	IF 094	C	25797			5.5	16.6	12.6	3.4	Chert–bluish gray (w/spots)
Form 4	BIBE2155	I	26785			6.2		12.7	4.1	Chert–light gray (w/spots)
Form 5	BIBE1594	F	25858			4.9	12.8	10.7	2.1	Chert–brownish gray (w/inclusions)
Form 5	BIBE1942	F	26272	43.2	28	6	10.6	9.4	6.8	Chert–brown
Form 5	IF 901	2010–D	27186	57.4	34.7	8.1	13	11.8	10.8	Chert–mottled brown
Form 6	BIBE1152	A	25191			6.3	13.3	12.5	4.2	Chert–mottled brown and purple
Form 6	BIBE0284	F	26467		24.1	6.7	12.6	12.5	4.3	Chalcedony–clear (w/inclusions)
Form 6	BIBE0775	L	26826			5.7	10	10.8	3.1	Chert–white (w/speckles)
Form 6	BIBE2763	2010–D	27217	34.9	*20.8	5.7	9.2	*13.1	3.7	Silicified Wood–dark brownish gray
Form 6	IF 957	A	27391	36.1	23.3	5.2	14.3	15.3	4.5	Chert–mottled white and tan
Form 7	BIBE1724	F	25809		27.4	4.8	10.5	9.9	3.3	Chert–gray
Form 7	BIBE1594	F	25851	45.6	26	3.8	10.6	11.2	3.2	Chert–brownish gray
Form 8	BIBE1945	F	26478	34.9	26	4.8	10	11.7	2.8	Chert–banded light gray
Form 8	BIBE1959	F	26487			6.1	8.8	12.1	3.6	Chert–white (w/speckles)
Form 9	BIBE0418	A	25036			5.6	14.4	14.5	5.5	Chert–mottled tan and pink (w/spots)
Form 9	BIBE1942	F	26270			4.4	13.4	13.4	3.9	Chert–dark brown
Form 9	BIBE1942	F	26289			6.9	15.6	15.1	6.2	Hornfels–black (w/patina)
Form 9	BIBE0761	T	27008			7.6	10.5	15.1	5.9	Hornfels–black (w/patina)
Form 9	BIBE2446	W	27029			6.6	12.2	13.2	5.1	Chert–red
Form 9	BIBE0415	U	27144			5.3		15.6	4	Chert–black
Form 10	BIBE0418	A	25019		*34.6	8	14.7	14	8.9	Rhyolite–dark brown
Form 10	BIBE0418	A	25047		29.5	7.3	13.7	13.2	6.1	Chert (fossiliferous)–pinkish brown
Form 10	BIBE1163	A	25217		29.6	6.1	14.7	14.9	6.4	Agate–mottled red and brown
Form 11	BIBE1163	A	25214		29.2	6.5	19.2	17	7.5	Agate–mottled red and brown
Form 12	BIBE1100	A	25067		33.6	7.2	10.9	20.2	6.7	Agate–mottled red and brown
Form 13	BIBE1205	B	25546	32.5	23.7	4.4	6.9	12.3	2.4	Chert (fossiliferous)–pinkish gray
Form 13	BIBE1849	F	25973	46.5	21.4	4.1	9.6	13	3.4	Chert–yellowish white (w/spots)
Form 14	BIBE1147	A	25180	47.3	20.3	4.7	15.6	10.4	3.3	Chert–light gray
Form 15	BIBE1214	B	25562			6.3	12.9	13.4	4.2	Chert–dark brown (w/patina)
Form 15	BIBE2490	T	26920	29.3	22.8	5.2	12.7	15.5	3.3	Chert–purple (w/speckles)
Form 15	BIBE2418	V	27041	*35.9		5.7		15.7	3.5	Chert–mottled light gray
Form 15	BIBE2640	2010–C	27250	38.4	*28	6.6	15.4	13.8	4.9	Chert–brown (w/speckles and patina)
Form 16—Miscellaneous	BIBE0438	A	25050			10	16.7	12.2	7.8	Claystone–brownish red
Form 16—Miscellaneous	BIBE0438	A	25053			6.2		13.6	4.1	Chert–gray

Table 6-II.23 Dimensions and Descriptions of Dart Points with Parallel Stems. *(continued)*

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 16–Miscellaneous	BIBE1100	A	25064	42.5		6.5	12.5	11.6	5.3	Silicified Wood–brownish gray
Form 16–Miscellaneous	BIBE1110	A	25080			5.7	7.5	15.9	4.3	Silicified Wood–mottled brown, gray, and red
Form 16–Miscellaneous	BIBE1163	A	25222		24.8	9.2	9.6	15.5	7.5	Agate–brown
Form 16–Miscellaneous	BIBE1942	B	26269			5	13.3	10.3	2.8	Chert (fossiliferous)–gray
Form 16–Miscellaneous	IF 150	E	25400			4		13.3	2.7	Mudstone–reddish purple
Form 16–Miscellaneous	BIBE1205	B	25527		16.6	6.9	15.6	8.8	3.8	Chalcedony–yellow (w/patina)
Form 16–Miscellaneous	BIBE1224	B	25601			6.8		13.8	4.3	Chert (fossiliferous)–gray
Form 16–Miscellaneous	BIBE1224	B	25602			5.4		15.2	8.9	Chert–brownish gray
Form 16–Miscellaneous	BIBE1251	B	25629			6.2		13	3.6	Chert (fossiliferous)–gray
Form 16–Miscellaneous	BIBE1270	B	25669			5.3	9.2		2.1	Chert–white
Form 16–Miscellaneous	BIBE1273	B	25675			5.4	7.9	10.8	3	Chert (fossiliferous)–light gray
Form 16–Miscellaneous	BIBE1291	B	25700			3.9		12.2	2.3	Chert–white
Form 16–Miscellaneous	BIBE1300	B	25709			7.3		17	7.9	Chert–brown (w/spots)
Form 16–Miscellaneous	BIBE1434	C	25781			5	7.7	12.3	3	Chert–light grayish pink
Form 16–Miscellaneous	BIBE1882	F	26025		17.2	6.3	8	9.9	3.8	Chert–mottled pink and gray
Form 16–Miscellaneous	BIBE1942	F	26273			5.2		14.3	3.4	Chert–mottled gray and red (w/speckles)
Form 16–Miscellaneous	BIBE1942	F	26308			5.7	15.6	10.9	3.4	Hornfels–black (w/patina)
Form 16–Miscellaneous	BIBE2126	I	26751			4.2		12.8	1.8	Chert–tan
Form 16–Miscellaneous	BIBE2364	P	26880	27.4	20	6.4	11.9	15	3.6	Chert (fossiliferous)–gray
Form 16–Miscellaneous	BIBE2491	T	26929			4.1		10.7	1.8	Jasper–brown
Form 16–Miscellaneous	BIBE0760	T	26964		32.9	9.3	9.3	14.9	8.6	Chert–yellowish brown
Form 16–Miscellaneous	BIBE0761	T	27006		13.9	4.8		10.2	1.3	Chert–white
Form 16–Miscellaneous	BIBE0970	V	27043			5.1		8.9	2	Chert–white
Form 16–Miscellaneous	BIBE0749	DD	27176			6.7	15.4	11.6	2.7	Chert–light gray (w/speckles)
Form 16–Miscellaneous	BIBE2254	L	27184		18.3	5.5	10.7	14.5	3.1	Chert–gray (w/patina)
Form 16–Miscellaneous	BIBE2716	2010-HH	27296			6.5	9.4	11.3	3.7	Agate–black

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

1964:40; Turner and Hester 1985:135). A distinctive attribute of Pandale points in the greater Big Bend region is parallel-oblique flaking across both faces of the blade (Ing et al. 1996:94). Pandale points date between ca. 3500 and 2100 B.C. (Turpin 1991:28) during the Early Archaic period. These projectiles typically dominate Early Archaic assemblages in the region, and comprise more than half of the BBNP collection dating to this period.

Nine specimens in the BBNP collection are classified as Form 2 parallel-sided stem dart points and are assigned to the Pandale type. These specimens have convex blade edges and exhibit the distinctive corkscrew-twist from alternate beveling of the stems and blades that characterizes the type. As is typical of Pandale points, the stems are beveled on the right side of each face and the blades on the left side of each face, and two specimens have parallel-oblique flaking across their blades. The stems terminate primarily with convex bases, although some examples have straight basal edges. It is also noteworthy to mention that two specimens in this subcategory are uncharacteristically small in size. Kelly (1963:208) first recognized such examples from excavations at Roark Cave in eastern Brewster County and named them "short Pandale." Similar diminutive Pandale points have been recovered from the Rosillo Peak site and from foothill campsites of the Rosillos Mountains (Mallouf and Wulfkuhle 1989; Mallouf et al. 2006). These specimens were manufactured from a wide array of material types. See Form 13 in the expanding-stem dart point category below for additional specimens classified as Pandale.

***Form 3—Shumla** (26 specimens; Figure 6-II.60; Table 6-II.23)*

The Shumla type was originally named "Shumla Serrate" and "Shumla Stemmed" by Herbert C. Taylor (1948:81–85; Plate 9, D) from examples found in the Lower Pecos region of Texas. The name was ultimately shortened to Shumla and described by Suhm et al. (1954:480–481). Shumla points are characterized by triangular blades, varying blade edges that are often serrated, short-to-long barbs that extend downward toward the base, parallel-sided stems that may occasionally expand or contract slightly, convex or straight basal edges, and fine craftmanship (Suhm et al. 1954; Turner and Hester 1985:151). Another attribute that is common on Shumla points in the greater Big Bend are stems that are wedge-shaped in cross section, a result of patterned basal thinning on each face (Mallouf et al. 2006:50). These points are thought to date between ca. 1000 and 200 B.C. (Turner and Hester 1985:151; Turpin 1991:32–33) during the Late Archaic period.

Twenty-six specimens in the BBNP collection are classified as Form 3 parallel-sided stem dart points and are assigned to the Shumla type. All specimens, with the exception of one that is reworked, are fragmentary—the barbs and distal portions of the blades are most commonly missing or reworked. Lateral blade edges have variable shapes and lack serrations. The long downward sloping barbs that help to distinguish the type are missing on all examples, and two specimens completely lack barbs. Re-sharpening of the distal blade is noticeable on eight examples. The parallel-sided stems terminate with basal edges that are most commonly straight, although a few are convex. All exhibit well-thinned bases. Shumla points are fashioned from a variety of material types, primarily cherts. See Form 14 in the expanding-stem dart point category below for additional specimens classified as Shumla.

***Form 4** (6 specimens; Figure 6-II.60; Table 6-II.23)*

Six fragmentary specimens are classified as Form 4 parallel-sided stem dart points. Three have slightly concave lateral blade edges, while the other specimens are too fragmentary to note this characteristic. Shoulders are strong to moderate and slope slightly downwards. All of the stems have rectangular shapes with straight basal edges. These thin and rather well-crafted specimens are fashioned from different varieties of chert. Specimens in this group exhibit craftsmanship and shoulder morphology that is reminiscent of that seen on Langtry points, but they lack the characteristic contracting stem that helps to define that type.

Form 5 *(3 specimens; Figure 6-II.60; Table 6-II.23)*

Three specimens are classified as Form 5 parallel-sided stem dart points. Two of these are complete and have recurved blade edges while the remaining specimen is a stem fragment with one intact barb. All of these specimens exhibit strong shoulders that are well-barbed. The parallel-sided stems are square-shaped and terminate with straight basal edges. Craftsmanship as well as thickness varies among the group. Form 5 specimens are fashioned from different varieties of chert. These specimens exhibit attributes that are characteristic of various Late Archaic-aged projectile points.

Form 6 *(5 specimens; Figure 6-II.61; Table 6-II.23)*

Five specimens are classified as Form 6 parallel-sided stem dart points. While blade edge shape is variable, two specimens have serrated edges just above the shoulders. The blade of another specimen has been reworked and its blade edges are recurved. Shoulders are moderate to weak and extend outward. The parallel-sided stems are relatively long compared to other specimens in this category and terminate with convex or straight basal edges. These specimens are moderately thick and are fairly well made. Form 6 specimens are fashioned from various material types. This group exhibits attributes that are commonly associated with various Late Archaic-aged projectile points.

Figure 6-II.61 Parallel-sided stem dart points: (a–b) Form 6; (c) Form 7; (d) Form 8; (e–f) Form 9; (g–h) Form 10; (i) Form 11; (j) Form 12; (k) Form 13; (l) Form 14; (m–n) Form 15.

***Form 7** (2 specimens; Figure 6-II.61; Table 6-II.23)*

Two specimens, one complete and the other fragmentary, are classified as Form 7 parallel-sided stem dart points. The complete specimen has straight to slightly recurved blade edges, while the intact blade edge on the other specimen is recurved. Shoulders are strongly to moderately defined and barbed. The parallel-sided stems terminate with convex to slightly convex basal edges. The complete specimen is very thin and finely-crafted, while the fragmentary example is slightly thicker and made with less care. These specimens are manufactured from different varieties of chert and exhibit attributes that are characteristic of various Late Archaic-aged projectile points.

***Form 8** (2 specimens; Figure 6-II.61; Table 6-II.23)*

Two specimens, one complete and the other fragmentary, are classified as Form 8 parallel-sided stem dart points. Blade edges are recurved on the complete specimen, while the fragmentary example has remnants of concave edges. Shoulders and barbs are both moderately expressed. The parallel-sided stems terminate with slightly concave basal edges. These two specimens exhibit good craftsmanship, thinness, and are manufactured from different varieties of chert. Attributes of these specimens offer no clues as to their chronological placement within the lengthy Archaic period.

***Form 9** (6 specimens; Figure 6-II.61; Table 6-II.23)*

Six fragmentary specimens are classified as Form 9 parallel-sided stem dart points. These specimens have varying blade edge morphologies, strong to moderate shoulders that slope downwards, square to rectangular stems, and straight bases. Craftsmanship is crude to fair and most examples are relatively thick. Form 9 specimens are fashioned from various material types. Specimens in this group have attributes similar to Bulverde points (Suhm et al. 1954:404–405; Turner et al. 2011:67) of Central Texas.

***Form 10** (3 specimens; Figure 6-II.61; Table 6-II.23)*

Three fragmentary specimens are classified as Form 10 parallel-sided stem dart points. These specimens have strong to moderate shoulders that extend outward and relatively straight bases. Manufactured from various materials, they are moderately well-crafted. Attributes of these specimens offer no clues as to their chronological placement within the lengthy Archaic period.

***Form 11** (1 specimen; Figure 6-II.61; Table 6-II.23)*

One fragmentary specimen is classified as a Form 11 parallel-sided stem dart point. Missing the distal portion of the blade, it has weak shoulders, a long rectangular stem, and a straight base. It is similar to Form 9 parallel-sided specimens discussed above; however, this example is thinner and better crafted. Made of agate, it has similarities with Bulverde points (Suhm et al. 1954:404–405; Turner et al. 2011:67) of Central Texas.

***Form 12** (1 specimen; Figure 6-II.61; Table 6-II.23)*

One fragmentary specimen is classified as a Form 12 parallel-sided stem dart point. Missing the distal blade, it has moderately expressed shoulders with small barbs. The parallel-sided stem is short and wide and terminates with a slightly concave base. Fashioned from agate, this specimen exhibits good craftsmanship and is fairly thin. It has attributes similar to those displayed on Bulverde points (Suhm et al. 1954:404–405; Turner et al. 2011:67) of Central Texas.

***Form 13** (2 specimens; Figure 6-II.61; Table 6-II.23)*

Two fragmentary specimens are classified as Form 13 parallel-sided stem dart points. These specimens have moderately defined shoulders that extend outward, stems of variable length (short to long), and straight to slightly convex bases. Fashioned from different varieties of chert, they exhibit good craftsmanship and are relatively thin. Form 13 dart points exhibit attributes that are commonly associated with various Late Archaic-aged projectile points.

Form 14 (1 specimen; Figure 6-II.61; Table 6-II.23)

One complete specimen is classified as a Form 14 parallel-sided stem dart point. Relatively long and slender, it has straight blade edges, moderately defined shoulders that angle upward slightly, a rectangular stem, and a straight base. Fashioned from chert, it is thin and well-crafted. This example dates to an unknown portion of the Archaic period.

Form 15 *(4 specimens; Figure 6-II.61; Table 6-II.23)*

Four specimens are classified as Form 15 parallel-sided stem dart points. Lateral blade edges are highly variable as a result of reworking on three specimens, while the other is missing much of its blade. Moderate to weakly defined shoulders apparently terminated with small barbs which are now missing due to breakage. These specimens have concave bases and are made of different varieties of chert. Form 15 dart points exhibit attributes that are commonly associated with various Early Archaic projectile points, but cannot be conclusively affiliated with that period.

Form 16—Miscellaneous *(28 specimens; Table 6-II.23)*

The Form 16 miscellaneous parallel-sided stem dart point category contains 28 specimens that cannot be confidently assigned to any of the above subcategories. These specimens are manufactured from a variety of raw material types, primarily cherts.

Expanding Stems

A total of 358 specimens in the BBNP collection are classified as expanding-stem dart points. Within this category, 17 subcategories (Forms 1–17) conform to known types, while 27 additional subcategories (Forms 18–44) lack type designations. Specimens too fragmentary to allow confident placement in any of these subcategories are assigned to a miscellaneous group (Form 45). Descriptive and dimensional data for dart points in this category are presented in Table 6-II.24.

Form 1—Andice *(1 specimen; Figure 6-II.62; Table 6-II.24)*

The Andice type was named and described by Elton R. Prewitt (1983:1–6) from examples discovered by J.E. Pearce in 1929 at the Gault Farm site in Williamson County, Texas. Andice points are large triangular points with straight to convex blade edges, and long rectangular stems that are well-thinned. The type is known for its deep basal notches that produced massive, downward-angled barbs, the size of which resulted in a high rate of breakage (Prewitt 1983; Turner and Hester 1985:64–65). Andice points are affiliated with the Calf Creek horizon (Wyckoff 1994; Calame et al. 2002), and date between ca. 4500 and 3500 B.C. during the Early Archaic period (Turner et al. 2011:57; Houk et al. 2008, 2009).

One specimen in the BBNP collection is classified as a Form 1 expanding-stem dart point and is assigned to the Andice type. Made of chert, it has a heavily reworked blade and slightly convex blade edges. The large massive barbs are missing, having been reworked into weak shoulders, although one of these is also missing from a hinge fracture. The stem is long with a general rectangular shape although it expands slightly near the well-thinned convex base.

Form 2—Baker *(5 specimens; Figure 6-II.62; Table 6-II.24)*

Baker points were initially named and described by James H. Word and C.L. Douglas (1970:21) from examples found at Baker Cave in Val Verde County, Texas. They described two varieties of the type based on stem termination and shoulder attributes. One variety has an expanding stem with a bifurcated base and shoulders that may be strongly barbed. The second variety is characterized by convex stem edges giving the stems "bowlegged" appearances, concave bases with rounded basal ears, and shoulders that vary from weak to strong and are less commonly barbed. Both varieties

Figure 6-II.62 Expanding stem dart points: (a) Form 1—Andice; (b-c) Form 2—Baker; (d-e) Form 3—Bandy; (f) Form 4—Bell; (g-h); Form 5—Charcos; (i-j) Form 6—Conejo; (k-l) Form 7—Ellis; (m-p) Form 8—Ensor.

have straight to convex blade edges, thick cross-sections, and are well-crafted (Word and Douglas 1970; Turner and Hester 1985:68). Baker points date between ca. 6000 and 4000 B.C. during the Early Archaic period (Turner and Hester 1985:68).

Five specimens in the BBNP collection are classified as Form 2 expanding-stem dart points and are assigned to the Baker type. Due to breakage, blade edges can only be confidently classified on two specimens: one has been reworked with straight and convex edges, the other has slightly concave edges. Shoulders are weak to strong and one specimen has small barbs. The stems expand slightly, giving one a "bowlegged" appearance. Basal edges have variable shapes, from concave to convex. These specimens are fashioned from a variety of material types, primarily cherts.

Form 3—Bandy *(8 specimens; Figure 6-II.62; Table 6-II.24)*

Bandy points were originally named and described by James H. Word and C.L. Douglas (1970:21) using examples found at Baker Cave in Val Verde County, Texas. These thin and very well-crafted points are characterized by slightly convex to slightly recurved blade edges, strong barbs, stems that expand slightly, and concave bases with "fishtail" appearances. As noted by McReynolds (1993:15), some Bandy points have serrated blade edges. Bandy points date between ca. 6000 and 4000 B.C. during the Early Archaic period (Turner and Hester 1985:69; Houk et al. 2008, 2009).

Eight specimens in the BBNP collection are classified as Form 3 expanding-stem dart points and are

Table 6-II.24 Dimensions and Descriptions of Dart Points with Expanding Stems.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 1—Andice	IF 840	W	27023	45.9		6.1	18.1	16.4	5.3	Chert–brown
Form 2—Baker	BIBE1594	F	25518		*23.1	4.6	14.3	11	2.6	Chert–light gray (w/spots)
Form 2—Baker	BIBE0415	U	27141			6.6			2.8	Chert–mottled pink and purple
Form 2—Baker	BIBE0246	2010–D	27206	*29.9		5.2	12.7	10.7	2.4	Chert–yellowish white
Form 2—Baker	BIBE2668	2010–V	27265			7.4		11.6	2	Chert–light gray
Form 2—Baker	BIBE2697	2010–I	27280			5.4			3.4	Rhyolite–brown (w/patina)
Form 3—Bandy	BIBE1682	F	25448			5.5	5.7	12.1	3.8	Chert–mottled light brown (w/speckles)
Form 3—Bandy	BIBE1682	F	25453			5.2	7.9	14.8	5.9	Chert–purple (w/speckles)
Form 3—Bandy	BIBE1314	JQ–1	25736			4.2	6.4	12.4	3	Chert–light gray (w/patina)
Form 3—Bandy	BIBE0284	F	26469			4.1	*6.3	11.1	1.8	Chert–gray
Form 3—Bandy	BIBE2255	L	26816			3.6		11.9	2.1	Chalcedony–mottled clear and black (w/patina)
Form 3—Bandy	IF 823	T	26914			5.9	7.7	14.8	4.4	Chert–light gray (w/patina)
Form 3—Bandy	BIBE0246	2010–D	27207			4.6	6.4	14.5	4.3	Chalcedony–clear (w/patina)
Form 3—Bandy	BIBE2769	2010–D	27232			5.1	*7	16.2	4.5	Agate–dark brown
Form 4—Bell	BIBE2697	2010–I	27287		38.6	5.2	9.5	14.5	6.4	Chert–gray (w/patina)
Form 5—Charcos	BIBE1214	B	25558	37.6	24.6	5.2	8.2	12.7	4.3	Chert–mottled brown and gray (w/spots)
Form 5—Charcos	BIBE2624	2010–G	27237	32.6	22	5.3	8.9	11.9	3.3	Chert–mottled gray and red (w/inclusions)
Form 6—Conejo	BIBE0418	A	25000		*34.8	6.6	11.9	19.4	7.9	Chert (fossiliferous)–brown
Form 6—Conejo	BIBE0418	A	25039			5.7	9.4	20.4	7.4	Chert–mottled pink and brown
Form 6—Conejo	BIBE1100	A	25056		38.1	6.7	13.4	20	7.7	Agate–brown
Form 6—Conejo	BIBE1102	A	25070			4.7	10.3	17.3	4.8	Chert–gray
Form 6—Conejo	BIBE1135	A	25165			8	12	22.1	8.2	Chert–light gray (w/spots)
Form 6—Conejo	BIBE1668	E	25394		*42.1	7.4	10.1	23.8	10.7	Chert–purple (w/spots and patina)
Form 6—Conejo	BIBE1594	F	25519			6.1	10.1	15.3	3.8	Chert–mottled light gray
Form 6—Conejo	BIBE1214	B	25565		39.7	5.5	12.5	20.2	6.2	Chert–mottled tan
Form 6—Conejo	BIBE0124	B	25676	33.4	34.1	6.2	9.8	19.8	8.3	Chalcedony–white (w/patina)
Form 6—Conejo	BIBE1351	C	25773		*34	6.1	10	18.4	8.4	Chert–grayish purple (w/spots)
Form 6—Conejo	BIBE1849	F	25975			6		20.8	5.9	Silicified Wood–reddish brown
Form 6—Conejo	BIBE2501	T	26952			7.8	9.4	17.9	8.4	Chert–gray
Form 7—Ellis	BIBE0418	A	25029	38.3	27.1	7	10.9	17.6	6.4	Chert–brownish red (w/spots)
Form 7—Ellis	BIBE1163	A	25219		*30.6	7.4	9.3	17	6.6	Chert (fossiliferous)–reddish brown
Form 7—Ellis	IF 002	A	25233			5	10.5	13.5	3.7	Chert–light gray (w/spots)
Form 7—Ellis	BIBE1205	B	25539			4.4	10.6	14.1	1.8	Chert–white (w/patina)
Form 7—Ellis	BIBE1324	JQ–1	25750		*24.7	4.5	10.8	14.2	2.3	Agate–mottled red and brown
Form 7—Ellis	BIBE2433	W	27025	44.6	18.7	7.3	10	10.4	5.6	Jasper–mottled brown

Form 7—Ellis	BIBE2763	2010-D	27223	21.9	17	5	9.1	9.6	1.4	Chert–mottled light gray
Form 8—Ensor	BIBE0418	A	25003		21.7	6.2	13.2	12.2	4.5	Chert–grayish pink (w/spots)
Form 8—Ensor	BIBE1163	A	25226		21.8	8.1	14.2	10.8	6.7	Silicified Wood–mottled gray, brown, and red
Form 8—Ensor	BIBE1628	E	25314		23.1	6.6	11.9	12.3	4.6	Chert–light gray (w/spots)
Form 8—Ensor	BIBE1654	E	25351	30.1	19.5	5.5	12.5	11.4	2.9	Chert–light gray (w/spots)
Form 8—Ensor	BIBE1702	F	25498			6.6		23	3	Chert–banded brown
Form 8—Ensor	BIBE1205	B	25535	27.6	20.7	6.3	12.5	11.5	3.7	Chert–dark bluish gray (w/speckles)
Form 8—Ensor	BIBE1257	B	25648			6	11.2	13.3	5.3	Chert–mottled tan and white
Form 8—Ensor	BIBE1278	B	25687		21.4	6.9	10.6	12.1	3.3	Chert (fossiliferous)–mottled gray
Form 8—Ensor	BIBE1278	B	25688		*26.4	6.9	13.4	13.8	4.4	Chert (fossiliferous)–mottled pinkish gray
Form 8—Ensor	BIBE1278	B	25691			4.2	13.4	15.6	2.5	Chert–mottled purple and tan
Form 8—Ensor	BIBE1380	C	25776			5.6	11	13.7	2.5	Chert–dark brown
Form 8—Ensor	BIBE0546	Y	26080	40.8	23.3	8.6	14	13.3	5.7	Chert (fossiliferous)–brown
Form 8—Ensor	BIBE2535	AA	27077		23.7	6.6	12.5	11.3	4	Chert (fossiliferous)–brown
Form 8—Ensor	BIBE2572	Y	27088	30.3		5.3	12.8		2.2	Chert–pink (w/spots)
Form 8—Ensor	BIBE2574	Y	27089			7.4			4.8	Chert–white
Form 8—Ensor	BIBE2519	U	27101	29.1	18.3	5.2	9.3	9.7	2.6	Chert–grayish purple
Form 8—Ensor	BIBE2763	2010-D	27222			5.3		13.6	1.6	Chert–white
Form 8—Ensor	BIBE2697	2010-I	27285		29.6	6.9	12.9	17	7.8	Chert–light gray
Form 8—Ensor	BIBE2716	2010-HH	27290	30.5	22.7	5	12.7	13.2	3.3	Chert–pink (w/spots)
Form 8—Ensor	BIBE2716	2010-HH	27293	35.9	20.8	7.5	13.3	9.4	4.8	Chert–mottled gray and red (w/inclusions)
Form 9—Figueroa	BIBE1100	A	25066			5	8.3	14.3	1.9	Agate–mottled red and brown
Form 9—Figueroa	BIBE1672	F	25430			5.9		11.9	1.4	Chalcedony–brown
Form 9—Figueroa	BIBE1702	F	25495	30.6	16.5	5.4	9.6	9.2	2.3	Chalcedony–mottled clear and tan
Form 9—Figueroa	BIBE1205	B	25536		15.5	5.1		9.8	2.4	Chalcedony–clear
Form 9—Figueroa	BIBE1214	B	25557			6.2		12.4	2.3	Chert–light gray
Form 9—Figueroa	BIBE1594	F	25822		14.9	4	10.1	9	1.4	Chert–gray (w/spots)
Form 9—Figueroa	BIBE1849		25970		15.2	4.8	8.1	9.7	1.7	Chert–white
Form 9—Figueroa	BIBE1849	F	25974		17.4	5.3	11.1	12.1	2.3	Chert (fossiliferous)–dark bluish gray
Form 9—Figueroa	BIBE1849	F	25979	*32.3	18	4.7	8.2	15.4	2.6	Chert–light gray
Form 9—Figueroa	BIBE1849	F	25984			4.9	7.7	11.3	1.7	Chalcedony–mottled red and white
Form 9—Figueroa	BIBE1849	F	25996		17	4.4	8.3	13.7	1.8	Chert–light brown (w/speckles)
Form 9—Figueroa	BIBE1902	F	26031			4.8	7.6	11.6	1.4	Chert–purple (w/speckles)
Form 9—Figueroa	BIBE1942	F	26261	20.2	17.1	4.5	8.1	12.4	1.5	Chalcedony–yellowish white
Form 9—Figueroa	BIBE0775	L	26828	20.9	16.4	5.8	10.2	9.4	1.7	Chert–light purple (w/speckles)
Form 9—Figueroa	BIBE2491	T	26926			5.7	9	10.7	1.7	Chert–mottled white and red
Form 9—Figueroa	BIBE2497	T	26948	26.6	17.9	5.2	5.7	15.7	2.3	Chalcedony–mottled brown
Form 9—Figueroa	BIBE2502	T	26953	27.2	16.5	5.3	10.1	11.4	2.3	Chert–mottled light gray and tan (w/spots)
Form 9—Figueroa	BIBE2562	Y	27080	28.4	14.8	3.8	9.9	8.5	1.3	Chert–white

Table 6-II.24 Dimensions and Descriptions of Dart Points with Expanding Stems. *(continued)*

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 9—Figueroa	BIBE0415	U	27150	22.4	13.5	6.4	9.5	9.5	1.9	Silicified Wood–dark brown (w/patina)
Form 9—Figueroa	BIBE0246	2010–D	27193	*20.4		5.7	8.2	13.4	1.9	Chalcedony–mottled brown and white
Form 9—Figueroa	BIBE2662	2010–E	27257	*29.4	15.4	4.1	8.8	8.9	1.8	Chert–bluish gray (w/speckles)
Form 10—Hueco	BIBE1136	A	25168	31.8		6.3	9.5	14.5	4.2	Chert–mottled gray (w/spots)
Form 10—Hueco	IF 003	A	25234			7.4	10.4	13.8	5.5	Chert–light gray (w/speckles and patina)
Form 10—Hueco	IF 005	A	25235	49.6	24.9	7.1	9.5	12.1	7.5	Jasper–mottled brown and red
Form 10—Hueco	BIBE1604	E	25300			7	12.2	13	6	Chert–mottled gray (w/speckles)
Form 10—Hueco	BIBE1653	E	25348			7.3	11.4	15.6	6.6	Silicified Wood–dark brown
Form 10—Hueco	BIBE1682	F	25445			5.3	11.5	14	4.3	Chalcedony–gray (w/speckles)
Form 10—Hueco	BIBE1291	B	25702	24.1	21.9	5.1	11.3	13.2	2.4	Chalcedony–clear
Form 10—Hueco	BIBE1849	F	25977		22.2	5.6	9.7	14.6	4.9	Agate–brown
Form 10—Hueco	BIBE2430	O	26891	44.1	24.9	7.7	10.5	13.1	6.3	Chert–mottled brown and gray (w/speckles and patina)
Form 10—Hueco	BIBE2506	T	27015			5.7	10.6	14.5	3.7	Chert–mottled purple and white
Form 10—Hueco	BIBE2506	T	27020			6	9	13.7	3.5	Agate–brown
Form 10—Hueco	BIBE2572	Y	27085	*40.6	22	5.1	7.5	11.9	4.2	Chert–light gray (w/spots)
Form 10—Hueco	BIBE2526	U	27110	*41.8	26.7	7	10.1	15.3	6.8	Chert–mottled brown
Form 10—Hueco	BIBE0921	P	27209	39.4	23.1	5.4	11.5	10.3	4.4	Chert–white
Form 11—Martindale	IF 820	T	26912		*25	5.2	10.8	14.4	3.6	Chert–mottled gray and pink
Form 11—Martindale	BIBE2523	U	27103	47.7	25.1	6.5	11.5	15.4	7.2	Chert–banded gray and brown (w/spots)
Form 12—Paisano	BIBE1105	A	25071			5.7			2.2	Chert (fossiliferous)–brownish gray
Form 12—Paisano	BIBE1108	A	25072		*19.6	6.4	7.8	15.2	3.7	Chert–mottled red and tan
Form 12—Paisano	BIBE1109	A	25073			5.6		18.7	3.6	Chert–light gray
Form 12—Paisano	BIBE1118	A	25105		20.5	5.9	9.2	17.4	2.6	Chert–mottled light brown and purple
Form 12—Paisano	BIBE1149	A	25181			9.4			10.3	Rhyolite–reddish brown
Form 12—Paisano	BIBE1157	A	25202	37.2	19.7	5.3	8.8	15.8	3.2	Chert–white
Form 12—Paisano	BIBE1163	A	25207	31.6	19.7	5.1	7	16	2.5	Chert–gray
Form 12—Paisano	BIBE1611	E	25304			6		24.2	5.2	Chert–banded gray and brown
Form 12—Paisano	BIBE1654	E	25352	40.9	20.1	6.1	9.1	14.1	4.8	Chert–pink (w/spots and veins)
Form 12—Paisano	BIBE1668	E	25395	37.2	21	7.1	7.3	19.3	4.7	Chert–brownish gray (w/inclusions)
Form 12—Paisano	BIBE1205	B	25550		28	7.8	10.8	23.7	5.5	Chert–mottled gray
Form 12—Paisano	BIBE1214	B	25564		29.2	7.4	10.7	25	8	Chert (fossiliferous)–brownish gray
Form 12—Paisano	BIBE0048	B	25611			6.4		17.1	3.6	Chert (fossiliferous)–pinkish gray
Form 12—Paisano	BIBE1257	B	25639			6.2		14.9	4.5	Chert–white
Form 12—Paisano	BIBE1257	B	25641	*40.4		8		22.9	7.5	Chert (fossiliferous)–mottled gray and purple
Form 12—Paisano	BIBE1257	B	25646	42	32.7	7.4	12.1	26.2	7.6	Chert–mottled gray
Form 12—Paisano	BIBE1309	JQ–1	25731		16.2	6.3	8.2	13.5	1.4	Chalcedony–light gray

Form 12—Paisano	BIBE1942	F	26285		19.5	6.1	8.3	14	3.2	Chalcedony–mottled clear and black
Form 12—Paisano	BIBE1942	F	26286			6.5		14.7	1.6	Chert–pink (w/spots)
Form 12—Paisano	IF 615	L	26802	46.6	19.3	6.1	9	13.5	5.2	Chert–mottled brown
Form 12—Paisano	BIBE2394	R	26901		*18.5	5.6	8.7	13.5	2.8	Chert–mottled gray and purple
Form 12—Paisano	BIBE2394	R	26902		19.4	6.6	9.8	14.1	2.7	Chalcedony–mottled red and pink
Form 12—Paisano	BIBE2394	R	26903			5.9		16.4	3	Chert–light gray
Form 12—Paisano	BIBE2491	T	26925	*32.8	19.2	5.8	9	15	3.4	Chert–white
Form 12—Paisano	BIBE2501	T	26951		24.5	7.6	10	22.2	6.6	Chert–white (w/inclusions)
Form 12—Paisano	BIBE2503	T	26955	40.3	21.9	8.4	6.6	15.4	6.9	Chert–bluish gray (w/speckles)
Form 12—Paisano	BIBE0760	T	26984			6.9		22.5	6	Hornfels–black (w/patina)
Form 12—Paisano	BIBE0761	T	26988			6.2			3.1	Chert–mottled gray (w/spots)
Form 12—Paisano	BIBE0593	V	27051		19.9	6.4	8.7	16.8	3.1	Chert–bluish gray (w/speckles)
Form 12—Paisano	BIBE2551	Y	27079		*22.2	6		17	3.5	Chert–white
Form 12—Paisano	BIBE2519	U	27095	*49.7	27.4	6.2	10	17.7	6.5	Chert–light gray (w/spots)
Form 12—Paisano	BIBE2531	U	27128		23.4	6.5	10.7	17.9	4.3	Chert–tan
Form 12—Paisano	BIBE0415	U	27139	*42.4	19.2	6.8	6.5	14.5	5.5	Agate–brown
Form 12—Paisano	BIBE0988	EE	27171			6.1			2.6	Agate–dark brown
Form 12—Paisano	BIBE0988	EE	27172			7.9	*9.5	20.7	8.2	Hornfels–black (w/patina)
Form 13—Pandale	BIBE1124	A	25159		16.6	6.1	15	10	3.6	Agate–red
Form 13—Pandale	BIBE1152	A	25193		17.2	7.4	14.1	9.4	5.2	Chert (fossiliferous)–brownish gray
Form 13—Pandale	BIBE1203	B	25273	*31.8	16.4	5.1	8.5	13.1	2.6	Chert–mottled gray and purple
Form 13—Pandale	BIBE1638	E	25326		24.6	7.1	16.3	12.5	5.7	Chert–mottled purple and brown
Form 13—Pandale	BIBE1638	E	25328	*41.4	18.7	7	15.2	11.3	5.7	Chert (Maravillas)–black
Form 13—Pandale	BIBE1644	E	25338	*38.7	15.1	7.1	14.5	10.9	4.1	Chert (Maravillas)–black
Form 13—Pandale	BIBE1655	E	25355			5.8	9.4	11.7	2.7	Chalcedony–clear
Form 13—Pandale	BIBE1655	E	25379	33.1	19.2	4.1	10.2	10.6	2.8	Agate–brown
Form 13—Pandale	BIBE1205	F	25541		16.1	4.7	12.2	11.8	2.7	Chalcedony–clear
Form 13—Pandale	BIBE1682	F	25454		15.2	4.7	9.6	9.6	1.6	Agate–brown (w/patina)
Form 13—Pandale	BIBE1682	F	25457	*35.9	16.1	4.9	9.9	11.1	2.6	Agate–brown
Form 13—Pandale	IF 160	F	25480	*55.1	22	7.2	15.9	12.9	8.8	Agate–brown (w/patina)
Form 13—Pandale	BIBE1205	B	25534	40.6	19.9	6.3	15.2	12.8	4.8	Chert (fossiliferous)–brownish gray
Form 13—Pandale	BIBE1218	B	25592	*41.2	17.2	5.8	9.2	12.2	4.1	Chert–brownish red
Form 13—Pandale	BIBE1218	B	25598			7.3	16.4	14.5	5.2	Chert–mottled gray and brown (w/patina)
Form 13—Pandale	BIBE1251	B	25631		16.5	5.3	12.5	11.7	2.3	Chert–mottled gray
Form 13—Pandale	BIBE1315	JQ-1	25739		20	7.1	15.6	9.4	4.4	Chert–banded pink and gray
Form 13—Pandale	BIBE1849	F	25987	28.2	15.4	4.8	10.5	11.5	2.4	Agate–red
Form 13—Pandale	BIBE1849	F	25995	35.3	13.9	5.1	8.3	9.4	2.2	Chalcedony–mottled bluish gray
Form 13—Pandale	BIBE2117	I	26746	26.9	19.2	6	12.6	13.8	2.8	Chalcedony–red (w/speckles)
Form 13—Pandale	BIBE2142	I	26769	30.9	15	8	12.1	12.6	3.3	Chert–purple (w/spots)

Table 6-II.24 Dimensions and Descriptions of Dart Points with Expanding Stems. *(continued)*

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 13—Pandale	BIBE2215	K	26792		13.1	5			1.5	Jasper–red
Form 13—Pandale	IF 833	T	26918	40.6	22.2	6.7	18.3	15.3	6	Chert (fossiliferous)–brownish gray
Form 13—Pandale	BIBE2531	U	27127	43.6	17.3	6.5	15.7	10.1	3.9	Chert (fossiliferous)–gray
Form 13—Pandale	BIBE0988	EE	27170	26.4	14.4	5	9.1	11	1.9	Chert–purple (w/speckles and patina)
Form 13—Pandale	IF 939	2010–D	27189		19	7.1	17.3	13.4	6	Chert–mottled red and tan (w/spots)
Form 13—Pandale	BIBE2697	2010–I	27276		20.8	6	13.4	11.8	2.8	Chert–gray
Form 13—Pandale	BIBE2697	2010–I	27283			5.9		14.2	2.4	Chert–brownish gray (w/patina)
Form 14—Shumla	BIBE0418	A	25015			6.9	12.7	12.2	3.7	Chert–tan
Form 14—Shumla	BIBE0418	A	25031	45.7	22.9	4.3	10.3	8.5	2.3	Chert–gray (w/spots)
Form 14—Shumla	BIBE1140	A	25170			4.9	9.3	9.7	2.4	Chert–light gray
Form 14—Shumla	BIBE1157	A	25198			5.1	9	10	2.2	Chert–bluish gray (w/speckles)
Form 14—Shumla	BIBE1163	A	25227			4.2	8.5	9.3	1.9	Chert–gray (w/spots)
Form 14—Shumla	BIBE1175	B	25251	31.7		4.5	11.9	12.1	2.5	Chert–mottled gray
Form 14—Shumla	BIBE1655	E	25368			4.2	7.8	6.9	1.4	Chert–light gray (w/spots)
Form 14—Shumla	BIBE1681	F	25442	*32.2	20.2	4.9	10	11.7	2.5	Chert–light gray (w/spots)
Form 14—Shumla	BIBE1682	F	25446	32.8	27.9	5.2	11.1	10.8	3.3	Chert–black
Form 14—Shumla	BIBE1594	F	25520	42.2	27.1	4.6	10.2	10.8	4	Chert–brownish gray
Form 14—Shumla	BIBE1205	B	25543			5	11.9	12.4	3.1	Chert–mottled yellowish brown
Form 14—Shumla	BIBE1211	B	25554			7.6	10.8	13.1	5	Chalcedony–mottled red, gray, and tan
Form 14—Shumla	BIBE1218	B	25589			4.8	8.8		1.8	Chert–white
Form 14—Shumla	BIBE1308	JQ–1	25728			5.3	11.2	12.4	3.5	Chert–mottled tan and red
Form 14—Shumla	BIBE1323	JQ–1	25748			3.6		9.7	1.1	Chert–mottled grayish purple
Form 14—Shumla	LS 135a	D	25802			4.8	10.2	14.1	3.5	Chert–pink
Form 14—Shumla	LS 135b	D	25803	32.6		4.9		14	3.2	Chert–pinkish gray
Form 14—Shumla	BIBE1594	F	25850			4.9	10.8	13.1	1.7	Chert–dark gray (w/spots)
Form 14—Shumla	BIBE1753	F	25895	34.9		4.6	11.3	12.1	2.8	Chalcedony–mottled brown
Form 14—Shumla	BIBE1902	F	26032			5.1		7.2	1.7	Chert–brown
Form 14—Shumla	BIBE0859 (G)	F	26683			4.3	9.5	9.6	2.5	Chert (fossiliferous)–gray
Form 14—Shumla	BIBE2101	I	26744			4.5	9.5	13.4	3	Chert–mottled purple (w/patina)
Form 14—Shumla	BIBE0775	L	26834			3.9	10.6	11.8	2.2	Chert–purple (w/spots)
Form 14—Shumla	BIBE2323	L	26856			4.5	8	8.3	2.4	Chert–reddish brown
Form 14—Shumla	BIBE0761	T	26998			4	9.6	11.9	2	Chert–yellowish white
Form 14—Shumla	BIBE2506	V	27042			4	10.6	11	2.2	Chert–brown (w/spots)
Form 14—Shumla	BIBE0593	V	27053			5.1	9.7	9.2	1.9	Chert–mottled purple
Form 14—Shumla	BIBE2520	U	27102			5	12.7	14.2	3.2	Chert–white
Form 14—Shumla	BIBE0246	2010–D	27205	26.5		4.2	9.9	8.5	1.9	Chert–brownish gray

Form 14—Shumla	BIBE2763	2010-D	27218			4	10	9.7	1.9	Chert (fossiliferous)-brown
Form 14—Shumla	BIBE2763	2010-D	27226			4.9	8.6	9.9	1.7	Chert-white
Form 14—Shumla	BIBE2766	2010-D	27230			4.5	9.4	12.3	2.6	Chert-mottled gray
Form 14—Shumla	BIBE2624	2010-G	27236			4.6	9.9	9.9	2.7	Chert-mottled tan and light gray (w/speckles)
Form 14—Shumla	BIBE2634	2010-C	27244			4.2		9.7	1.8	Chert-mottled red
Form 15—Val Verde	BIBE1144	A	25174	*44.4	20.6	6	16.3	9.9	3.8	Jasper-mottled reddish brown
Form 15—Val Verde	BIBE1145	A	25176			4	11.8	8.7	1.9	Chert-gray
Form 15—Val Verde	BIBE1163	A	25211		23.7	4.8	13.2	10.8	2.4	Agate-brown
Form 15—Val Verde	BIBE1216	B	25573			6.6	14.6	10.9	5.1	Hornfels-gray (w/patina)
Form 15—Val Verde	BIBE1942	F	26275	48	*25.8	5.2	14.1	10.6	5.4	Hornfels-black (w/patina)
Form 15—Val Verde	BIBE2403	R	26911	43.8		5.1		7.8	2.4	Chert-gray (w/spots)
Form 15—Val Verde	BIBE0761	T	26987	37.2	18.1	4.7	13.3	9	2.8	Hornfels-gray (w/patina)
Form 16—Van Horn	IF 707	L	26847		21.9	4.7		10	3.7	Chert-white
Form 16—Van Horn	BIBE0415	U	27145	32	18.1	4.7	8.5	6.9	1.9	Agate-mottled red and brown
Form 17—Zorra	BIBE2497	T	26944	39.3	23.2	6.1	17	13.2	5.1	Mudstone-dark brown
Form 18	BIBE2697	2010-I	27281	38.4	21.4	6.5	10.8	11	4	Chert (fossiliferous)-mottled gray
Form 19	BIBE1118	A	25118		16	6.4		8.2	3.8	Chalcedony-clear (w/patina)
Form 19	BIBE1336	JQ-2	25769	*30.3	*14.8	5.8	10.2	7.6	2.2	Chalcedony-white (w/speckles)
Form 20	BIBE0418	A	25001	46.8	20.6	7.2	6.9	15.3	6.3	Chert-pinkish gray
Form 20	BIBE1204	B	25288		20.4	5.4	8.5	15.5	5.6	Chert (fossiliferous)-pink
Form 20	BIBE1690	F	25469		15.7	7		12.3	3.4	Chert-mottled gray and brown (w/spots)
Form 20	BIBE1700	F	25479		*23.3	8.6	*8.2	18	7	Chert-tan (w/speckles and patina)
Form 20	BIBE2136	I	26763		19.1	7.8	9.3	13.9	4.2	Chert-mottled purple
Form 20	BIBE2394	R	26906		17.8	8.2	9.6	14	5.3	Agate-brown
Form 20	BIBE2497	T	26945		20.1	4.9	*7	15.6	2.9	Chert-white
Form 20	BIBE2509	X	27010		19.7	6.7	6.7	14.1	4.3	Chert-mottled gray and purple
Form 20	BIBE2763	2010-D	27221			5.4		14.3	2	Chert-white
Form 21	BIBE1694	F	25474	*31.8	24.7	5.7	8.6	18.7	3.8	Chert-grayish purple
Form 21	BIBE1291	B	25703			6.7	11	20.5	4.6	Chert-mottled red
Form 21	BIBE1594	F	25824	34.8	22.4	8.1	8.5	18.3	5.2	Chert-brown (w/spots)
Form 21	BIBE1594	F	25841	*33.3	25.7	6.5	9.2	22.3	4.6	Claystone-mottled gray and red
Form 21	BIBE2254	L	26815			5.1	8.7	19.6	3.5	Chert-mottled tan and white
Form 21	BIBE0760	T	26983		26.2	5.6	10.6	20.5	3.2	Chert-yellowish white
Form 22	BIBE2430	O	26890		17.3	4.9	9	8.8	2.2	Chert-light gray and purple (w/spots and patina)
Form 22	IF 888	U	27090	34.5	*18.6	5.2	9.3	11.1	2.7	Chalcedony-mottled tan (w/patina)
Form 23	BIBE1628	E	25315	25.8	18.2	5.9	10.4	12.4	2.3	Chert-pink (w/spots)
Form 23	BIBE2490	T	26923	*30.4	*18.9	7.7	11.1	12.9	3.8	Chert-mottled red and white (w/patina)
Form 24	BIBE1639	E	25332		16.2	5.4	11.5	9.4	2.1	Chert-brownish gray
Form 24	BIBE1205	B	25548	27.2	16.8	6.5	11.8	9.1	2.3	Chert-mottled tan and white

Table 6-II.24 Dimensions and Descriptions of Dart Points with Expanding Stems. *(continued)*

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 24	IF 081	B	25718		21.1	8.1	14.7	13.9	7.3	Agate–brown
Form 24	BIBE2527	U	27115			5.1		11.4	1.3	Chert (fossiliferous)–pinkish gray
Form 25	BIBE2497	T	26949		24.5	6.4	10.9	15.7	4.7	Silicified Wood–clear and white
Form 25	BIBE2503	T	26954		*22.8	6.9	12.1	14.4	3.1	Chert–mottled brownish gray (w/spots)
Form 26	BIBE1654	E	25350	29.1	20.1	6.1	9.9	8.5	2.3	Chert–mottled brown and red
Form 27	BIBE1604	E	25301		17.8	5	9.2	12	1.9	Chalcedony–white (w/patina)
Form 27	BIBE1257	B	25632	34.8	19.5	5.3	9.4	11.6	3.2	Chert–mottled white
Form 27	IF 832	T	26917	*27.9	*19.4	5.3	8.8	10.2	1.9	Chert–purple (w/spots)
Form 28	BIBE1163	A	25225		*18.9	5.7	10	11.3	3.2	Jasper–mottled brown and red
Form 28	LS 165	F	25481			5.7	8.9	11.9	1.4	Chert–white
Form 29	BIBE1682	F	25447			5.1	8.8	11.7	2.4	Chert–white
Form 30	BIBE1216	B	25576			5.2	11.1	14.2	1.5	Chert–mottled brown (w/spots)
Form 30	BIBE2255	L	26818			4.9	10.7	*14.2	2.3	Chalcedony–white (w/speckles and patina)
Form 30	BIBE0761	T	27009			6.2	11.9	*12.7	2.5	Chert–dark brown
Form 30	BIBE2695	2010–I	27272			5.8		13.2	2.1	Chert–mottled white
Form 31	BIBE1257	B	25635	39.2	24.7	7.4	18.3	16.6	6.6	Chert–light brown
Form 32	BIBE0438	A	25055		20.7	6.1	17.6	11.6	3.1	Chert (Maravillas)–black
Form 32	BIBE0760	T	26981	*52.5	21.6	6.8	17.2	12.2	7.1	Hornfels–black (w/patina)
Form 32	BIBE2519	U	27100		21.5	5.6		10.8	4.4	Chert–white
Form 32	BIBE2662	2010–E	27259		19.9	7.7	16.5	12.2	6.4	Hornfels–gray (w/patina)
Form 33	BIBE0438	A	25054		30.5	6	10.4	16.2	3.7	Chert–mottled brownish red and white
Form 33	BIBE1849	F	25972	42.7	25.6	5.3	10.3	13.7	4.5	Chalcedony–mottled yellowish brown
Form 33	BIBE2030 (B)	F	26551			7.3	8.4	12.5	5.1	Chert–white (w/speckles)
Form 34	BIBE1681	F	25441	*79.8	35.6	7.1	12.2	19.2	17.8	Chert–brownish gray
Form 34	BIBE2280	L	26845		37.9	8.6	14.2	22.2	24.6	Chert–mottled pink (w/patina)
Form 35	BIBE1682	F	25444			4.4	8.7	*15.5	3.5	Chert–mottled tan and pink
Form 35	BIBE1682	F	25454			4.1	8	12.5	2.2	Hornfels–black (w/patina)
Form 36	BIBE1655	E	25373	23.9	20.2	4.8	9.3	10.7	1.6	Chert–mottled pink and white
Form 36	BIBE1959	F	26484			4	8.9	10.6	0.9	Chert–tan
Form 36	BIBE2155	I	26778	25.8	18.5	4.3	9	8.6	1.2	Agate–mottled dark brown and red
Form 36	BIBE0415	U	27143		22.3	4.6	8.3	9.9	3	Chert–mottled black and red (w/spots)
Form 37	BIBE0761	T	27002			6.6	6.4	11.1	1.7	Chert–purple (w/spots)
Form 37	BIBE2670	2010–BB	27266			5.4	6.8	10.1	0.5	Hornfels–black
Form 38	BIBE1257	B	25644		34.5	6	12.7	18.9	7.6	Chert–white
Form 38	BIBE2488	T	26919		35.4	8.2	15.7	14.6	9.6	Chert–mottled white and tan (w/patina)
Form 38	BIBE0246	2010–D	27199			9.1	14.2	18.9	6.9	Chert–banded dark brown

Form 39	BIBE1157	A	25199	24.2	18.7	5.2	9.8	10.9	1.7	Chert–pinkish gray (w/spots)
Form 39	BIBE1655	E	25378			5.8		12.6	2.1	Chert–white
Form 39	BIBE1205	B	25537	29.6		5.8	10.7	13	2.7	Chert–tan
Form 39	BIBE2323	L	26855			6.4	14.5	12.9	3.7	Chert–white
Form 39	BIBE2491	T	26932			7.6	10.3	12.2	5.1	Chert–brown (w/spots)
Form 39	BIBE0415	U	27149			6.6	10.9	12.3	3.7	Chert–mottled brownish gray
Form 39	BIBE1152	A	27328		*20.7	6.8	10.7	10.3	3.2	Chert–light gray (w/spots)
Form 40	BIBE1648	E	25347			4.8	9.9	8.2	1.2	Chert–white
Form 40	BIBE1655	E	25369			3.8	10.6	11.6	1.2	Chert–banded gray
Form 40	BIBE1910	F	26068	31	*17.2	5.8	11.6	11.7	2.1	Chert–white
Form 40	BIBE2497	T	26943	*30.7	14.3	5.7	10.4	8.6	1.7	Chert–white
Form 41	BIBE1859	F	26023		*30.1	5.8	10.4	13.2	3.6	Chert–grayish purple
Form 42	BIBE2662	2010–E	27260	45.9	18.7	7.6	8.7	10.3	5.4	Chert–dark bluish gray
Form 43	IF 029	A	25250	28.9	17.7	4.2	8	10.7	1.6	Chert–white
Form 43	BIBE1849	F	25985	*31.1	19.2	6.1	10.9	12.8	2.5	Chert–mottled pink and red (w/spots)
Form 44	BIBE1203	B	25276		19.5	4.6	10	7.8	2.5	Chert–light gray (w/spots)
Form 45—Miscellaneous	BIBE0418	A	25020		19.3	6.5		10.5	3.7	Chert–light gray
Form 45—Miscellaneous	BIBE0418	A	25028			7.3	18.1	17.6	6.3	Chert (fossiliferous)–mottled gray and purple
Form 45—Miscellaneous	BIBE0418	A	25030			5.8			1.8	Chert–gray
Form 45—Miscellaneous	BIBE0418	A	25035			5.1			1	Chert–gray
Form 45—Miscellaneous	BIBE0418	A	25045	*33.4	15.7	5.9	7	9.6	3	Agate–brown
Form 45—Miscellaneous	BIBE0438	A	25052			4.5		9	1.5	Chert–white
Form 45—Miscellaneous	BIBE1100	A	25062			5.4		9.9	2.1	Agate–mottled red and brown
Form 45—Miscellaneous	BIBE1112	A	25089			8.2	12.8		9.3	Chert–pink (w/spots)
Form 45—Miscellaneous	BIBE1119	A	25149			5.2			1.5	Chert (fossiliferous)–mottled gray and purple
Form 45—Miscellaneous	BIBE1124	A	25162			5.5			2	Chert–light gray
Form 45—Miscellaneous	BIBE1134	A	25164	*40.2	26	4.4	9.3	15.2	5.3	Chert–mottled pinkish gray
Form 45—Miscellaneous	BIBE1136	A	25167			4.9			0.8	Chert–grayish purple
Form 45—Miscellaneous	BIBE1152	A	25188			8.4		15.5	7.4	Mudstone–light brown (w/inclusions)
Form 45—Miscellaneous	BIBE1152	A	25190		*26.9	7.1		11	5.7	Chert (fossiliferous)–brown
Form 45—Miscellaneous	BIBE1156	A	25195			6.4			2.5	Chert–mottled grayish purple
Form 45—Miscellaneous	BIBE1157	A	25203	*31.7	*20.1	5	7.8	11.7	2.5	Chert (fossiliferous)–reddish brown
Form 45—Miscellaneous	BIBE1163	A	25229			5		13.4	3	Chert–white
Form 45—Miscellaneous	IF 008	A	25238			5.5			1.8	Chert–light purple (w/spots)
Form 45—Miscellaneous	BIBE1604	E	25303			5.9	8	14.6	5	Agate–red
Form 45—Miscellaneous	BIBE1637	E	25325			5.9	10		3	Chalcedony–tan (w/spots)
Form 45—Miscellaneous	BIBE1654	E	25349			7			3.7	Chert–pink
Form 45—Miscellaneous	BIBE1655	E	25371			5.8		12.8	3.1	Chert–banded light gray
Form 45—Miscellaneous	IF 130	E	25387		21.7	6	8.4	12.5	5.5	Chert–mottled gray

Table 6-II.24 Dimensions and Descriptions of Dart Points with Expanding Stems. *(continued)*

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 45—Miscellaneous	BIBE1668	E	25397			8.4		13.7	5.3	Chert–mottled gray
Form 45—Miscellaneous	BIBE1520	F	25413			5.3			1.3	Agate–brown
Form 45—Miscellaneous	BIBE1520	F	25418			6.3	11.1	10.6	3.7	Chert–mottled tan and white (w/veins)
Form 45—Miscellaneous	BIBE1684	F	25460			8.5	10.3	18.1	9.7	Agate–brown
Form 45—Miscellaneous	BIBE1688	F	25466			4.8			2.5	Chert–tan
Form 45—Miscellaneous	BIBE1594	F	25517			4.5			0.8	Chert–gray
Form 45—Miscellaneous	BIBE1216	B	25572		21.8	6.7		11.2	3.1	Chalcedony–white (w/patina)
Form 45—Miscellaneous	BIBE1218	B	25583			6.6		13.2	6	Chert–tan (w/inclusions)
Form 45—Miscellaneous	BIBE0048	B	25612	25.1		6	9.2	12	2.7	Chert–dark brown (w/patina)
Form 45—Miscellaneous	BIBE0049	B	25616			8	9.5	16	10.3	Chert–mottled purple and white
Form 45—Miscellaneous	BIBE0123	B	25627			4.4			1.6	Chert–mottled tan and white
Form 45—Miscellaneous	BIBE1278	B	25690			5.7		14.1	3.5	Chert (fossiliferous)–gray
Form 45—Miscellaneous	BIBE1295	B	25705			7			6.2	Chert (fossiliferous)–gray
Form 45—Miscellaneous	BIBE1296	B	25707			5.5			1.4	Chert–yellowish white
Form 45—Miscellaneous	BIBE1594	F	25836			6.9		11.1	4	Chalcedony–white
Form 45—Miscellaneous	BIBE1594	F	25857			3.5	6.7	11.9	2.3	Chalcedony–white
Form 45—Miscellaneous	BIBE1738	F	25863		17.8	5.9	7.7	11.4	3.8	Agate–black
Form 45—Miscellaneous	BIBE1849	F	25978		17	6.3	13	11.4	2.4	Chert–light brown (w/spots)
Form 45—Miscellaneous	BIBE1849	F	25981			5.5		12.8	2.9	Chert–white (w/speckles)
Form 45—Miscellaneous	BIBE1859	F	26024	29.7	19.6	6.2	9.8	8.3	2.8	Chalcedony–mottled red and brown
Form 45—Miscellaneous	BIBE1898	F	26030	26.5	15.8	3.5	7	11.3	1.3	Chert–red (w/spots)
Form 45—Miscellaneous	BIBE1942	F	26290	29.1		5	7.8	9.6	2.2	Agate–brown
Form 45—Miscellaneous	BIBE1942	F	26311			5.8			1.3	Chert–light gray
Form 45—Miscellaneous	BIBE0284	F	26474			6	8.4	13.3	3.1	Chert–brownish pink (w/spots)
Form 45—Miscellaneous	BIBE1959	F	26485			5.1		10.4	3	Hornfels–black (w/patina)
Form 45—Miscellaneous	BIBE1984	F	26509			6.1	10.5		3.8	Chalcedony–light gray (w/patina)
Form 45—Miscellaneous	BIBE2004	F	26528		16.9	7.4	11.5	13.7	4	Agate–mottled red and brown
Form 45—Miscellaneous	BIBE2085	H	26726			5.4		18.6	1.9	Chert–pinkish gray (w/spots)
Form 45—Miscellaneous	BIBE2155	I	26782			5		10	1.8	Chert–pink (w/spots)
Form 45—Miscellaneous	BIBE2338	L	26868			6	10.7	11.8	3.3	Chert–white (w/spots)
Form 45—Miscellaneous	BIBE2430	O	26889		17.4	5.2		10.1	2.6	Jasper–dark red
Form 45—Miscellaneous	BIBE0761	T	26989	21.1		4.1			1.3	Chert–mottled red and white
Form 45—Miscellaneous	BIBE0761	T	26990		*21.1	5.9	9.8	15	2.7	Chert–gray and purple (w/spots)
Form 45—Miscellaneous	BIBE0761	T	26993			5.9			3.7	Chert–dark brown
Form 45—Miscellaneous	BIBE0761	T	26995			6.5		12.4	3.1	Chert–mottled gray
Form 45—Miscellaneous	BIBE0761	T	26999			5.6	11.7	12.9	2.2	Chert–mottled red and purple

Form 45–Miscellaneous	BIBE0761	T	27000		21.9	4.6	8.9	10.6	1.7	Chert–brownish gray
Form 45–Miscellaneous	BIBE0761	T	27007		19.8	6.1	8.6	10.9	4.6	Hornfels–gray (w/patina)
Form 45–Miscellaneous	BIBE2516	X	27011			5.6	7.1	9.2	3.6	Chert–light gray
Form 45–Miscellaneous	BIBE2418	V	27040			4.8	10.7	11.6	2.5	Agate–brown
Form 45–Miscellaneous	BIBE0970	V	27048		21.2	7	11	9.6	2.8	Agate–red
Form 45–Miscellaneous	BIBE0593	V	27052			4.9		10.8	1.6	Chert–gray (w/spots)
Form 45–Miscellaneous	BIBE2473	Z	27076			5.2	8.6	9.2	1.2	Chert–red (w/spots)
Form 45–Miscellaneous	BIBE2572	Y	27087		17.6	5.9	6.4	9.3	2.6	Chert–brown
Form 45–Miscellaneous	IF 893	U	27092	*42.7		4.6	7.6	10.7	4	Agate–brown
Form 45–Miscellaneous	BIBE0430	U	27108			5.3			2.8	Chert–purple (w/spots)
Form 45–Miscellaneous	BIBE2527	U	27112			5.6			1.7	Chert–gray (w/spots)
Form 45–Miscellaneous	BIBE2527	U	27117			5		16.4	2.2	Chert–brown (w/spots)
Form 45–Miscellaneous	BIBE2531	U	27126			5.2		13.6	1.5	Chert–gray
Form 45–Miscellaneous	BIBE0415	U	27142			4.9	7.7	13.3	2.1	Jasper–dark red
Form 45–Miscellaneous	BIBE2588	EE	27161			6.9	9.9	18.7	6.6	Chert–gray (w/spots)
Form 45–Miscellaneous	IF 902	2010-D	27187			4.9		10.4	2	Chert–white (w/patina)
Form 45–Miscellaneous	IF 903	2010-D	27188	*30.2	23.3	5.6	6.4	11.4	3	Chert–mottled tan and red (w/spots)
Form 45–Miscellaneous	BIBE0987	2010-X	27211			6.1	10.2	12.5	4.4	Chert–white
Form 45–Miscellaneous	BIBE1575	P	27215		20.2	5.4	9.4	12.1	3	Chert–light gray
Form 45–Miscellaneous	BIBE2763	2010-D	27224			5		12.7	1.2	Chert–light gray
Form 45–Miscellaneous	BIBE2763	2010-D	27227			6.4		12.6	2.8	Chert–dark red
Form 45–Miscellaneous	BIBE2763	2010-D	27228			5.2			2.9	Chalcedony–clear (w/patina)
Form 45–Miscellaneous	BIBE2662	2010-E	27262		22.4	4.2	8.6	12.3	2.4	Chert–mottled pink and white

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

assigned to the Bandy type. Five of these specimens have slightly recurved blade edges, the remainder slightly convex edges. As a result of breakage, all eight specimens are missing the strong barbs that typify the Bandy type. Stems are short and expand widely, and bases have variable shapes—concave (n=5), convex (n=2), and straight (n=1). Craftsmanship ranges from fair to excellent, and it is notable that five of these points are exceptionally thin. These eight specimens are made of various material types.

Form 4—Bell (1 specimen; Figure 6-II.62; Table 6-II.24)

One specimen in the BBNP collection is classified as a Form 4 expanding-stem dart point and is assigned to the Bell type. The reader is referred to the contracting-stem category (Form 3) above for background information and a description of the Bell dart point type. Unlike other Bell points from the BBNP assemblage (see Form 3 in the contracting-stem category and Form 1 in the parallel-sided stem category), this specimen has an expanding stem which is more typical for the type. It is missing the distal tip and one of its distinctive long barbs, a distinguishing attribute of the type. The base is slightly convex, blade edges are fragmentary, and the mostly intact barb is relatively long, extending downward toward the base. This specimen is made of chert and is broad, very thin and well crafted.

Form 5—Charcos (2 specimens; Figure 6-II.62; Table 6-II.24)

Charcos points were named and described by Lorraine Heartfield

(1975:136–137) from examples found in the Charcos de Risa Desert in the northern state of Coahuila, Mexico. Three varieties of the point were recognized based on different blade morphologies, specifically the presence/absence and frequency of blade notching: 1) Charcos unnotched, 2) Charcos single-notched, and 3) Charcos double-notched. The points have triangular blades with variably shaped lateral edges. Shoulders are asymmetrical with one undeveloped and the opposite one barbed. The single barb is short to long and usually hooks downward toward the stem; above the undeveloped shoulder are one or two blade notches that typically occur on a straighter lateral edge than the opposite side. Stems are expanding, vary from short to long, and terminate with concave, convex, or straight basal edges that are bifacially thinned. Charcos points date to either the Middle or Late Archaic period (Turner and Hester 1985:79). It is notable that Charcos points rarely occur in the Big Bend region of Texas.

Two complete specimens in the BBNP collection are classified as Form 5 expanding-stem dart points and are assigned to the Charcos type. Both specimens have asymmetrical shoulders with one undeveloped shoulder and the other one barbed. One of these has a long barb that hooks down and inward toward the base of the stem, while the other has a much smaller barb. Both have a single blade notch above the undeveloped shoulder. Both notched blade edges are slightly convex, while the opposite edges are convex and straight. The expanding stems are relatively long and terminate with straight basal edges that are bifacially or unifacially thinned. These specimens are fashioned from different varieties of chert, and are thin and well-crafted.

Form 6—Conejo *(12 specimens; Figure 6-II.62; Table 6-II.24)*

The Conejo type was proposed by LeRoy Johnson (1964:32–33) using examples recovered from the Devil's Mouth site in Val Verde County, Texas. The point is characterized by slightly expanding and relatively short stems, corner notches, and basal edges with shallow center notches. He described two varieties of Conejo points—one that is lanceolate in outline with barbed blades, and a second that is a sub-triangular variant with recurved lateral blade edges. Conejo points are chronologically placed within the early part of the Late Archaic period (Turner and Hester 1985:82; Turpin 1991:31).

Twelve specimens in the BBNP collection are classified as Form 6 expanding-stem dart points and are assigned to the Conejo type. One of these is complete, the others fragmentary. The complete specimen has recurved blade edges, and although the remaining 11 specimens are fragmentary, they display remnants of convex or slightly recurved blade edges. Shoulders are weakly to strongly formed and have small to medium length barbs, although one specimen is barbless. The stems are short and expand widely, with basal edges that are shallowly concave on eight specimens and straight on the other four. Most of these specimens are relatively wide compared to their lengths, and have variable thicknesses and craftsmanship. Conejo points in the collection are fashioned from a variety of materials, primarily cherts.

Form 7—Ellis *(7 specimens; Figure 6-II.62; Table 6-II.24)*

The Ellis type was originally named "Ellis Stemmed" by H. Perry Newell and Alex D. Krieger (1949:166–167) from examples found at the George C. Davis Site in Cherokee County, Texas. The name was ultimately shortened to Ellis and described by Suhm et al. (1954:420–422). The type is characterized by short triangular blades with lateral edges that are typically straight to convex, but occasionally slightly concave; shoulders extend outwards and are well-barbed, with expanding stems formed by corner-notching; basal edges are straight to convex. Ellis points date to ca. 1000 B.C. during the Late Archaic period (Turner et al. 2011:93).

Seven specimens in the BBNP collection are classified as Form 7 expanding-stem dart points and are assigned to the Ellis type. Blade edges are straight to convex, although two specimens have re-sharpened blades. Shoulders are moderately defined, with small barbs that are missing on most specimens. The stems are uniformly short and expand widely, with basal edges that are straight on four specimens and slightly convex on the other three. Specimens are small- to medium-sized, and have variable thicknesses and craftsmanship. Ellis points in the collection are fashioned from a variety of materials.

***Form 8—Ensor** (20 specimens; Figure 6-II.62; Table 6-II.24)*

This type was originally named "Juno Broad Base" by J. Charles Kelley (1947c:124), and "Ensor Stemmed" by E.O. Miller and Edward B. Jelks (1952:172–173) who described it a few years later. The name was ultimately shortened to Ensor and described by Suhm et al. (1954:422–423), indicating the type is characterized by triangular blades with straight or convex lateral edges that are sometimes serrated, expanding stems with bases that are wider than the shoulders, corner or side notching that may have formed small barbs, and typically straight basal edges that may also have convex or concave shapes. Ensor points date between ca. 200 B.C. and A.D. 600 within the Late Archaic period (Turner and Hester 1985:94).

Twenty specimens in the BBNP collection are classified as Form 8 expanding-stem dart points and are assigned to the Ensor type. These specimens exhibit blade edges that are straight or convex with one specimen that has serrated blade edges. Blades have been re-sharpened on six specimens, including one where this flaking produced a steep, left-hand alternate bevel. Nineteen specimens are side-notched and the remaining one is corner-notched. Pronounced shoulders occur on all but four specimens, which have small downturned barbs. These expanding-stem points are relatively thick, and have broad bases that terminate with various basal edge forms, consisting of slightly concave (n=11), convex (n=5), and straight (n=4). Almost all Ensor points in the collection are fashioned from different varieties of chert.

***Form 9—Figueroa** (21 specimens; Figure 6-II.63; Table 6-II.24)*

The Figueroa type was originally proposed by LeRoy Johnson (1964:36–37) using examples recovered from the Devil's Mouth site in Val Verde County, Texas. Johnson described this expanding-stem type as particularly small and lacking barbs. He separated the Figueroa type into four varieties based on basal edge configuration: 1) concave, 2) convex, 3) straight, and 4) shallowly notched. Figueroa points date between ca. 200 B.C. and A.D. 600 during the Late Archaic period (Turner and Hester 1985:97). Although the Figueroa type was inexplicably omitted from the most recent point typology publication (Turner et al. 2011), the present authors believe it remains a viable type in the Big Bend region.

Twenty-one specimens in the BBNP collection are classified as Form 9 expanding-stem dart points and are assigned to the Figueroa type. Blade edges are typically convex or straight, although two specimens have concave edges, a result of re-sharpening. These expanding stem points are relatively small, thick to thin, and most are crudely chipped. Barbless shoulders are slightly to moderately pronounced, formed through stem notching. Twelve specimens are side-notched and nine are corner-notched. Basal edges are mostly convex (n=16), while the remaining five are straight. Figueroa points in the collection are fashioned from various materials, primarily cherts, followed by chalcedony.

***Form 10—Hueco** (14 specimens; Figure 6-II.63; Table 6-II.24)*

The Hueco type was named by C.B. Cosgrove (1947) and Donald J. Lehmer (1948), who originally included it as a material trait of the Hueco phase in the El Paso region of the Jornado Mogollon culture. Although the type was used sparingly—or not at all—in subsequent years by archaeologists working in the eastern Trans-

Figure 6-II.63 Expanding stem dart points: (a-c) Form 9—Figueroa; (d-f) Form 10—Hueco; (g-h) Form 11—Martindale; (i-l) Form 12—Paisano; (m-p) Form 13—Pandale.

Pecos, Mallouf (2013b:205–209) recently reintroduced the Hueco dart point as a common type for much of the region, including the Big Bend. Hueco points are characterized by convex blade edges with small down-sloping barbs and short, broad expanding stems resulting from corner notching; basal edges are moderately to strongly convex (Mallouf 2013b:207; Turner et al. 2011:116). Hueco points date from ca. 1000 B.C. to A.D. 500 during the Late Archaic period (MacNeish and Beckett 1987:18; MacNeish 1993:183).

Fourteen specimens in the BBNP collection are classified as Form 10 expanding-stem dart points and are assigned to the Hueco type. Blade edges are convex with the exception of one that exhibits recurved edges. These corner-notched points have small barbs and short, broad expanding stems that terminate with convex basal edges. Most specimens are relatively thick in cross-section, with craftsmanship fair to good. Hueco points in the collection are fashioned from a wide array of material types.

Form 11—Martindale *(2 specimens; Figure 6-II.63; Table 6-II.24)*

Martindale points were originally named "Martindale Fishtail" by J. Charles Kelley, but were first described by E. O. Miller and Edward B. Jelks (1952:171, 176) from an example recovered in Central Texas. The name was ultimately shortened to Martindale and described by Suhm et al. (1954:446–447). The type is characterized by convex to straight blade edges, barbs formed by corner-notching, and an expanding stem that terminates with a central concave basal edge that gives it a "fishtail" appearance. Martindale points are chronologically placed in the Early Archaic period (Turner and Hester 1985:120; Houk et al. 2008, 2009).

Two specimens in the BBNP collection are classified as Form 11 expanding-stem dart points and are assigned to the Martindale type. One has convex blade edges and the other is missing the blade element. These corner-notched points have small barbs and short, broad expanding stems. Concave basal edges give each point the distinctive "fishtail" appearance that helps to distinguish the type. Workmanship is good and these specimens are manufactured from two different varieties of chert.

Form 12—Paisano *(35 specimens; Figure 6-II.63; Table 6-II.24)*

Paisano points were originally illustrated in Kelley et al. (1940: Fig. 2) as a projectile of the Chisos focus in the Big Bend region of Texas. The type was first mentioned in print by Herbert C. Taylor (1948:81, 84, Plate 9D) who called it "Paisano Indented Base," but it was likely originally named by J. Charles Kelley who used such three-word names. Ultimately, the name was shortened to Paisano and described by Suhm et al. (1954:460–461). Paisano points have convex lateral blade edges that are frequently serrated, and an expanding stem formed by shallow side notches, with concave to deeply indented basal edges. Paisano points in the Lower Pecos region of Texas date between ca. 200 B.C. and A.D. 600 (or later) during the Late Archaic period (Turner and Hester 1985:133). In the Big Bend region (Colorado Canyon along the Rio Grande), charcoal within a hearth in direct association with a Paisano point yielded a radiocarbon date of A.D. 560±335 (TX-4638; Mallouf 1985:33, 1999:61).

Thirty-five specimens in the BBNP collection are classified as Form 12 expanding-stem dart points and are assigned to the Paisano type. Blade edges are almost always convex and rarely straight, with 12 specimens exhibiting serrated blades. Re-sharpening of the distal blade is evident on nine specimens. The flaring expanding stems are formed by shallow side notches while the basal edges are concave. These specimens are relatively thick in cross-section and craftsmanship is fair to good. Paisano points in the collection are fashioned from various materials although cherts are dominant.

Form 13—Pandale *(28 specimens; Figure 6-II.63; Table 6-II.24)*

Thomas C. Kelly (1963:208) first recognized and named this expanding stem variety "short Pandale" from excavations at Roark Cave in eastern Brewster County. Diminutive specimens were also recovered from the Rosillo Peak site and from foothill campsites of the Rosillos Mountains (Mallouf and Wulfkuhle 1989; Mallouf et al. 2006). Pandale points are characterized as long, usually lanceolate points distinguished by alternate beveling of the stem and the blade.

Twenty-eight specimens in the BBNP collection are classified as Form 13 expanding-stem dart points and are assigned to the Pandale type. Although other Pandale points from the BBNP assemblage have parallel-sided stems, these expanding stem specimens are the most prevalent among this type in the collection. The reader is referred to Form 2 in the parallel-sided stem category for background history and a description of the Pandale type.

Most of the Pandale points in this subcategory have convex blade edges, although they are on occasion straight, and all exhibit the distinctive alternate beveling that characterizes this type. Another distinctive attribute of the type, oblique transverse flaking across the blade, occurs on 13 specimens. Convex basal edges are the most common (n=15), while straight (n=9) and concave (n=4) forms are also present. It is noteworthy that nine specimens in this category are uncharacteristically small, including one with a distal tip reworked into a perforator/drill. These expanding-stem Pandale points are manufactured from a wide array of materials, primarily cherts.

Form 14—Shumla (34 specimens; Figure 6-II.64; Table 6-II.24)

Thirty-four specimens in the BBNP collection are classified as Form 14 expanding-stem dart points and are assigned to the Shumla type. Unlike other Shumla points from the BBNP assemblage (see Form 3 in the parallel-sided-stem category above), these specimens have expanding stems and are the most prevalent among this type in the collection. The reader is referred to Form 3 in the parallel-sided-stem category for background history and a description of the Shumla type.

Based on seven intact or near-intact blades within this group, blade edges vary from convex to straight. Notably, four specimens have remnants of serrated blades, and numerous distal blades have been broken and reworked. These slightly expanding-stem points have deep corner notches that form small to long barbs that are rarely intact. The stem bases are usually slightly convex, sometimes straight, but always with a wedge shape in cross-section—a result of basal thinning on both faces. Overall thickness and craftsmanship are variable. Shumla points in this subcategory are fashioned from various materials, although cherts are dominant.

Form 15—Val Verde (7 specimens; Figure 6-II.64; Table 6-II.24)

The Val Verde type was named and described by M.K. Schuetz (1956:141–143) from examples found in Val

Figure 6-II.64 Expanding stem dart points: (a-d) Form 14—Shumla; (e-f) Form 15—Val Verde; (g-h) Form 16—Van Horn; (i) Form 17—Zorra; (j) Form 18; (k-l) Form 19; (m-n) Form 20; (o-p) Form 21.

Verde County, Texas. Val Verde points are characterized by an expanding stem, often steeply beveled, formed by wide concavities from the shoulder to the base; weak shoulders; and concave basal edges (Schuetz 1956; Turner et al. 2011:168). Val Verde points are typically thin and well-made and date to between ca. 2500 and 1000 B.C. during the Middle Archaic period (Turner and Hester 1985:156).

Seven specimens in the BBNP collection are classified as Form 15 expanding-stem dart points and are assigned to the Val Verde type. Blade edges are slightly concave on six specimens, while the remaining example is slightly convex. Shoulders are weak and stems expand, formed by wide concavities from the shoulders to the bases. Five specimens have slightly concave basal edges; the other two are slightly convex. None of the BBNP specimens have beveled stems. Val Verde points in this subcategory are thin and well-crafted like other contemporary types (e.g., Langtry and Arenosa), and are fashioned from a wide array of material types.

Form 16—Van Horn *(2 specimens; Figure 6-II.64; Table 6-II.24)*

The Van Horn type was proposed by John A. Hedrick (1993) from examples found in southern Culberson County, Texas. Van Horn points are characterized by distinctive blade notching that occurs above the midpoint of the blade. These projectiles have from one to four notches, typically straight blade edges, barbed shoulders from corner-notching, expanding stems, and basal edges that are typically convex or rounded (Hedrick 1993:89–99; Turner et al. 2011:169). Although these points have not been found in stratified sequences or other dated contexts, they likely fall somewhere within the Late Archaic period (Hedrick 1993:99; Turner et al. 2011:169).

Two specimens in the BBNP collection are classified as Form 16 expanding-stem dart points and are assigned to the Van Horn type. One is complete and has convex blade edges with three notches on one edge and two on the opposite side. The other specimen is fragmentary, but appears to have had straight blade edges with three notches on each side. Both specimens are barbed, formed by corner-notching, with expanding stems that terminate in convex basal edges. Fashioned from chert and agate, these Van Horn specimens are thin and well-crafted.

Form 17—Zorra *(1 specimen; Figure 6-II.64; Table 6-II.24)*

The Zorra type was proposed by LeRoy Johnson (1964:45) using examples recovered from the Devil's Mouth site in Val Verde County, Texas. They are characterized by convex blade and basal edges, barbless rounded shoulders, and slightly expanding stems that are sometimes beveled on one or both edges. Zorra points are chronologically placed in the Early Archaic period (Turner and Hester 1985:161).

One specimen in the BBNP collection is classified as a Form 17 expanding-stem dart point and is assigned to the Zorra type. This complete Zorra dart point has convex blade edges, weak shoulders that are barbless, and a convex basal edge. The relatively long stem expands slightly, and both stem edges are beveled on one face. This specimen is fashioned from mudstone, is thin, and exhibits good craftsmanship.

Form 18 *(1 specimen; Figure 6-II.64; Table 6-II.24)*

One specimen is classified as a Form 18 expanding-stem dart point. This complete specimen has convex lateral blade edges with a slight, left-hand alternately beveled blade. It has moderate shoulders that slope slightly downwards. The stem expands moderately from corner-notching and terminates with a slightly convex basal edge. Fashioned from chert, it is moderately thick yet exhibits good craftsmanship. This specimen has attributes that are commonly associated with various Late Archaic-aged projectile points.

Form 19 *(2 specimens; Figure 6-II.64; Table 6-II.24)*

Two specimens are classified as Form 19 expanding-stem dart points. Both specimens have convex blade edges and one has a serrated blade. The shoulders are weakly formed and are barbless, the stems expand moderately from corner-notching, and the basal edge is straight on one specimen and fragmentary on the other. Both examples are relatively narrow, thick, and poorly-crafted. Form 19 expanding-stem specimens are fashioned from different varieties of chalcedony and exhibit attributes that are commonly associated with various Late Archaic-aged projectile points.

Form 20 *(9 specimens; Figure 6-II.64; Table 6-II.24)*

Nine specimens are classified as Form 20 expanding-stem dart points. Blade edges range from convex to straight and blades are long and narrow. Stems are very short, broad, and expand widely as a result of shallow side-notching which starts just above the base. Bases are typically as wide as the shoulders, with straight or slightly concave basal edges. Most specimens are thick and exhibit crude to fair craftsmanship. Form 20 expanding-stem specimens are fashioned from various materials, primarily cherts. These examples exhibit attributes that are commonly associated with various Late Archaic-aged projectile points.

Form 21 *(6 specimens; Figure 6-II.64; Table 6-II.24)*

Six specimens are classified as Form 21 expanding-stem dart points. These points have short, broad blades with convex or straight lateral edges. The stems are very short, broad, and expand widely as a result of shallow side-notching starting just above the base. The bases are typically as wide as or wider than the shoulders, with straight or slightly concave basal edges. These examples range from thick to thin and exhibit fair to good craftsmanship. They are fashioned from various materials, primarily cherts. Form 21 expanding-stem specimens exhibit attributes that are commonly associated with various Late Archaic-aged projectile points. Although they are similar and comparable to Fairland points (Suhm et al. 1954:424–425; Turner and Hester 1985:96) of this period, they lack the deep basal concavity characteristic of that type.

Form 22 *(2 specimens; Figure 6-II.65; Table 6-II.24)*

Two specimens are classified as Form 22 expanding-stem dart points. They have slender blades, straight blade edges, and short stems that expand widely as a result of moderately deep side-notching. The base is as wide as the shoulders and the basal edge is straight. Both specimens are relatively thin and exhibit good craftsmanship. Form 22 expanding stem specimens are fashioned from chert and chalcedony and exhibit attributes that are commonly associated with various Late Archaic-aged projectile points.

Form 23 *(2 specimens; Figure 6-II.65; Table 6-II.24)*

Two specimens are classified as Form 23 expanding-stem dart points. These specimens have short blades and convex blade edges that have been re-sharpened. The stems expand widely, a result of moderately deep side-notching. The bases are as wide as the shoulders and basal edges vary from convex to slightly concave. These relatively thick examples exhibit crude to fair craftsmanship. Form 23 expanding-stem specimens are fashioned from different varieties of chert and exhibit attributes that are commonly associated with various Late Archaic-aged projectile points.

Form 24 *(4 specimens; Figure 6-II.65; Table 6-II.24)*

Four specimens are classified as Form 24 expanding-stem dart points. These somewhat slender points have short to long blades with convex or straight blade edges, including one that is serrated. The stems expand widely as a result of deep side-notches. The bases are as wide as the shoulders and the basal edges are strongly convex. These examples range from thick to thin and exhibit fair craftsmanship. Form 24 expanding-stem specimens are fashioned from various material types and exhibit attributes that are commonly associated with various Late Archaic-aged projectile points.

Figure 6-II.65 Expanding stem dart points: (a–b) Form 22; (c) Form 23; (d–e) Form 24; (f) Form 25; (g) Form 26; (h–i) Form 27; (j) Form 28; (k) Form 29; (l) Form 30; (m) Form 31.

***Form 25** (2 specimens; Figure 6-II.65; Table 6-II.24)*

Two specimens are classified as Form 25 expanding-stem dart points. These relatively short and wide points have convex blade edges, including one that has been re-sharpened. Both stems expand widely, a result of moderately deep side-notches. The base is as wide as the shoulders on one specimen but not as wide on the other; basal edges are moderately convex. Both specimens are thick, yet relatively well made. They are fashioned from chert and silicified wood. These specimens exhibit attributes commonly associated with various Late Archaic-aged projectile points.

***Form 26** (1 specimen; Figure 6-II.65; Table 6-II.24)*

One specimen is classified as a Form 26 expanding-stem dart point. This triangular-shaped specimen has straight lateral blade edges with small barbs. The stem is short and expands widely from deep side-notches. The base is as wide as the shoulders and has a straight basal edge. This chert point is moderately thick but exhibits good craftsmanship. It has attributes that are commonly associated with various Late Archaic-aged projectile points.

***Form 27** (3 specimens; Figure 6-II.65; Table 6-II.24)*

Three specimens are classified as Form 27 expanding-stem dart points. Blade edges are convex, and one specimen has two shallow blade notches along one edge above the shoulder. The stems are short and expand widely as a result of moderately deep side-notching. The bases are as wide as the shoulders with slightly concave basal edges. These three examples are relatively thin and exhibit good craftsmanship. Form 27 expanding-stem specimens are fashioned from a variety of materials and exhibit attributes commonly associated with various Late Archaic-aged projectile points.

***Form 28** (2 specimens; Figure 6-II.65; Table 6-II.24)*

Two specimens are classified as Form 28 expanding-stem dart points. One of these is long and slender with convex blade edges, while the other is missing its blade. The stems are short and expand widely as a result of moderately deep side-notching. The bases are as wide as the shoulders, with slightly concave basal edges. These two examples are relatively thin and exhibit fair to good craftsmanship. The Form 28 expanding-stem specimens are fashioned from chert and jasper and exhibit attributes that are commonly associated with various Late Archaic-aged projectile points.

***Form 29** (1 specimen; Figure 6-II.65; Table 6-II.24)*

One specimen is classified as a Form 29 expanding-stem dart point. Although this specimen is broken, it appears to have had asymmetrical blade edges when complete, one that was convex and one that was recurved. The shoulders are fragmentary, but probably had small barbs when complete. The stem is short and expands strongly from corner-notching; the basal edge is concave, with an overall "fishtail" appearance. It is thin, well-crafted, and fashioned from chert. The Form 29 expanding-stem specimen exhibits stem and basal attributes that are similar to those found on several Early Archaic-aged projectile points.

***Form 30** (4 specimens; Figure 6-II.65; Table 6-II.24)*

Four proximal fragments, all missing blade elements, are classified as Form 30 expanding-stem dart points. The shoulders of these specimens are highly fragmentary as well, although one is moderately defined and another is well-barbed. The latter has lightly ground stem and basal edges, while the other three lack such grinding. These four specimens have moderately long stems that expand slightly to moderately from corner-notching, and slightly concave basal edges. These examples range from thick to thin and exhibit fair to good craftsmanship. Form 30 specimens are fashioned from various materials and exhibit stem and basal attributes that are similar to those found on several Early Archaic-aged projectile points.

***Form 31** (1 specimen; Figure 6-II.65; Table 6-II.24)*

One specimen is classified as a Form 31 expanding-stem dart point. This specimen has straight to convex blade edges that have been re-sharpened. The stem is very long, expanding widely from corner-notching, and exhibits lightly ground edges. The base is as wide as the shoulders with a slightly concave basal edge that is moderately ground as well. This point is thick, fairly well-crafted, and fashioned from chert. It is similar to the Wilson type (Turner et al. 2011:172) of the Late Paleoindian period.

***Form 32** (4 specimens; Figure 6-II.66; Table 6-II.24)*

Four specimens are classified as Form 32 expanding-stem dart points. These specimens are long and slender with blade edges that are typically convex, although sometimes straight or recurved. Corner-notched, they have long stems that expand gradually to the base and have basal edges that are strongly convex. These specimens have variable thicknesses and craftsmanship, and are manufactured from a variety of raw material types. Form 32 expanding-stem specimens are similar to Pandale points (Suhm et al. 1954:464–465) of the Early Archaic period in general outline, but lack the distinctive twist or alternate beveling that distinguishes

Figure 6-II.66 Expanding stem dart points: (a–b) Form 32; (c) Form 33; (d) Form 34; (e–f) Form 35; (g–h) Form 36; (i) Form 37; (j) Form 38; (k–m) Form 39; (n–o) Form 40.

that type. These examples are thought to date to an unknown portion of the Archaic period.

***Form 33** (3 specimens; Figure 6-II.66; Table 6-II.24)*

Three specimens are classified as Form 33 expanding-stem dart points. Blade edges vary from slightly convex to nearly straight. Stems are short and expand slightly, a result of shallow corner-notching. Shoulders are moderately- to well-developed, barbless, and wider than the bases. Basal edges are slightly convex. These examples range from thick to thin and exhibit fair to good craftsmanship. Form 33 expanding-stem specimens are fashioned from various materials and exhibit attributes that are characteristic of various Late Archaic-aged projectile points.

***Form 34** (2 specimens; Figure 6-II.66; Table 6-II.24)*

Two specimens are classified as Form 34 expanding-stem dart points. These very large points have long blades with convex to straight lateral edges. Shoulders are moderately developed and barbless. Stems on these two specimens are short and expand slightly from corner-notching, and basal edges are straight and slightly convex. Fashioned from different varieties of chert, both examples are relatively thick and exhibit fair to good craftsmanship. Form 34 expanding-stem specimens exhibit attributes that are characteristic of various Late Archaic-aged projectile points.

***Form 35** (2 specimens; Figure 6-II.66; Table 6-II.24)*

Two specimens are classified as Form 35 expanding-stem dart points. Both of these thin and well-crafted points are missing lateral blade edges. The stems are short and expand moderately from narrow corner-notches that produced strong barbs. The basal edges are mildly convex. These two specimens are fashioned from chert and hornfels. Form 35 expanding-stem specimens are similar to the Bandy type (Word and Douglas 1970:21) of the Early Archaic period, but lack the "fishtail" bases that characterize that type.

***Form 36** (4 specimens; Figure 6-II.66; Table 6-II.24)*

Four specimens are classified as Form 36 expanding-stem dart points. These relatively small points have straight to convex lateral blade edges. The stems are short and expand slightly, a result of corner-notching that produced small barbs. Basal edges on all four specimens are slightly convex. These examples are relatively thin and well-crafted. Form 36 expanding-stem specimens are fashioned from a variety of materials and exhibit attributes that are characteristic of various Late Archaic-aged projectile points.

***Form 37** (2 specimens; Figure 6-II.66; Table 6-II.24)*

Two specimens are classified as Form 37 expanding-stem dart points. Both of these relatively small points are missing the distal portion of their blades. The stems are very short and expand strongly from corner-notches that produced small barbs. Basal edges are mildly convex. Thick and fairly well-made, the points are fashioned from chert and hornfels. Form 37 expanding-stem specimens exhibit attributes that are characteristic of various Late Archaic-aged projectile points.

***Form 38** (3 specimens; Figure 6-II.66; Table 6-II.24)*

Three specimens are classified as Form 38 expanding-stem dart points. These relatively large and broad points are all missing distal blade elements. Stems are long and expand moderately from corner-notches that produced prominently barbed shoulders. The basal edges are convex. These examples are thick, exhibit good craftsmanship, and are fashioned from different varieties of chert. Form 38 expanding-stem specimens are similar to the Lange type (Suhm et al. 1954:436–437) of the Late Archaic period.

***Form 39** (7 specimens; Figure 6-II.66; Table 6-II.24)*

Seven specimens are classified as Form 39 expanding-stem dart points. Two of these exhibit convex lateral blade edges, while the other five are too fragmentary for this assessment. Stems of this form are moderately long and expand slightly to strongly from corner-notches that sometimes produced small barbs. All basal edges are convex. These specimens are relatively thick, exhibit fair to good craftsmanship, and are fashioned from different varieties of chert. Form 39 expanding-stem specimens exhibit attributes that are characteristic of various Late Archaic-aged projectile points.

***Form 40** (4 specimens; Figure 6-II.66; Table 6-II.24)*

Four specimens are classified as Form 40 expanding-stem dart points. These relatively small points have short blades with straight to convex blade edges. Stems are moderately long and expand strongly from corner-notches that sometimes produced small barbs. Basal edges are strongly convex. These moderately well-crafted specimens exhibit variable thicknesses, and are fashioned from different varieties of chert. Form 40 expanding-stem specimens exhibit attributes that are characteristic of various Late Archaic-aged projectile points.

***Form 41** (1 specimen; Figure 6-II.67; Table 6-II.24)*

One specimen is classified as a Form 41 expanding-stem dart point. It is missing the distal portion of the blade. The stem is relatively short and expands strongly from deep corner-notches that produced prominent barbed shoulders. The basal edge is slightly convex. This specimen is relatively thin, well-crafted, and fashioned from chert. It exhibits attributes that are characteristic of various Late Archaic-aged projectile points.

Figure 6-II.67 Expanding stem dart points: (a) Form 41; (b) Form 42; (c–d) Form 43; (e) Form 44. Dart point preform (f).

***Form 42** (1 specimen; Figure 6-II.67; Table 6-II.24)*

One specimen is classified as a Form 42 expanding-stem dart point. This complete moderately-sized specimen has a relatively narrow blade with convex lateral edges. The distal tip is alternately beveled (right-hand side of each face with bevels extending to the blade mid-points) from re-sharpening. The stem is relatively short and expands strongly from corner-notching that produced slightly downturned shoulders. The basal edge is strongly convex. This specimen is relatively thick, exhibits good craftsmanship, and is fashioned from chert. It dates to an unknown portion of the Archaic period.

***Form 43** (2 specimens; Figure 6-II.67; Table 6-II.24)*

Two specimens are classified as Form 43 expanding-stem dart points. These complete specimens have short blades with convex edges. The blade of one has been alternately beveled in a left-handed fashion, while the other specimen has a right-handed bevel on a single face. The short stems expand strongly from corner-notches that produced small barbless shoulders. Both basal edges are slightly convex. The specimen with a right-handed bevel of the blade has a left-handed, alternately beveled stem. They have variable thicknesses, exhibit good craftsmanship, and are fashioned from different varieties of chert. Although these specimens have beveling similar to that of Pandale points (Suhm et al. 1954:464–465) from the Early Archaic period, they are likely re-sharpened projectiles from the Late Archaic period.

***Form 44** (1 specimen; Figure 6-II.67; Table 6-II.24)*

One specimen is classified as a Form 44 expanding-stem dart point. This fragmentary specimen is missing its distal tip and exhibits serrated blade edges. It has a moderately long stem that expands strongly from deep and wide corner-notches, producing prominent shoulders that slope slightly downwards. The basal edge is slightly convex. Fashioned from chert, this specimen is relatively thin and exhibits good craftsmanship. It has attributes characteristic of various Late Archaic-aged projectile points.

Form 45—Miscellaneous (82 specimens; Table 6-II.24)

The Form 45 miscellaneous expanding-stem dart point category contains 82 specimens that cannot be confidently assigned to any of the above subcategories. This classification contains 77 proximal and 5 medial fragments. Sixty-nine of these specimens are corner-notched; the remainder are side-notched. Form 45 expanding-stem specimens are manufactured from a variety of raw material types, primarily cherts.

Bulbous Stems

Fourteen specimens in the BBNP collection are classified as bulbous-stem dart points. Within this classification, one subcategory (Form 1) conforms to an established type, while an additional unnamed subcategory (Form 2) is also recognized. Specimens that are too fragmentary to allow confident placement with other bulbous-stem forms are assigned to a miscellaneous group (Form 3). Descriptive and dimensional data for dart points in this category are presented in Table 6-II.25.

Form 1—Palmillas (6 specimens; Figure 6-II.68; Table 6-II.25)

The Palmillas type was originally named by R.S. MacNeish in an unpublished manuscript using specimens recovered in southern Tamaulipas, Mexico. The name was then applied to examples found in Texas and described by Suhm et al. (1954:462–463). Palmillas points are leaf-shaped and characterized by bulbous stems with rounded sides and convex basal edges, slight- to well-barbed shoulders, and straight to convex blade edges (Suhm et al. 1954:462–463; MacNeish 1958:67). This type is broadly defined and poorly understood, dating somewhere within the Middle to Late Archaic periods (Turner and Hester 1985:134).

Six specimens in the BBNP collection are classified as Form 1 bulbous-stem dart points and are assigned to the Palmillas type. While most of these specimens are

Figure 6-II.68 Bulbous stem dart points: (a-d) Form 1—Palmillas; (e-f) Form 2.

missing their blades, those that are intact have straight or convex blade edges. Rounded bulbous stems and strongly convex basal edges occur on all six examples. These relatively thick, corner-notched points have small barbs, exhibit crude to good craftsmanship, and are fashioned from different varieties of chert.

Form 2 (4 specimens; Figure 6-II.68; Table 6-II.25)

Four specimens are classified as Form 2 bulbous-stem dart points. These specimens are long and slender with blade edges that are typically convex. They are corner-notched and have long bulbous stems that terminate with strong convex basal edges. Moderately thick, these specimens exhibit fair craftsmanship and are fashioned from various material types. In general outline they resemble Pandale points (Suhm et al. 1954:464–465) of the Early Archaic period, but lack the distinctive twist or alternate beveling that distinguishes that type. Accordingly, they can only be affiliated with an unspecified portion of the Archaic period.

Form 3—Miscellaneous (4 specimens; Table 6-II.25)

The Form 3 miscellaneous bulbous-stem dart point category contains four specimens that cannot be confidently assigned to either of the above subcategories. Most specimens in this group have general outlines or appearances that are similar to bulbous-stem forms from the BBNP collection but are lacking conclusive attributes of a defining type or form. In the BBNP collection, three specimens are proximal fragments, while the other is a medial fragment. Form 3 specimens are manufactured from a variety of raw material types.

Triangular Dart Points

A total of 35 specimens in the BBNP collection are classified as triangular dart points. One subcategory (Form 1) is typeable, while nine additional subcategories (Forms 2–10) are recognized. Specimens too fragmentary to allow confident grouping with other triangular forms are assigned to a miscellaneous subcategory (Form 11). Descriptive and dimensional

Table 6-II.25 Dimensions and Descriptions of Dart Points with Bulbous Stems.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 1–Palmillas	BIBE1163	A	25213			5	14.2	11.3	3.1	Chert–mottled gray (w/spots)
Form 1–Palmillas	IF 020	A	25244	*34.6	*21.4	6.3	12.2	9.7	3.5	Chert (fossiliferous)–gray
Form 1–Palmillas	BIBE1706	F	25507			6.2	11.6	10.9	3.7	Chert–mottled bluish gray (w/patina)
Form 1–Palmillas	BIBE1291	B	25701			5.2	10.3	10.4	2.3	Chert–white
Form 1–Palmillas	BIBE1594	F	25837			5.5	10.3	8.4	2.2	Chert–gray (w/spots)
Form 1–Palmillas	BIBE1829	G	25942			7.7		11	4.7	Chert–mottled light gray and white
Form 2	BIBE1152	A	25189		20.3	6.9	19.2	12.3	5.7	Claystone–brown
Form 2	BIBE1203	B	25280			5.5	14.5	13.3	3.1	Hornfels–black (w/patina)
Form 2	BIBE1214	B	25566		16.8	5.8	14.5	11.3	4	Quartzite–brown
Form 2	BIBE2527	U	27120			6.5		12.3	5.1	Chert–white
Form 3–Miscellaneous	BIBE1152	A	25186			6.9			2.6	Chalcedony–light gray
Form 3–Miscellaneous	BIBE1682	F	25450		23.8	6.2		9.4	4.9	Agate–brown
Form 3–Miscellaneous	IF 222	G	25934			5.1		9.2	2.8	Chert–mottled pinkish brown
Form 3–Miscellaneous	BIBE2664	2010-Y	27263			6			5.2	Chert–tan (w/patina)

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

data for dart points in this category are presented in Table 6-II.26.

Form 1—Early Triangular *(2 specimens; Figure 6-II.69; Table 6-II.26)*

Early Triangular dart points were originally recognized and named "Baird Beveled Blade" and "Taylor Thinned Base" by J. Charles Kelley (1947b:99 and Plate X) although they were eventually renamed and described by Thomas R. Hester (1971:51–148) from examples found at the La Jita site in Uvalde County, Texas. These unstemmed points are characterized by triangular shapes with lateral edges that are usually straight or convex, sometimes alternately beveled and lightly serrated; straight or slightly concave basal edges; well-thinned cross-sections; and parallel-oblique flaking (Hester 1971; Turner and Hester 1985:89–90; Turner et al. 2011:88–90; Houk et al. 2008, 2009). Early Triangular points are thought to date to the latter portion of the Early Archaic period based on radiocarbon dates with good contexts (Houk et al. 2008: Appendix C, 18–20).

Two specimens in the BBNP collection are classified as Form 1 triangular dart points and are assigned to the Early Triangular type. Distal blade tips are missing on both specimens, and one has remnants of lightly serrated blade edges. These triangular-shaped points are very thin and exhibit excellent craftsmanship. The basal edges are straight and slightly concave, respectively, with multiple thinning flakes removed from both specimens. They are manufactured from different varieties of chert.

Figure 6-II.69 Triangular dart points: (a–b) Form 1—Early Triangular; (c) Form 2; (d–e) Form 3; (f–g) Form 4; (h–i) Form 5; (j) Form 6; (k) Form 7; (l–m) Form 8; (n) Form 9; (o) Form 10.

Table 6-II.26 Dimensions and Descriptions of Triangular Dart Points.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Basal Depth (mm)	Weight (g)	Material Type–Color
Form 1—Early Triangular	BIBE1682	F	25455		*35.4	5.1		5.3	Chert–gray (w/patina)
Form 1—Early Triangular	BIBE1594	F	25854		34.3	5.5		4.8	Chert–brown (w/speckles)
Form 2	BIBE0418	A	25008			6.4	5.1	1.5	Chert–light gray
Form 2	BIBE1138	A	25169		*27.4	6.5	6.3	7.3	Chert (fossiliferous)–light gray
Form 2	BIBE0430	U	27107			6.6	*4.6	4.6	Chert–mottled brown
Form 3	BIBE1325	JQ–1	25755			6.7	*2.5	6.2	Chert–dark gray
Form 3	BIBE2490	T	26921		*22.1	7.3	*3.3	4.3	Chert–mottled white and tan
Form 3	BIBE0760	T	26970			6.6		7.1	Hornfels–black (w/patina)
Form 4	BIBE1438	JQ–2	25785	53.8	24.6	7.4	4.7	10.3	Chert–dark blackish purple (w/speckles)
Form 4	BIBE2531	U	27124		19.3	4.9	*4.1	2.3	Agate–mottled red and brown
Form 5	BIBE1119	A	25124	*34.4	17.2	6.3	2.2	3.1	Chert–mottled gray and pink
Form 5	BIBE1119	A	25150		19.9	5.4	*2.7	2.4	Chert–mottled brown
Form 5	BIBE1214	B	25561			5.6	2.2	2.4	Chert–light gray
Form 5	BIBE1218	B	25597			5.7		1.4	Chert–light gray (w/patina)
Form 5	BIBE1286	B	25694		16.3	5.1	2.6	1.7	Chert–mottled purple and gray
Form 5	BIBE1286	B	25696			7.4	*2.1	3.4	Chert–mottled white and red
Form 5	BIBE2394	R	26900		21.6	10.2	3.5	8.6	Chert–white
Form 6	BIBE1636	E	25323			6.6		3.8	Chert–dark gray
Form 7	BIBE2697	2010–I	27286		16.9	5.2		2.4	Chert–gray (w/patina)
Form 8	BIBE1594	F	25839			6.2	1.3	4.1	Chert–mottled gray and brown
Form 8	BIBE1849	F	25986	48.3	25.2	8	1.9	9.9	Chert (fossiliferous)–brown
Form 8	BIBE0546	Y	26079		26.4	5.8	2.4	3.9	Chert–gray (w/spots)
Form 8	BIBE2519	U	27098		25.2	6	1	4.3	Chert–light gray (w/spots)
Form 9	BIBE1668	E	25396		20.1	4.7		3	Chert–mottled light gray (w/spots)
Form 10	BIBE2394	R	26908		18.9	6.8		4.9	Chert–mottled white and tan (w/inclusions)
Form 10	BIBE2634	2010–C	27246		15.3	7		4.1	Chert–light gray
Form 11—Miscellaneous	BIBE0418	A	25002	*47.9		7.1		6.8	Chert–mottled brown
Form 11—Miscellaneous	BIBE1163	A	25208			5.8		2.5	Chert–gray
Form 11—Miscellaneous	BIBE1628	E	25311			7.7		4.8	Jasper–brown
Form 11—Miscellaneous	BIBE1637	E	25324			6		4.5	Chert–light gray
Form 11—Miscellaneous	BIBE1693	F	25470			7.5		5.5	Chert–banded purple and white (w/speckles and spots)
Form 11—Miscellaneous	BIBE1702	F	25504		23.8	6.7		5	Chert–banded gray (w/spots)
Form 11—Miscellaneous	BIBE1326	JQ–2	25765			5.7		4	Chert–tan (w/patina)
Form 11—Miscellaneous	BIBE0246	2010–D	27203		16.2	5.2		3	Agate–purple (w/patina)
Form 11—Miscellaneous	BIBE2654	2010–C	27255		26.7	5.2		2.4	Chert–tan (w/patina)

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

***Form 2** (3 specimens; Figure 6-II.69; Table 6-II.26)*

Three specimens are classified as Form 2 triangular dart points. Two of these exhibit recurved blade edges that begin above the base, while the other is missing the distal portion of the blade. These triangular-shaped points have basal corners that are slightly flared with a deep, concave basal concavity. Moderately thick and fashioned from different varieties of chert, these specimens exhibit fair to good craftsmanship. Form 2 triangular points have similarities with the Paisano type (Suhm et al. 1954:460–461) of the Late Archaic period.

***Form 3** (3 specimens; Figure 6-II.69; Table 6-II.26)*

Three specimens are classified as Form 3 triangular dart points. These points have blade edges that range from straight to convex and basal edges that are mildly concave. They are relatively thick, yet exhibit good craftsmanship. Form 3 specimens are fashioned from various materials and exhibit attributes that are commonly associated with various Late Archaic-aged projectile points.

***Form 4** (2 specimens; Figure 6-II.69; Table 6-II.26)*

Two specimens are classified as Form 4 triangular dart points. These projectiles have convex blade edges and concave basal edges. They are relatively thick, but exhibit good craftsmanship. Form 4 specimens are fashioned from chert and agate and have attributes that are commonly associated with various Late Archaic-aged projectile points.

***Form 5** (7 specimens; Figure 6-II.69; Table 6-II.26)*

Seven specimens are classified as Form 5 triangular dart points. These slender points are mostly fragmentary, with variably shaped blade edges and concave basal edges. They are relatively thick, exhibit crude to good craftsmanship, and are fashioned from different varieties of chert. Form 5 specimens exhibit attributes that are commonly associated with various Late Archaic-aged projectile points.

***Form 6** (1 specimen; Figure 6-II.69; Table 6-II.26)*

One specimen missing its distal blade tip is classified as a Form 6 triangular dart point. This relatively thick, unstemmed specimen has a concave basal edge. Fashioned from chert, it exhibits good craftsmanship and has attributes that are commonly associated with various Late Archaic aged-projectile points.

***Form 7** (1 specimen; Figure 6-II.69; Table 6-II.26)*

One specimen is classified as a Form 7 triangular dart point. It has a re-sharpened blade with recurved edges and a concave basal edge that also has been reworked. Fashioned from chert, it is relatively thin and exhibits good craftsmanship. The chronological placement of this point is unknown, thus it can only be generally dated to the Archaic period.

***Form 8** (4 specimen; Figure 6-II.69; Table 6-II.26)*

Four specimens are classified as Form 8 triangular dart points. All of these have convex blade edges and two specimens have serrations on a single blade edge. A third specimen has a left-sided, alternately beveled blade. Basal edges are slightly concave. These four specimens have variable thicknesses and craftsmanship, and are fashioned from different varieties of chert. Form 8 specimens can only be generally dated to the Archaic period.

***Form 9** (1 specimen; Figure 6-II.69; Table 6-II.26)*

One specimen is classified as a Form 9 triangular dart point. Although missing the blade tip, intact blade edges are recurved. Additionally, the blade is alternately beveled (right-sided), beginning just above the base on each face. The basal edge is straight. This specimen is thin, exhibits excellent craftsmanship with parallel flaking, and is fashioned from chert. It is from an unspecified portion of the Archaic period.

***Form 10** (2 specimens; Figure 6-II.69; Table 6-II.26)*

Two specimens are classified as Form 10 triangular dart points. Both have slightly convex blade edges that are serrated, and one has a single edge notch just above the base. The basal edges are convex and slightly concave. These two specimens are relatively thick, exhibit good craftsmanship, and are fashioned from different varieties of chert. Form 10 specimens are from an unspecified portion of the Archaic period.

***Form 11—Miscellaneous** (9 specimens; Table 6-II.26)*

The Form 11 miscellaneous triangular dart point category contains nine specimens that cannot be confidently assigned to any of the above subcategories. Basal edges are concave on five specimens, convex on two, and straight on the other two. These nine specimens have a wide range in thickness and craftsmanship, and are manufactured from a variety of raw material types, primarily cherts.

Unidentified Dart Point Fragments

Due to extensive breakage, 113 dart point fragments cannot be assigned to any of the above categories or subcategories. This grouping consists of 42 distal, 28 medial, 7 proximal, and 36 inconclusive fragments. Five of the distal fragments are alternately beveled and may be Pandale dart point fragments from the Early Archaic period. The remaining fragments are thought to have Archaic affinities. This classification contains specimens manufactured from a variety of raw material types.

***Dart Point Preform** (1 specimen; Table 6-II.27)*

One specimen is classified as a dart point preform. It exhibits flaking attributes suggestive of late stage reduction. Triangularly-shaped with strongly convex blade edges, it has a concave basal edge, is relatively thin, and is fashioned from hornfels. This specimen has similarities with Paisano points of the Late Archaic period and could be a preform for that type.

Arrow Points

A total of 360 complete and fragmentary arrow points were collected during the BBNP project. Of these, 165 specimens conform to established arrow point types. The majority, however, (n=195) cannot be typed due to a dearth of typological work in the region, especially in regard to the many arrow point forms that are present. Among the more recognizable and regionally common arrow point types in the collection are Livermore, Perdiz, Toyah, Fresno, Alazan, and Cliffton.

As indicated previously, typological assignments in the Big Bend must rely heavily on findings from adjacent regions of Texas where numerous controlled excavations have facilitated establishment of viable projectile point frameworks. However, over the last several decades, excavations in the Big Bend area and associated analyses have provided considerable new typological data, especially concerning several arrow point types, including Alazan (Mallouf 2013b), Means (Mallouf 2013b), Perdiz (Mallouf 1987, 1992, 2011; Cloud 2002, 2013), and Toyah points (Cloud et al. 1994; Corrick 2000; Cloud and Piehl 2008).

In this analysis, 294 arrow points (of the total 360) are separated into two broad morphological categories: stemmed and triangular. The stemmed points are further divided into four subcategories based on stem shape (contracting, expanding, parallel-sided, and bulbous). Specimens within the stemmed subcategories and the triangular category are further separated into discrete forms below with type names assigned when applicable. A final grouping is comprised of the remaining 66 arrow points, all of which are fragmentary and cannot be assigned to either a typological or morphological subcategory.

Stemmed Arrow Points

A total of 198 stemmed arrow points are placed in four subcategories based on stem shape. These consist of 127 specimens with contracting stems, 22 with

Table 6-II.27 Dimension and Description of Dart Point Preform.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Preform	BIBE1849	F	25980		33.2	7.2	12.7	24.8	11.4	Hornfels–black

parallel-sided stems, 38 with expanding stems, and 11 with bulbous stems.

Contracting Stems

A total of 127 specimens in the BBNP collection are classified as contracting-stem arrow points. Within this category, three subcategories (Forms 1–3) are recognized as conforming to established types, while an additional subcategory (Form 4) lacking type designation is also included. Specimens too fragmentary to allow confident placement in any of these subcategories are assigned to a miscellaneous group (Form 5). Descriptive and dimensional data for arrow points in this category are presented in Table 6-II.28.

Form 1—Cliffton (13 specimens; Figure 6-II.70; Table 6-II.28)

Originally named "Cliffton Contracting Stem" by J. Charles Kelley, the type was first illustrated and briefly described by Alex D. Krieger (1946:115–116). The name was ultimately shortened to Cliffton by Suhm et al. (1954:496–497) and described as crudely chipped points, often only modified on a single face, with random blade edges and weak shoulders that are hard to distinguish from the short and broad contracting stems. Turner and Hester (1985:169) included Cliffton in their original point typology publication, but cited studies claiming the type represented unfinished Perdiz arrow points or preforms. In a more recent version of that publication, Turner et al. (2011:206) indicate they no longer consider Cliffton a valid type based on specimen studies from the Buckhollow site in west-central Texas (Johnson 1994) and the Cardinal site in Tamaulipas (Boyd 1997). However, a contradictory study based on a use-wear analysis of Cliffton points recovered from the Varga site in Edwards County, Texas, provided evidence that these projectiles had been hafted (Quigg et al. 2008). Furthermore, Mallouf (in Ing et al. 1996:117) believed that Cliffton points recovered at Big Bend Ranch State Park were functional, well-made projectiles, rather than preforms. For the purposes of this report, Cliffton is considered a valid type.

Thirteen specimens in the BBNP collection are classified as Form 1 contracting-stem arrow points and are assigned to the Cliffton type. All of these points adhere to the general Cliffton description although a wide range of workmanship is evident. Interestingly, 12 of the 13 specimens in the collection are bifacially worked, including 70 percent that are thin and well-crafted, all of which suggests they were, indeed, finished projectiles. Cliffton specimens are fashioned from a wide array of material types, primarily cherts.

Form 2—Livermore (16 specimens; Figure 6-II.70; Table 6-II.28)

The Livermore type was originally defined by Kelley et al. (1940:30) from examples found in the Big Bend, including a large cache of these distinctive points discovered on the summit of Mt. Livermore in 1895 (Janes 1930). The type was later described by Suhm et al. (1954:502–503) in the first Texas statewide typology handbook. In a subsequent clarification concerning the Livermore focus by J. Charles Kelley (1957), he called the type "Livermore Barbed." The shortened version of the type name is commonly used today. Livermore points are distinguished by slightly contracting stems that terminate with convex (sometimes straight) basal edges, long and slender blades with concave lateral edges that are frequently serrated, and right-angled shoulders (Kelley et al. 1940; Suhm et al. 1954; Turner and Hester 1985:181; Mallouf 1985, 1999).

Figure 6-II.70 Contracting stem arrow points: (a–g) Form 1—Cliffton; (h–m) Form 2—Livermore; (n–w) Form 3—Perdiz; (x–z) Form 4.

Sixteen specimens in the BBNP collection are classified as Form 2 contracting-stem arrow points and are assigned to the Livermore type. All of these adhere well to the type description. Three specimens demonstrate recurved blade edges, a characteristic common among this type, although concave blade edges are dominant. Because the degree of concavity differs between specimens, the prominence of the shoulders can appear slight to extreme. Over half (56 percent) of the specimens exhibit serrated blade edges to varying degrees. Livermore points in the collection are manufactured from a variety of raw material types, primarily cherts.

***Form 3—Perdiz** (72 specimens; Figure 6-II.70; Table 6-II.28)*

Perdiz points were originally illustrated and briefly discussed by Kelley et al. (1940), later being formally named "Perdiz Pointed Stem" by J. Charles Kelley (1947c:122) from examples recovered in Lehmann Rockshelter in Central Texas. The name was ultimately shortened to Perdiz by Suhm et al. (1954:504–505). Perdiz points are characterized by triangular blades with usually straight edges, well-barbed shoulders, and contracting stems. Barbs can be long or exaggerated but are typically small to moderate in length, often the result of reworking. Aside from these general characteristics, Perdiz points exhibit a high degree of stylistic diversity which is typical among Perdiz assemblages (Suhm et al. 1954:504–505; Suhm and Jelks 1962:283–284; Turner and Hester 1985:187; Black 1986; Mallouf 1987; Johnson 1994; Ing et al. 1996:117; Cloud 2002, 2013).

Seventy-two specimens in the BBNP collection are classified as Form 3 contracting-stem arrow points and are assigned to the Perdiz type, representing the largest group of identified projectiles in the collection. Nearly all (96 percent) of the specimens are fragmentary, yet retain readily apparent attributes commonly

Table 6-II.28 Dimensions and Descriptions of Arrow Points with Contracting Stems.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 1—Cliffton	BIBE1109	A	25075	41.1	19.7	4.5	4	10.5	3.5	Chert–tan (w/spots)
Form 1—Cliffton	BIBE1109	A	25079		16.6	2.8	7.2	8.7	0.9	Agate–brown
Form 1—Cliffton	BIBE1657	E	25385		16.5	4.5	5.1	7	1.1	Chert–white
Form 1—Cliffton	BIBE0136	B	25686	20	13.5	2.6	4.3	10.1	0.4	Chert–bluish gray
Form 1—Cliffton	BIBE1594	F	25829		13.3	2.5	6.2	9.4	0.4	Chert–gray (w/patina)
Form 1—Cliffton	BIBE1738	F	25884		20.6	3.1	8.1	14.2	1.4	Agate–brown
Form 1—Cliffton	BIBE1738	F	25887	21.9	15.2	2.9	2.9	7.7	0.7	Hornfels–black
Form 1—Cliffton	BIBE1751	F	25892		24	4.2	8.7	18	2.1	Chert–dark brown
Form 1—Cliffton	BIBE1844	F	25964		19.2	3.1	7.7	10.7	1	Chalcedony–mottled light gray
Form 1—Cliffton	BIBE1849	F	25988		24.1	4.2	9.6	14.4	1.8	Chert–light pinkish gray
Form 1—Cliffton	BIBE1910	F	26051		20.8	3.5	5	9.4	1.8	Chert–brown
Form 1—Cliffton	BIBE2506	T	27016	26.5	15.9	3.2	4.4	8.9	0.9	Chalcedony–brown (w/patina)
Form 1—Cliffton	BIBE0246	2010–D	27197	22.2	*14.7	3.6	5.4	7.2	0.7	Chert–tan
Form 2—Livermore	BIBE0418	A	25025			1.9		4.8	0.3	Chert–mottled pink and light gray
Form 2—Livermore	BIBE1119	A	25136		12.1	2.7		5	0.4	Chert–banded pink and red
Form 2—Livermore	BIBE1119	A	25139		11.6	2.8		5	0.3	Chert–mottled white and red
Form 2—Livermore	BIBE1119	A	25140			2.9	7.1	5	0.4	Chert–light gray
Form 2—Livermore	BIBE1119	A	25141		15.1	2.2			0.3	Chert–grayish purple (w/patina)
Form 2—Livermore	BIBE1119	A	25153		12.6	3.3		4.2	0.3	Chert–pinkish gray
Form 2—Livermore	IF 023	A	25246		14.4	2.3			0.6	Chert–gray (w/spots)
Form 2—Livermore	BIBE1628	E	25308	*29.5	13.9	2.8	7.5	3.9	0.7	Hornfels–black
Form 2—Livermore	BIBE1628	E	25310		15.5	3.6	6.7	4.7	0.9	Hornfels–black
Form 2—Livermore	BIBE1639	E	25331			4.2	5.9	5.2	1.2	Chert–dark red (w/speckles)
Form 2—Livermore	BIBE1644	E	25339	19.1	*14.7	2.2	5.1	3.9	0.3	Chert–dark gray
Form 2—Livermore	BIBE1849	F	26000		13.7	3	5.3	4.3	0.4	Chert–light gray (w/spots)
Form 2—Livermore	BIBE1942	F	26302		14.5	4.2		5.3	2.4	Chert–banded brown, red, and gray
Form 2—Livermore	BIBE2527	U	27118		11.3	4	8.4	3.9	0.6	Chert–tan
Form 2—Livermore	BIBE2527	U	27119		*12.8	2.9		4.8	0.3	Chert–light gray (w/spots)
Form 2—Livermore	BIBE2527	U	27123		14.1	2.2			0.4	Chert–mottled gray
Form 3—Perdiz	BIBE1109	A	25074			2.6	8.5	7.1	0.6	Chert (fossiliferous)–mottled brown and purple
Form 3—Perdiz	BIBE1111	A	25085			2.5		6	0.3	Chert–mottled brown
Form 3—Perdiz	BIBE1118	A	25103			3.3	6.4	7.8	0.6	Chalcedony–light gray
Form 3—Perdiz	BIBE1118	A	25106			3.7	9.8	6.2	0.7	Chert–mottled gray
Form 3—Perdiz	BIBE1119	A	25156			2.5	9.7	5.4	0.3	Chert–pink (w/spots)
Form 3—Perdiz	BIBE1150	A	25184		13	3.2		5.7	0.7	Chert–light brown (w/spots)

Form 3—Perdiz	BIBE1150	A	25185			2.5	10.9	6.5	0.7	Chert–banded gray (w/spots)
Form 3—Perdiz	BIBE1163	A	25206			2.6	5.1	4.1	0.3	Chert–brownish gray
Form 3—Perdiz	IF 006	A	25236			2.6		6.3	0.4	Chert–light purple (w/spots)
Form 3—Perdiz	BIBE1182	B	25255			2.5	13.3	7	0.8	Chert (fossiliferous)–mottled brown and purple
Form 3—Perdiz	BIBE1628	E	25316	24.5	15	2.3	11.4	5.3	0.3	Chert–light gray
Form 3—Perdiz	BIBE1640	E	25335			2.3		6.4	0.5	Chert–brownish gray (w/spots)
Form 3—Perdiz	BIBE1655	E	25366		13.3	2.8	10.8	6.1	0.4	Chalcedony–clear
Form 3—Perdiz	BIBE1655	E	25370		15.8	3.4	12.6	6.4	0.9	Chert–purple (w/speckles)
Form 3—Perdiz	BIBE1655	E	25372			2.7		7.2	0.7	Chert–mottled brown and gray
Form 3—Perdiz	BIBE1655	E	25374		14	2.9		5.9	0.5	Chert–white
Form 3—Perdiz	BIBE1655	E	25375			3			1	Chalcedony–mottled brown
Form 3—Perdiz	BIBE1676	F	25437			2	8.4	4.5	0.2	Chalcedony–gray (w/speckles)
Form 3—Perdiz	BIBE1676	F	25440		14.1	2.7	9.6	5	0.3	Chert–brownish gray (w/spots)
Form 3—Perdiz	BIBE1694	F	25471	29.1		2.9	12	5.5	0.5	Chert–pink
Form 3—Perdiz	BIBE1694	F	25473	*26.2	16.7	4.5		5.9	1.5	Chert–mottled brown and white
Form 3—Perdiz	BIBE1702	F	25486			2.3	11.4	5.6	0.3	Chert–mottled purple and white
Form 3—Perdiz	BIBE1216	B	25571			2.9	5.9	6	0.5	Hornfels–black
Form 3—Perdiz	BIBE1218	B	25586			2.9		7.7	0.5	Chert–brown
Form 3—Perdiz	BIBE0050	B	25620		16.7	2.9	12	6.6	1.5	Chert–light gray
Form 3—Perdiz	BIBE0296	JQ–2	25762		16.9	3.4		7.7	0.6	Chert–banded white and brown
Form 3—Perdiz	BIBE1335	JQ–2	25768			2.1		7.1	0.6	Chalcedony–mottled light gray and pink
Form 3—Perdiz	BIBE1336	JQ–2	25770	18.9		2.6	8.4	6	0.3	Chert–brownish gray
Form 3—Perdiz	BIBE1338	JQ–2	25772			2.8	9.4	5.8	0.6	Chert–white
Form 3—Perdiz	IF 095	C	25798			3.2		7.2	0.8	Chert–dark bluish gray
Form 3—Perdiz	BIBE1594	F	25820			2.3	9.7	6.5	0.3	Chert–banded light gray and brown
Form 3—Perdiz	BIBE1594	F	25826			3.5	9.5	6.8	0.7	Chalcedony–gray (w/speckles)
Form 3—Perdiz	BIBE1594	F	25827			2.2	6.5	6.2	0.2	Chert–brownish gray
Form 3—Perdiz	BIBE1594	F	25847	33.5		3.1	7.6	5.3	0.8	Chalcedony–white (w/speckles)
Form 3—Perdiz	BIBE1738	F	25868		17.1	2	9.6	7.7	0.5	Chert–brown
Form 3—Perdiz	BIBE1738	F	25874	25.9		2.6	10	5.2	0.4	Chalcedony–white (w/patina)
Form 3—Perdiz	BIBE1738	F	25875			2.8		7.8	0.8	Chert–brownish gray
Form 3—Perdiz	BIBE1738	F	25885			3.1		7.8	0.4	Chalcedony–brown (w/patina)
Form 3—Perdiz	BIBE1752	F	25893		15.3	3.8	11.7	9.7	0.8	Chert–light gray
Form 3—Perdiz	IF 196	F	25896		16.3	2.7		5.2	0.3	Chalcedony–white (w/speckles)
Form 3—Perdiz	BIBE1594	F	25927	23.6	13.8	2.8	11.7	5.2	0.3	Chalcedony–light gray (w/spots)
Form 3—Perdiz	BIBE1844	F	25962			2.4		5	0.2	Chalcedony–gray (w/speckles)
Form 3—Perdiz	BIBE1844	F	25963	29.2		3.7	12.2	7.9	1.1	Chalcedony–mottled gray and purple
Form 3—Perdiz	BIBE1850	F	26015		16.4	3.7		7.1	0.8	Agate–brown
Form 3—Perdiz	BIBE1882	F	26026			3.6	14	6.8	0.4	Agate–brown

Table 6-II.28 Dimensions and Descriptions of Arrow Points with Contracting Stems. *(continued)*

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 3—Perdiz	BIBE1910	F	26046			2.3	8.6	5.6	0.2	Chert–light gray
Form 3—Perdiz	BIBE1910	F	26049	20.5		2.5	9.8	5.7	0.2	Chert–gray (w/speckles)
Form 3—Perdiz	BIBE1910	F	26050			2.6			0.4	Chalcedony–tan (w/speckles)
Form 3—Perdiz	BIBE1910	F	26052			2.7	10.8	5.5	0.2	Chert–light gray
Form 3—Perdiz	BIBE1910	F	26055			2.2	8.2	5.6	0.2	Chalcedony–gray
Form 3—Perdiz	BIBE0537	Y	26073		15.3	2.6	10	5.8	0.8	Chert–light gray
Form 3—Perdiz	BIBE0284	F	26462			3.1	8.3	6.3	0.6	Chert–purple
Form 3—Perdiz	BIBE0284	F	26468			2.6		6.6	0.4	Chert–reddish brown (w/spots)
Form 3—Perdiz	BIBE0284	F	26472			3.6		6.2	0.5	Rhyolite–reddish brown (w/spots)
Form 3—Perdiz	BIBE1910	F	26475			3		6.2	0.8	Chalcedony–white
Form 3—Perdiz	BIBE1982	F	26504			3.7		6.8	0.9	Chert–light gray
Form 3—Perdiz	BIBE1982	F	26508			2.8			0.5	Chert–white
Form 3—Perdiz	BIBE2004	F	26527			2.8			0.5	Chert–mottled gray and purple
Form 3—Perdiz	BIBE2085	H	26721		14.1	2.3			0.3	Chert–mottled brown
Form 3—Perdiz	BIBE2085	H	26732		20	2.5		5.6	0.7	Chert–brown
Form 3—Perdiz	BIBE2085	H	26738			3.5	10.4	6.1	0.8	Chert–mottled dark brown
Form 3—Perdiz	BIBE2430	O	26892			3.8	5.5	4.4	0.4	Chert–banded white
Form 3—Perdiz	BIBE2491	T	26933			2			0.2	Chert–dark bluish gray
Form 3—Perdiz	BIBE0760	T	26963	20.2		1.9	4.6	3.1	0.1	Chert–gray (w/spots)
Form 3—Perdiz	BIBE2516	X	27012			3.2		7.7	0.9	Chert–gray
Form 3—Perdiz	BIBE2445	W	27027			2.9		6.8	0.1	Chalcedony–gray
Form 3—Perdiz	BIBE0970	V	27045			2.7	9.8	5.8	0.4	Agate–brown
Form 3—Perdiz	BIBE2531	U	27129			3.1		7.4	0.6	Chert–mottled purple
Form 3—Perdiz	BIBE0978	2010–X	27210	23.6	13.5	1.9	8.4	5	0.3	Chert–mottled purple and pink
Form 3—Perdiz	BIBE2454	BB	27216			2.4		5.2	0.3	Chalcedony–gray
Form 3—Perdiz	BIBE2768	2010–D	27231		14.7	2.4	7.9	6.6	0.3	Chert–banded brownish gray and light gray
Form 3—Perdiz	BIBE2648	2010–C	27252			1.8		5	0.1	Chert–white
Form 4	BIBE1257	B	25637		*20.9	2.9	6.7	5.5	1.4	Hornfels–black
Form 4	BIBE2491	T	26928	*30.8	*20.8	5.2	7.1	7.3	1.8	Chert–light gray (w/patina)
Form 4	BIBE2717	2010–HH	27304	*30.5	*18.5	7.4	7.2	7.1	2.1	Chert–white
Form 5—Miscellaneous	BIBE0418	A	25005		17.8	2.7	7.7	6.3	0.5	Chert–tan
Form 5—Miscellaneous	BIBE0418	A	25024		20.1	3.3	6.1	7.1	1	Chert–mottled white and pink
Form 5—Miscellaneous	BIBE0418	A	25027			4		8.8	1.2	Chalcedony–mottled light gray and brown
Form 5—Miscellaneous	BIBE1119	A	25144	26.8	14.7	2.6	8.2	8.3	0.6	Chert–mottled gray (w/spots)
Form 5—Miscellaneous	BIBE1628	E	25309		20.7	3.6	6.2	9	1	Chert–mottled black and dark gray
Form 5—Miscellaneous	BIBE1628	E	25313	24.3	14.7	4.3	4.5	6.3	1	Chert–gray

Form 5—Miscellaneous	BIBE1655	E	25364		17.5	3.3	5.2	6.7	0.7	Chert–gray (w/spots)
Form 5—Miscellaneous	BIBE1655	E	25365		15.8	3.7	4.7	8.2	0.4	Chert–gray
Form 5—Miscellaneous	BIBE1257	B	25642		14.9	3.5	6.6	5.9	0.6	Chert–light gray
Form 5—Miscellaneous	BIBE1749	F	25890	36.3	*21.1	5.8	6.3	8.3	2.5	Chert–mottled purple
Form 5—Miscellaneous	BIBE0537	Y	26078	31.5	13	3.2	7.6	8.5	0.7	Chert–light gray
Form 5—Miscellaneous	BIBE1942	F	26279	18.2	15.5	2.5	6.3	7.3	0.2	Hornfels–black
Form 5—Miscellaneous	BIBE1976	F	26496		16.4	2.4	10.5	7.6	0.4	Jasper–brown
Form 5—Miscellaneous	BIBE1982	F	26506	24.4		4.3	6.7	9.2	1.6	Chalcedony–mottled light gray and brown
Form 5—Miscellaneous	BIBE0775	L	26833	25.7		2.8	5.4	6.2	1	Hornfels–black
Form 5—Miscellaneous	BIBE0761	T	26996		17.1	3.3	5.1	5.9	0.7	Chert–white
Form 5—Miscellaneous	BIBE0761	T	26997		17.9	2.8		7.7	0.6	Chert–mottled brown and purple
Form 5—Miscellaneous	BIBE0761	T	27003		13.2	2.4	4.7	5.5	0.1	Chert–tan (w/spots)
Form 5—Miscellaneous	IF 897	U	27093			2.6	4.9	6.4	0.5	Chalcedony–light gray
Form 5—Miscellaneous	BIBE2527	U	27116			3.6	3.7	4.6	0.5	Chert–mottled brown
Form 5—Miscellaneous	BIBE2577	EE	27160	36.5	18.9	5.3	7	6.7	3.1	Chert–mottled gray and brown (w/patina)
Form 5—Miscellaneous	BIBE2475	DD	27177			3.6	8.4	9.2	1.9	Chert–mottled light gray and brown (w/speckles)
Form 5—Miscellaneous	IF 942	2010-G	27190	29		2.9	5.8	6.6	0.7	Chert–mottled light gray and brown

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

recognized for the type. Fifteen specimens have lightly to extremely serrated blade edges, a relatively common trait of the type. Most specimens have contracting or slightly contracting stems; four are anomalous with particularly long stems. Although all specimen stems are bifacially worked, over 75 percent of the points retain remnant original flake scars on one face of their blade elements, a characteristic attribute of the type in the Big Bend. Stems have variable lengths and widths and some occasionally exhibit lateral edge beveling. Bases are pointed or rounded, and most specimens have been reworked. Generally speaking, workmanship is of a high quality. These arrow points are fashioned from a wide array of material types, primarily of fine-grained cherts and chalcedonies.

Form 4 *(3 specimens; Figure 6-II.70; Table 6-II.28)*

Three specimens are classified as Form 4 contracting-stem arrow points. They have small protruding right angle shoulders, moderately broad blades, and straight to slightly recurved blade edges that are serrated. These arrow points have contracting stems with rounded basal edges. Two specimens made of chert are bifacially worked and relatively thick. In contrast, the other specimen in this subcategory is made of hornfels, flaked more on one face than the other, and moderately thin. All three specimens have morphological similarities with Livermore arrow points (Suhm et al. 1954:502–503; Turner and Hester 1985:181), but lack the distinctive barbs that distinguish that type. This form can be confused with the Bonham (Suhm et al. 1954:496–497; Turner and Hester 1985:165) or Alba (Suhm et al. 1954:494–495; Turner and Hester 1985:163) arrow point types, types commonly found in east-central and East Texas, respectively.

Form 5—Miscellaneous *(23 specimens; Table 6-II.28)*

The Form 5 miscellaneous contracting-stem arrow point category contains 23 specimens that cannot be confidently assigned to any of the above subcategories. These specimens are manufactured from a variety of raw material types, primarily cherts and chalcedonys.

Parallel-Sided Stems

Twenty-two specimens in the BBNP collection are classified as parallel-sided stem arrow points. Within this category, two subcategories (Forms 1 and 2) are recognized. Specimens too fragmentary to allow confident placement in either of these subcategories are assigned to a miscellaneous group (Form 3). Descriptive and dimensional data for arrow points in this category are presented in Table 6-II.29.

Form 1 *(12 specimens; Figure 6-II.71; Table 6-II.29)*

Twelve specimens are classified as Form 1 parallel-sided stem arrow points. Distinctive attributes of this form are concave blade edges that are sometimes lightly serrated, strong shoulders, and narrow parallel-sided stems that terminate with rounded or straight basal edges. These specimens are bifacially flaked and exhibit remnant original flake scars, usually only on a single face. Another distinctive attribute is the high level of craftsmanship. These specimens are typically thin and very well-made, exhibiting an almost artistic quality. They are fashioned from various materials, primarily cherts. This form can be confused with Bonham arrow points (Suhm et al. 1954:496–497; Turner and Hester 1985:165), a type found in Central and East Texas.

Form 2 *(2 specimens; Figure 6-II.71; Table 6-II.29)*

Two fragmentary specimens are classified as Form 2 parallel-sided stem arrow points. Both specimens have long downward sloping barbs, and exhibit broad, rectangular-shaped stems that terminate in straight basal edges. The most complete specimen has a convex lateral blade edge, including a right-hand, alternately beveled distal tip that extends halfway down the blade. The other specimen retains a large remnant of the original flake scar on one face. These specimens are fashioned from different varieties of chert. This form can be confused with Alba arrow points (Suhm et al. 1954:494–495; Turner and Hester 1985:163), a type commonly found in East Texas.

Form 3—Miscellaneous *(8 specimens; Table 6-II.29)*

The Form 3 miscellaneous parallel-sided stem arrow point category contains eight specimens that cannot be confidently assigned to any of the above subcategories. All specimens exhibit asymmetrical qualities in blade, shoulder, and stem morphologies. The parallel-sided stems are relatively short and have variable widths, while some specimens have irregular stem edges. The quality of craftsmanship, blade edge configuration, and shoulder morphology is highly variable. One specimen has serrated blade edges and another is the single barbed example among this subcategory. These specimens are manufactured from a variety of raw materials.

Expanding Stems

A total of 38 specimens in the BBNP collection are classified as expanding-stem arrow points. Within this category, two subcategories (Forms 1 and 2) are recognized as conforming to established types; six additional subcategories (Forms 3–8) embrace morphological variants. Specimens too fragmentary to allow confident placement in any of these subcategories are assigned to a miscellaneous group (Form 9). Descriptive and dimensional data for arrow points in this category are presented in Table 6-II.30.

Form 1—Alazan *(12 specimens; Figure 6-II.71; Table 6-II.30)*

Recently typed by Robert J. Mallouf (2013b), the Alazan type occurs across the eastern Trans-Pecos, including the Big Bend. These distinctive points have variable blade edge configurations that are frequently serrated, with barbs that may project at right angles or slope downwards. Stems are typically short and expanding, but may be parallel-sided, and usually exhibit a small basal indentation (Mallouf 2013b; Turner et al. 2011:176).

Twelve specimens in the BBNP collection are classified as Form 1 expanding-stem arrow points and are

Figure 6-II.71 Expanding stem arrow points: (a-f) Form 1—Alazan; (g-h) Form 2; (i) Form 3; (j) Form 4; (k) Form 5; (l) Form 6. Parallel-sided stem arrow points: (m-v) Form 1; (w-x) Form 2. Bulbous stem arrow points: (y-ad) Form 1; (ae-ag) Form 2.

assigned to the Alazan type. They have variable blade edge configurations and 75 percent exhibit serrated blades. Barbs are characteristic of the type, while stems tend to expand, as displayed on 10 of the 12 specimens. Only four in the collection exhibit a slight basal indentation, the remainder have straight to convex basal edges. Alazan points are manufactured from a wide array of material types, primarily cherts.

Form 2—Means (2 specimens; Figure 6-II.71; Table 6-II.30)

Newly recognized by Robert J. Mallouf (2013b), the Means type occurs most often in the central and northern sections of the eastern Trans-Pecos. The type is characterized by long, narrow blades with serrated blade edges, well-defined barbs that project laterally at right angles, and bases that expand strongly resulting from side-notching. Basal edges are usually straight and often approximate the width of the well-defined barbs (Mallouf 2013b:198–201; Turner et al. 2011:203).

Two specimens in the BBNP collection are classified as Form 2 expanding-stem arrow points and are assigned to the Means type. One specimen lacks the distinctive, well-defined barbs of the type and is only slightly serrated along one blade edge while the other specimen lacks serrations entirely. However, both specimens have stem, basal, and other blade attributes that are characteristic of the Means type. Fashioned from chert and jasper, these specimens are both bifacially

Table 6-II.29 Dimensions and Descriptions of Arrow Points with Parallel Stems.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 1	BIBE1111	A	25086		15.4	2.4		3.4	0.4	Chert–gray
Form 1	BIBE1630	E	25317	17.6	13.9	1.6	4.9	4.4	0.2	Chert–mottled pink and white
Form 1	BIBE1655	E	25357	23.4	11.8	3.3	5.7	3.6	0.7	Chert–dark gray
Form 1	BIBE1655	E	25361			3.1	6.2	4.8	0.6	Chert–gray (w/spots)
Form 1	BIBE1655	E	25363		12.1	2.5	5	2.6	0.2	Chalcedony–mottled brown
Form 1	BIBE0537	Y	26072			1.9			0.4	Silicified Wood–dark brown
Form 1	BIBE0537	Y	26077		15.2	2.3	5.5	4.2	0.4	Chert–mottled pink and gray
Form 1	BIBE0760	T	26977		17	2.5		4.2	0.5	Chert–brownish gray
Form 1	BIBE0761	T	26994			2.8	6.4	4.4	0.4	Chert–light gray (w/spots)
Form 1	BIBE2432	T	27014	19.3		2.1	4.6	4.8	0.5	Chert (fossiliferous)–brown
Form 1	BIBE0604	W	27035	*24.5	13.5	2.2	5.8	3.7	0.4	Chert–white
Form 1	BIBE2524	U	27105	20.1		2.1	5.4	4.6	0.4	Chert–mottled pink and tan
Form 2	IF 131	E	25391	25.7		2.9	8.1	7	1	Chert–mottled pink and white
Form 2	BIBE1849	F	25969			2.5	7.1	6.2	0.4	Chert–light gray
Form 3–Miscellaneous	BIBE0418	A	25012		21.2	3	5.6	7.2	0.8	Silicified Wood–brown
Form 3–Miscellaneous	BIBE1119	A	25129			2.8			0.3	Chalcedony–light brown (w/speckles)
Form 3–Miscellaneous	BIBE1119	A	25133		13.5	4.8		5.2	0.9	Chert–white
Form 3–Miscellaneous	BIBE1257	B	25640		20.3	3.1	4.5	6.5	1.3	Chalcedony–mottled white and red (w/spots)
Form 3–Miscellaneous	BIBE2490	T	26922		12.7	3.8		3.5	1.1	Chert–light gray
Form 3–Miscellaneous	BIBE0246	2010–D	27195	*23.6	15.8	3.8	5.2	6.3	1.1	Chert–mottled white and purple
Form 3–Miscellaneous	BIBE2656	2010–C	27256			2	4.9	6.2	0.5	Chert–gray (w/spots)
Form 3–Miscellaneous	BIBE0817	2010–P	27268	*20.4	13	2.7	4.5	5.9	0.6	Chert–light gray

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

worked. It is noteworthy that Means points are relatively rare in the Big Bend proper (Mallouf 2013b:200).

Form 3 (2 specimens; Figure 6-II.71; Table 6-II.30)

Two specimens are classified as Form 3 expanding-stem arrow points. One is complete and rather well-made when compared to the other, a much cruder and fragmentary specimen that is missing part of the basal edge. Both examples are characterized by straight blade edges, corner-notching, and short, wide expanding stems with slightly convex basal edges. One specimen is complete and made of chert, while the other, a fragmentary chalcedony specimen, contains remnant original flake scars on both faces of its blade. These specimens share attributes with the Scallorn arrow point type (Suhm et al. 1954:506–507; Turner and Hester 1985:189), but are much smaller.

Form 4 (1 specimen; Figure 6-II.71; Table 6-II.30)

One complete specimen is classified as a Form 4 expanding-stem arrow point. It has straight blade edges, small barbs, a broadly expanding stem that is wider than the blade, and a concave basal edge. Fashioned from chalcedony, this well-made and bifacially worked specimen has similarities with the Edwards arrow

Table 6-II.30 Dimensions and Descriptions of Arrow Points with Expanding Stems.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 1—Alazan	BIBE0246	2010–D	27201			3			0.5	Chert-brownish-gray
Form 1—Alazan	BIBE0418	A	25009			3.4	5.8	4.8	0.6	Chert-tan
Form 1—Alazan	BIBE0760	T	26962		14.4	3.4	5.3	5.2	0.4	Chert-mottled pink
Form 1—Alazan	BIBE1119	A	25126			2.8		5	0.5	Chert-gray
Form 1—Alazan	BIBE1655	E	25358		12.2	2.1	4.4	5.4	0.1	Jasper-red
Form 1—Alazan	BIBE1702	F	25490		14.1	3.4	6.7	5.2	0.6	Chert-reddish-brown
Form 1—Alazan	BIBE1702	F	25493		14.3	3	5.6	4.4	0.6	Chert-banded reds-speckles
Form 1—Alazan	BIBE1738	F	25862	35.2	16.1	3.4	5.9	6.3	0.9	Chert-white
Form 1—Alazan	BIBE2497	T	26940			3		5.5	0.6	Chert-gray
Form 1—Alazan	BIBE2604	CC	27180			2.1		5.3	0.5	Chalcedony-Mottled brn-gray
Form 1—Alazan	BIBE2632	2010–C	27240			2.7		5.3	0.4	Chlacedony-white
Form 1—Alazan	BIBE2717	2010–HH	27303		15.1	1.2	5.7	5.9	0.1	Chert-mottled purple
Form 2—Means	BIBE1594	F	25522	25	9.8	3	6.3	4.2	0.3	Jasper-brown
Form 2—Means	BIBE2636	2010-C	27247		13.4	2.6	8	5.4	0.7	Chert-gray
Form 3	BIBE1594	F	25825			3.3		5.3	0.4	Chalcedony-mottled yellow-gray-red
Form 3	BIBE2716	2010–HH	27298	22.6	12.4	2.8	5.3	5.1	0.4	Chert-light gray
Form 4	BIBE1849	F	26001	23.6	14	3.3	8	7	0.6	Chalc.-mt. purple-gray (w/speckles)
Form 5	BIBE2437	W	27026	28.4	15.4	4.2	6.8	6.2	1.3	Chert-gray
Form 6	BIBE2255	L	26820		13.7	4.4		6.7	1.8	Chert-mottled purple (w/speckles)
Form 7	BIBE1942	F	26283		18.1	4.5	5.7	7.6	1.5	Chert-mottled brown-gray
Form 8	BIBE0775	L	26829	20.6	12	5.3	N/A	6.9	0.7	Chert-white
Form 8	BIBE2085	H	26729	18.7	10.5	2.7	N/A	7.6	0.2	Chalcedony-light brown-speckled
Form 9—Miscellaneous	BIBE0246	2010–D	27200		13	2.6		6.3	0.6	Chalcedony-mottled purple & white
Form 9—Miscellaneous	BIBE0284	F	26470	19.3	11.7	3.9	5.7	7.3	0.5	Chalcedony-white
Form 9—Miscellaneous	BIBE0760	T	26959			3.3	6.9	4.1	0.1	Chert-light gray
Form 9—Miscellaneous	BIBE1118	A	25112			2.4		6.8	0.4	Chert-bluish-gray
Form 9—Miscellaneous	BIBE1118	A	25120		19.7	5	8.3	6.9	2.5	Chert-brownish-gray
Form 9—Miscellaneous	BIBE1152	A	25187	33.1	14.9	4.9	7.4	6.6	1.8	Chert-light gray
Form 9—Miscellaneous	BIBE1325	JQ–1	25756	26.6	12.2	4.6	8.3	5.9	0.9	Chalcedony-white
Form 9—Miscellaneous	BIBE1441	JQ–2	25786			2.6		5.9	0.6	Chert-mottled dark purple & gray
Form 9—Miscellaneous	BIBE1594	F	25525		15.7	3.8		5.5	0.8	Chert-mottled brown
Form 9—Miscellaneous	BIBE1594	F	25819		14	3.5		6.4	0.5	Chert-brown
Form 9—Miscellaneous	BIBE1702	F	25496		14	4.6		6.6	1.8	Chert-mottled light gray
Form 9—Miscellaneous	BIBE1738	F	25871			2.3	6	6.5	0.4	Chert-brownish-gray
Form 9—Miscellaneous	BIBE1849	F	26008			3.8		4.9	0.6	Chert-white
Form 9—Miscellaneous	BIBE1849	F	26009	25.2	10.1	3.4	4.9	4.6	0.6	Chalcedony-light gray
Form 9—Miscellaneous	BIBE2527	U	27121	26		4	5.9	7.1	1	Chert-brownish-gray
Form 9—Miscellaneous	BIBE2687	2010–P	27270		13.4	5.2	7.7	7.8	1.4	Chert-white

point type of south-central Texas (Turner and Hester 1985:173). It is not classified as such due to having smaller dimensions than those established for the type.

Form 5 *(1 specimen; Figure 6-II.71; Table 6-II.30)*

A complete and distinctive specimen is classified as a Form 5 expanding-stem arrow point. It exhibits single blade notches mid-way along each convex lateral edge. With very small barbs, it has a strongly expanding stem and a convex basal edge. This bifacially worked specimen is manufactured from chert and has similarities with Diablo arrow points, a type of the northern and central sectors of the eastern Trans-Pecos and adjacent southeastern New Mexico (Mallouf 2013b; Turner et al. 2011:189).

Form 6 *(1 specimen; Figure 6-II.71; Table 6-II.30)*

A single arrow point fragment is classified as a Form 6 expanding-stem arrow point. This nearly complete specimen has a long, slender blade with convex and straight lateral edges. Although both barbs are missing, remnants remain of these downward-sloping projections. The strongly expanding stem has rounded corners and a snapped basal edge that was likely convex when intact. Bifacially worked, this arrow point is fashioned from chert.

Form 7 *(1 specimen; Figure 6-II.71; Table 6-II.30)*

A single arrow point fragment is classified as a Form 7 expanding-stem arrow point. The specimen has a short, broad blade with convex lateral edges and small barbs. The stem expands strongly and terminates in a slightly convex basal edge. This well-crafted specimen is bifacially worked and fashioned from chert.

Form 8 *(2 specimens; Figure 6-II.71; Table 6-II.30)*

Two complete specimens are classified as Form 8 expanding-stem arrow points. These small specimens are distinguished by their strongly convex basal edges and side notches above the base. The chert specimen is thicker and bifacially worked, while the chalcedony specimen exhibits remnants of the original flake scars on both faces and contains serrated blade edges. Form 8 expanding-stem specimens have no similarities with any known regional arrow point types.

Form 9—Miscellaneous *(16 specimens; Table 6-II.30)*

The Form 9 miscellaneous expanding-stem arrow point category contains 16 specimens that cannot be confidently assigned to any of the above subcategories. All specimens are asymmetrical in blade, shoulder, and stem morphologies, and the quality of craftsmanship is variable. Blade edge configurations are concave, convex, and straight; two of the specimens have serrated edges. Shoulders vary from weak to moderate, including barbed examples that comprise 50 percent of the specimens. Expanding stems are short and vary from wide to narrow, with some examples displaying irregular stem edges. Toolstone used for these miscellaneous arrow points consists of cherts and chalcedonies.

Bulbous Stems

Eleven specimens in the BBNP collection are classified as bulbous-stem arrow points. Within this category, one subcategory (Form 1) is recognized. Specimens too fragmentary to allow confident placement in that subcategory are assigned to a miscellaneous group (Form 2). Descriptive and dimensional data for arrow points in this category are presented in Table 6-II.31.

Form 1 *(8 specimens; Figure 6-II.71; Table 6-II.31)*

Eight specimens are classified as Form 1 bulbous-stem arrow points. These specimens are distinguished by short and narrow bulbous-shaped stems that terminate in convex basal edges. One specimen exhibits right-hand alternate beveling of the stem. Shoulders are weak to strong. Blade edges are concave or convex, with four lightly serrated. Five specimens exhibit remnants of original flake scars on one face, and are better crafted than the remaining three specimens that are bifacially worked. These arrow points are manufactured from various cherts and chalcedonies. This form can be confused with Bonham arrow points (Suhm et al. 1954:496–497; Turner and Hester 1985:165), a type found in Central and East Texas.

__Form 2—Miscellaneous__ (3 specimens; Figure 6-II.71; Table 6-II.31)

The Form 2 miscellaneous bulbous-stem arrow point category contains three specimens that cannot be confidently assigned to the Form 1 subcategory. These fragmentary, but mostly intact, specimens have variable shapes but all are relatively thin and have large original remnant flake scars occurring on single faces. The bulbous-stem morphology is variable, including the overall dimensions of each specimen's stem. Blade edges are straight to convex, with one specimen having serrated edges as well as shoulders. The other two specimens are barbed. These specimens are manufactured from a variety of raw material types.

Triangular Arrow Points

A total of 96 specimens in the BBNP collection are classified as triangular arrow points. Within this category, two subcategories (Forms 1 and 2) conform to established types, while five additional subcategories (Forms 3–7) are recognized. Specimens too fragmentary to allow confident placement in any of these subcategories are assigned to a miscellaneous group (Form 8). Descriptive and dimensional data for arrow points in this category are presented in Table 6-II.32.

__Form 1—Fresno__ (8 specimens; Figure 6-II.72; Table 6-II.32)

Fresno points were first described by Alex D. Krieger (1946:115–116) using examples found at the Harrell Site, but were not named. They were formally named "Fresno Triangular Blade" by J. Charles Kelley (1947c:122) using specimens recovered from Lehmann Rockshelter in Central Texas. The name was ultimately shortened to Fresno by Suhm et al. (1954:498–499). Fresno points are characterized by triangular-shaped bodies with straight to convex blade edges. These often finely made points typically have straight basal edges, but concave and convex examples also occur (Suhm et al. 1954:498–499; Turner and Hester 1985:174).

Eight specimens in the BBNP collection are classified as Form 1 triangular arrow points and are assigned to the Fresno type. These specimens exhibit variable blade edge configurations and include one that is serrated. Six specimens have large remnant original flake scars on one face. The majority of specimens exhibit slightly concave basal edges; however, on two specimens these edges are straight. These specimens are fashioned from various cherts and chalcedonies. Turner et al. (2011:191) caution that "some of these specimens may be preforms and not a distinct type. However, on the Texas coast, carefully chipped specimens appear to represent a typological group." It is noteworthy that specimens in the BBNP collection are rather well-made and appear to be finished points.

__Form 2—Toyah__ (42 specimens; Figure 6-II.72; Table 6-II.32)

Kelley et al. (1940) originally discussed and illustrated this form, separating it into two distinct varieties which he later named "Toyah Triple Notched" and "Piedras Triple Notched" (Kelley 1947c, 1957). Ultimately, these two varieties were lumped together, described, and renamed Toyah by Suhm et al. (1954:506, 508–509). Kelley (1957) argued that the Piedras Triple Notched is often asymmetrical, thicker, much more crudely made, and has smaller notches when compared to Toyah Triple Notched. Toyah points are characterized by triangular blades that are often strongly serrated, side notches anywhere near the bases to about the middle of the points, and a larger third notch in the center of the bases (Suhm et al. 1954:506, 508–509; Turner and Hester 1985:193).

Forty-two specimens in the BBNP collection are classified as Form 2 triangular arrow points and are assigned to the Toyah type. These specimens are mostly fragmentary (74 percent), with the most

Figure 6-II.72 Triangular arrow points: (a-c) Form 1—Fresno; (d-l) Form 2—Toyah; (m-n) Form 3; (o-r) Form 4; (s-u) Form 5; (v-x) Form 6; (y-aa) Form 7; (ab-af) Form 8—Miscellaneous.

common breakage found on the distinctive flaring basal ears. All 42 specimens fit the Toyah description and over 70 percent exhibit serrated blade edges. These arrow points are well-crafted, and 63 percent have remnants of the original flake scars on one face. Most specimens in the collection are small in overall length, including 19 that have short blades from reworking. It is noteworthy that heavily reworked Toyah points were also recovered from the Polvo site (Cloud et al. 1994) to the west of BBNP. Toyah points in the BBNP collection are fashioned from a wide array of raw material types, primarily cherts and chalcedonies.

***Form 3** (3 specimens; Figure 6-II.72; Table 6-II.32)*

Three fragmentary specimens are classified as Form 3 triangular arrow points. These specimens are characterized by triangular blades, side notches near the base, and concave basal edges. Two specimens are worked bifacially and are fashioned from different varieties of chert. The other specimen, fashioned from chalcedony, has large remnants of the original flake scars on both faces and lightly serrated blade edges. These three well-crafted specimens have similarities with the Toyah arrow point type (Suhm et al. 1954:508–509; Turner and Hester 1985:193), but are not classified as such because they lack a basal notch.

Table 6-II.31 Dimensions and Descriptions of Arrow Points with Bulbous Stems.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 1	BIBE1119	A	25128		13.1	2.2	6.8	3.7	0.5	Chert–grayish purple
Form 1	BIBE1119	A	25132		12.1	2.5	6	3.9	0.5	Chert–mottled brown
Form 1	BIBE1119	A	25143			2.6		3	0.5	Chert–gray
Form 1	BIBE1119	A	25154			2.2	6.2	3.5	0.4	Chert–mottled gray
Form 1	BIBE1655	E	25359		13.4	2.8	8.2	4.1	0.6	Chert–light gray
Form 1	BIBE1849	F	25990	24.4	14	3.2	5.8	3.2	0.7	Chalcedony–gray
Form 1	BIBE0604	W	27031			3.5	5.8	3.5	0.8	Chert–gray
Form 1	BIBE2628	E	27238		*12.1	3.8		4.5	1	Chert–white
Form 2–Miscellaneous	BIBE1594	F	25521		15.5	2.9	6.7	7.2	1.2	Chert–black
Form 2–Miscellaneous	BIBE1734	F	25860	*28.6		2.8	5.6	5.5	1	Chalcedony–mottled light gray and brown
Form 2–Miscellaneous	BIBE1850	F	26017	35.3	17.6	3.4	6.6	8	1.7	Chert–mottled bluish gray

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

Form 4 (9 specimens; Figure 6-II.72; Table 6-II.32)

Nine specimens are classified as Form 4 triangular arrow points. These points are distinguished by side notches near the base and a straight to slightly concave basal edge. Other distinctive attributes are straight blade edges, narrow blades, and serrated edges. The latter occur on six specimens. Additionally, six specimens retain remnants of original flake scars on one face. These well-crafted specimens are manufactured from various high-quality chalcedonies and cherts. They have similarities with the Washita arrow point type of the Texas Panhandle (Turner and Hester 1985:195) but are not classified as such due to different notch positioning. Washita points have deep, lateral side notches located higher up on the blade that produce a large base or stem area (Turner and Hester 1985:195). It is noteworthy to mention that side-notched, triangular arrow points are a relatively common point style in the La Junta district (Shackelford 1951: Plate XXV) to the west of BBNP.

Form 5 (5 specimens; Figure 6-II.72; Table 6-II.32)

Five specimens are classified as Form 5 triangular arrow points. These triangular-shaped specimens exhibit shallow side notches near the base and terminate with straight to slightly convex basal edges. Two specimens have single side notches, while the others are notched on both sides. Blade edges are straight to slightly convex with three specimens retaining remnants of the original flake scars on one face. Form 5 specimens are manufactured from a variety of raw material types. Side-notched triangular arrow points are a relatively common point style in the La Junta district (Shackelford 1951: Plate XXV) to the west of BBNP.

Form 6 (6 specimens; Figure 6-II.72; Table 6-II.32)

Six specimens are classified as Form 6 triangular arrow points. These specimens are triangular-shaped and have long narrow blades. The blade edges are sharply concave, starting just above the basal edges, which produce distinctive flaring bases. The basal edge is

Table 6-II.32 Dimensions and Descriptions of Triangular Arrow Points.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 1—Fresno	BIBE1118	A	25115			2.7	N/A	0.5	Chert-mottled purple-gray
Form 1—Fresno	BIBE1333	JQ–2	25767	20		3.1	N/A	0.6	Chert-white
Form 1—Fresno	BIBE1702	F	25492		14.1	3.1	N/A	0.2	Chert-brown w/speckles
Form 1—Fresno	BIBE1738	F	25867	17.2	14.8	3.6	N/A	0.4	Chert-brownish-red
Form 1—Fresno	BIBE1738	F	25870		17.3	3.3	N/A	0.6	Chalcedony-speckled gray
Form 1—Fresno	BIBE1849	F	25998			4.2	N/A	0.5	Chert-white
Form 1—Fresno	BIBE1849	F	26005		12.8	2.7	N/A	0.2	Chert-mottled light gray
Form 1—Fresno	BIBE1942	F	26300		18.6	3.3	N/A	0.7	Chalcedony-speckled white
Form 2—Toyah	BIBE0284	F	26471		14.7	3	9.6	0.2	Chert-reddish-brown-speckles
Form 2—Toyah	BIBE0760	T	26965	19.6	13.2	2.5	7.6	0.2	Chert-tan-speckles
Form 2—Toyah	BIBE0760	T	26966			2.4	7.4	0.2	Chert-red-speckles
Form 2—Toyah	BIBE0760	T	26967	15.3		2.3		0.2	Chert-mottled brown
Form 2—Toyah	BIBE0760	T	26969			3.2		0.2	Chalcedony-clear-black speckles
Form 2—Toyah	BIBE0760	T	26982			2.9	8.1	0.2	Chert-tan
Form 2—Toyah	BIBE0760	T	26986			2.6	8.9	0.2	Chalcedony-clear-cloudy
Form 2—Toyah	BIBE1118	A	25101			2.2	7.4	0.1	Chert-mottled purple-gray
Form 2—Toyah	BIBE1118	A	25102			3.3	7.7	0.2	Chert-mottled red-pink
Form 2—Toyah	BIBE1118	A	25104			2.3	8.4	0.2	Chalcedony-white
Form 2—Toyah	BIBE1118	A	25107			2.5	7.5	0.2	Agate-brown-opaque
Form 2—Toyah	BIBE1118	A	25108			1.6	6.2	0.1	Chalcedony-white
Form 2—Toyah	BIBE1118	A	25121		10.3	1.8	6.6	0.1	Chalcedony-light gray
Form 2—Toyah	BIBE1124	A	25158	18.2		2.3	8.2	0.2	Chalcedony-clear
Form 2—Toyah	BIBE1264	B	25654	20.6	17.3	2.4	8.3	0.4	Chert-white
Form 2—Toyah	BIBE1264	B	25655	17		2.4	7.2	0.2	Chalcedony-white
Form 2—Toyah	BIBE1520	F	25417		13.3	3	8.5	0.5	Chert-brown w/speckles
Form 2—Toyah	BIBE1594	F	25516			3		0.3	Chalcedony-light gray
Form 2—Toyah	BIBE1594	F	25821			2.2	5.6	0.2	Chert-dark purple w/speckles
Form 2—Toyah	BIBE1676	F	25438	16.8	15.1	3	8.1	0.5	Chert-white
Form 2—Toyah	BIBE1676	F	25439	17.1	12.4	2.1	6.2	0.4	Agate (moss) purple
Form 2—Toyah	BIBE1702	F	25488			1.5		0.1	Chert-white
Form 2—Toyah	BIBE1702	F	25502			2.1	7.4	0.2	Chert-white
Form 2—Toyah	BIBE1738	F	25861	23.1	13.2	3.8	8.6	0.5	Chert-light gray
Form 2—Toyah	BIBE1738	F	25865			3.1	9.6	0.2	Chert/jasper-reddish-brown
Form 2—Toyah	BIBE1738	F	25869	27.3	16.5	3.8	7.4	0.6	Chert-light brown w/speckles
Form 2—Toyah	BIBE1738	F	25872			2.9		0.5	Chert-mottled purple-gray

Form 2—Toyah	BIBE1738	F	25873			3.5	7.5	0.3	Chert-mottled brown w/speckles
Form 2—Toyah	BIBE1738	F	25877	27.2		2.9	8.1	0.4	Chert-light gray
Form 2—Toyah	BIBE1796	G	25928			2	9.5	0.2	Chalcedony-gray-speckled
Form 2—Toyah	BIBE1849	F	25999			2.5	7	0.3	Chert-light gray
Form 2—Toyah	BIBE1849	F	26003	15.4	11.9	2.9	6	0.2	Chert-white
Form 2—Toyah	BIBE1849	F	26011			2.9		0.6	Chert-light brown
Form 2—Toyah	BIBE1849	F	26012	20.7		3	6.5	0.3	Chalcedony-tan
Form 2—Toyah	BIBE1942	F	26282	25.6	17.7	3.9	8.9	0.8	Chert-fossiliferous-purple-gray
Form 2—Toyah	BIBE2085	H	26722	15.6	13.9	2.4	6.4	0.2	Chert-reddish-purple
Form 2—Toyah	BIBE2085	H	26727	17.7	14.3	2.4	7.6	0.2	Chalcedony-yellowish-white
Form 2—Toyah	BIBE2085	H	26730			2.1		0.2	Chert-red-speckles
Form 2—Toyah	BIBE2085	H	26731			2.2	6.8	0.1	Chalcedony-light gray
Form 2—Toyah	BIBE2497	T	26946	16.4	13.1	2.1	6	0.4	Chert-white
Form 2—Toyah	BIBE2524	U	27104	18		2.8		0.2	Chert-tan-speckles
Form 2—Toyah	BIBE2633	2010–C	27241			2		0.1	Chert-white
Form 3	BIBE1163	A	25205			2.3	4.6	0.2	Chert-white
Form 3	BIBE1265	B	25664			3.3	6.7	0.5	Chert-mottled pink and tan
Form 3	BIBE1702	F	25503	*17.2		1.4	6.6	0.2	Chalcedony-yellowish white
Form 4	BIBE1118	A	25114		14	3.4	9.4	0.4	Chalcedony-light gray-speckled
Form 4	BIBE1118	A	25116		12.1	1.9	6.9	0.2	Chalcedony-mottled yellowish white
Form 4	BIBE1594	F	25926			2.8	6.2	0.4	Chalcedony-mottled brown
Form 4	BIBE1738	F	25876		14.8	3.1	9.7	0.3	Chalcedony-white-speckled
Form 4	BIBE1738	F	25878			2.9	7.5	0.2	Chalcedony-white-speckled
Form 4	BIBE2394	R	26905		17.3	2.1	7.8	0.2	Chert-light pinkish-gray
Form 4	BIBE2486	Q	26894			2.9	5.5	0.3	Chert-light gray
Form 4	BIBE2717	2010–HH	27300		19.8	3	8.8	0.5	Chert-gray
Form 4	IF 860	2010–C	27185		13.3	2.6	5.6	0.2	Chert-yellowish-white
Form 5	BIBE1203	B	25274	22.5	13.1	2.8	8.2	0.4	Chert-mottled black-gray
Form 5	BIBE1702	F	25485	25.7	15.1	3.6		0.8	Agate-red-brown
Form 5	BIBE1849	F	25997	22.1	10.6	3.4	6.9	0.3	Chalcedony-gray-speckled
Form 5	BIBE1942	F	26284	17.3	12.8	2.9		0.2	Hornfels-black
Form 5	BIBE2716	2010–HH	27292	22.6	14.1	3.3	8.8	0.6	Agate-green-brown
Form 6	BIBE0415	U	27140			2.7		0.3	Rhyolite-dark brown
Form 6	BIBE0760	T	26961			1.6		0.1	Chert-white
Form 6	BIBE1942	F	26280		13.4	2.3		0.2	Chert-white-speckled
Form 6	BIBE2498	T	26950	14.7		2.5		0.1	Chalcedony-light gray
Form 6	BIBE2636	2010–C	27248			3.8		0.3	Chert-white
Form 6	BIBE2652	2010–C	27253			2.1		0.2	Chert-white
Form 7	BIBE1849	F	25993		15.9	3.6		0.9	Chert-speckled-Brown-gray

Table 6-II.32 Dimensions and Descriptions of Triangular Arrow Points. *(continued)*

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Form 7	BIBE2604	CC	27181		21.1	4.5		2	Chert-light gray-white
Form 7	IF 824	T	26915		13.9	4.1		1.4	Chert-white
Form 7	IF 834	T	27021		13.2	3.8		0.5	Chert-mottled brown-gray
Form 8–Miscellaneous	BIBE0246	2010–D	27204	22.1	13.6	3.8		0.9	Chert-mottled purple
Form 8–Miscellaneous	BIBE0418	A	25014	34.5	21	4.6		2.2	Chert-dark brown
Form 8–Miscellaneous	BIBE0760	T	26979			4		1.1	Chert-mottled red-brown
Form 8–Miscellaneous	BIBE0760	T	26980		19.1	4.4		1.8	Chert-mottled dark gray
Form 8–Miscellaneous	BIBE1111	A	25084	20.5	14.4	4.4		0.8	Chert-mottled pink-purple
Form 8–Miscellaneous	BIBE1325	JQ–1	25752	21	19	4.2		1.1	jasper-red
Form 8–Miscellaneous	BIBE1554	C	27214		15.4	3.7		0.8	Chert-mottled purple w/speckles
Form 8–Miscellaneous	BIBE1655	E	25381	29.2	17.6	2.4		0.8	Chert-brown
Form 8–Miscellaneous	BIBE1702	F	25500		12	3.1		0.5	jasper-brown
Form 8–Miscellaneous	BIBE1849	F	25991	34.4		2.9		0.6	Chert-light gray
Form 8–Miscellaneous	BIBE1849	F	26006			3		0.5	Chert-white
Form 8–Miscellaneous	BIBE1849	F	26010	31.3	17.2	3.5		1.2	Chalcedony-speckled-gray-brown
Form 8–Miscellaneous	BIBE1942	F	26303	21.2	14.7	3.4		0.6	Chert-mottled gray
Form 8–Miscellaneous	BIBE1942	F	26310		7.7	2	5	0.2	Chalcedony-brown
Form 8–Miscellaneous	BIBE2085	H	26723		10.8	3.6		0.7	Chert-mottled purple-white
Form 8–Miscellaneous	BIBE2428	O	26887	24.4	20.4	4.5		2	Chert-light gray-Speckles
Form 8–Miscellaneous	BIBE2636	2010–C	27249	22.3	12.4	3.5		0.9	Agate-purple-red
Form 8–Miscellaneous	BIBE2652	2010–C	27254		17.1	4.6		1.2	Chert-white
Form 8–Miscellaneous	BIBE2717	2010–HH	27302	27		2.6		0.3	Chalcedony-brown

* = small nick on projectile point; measurement taken slightly beyond nick to get approximate complete measurement.

concave or slightly concave. Two specimens retain large remnants of the original flake scars on one face, while the remaining four are worked bifacially. These specimens are typically thin, and vary in overall length and material type. The BBNP specimens are very similar to the Soto arrow point type (Phelps 1987), but are not classified as such because they lack the prominent basal notch characteristic of the type.

***Form 7** (4 specimens; Figure 6-II.72; Table 6-II.32)*

Four specimens are classified as Form 7 triangular arrow points. These specimens have recurved blade edges, thinned basal edges with shallow concavities, and small, pointed basal ears. These well-crafted specimens are bifacially worked, but some have remnants of original flake scars on one face. Fashioned from different varieties of chert, they have similar shapes and outlines as Fresno arrow points (Suhm et al. 1954:498–499; Turner and Hester 1985:174), but exhibit attributes that are often associated with the Guerrero arrow point type of South Texas (Turner and Hester 1985:177).

***Form 8—Miscellaneous** (19 specimens; Figure 6-II.72; Table 6-II.32)*

The Form 8 miscellaneous triangular arrow point category contains 19 specimens that cannot be confidently assigned to any of the above subcategories. Fifteen un-notched specimens are triangular shaped and are similar to the Fresno arrow point type, but are not classified as such because they lack the fine craftsmanship characteristic of the type. The remaining 4 specimens consist of 2 that have basal notches, 1 with a concave basal edge, and 1 that is side-notched. Form 8 miscellaneous triangular specimens are manufactured from a variety of raw material types, primarily cherts.

Unidentified Arrow Point Fragments

Due to extensive breakage, 66 specimens cannot be assigned to any of the above categories or subcategories. This grouping consists of 35 distal, 27 medial, and 4 proximal fragments. Eight of the distal fragments contain attributes (i.e., sloping barbs, serrated blade edges, or large remnant original flake scars) reminiscent of Perdiz arrow point technology and likely represent this type. The remaining 27 distal fragments probably represent a variety of arrow point types or forms. Ten of the medial fragments also have characteristics similar to the Perdiz type. Of the remaining medial fragments, 10 display shoulders of random morphology and 7 are nondescript. All four proximal fragments are asymmetrical with reworked basal edges. These specimens are manufactured from a variety of raw material types, primarily cherts.

Arrow Point Preforms (16 specimens; Figure 6-II.73; Table 6-II.33)

Sixteen specimens are classified as arrow point preforms and exhibit flaking attributes of middle through late stage reduction. Fifteen have contracting-stem morphologies and 12 of these have characteristics of in-process manufacture of Perdiz or Cliffton arrow points. The latter have remnants of the original flake scars on both faces and two display stems that are alternately beveled. The other three preforms with contracting-stem morphologies are all highly variable in stem size, and include the only specimen with serrated blade edges in this category, as well as another specimen exhibiting bifacial flaking. The other arrow point preform is a distal blade fragment. These specimens are manufactured from a wide variety of raw material types.

Other Chipped Stone Artifacts

A total of 242 specimens in the collection are classified as other chipped stone artifacts. When possible, presumed functional categorizations have been applied to these classifications. Consisting of stone tools and other culturally altered debris, this category includes perforators/drills (n=11), knives (n=47), scrapers (n=54), adzes/gouges (n=3), spokeshaves (n=4), net sinkers (n=2), choppers (n=2), other bifaces (n=55), edge-modified debitage (n=36), and cores and unmodified debitage (n=28).

Perforators/Drills (11 specimens; Figure 6-II.74; Table 6-II.34)

Perforators/drills were stone tools used to bore, punch, or pierce various materials. These tools were used in performing a variety of tasks, such as drilling holes in shell to fashion ornaments or punching holes in leather prior to sewing. All of the perforators/drills show evidence of bifacial workmanship, although the extent of flaking on each face varies greatly. The various shapes and sizes in the collection are suggestive of different uses. It is noteworthy that bit edges on these specimens are often alternately beveled.

Of the 11 specimens in this classification, 3 are distinctive tools known as "flake drills" that are often found in association with Perdiz-bearing components of the Late Prehistoric period. These tools were produced on relatively small tertiary or secondary flakes and exhibit small bits formed from trimming both faces. The remaining eight perforators/drills in the collection are all bifacially worked into formal shapes that are much thicker and larger than the flake drills. Five of these have long and slender bits with proximal ends that are somewhat wider, perhaps for hafting purposes. Four of these are much larger in size than the other seven perforators/drills in the collection. Two specimens are fragmentary, one with a long reworked bit from

Figure 6-II.73 Arrow point preforms (a–m).

a larger drill and the other displaying a small bit and wide proximal end. The last specimen is complete with an unusual crescent shape and drill bits on both ends.

Knives (47 specimens; Figures 6-II.75 to 6-II.78; Table 6-II.35)

Knives are typically thin and formally shaped tools that exhibit bifacial flaking. Forty-seven specimens in the BBNP collection are classified as knives. They have various shapes and sizes, but share morphological attributes suggesting use as knives. These specimens have been separated into the following categories: beveled (n=4), bi-pointed (n=4), pointed-ovate (n=15), triangular (n=6), and knife fragments (n=18).

Beveled Knives *(4 specimens; Figure 6-II.75; Table 6-II.35)*

Four specimens are classified as beveled knives. Beveled knives are characterized by steep bevels on alternating edges of the blade. This distinctive Late Prehistoric tool type is found across most of Texas and occurs in two forms—two-beveled and four-beveled. The latter are sometimes called "Plains Knives" or "Harahey Knives." Turner and Hester (1999:274) have indicated the two-beveled form resulted from patterned re-sharpening and is almost entirely restricted to South Texas. However, all four beveled knives in the BBNP collection exhibit attributes that are most similar with this two-beveled form. Although blade edges vary greatly in shape—with concave, convex, and straight examples

Table 6-II.33 Dimensions and Descriptions of Arrow Point Preforms.

Form–Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Stem Length (mm)	Neck Width (mm)	Weight (g)	Material Type–Color
Preform	BIBE1644	E	25337	33.1	21.4	3.6	8.1	16	2.4	Chert–banded brownish gray
Preform	BIBE1218	B	25599		21	4	5.6	15.5	1.6	Chert–dark green
Preform	BIBE0050	B	25621		15.7	4.6		8.2	1.3	Chert–grayish purple (w/spots)
Preform	BIBE1713	F	25807		23	3.6		9.1	1.5	Chalcedony–light gray (w/inclusions)
Preform	BIBE1849	F	25989		16.4	3.2		9	1.5	Chert–pinkish brown
Preform	BIBE1975	F	26489	39.9	17.1	3.8	10.3	7.9	1.9	Chalcedony–light gray (w/speckles)
Preform	BIBE1976	F	26497	29.5	19.3	4.7	8.4	16.8	2.1	Jasper–brown
Preform	BIBE2096	I	26740		22.5	3.8	8.8	9.9	2.5	Chert–mottled purple and brown
Preform	BIBE2195	K	26789	35.6		3	9.6		1.8	Chalcedony–light gray
Preform	BIBE2196	K	26791		25.1	3.1	8.8	10.7	1.7	Chert–purple (w/spots)
Preform	BIBE0761	T	27001		18.1	3.5	5.5	4.1	1.5	Hornfels–black (w/patina)
Preform	BIBE2447	W	27030		23.3	4.3	12.2	12.2	2.3	Chert–white
Preform	BIBE2572	Y	27086	30.1	18.2	5.6	8.6	10	2.9	Jasper–brown (w/cortex)
Preform	BIBE2604	CC	27178		20.9	3.2		9.4	1.4	Chert–white
Preform	BIBE2763	2010–D	27225		23.3	4.8	3.3	7	2	Chert–brownish gray
Preform	BIBE2633	2010–C	27242	29.8	19.5	3.6	10.7	12.8	1.5	Chert–mottled purple (w/spots)

present—all of these specimens have the distinctive alternately beveled blade and exhibit good to excellent workmanship. Three of the four have convex to pointed proximal ends that are relatively short when compared to blade length.

***Bi-Pointed Knives** (4 specimens; Figure 6-II.76; Table 6-II.35)*

Four specimens are classified as bi-pointed knives. They have shapes similar to that of beveled knives, but lack the distinctive beveling. All four specimens in the collection are bifacially worked with pointed distal and proximal ends, as well as convex blade edges. Three of these are particularly well made.

***Pointed-Ovate Knives** (15 specimens; Figure 6-II.77; Table 6-II.35)*

Fifteen specimens are classified as pointed-ovate knives. These specimens are characterized by their distinctive shapes—broad convex proximal or basal ends and narrow distal tips that are typically pointed. Pointed-ovate knives in the collection are made on flakes or blades of various sizes and are bifacially worked. Most specimens are long, slender, and well made, and all have convex blade edges. Seven specimens are fragmentary, but retain convex proximal ends allowing placement in this classification.

***Triangular Knives** (6 specimens; Figure 6-II.78; Table 6-II.35)*

Six specimens are classified as triangular knives and are characterized by their triangular shapes, straight bases, and pointed distal tips. Like other knife subcategories, these bifacially worked specimens vary in size and shape and all were made on a flake or blade. The four largest specimens have convex lateral blade edges, while the other two specimens each have one convex and one recurved blade edge.

Figure 6-II.74 Perforators/drills: (a–e) bifacial perforators/drills; (f-g) flake drills.

Table 6-II.34 Dimensions and Descriptions of Perforators/Drills.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Lithic Type	Material Type	Comments
BIBE1203	B	25270	* 70.2	23.1	8.6	11	biface	Hornfels–black (w/patina)	
IF 148	E	25399		17	5.9	7.1	biface	Hornfels–black (w/patina)	
BIBE1694	F	25472	33.1	41	6.6	5.1	biface	Chert–mottled brown, white, and pink	Crescent shaped; two bits.
BIBE1257	B	25645		24	8.7	10.6	biface	Chert–mottled gray and purple	
BIBE1257	B	25649	23.5	14.4	3	1	uniface	Chert–light gray (w/spots)	Flake perforator.
BIBE1270	B	25670		22.9	6.9	5.5	biface	Chert–banded gray, white, and light gray	
BIBE1738	F	25888	21.4	16	2.6	0.8	biface	Chert–brownish gray	Flake perforator.
BIBE853	H	26707	22.2	16.1	3.5	0.9	uniface	Chert–brown (w/spots)	Flake perforator.
BIBE2367	P	26882			6.5	4.3	biface	Chert–motttled white and tan	
BIBE2623	2010–G	27235		12.3	5.1	0.9	biface	Chert–purple (w/spots)	
BIBE2717	2010–HH	27301	32.1	9.7	6.1	1.5	biface	Chert–white	

* = small nick on artifact; measurement taken slightly beyond nick to get approximate complete measurement.

Figure 6-II.75 Knives: (a–d) Two-beveled knives.

Figure 6-II.76 Knives: (a–d) Bi-pointed knives.

Table 6-II.35 Dimensions and Descriptions of Knives and Knife Fragments.

Style	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type–Color
Bi-pointed	BIBE1119	A	25148	79.5	38.2	11.7	30	Chert–mottled gray
Bi-pointed	BIBE1688	F	25465	74	33.4	10.2	21.5	Chert–mottled pink, red, and purple
Bi-pointed	BIBE1315	JQ–1	25737	62.5	29.7	8.2	14.6	Hornfels–black (w/patina)
Bi-pointed	BIBE1975	F	26492	80.1	33.7	7.9	19.5	Chert–mottled pink, brown, and gray
Pointed-Ovate	BIBE1157	A	25201	* 91.9	37	7	25.3	Chert–mottled brown and pink
Pointed-Ovate	BIBE1636	E	25322	134.4	56.8	8.1	65.5	Hornfels–black (w/patina)
Pointed-Ovate	BIBE1216	B	25578			8.7	24.4	Hornfels–black (w/patina)
Pointed-Ovate	BIBE0049	B	25617		55.5	7.6	28.1	Hornfels–black (w/patina)
Pointed-Ovate	BIBE0123	B	25622		41.6	6.6	16.1	Hornfels–black (w/patina)
Pointed-Ovate	BIBE1264	B	25659	66.2	31.8	7.9	17.4	Chert–mottled gray and purple (w/spots)
Pointed-Ovate	BIBE1738	F	25866	74.6	46	9.3	34.1	Chert–mottled gray
Pointed-Ovate	IF 198	F	25897	60.4	44.9	9.7	24.6	Agate–mottled brown and red
Pointed-Ovate	BIBE1910	F	26048		35.4	8.8	25.2	Chert–mottled reddish brown and light gray (w/speckles)
Pointed-Ovate	BIBE1975	F	26490	79.1	36.1	9.5	24.2	Chert–mottled gray, white, and red
Pointed-Ovate	BIBE2145	I	26770	95.3	42.1	10.2	41.1	Hornfels–gray (w/patina)
Pointed-Ovate	BIBE2281	L	26846		44.7	8.6	24.2	Chert–pink (w/spots)
Pointed-Ovate	BIBE2491	T	26927		42.7	9.8	26.7	Agate–mottled brown and black
Pointed-Ovate	BIBE0630	X	27013	60.1	26.4	5.6	8.6	Chert–mottled brown and pink (w/spots)
Pointed-Ovate	BIBE2519	U	27096	72.4	46.5	10.9	35.1	Chert–banded gray and white (w/spots)
Triangular	BIBE1112	A	25090		42.9	8.1	28	Chert–mottled grayish purple, red, and gray
Triangular	BIBE1140	A	25171	81.2	50.1	7.7	30.7	Chert–mottled grayish red and gray (w/spots)
Triangular	IF 007	A	25237		23.8	6.7	9.8	Hornfels–black (w/patina)
Triangular	BIBE1218	B	25595	68.9	36.5	7.5	18.7	Chert–mottled pink, red, and purple (w/spots)
Triangular	BIBE2428	O	26886		20.2	7.4	6.6	Chert–mottled dark red
Triangular	BIBE2674	2010–H	27267	63.4	35.3	8.4	16.7	Chert–mottled bluish gray and gray (w/speckles)
Two-beveled	BIBE1145	A	25177	79.7	23.5	6.5	11.2	Chert (fossiliferous)–pinkish tan
Two-beveled	BIBE1203	B	25279	* 70	32.7	6.6	15.6	Chert–mottled gray (w/speckles)
Two-beveled	BIBE1655	E	25360	103.1	29.1	6.3	21.7	Chert–mottled light brown
Two-beveled	BIBE0135	B	25685		46.2	7.4	31.3	Chert–mottled brown and gray
Knife Fragment	BIBE1118	A	25100		37.1	8.5	20.4	Chert–mottled gray, brown, and black
Knife Fragment	BIBE1157	A	25196		43.5	8.8	16.3	Chert (fossiliferous)–grayish purple
Knife Fragment	BIBE1655	E	25356		33.3	8.2	38.6	Hornfels–black (w/patina)
Knife Fragment	BIBE1209	B	25552		29	5.8	9.7	Chert (fossiliferous)–brownish gray
Knife Fragment	BIBE1215	B	25568		33.9	13.6	37.2	Hornfels–gray (w/patina)
Knife Fragment	BIBE0049	B	25614			8.5	23	Hornfels–black (w/patina)

Knife Fragment	BIBE0049	B	25615		27.9	7.9	13.2	Hornfels–black (w/patina)
Knife Fragment	BIBE0123	B	25623			7.1	10.2	Hornfels–black (w/patina)
Knife Fragment	BIBE0123	B	25626		31	7.2	14.6	Chert–black (w/patina)
Knife Fragment	BIBE1251	B	25630		35.7	9.7	18.3	Hornfels–black (w/patina)
Knife Fragment	BIBE1267	B	25666		24.1	7	10.8	Chert–black
Knife Fragment	BIBE1315	JQ–1	25738		26.1	6.5	9.4	Hornfels–black (w/patina)
Knife Fragment	BIBE1829	G	25940			5.5	5.4	Chert–mottled pink and tan (w/spots)
Knife Fragment	BIBE1910	F	26057		28.5	7.6	10.3	Chert (fossiliferous)–mottled brown and gray
Knife Fragment	BIBE1959	F	26488			8.1	9.2	Chert–mottled brown and purple (w/spots)
Knife Fragment	BIBE2096	I	26739		54	10.1	31	Hornfels–black (w/patina)
Knife Fragment	BIBE2429	O	26885			11.2	27	Chert–white (w/speckles and patina)
Knife Fragment	BIBE2497	T	26947			6.4	7.9	Hornfels–black (w/patina)

* = small nick on artifact; measurement taken slightly beyond nick to get approximate complete measurement.

Knife Fragments (18 specimens)

Eighteen specimens are classified as knife fragments. These specimens are fragmentary and cannot be reliably placed within any other knife subcategory. Made on flakes or blades of various sizes, they are all bifacially worked and distinguished by their thinness and workmanship. Fifteen of these are distal fragments with pointed or rounded tips, while the other three are fragmentary mid-sections. It appears all of the fragments, when complete, would have had convex lateral edges.

Scrapers (54 specimens; Figures 6-II.79 to 6-II.82; Table 6-II.36)

Scrapers are beveled stone tools that typically have a plano-convex cross-section with a moderate to steep bit or working edge positioned on the convex/dorsal face. While most scrapers have a single bit, some have more than one. Most scrapers are thought to have been used to de-flesh or process animal hides, but there may have been other uses. Recognized in the BBNP collection are 54 scrapers which have been subdivided into the following categories: end-scrapers (n=2), side-scrapers (n=14), side- and end-scrapers (n=27), sub-circular scrapers (n=7), and scraper fragments (n=4).

End-Scrapers (2 specimens; Figure 6-II.79; Table 6-II.36)

Two scrapers are classified as end-scrapers. End-scrapers have the convex beveled bit or working edge on one or both ends of the long axis, with the bevel formed by unifacial flaking or use (Crabtree 1972:60). Both specimens were formed on secondary flakes with single bits positioned on the dorsal surface at the end opposite the platform. One is made on a relatively thin flake with maximum thickness at the convex bit end, which is unifacially trimmed with a steep bit. It also exhibits use-wear along practically the entire length of both lateral edges. The other specimen was made on a short, thick flake with maximum thickness located near the cortex-covered platform. The bit end

Figure 6-II.77 Knives: (a-e) Pointed-ovate knives.

Figure 6-II.78 Knives: (a-d) Triangular knives.

Figure 6-II.79 Scrapers: (a-b) End-scrapers.

was unifacially trimmed, forming a moderately steep and convex working edge.

Side-Scrapers *(14 specimens; Figure 6-II.80; Table 6-II.36)*

Fourteen specimens are classified as side-scrapers. Side-scrapers are scraping tools with beveled bits or working edges positioned on one or more lateral margins (i.e., on the sides, perpendicular to the axis formed by the platform and the termination). Eleven of the 14 BBNP specimens have side bits on both sides and three have single side bits. Each specimen is made on either a tertiary or secondary flake, and three have more formal appearances than the other side-scrapers. Twelve of the bit edges are unifacially trimmed and two are bifacially trimmed. Bit angles range from low to steep, and bit morphologies are predominantly convex.

Side- and End-Scrapers *(27 specimens; Figure 6-II.81; Table 6-II.36)*

Twenty-seven specimens are classified as side- and end-scrapers. Side- and end-scrapers are tools that exhibit characteristics of both end-scrapers and side-scrapers, as defined above. All of these tools have single end-scaper bits and one or more scraper bits positioned on their sides. Nineteen specimens have bits on both sides, while the remaining eight have single side bits. Each specimen was made on either a secondary or tertiary flake, including three that were made on long, thin blades. Eleven are tear-drop shaped and four of these have formal appearances. All bit edges are unifacially trimmed, although a few exhibit minor flake scars at the bit or platform on the ventral surface. Bit angles range from low to steep, and bit morphologies are predominantly convex.

Table 6-II.36 Dimensions and Descriptions of Scrapers.

Scraper Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Bit Angle	Bit Morphology	Lithic Type	Material Type
End	BIBE0123	B	25625	62.7	29.8	8.6	14.1	steep	convex	uniface	Chert–brown (w/spots and cortex)
End	BIBE1829	G	25941	34.5	40.3	20.3	28.6	moderate	convex	uniface	Chert–mottled gray and brown (w/cortex)
Side	BIBE1114	A	25092	94.2	57.8	15.3	90	one side moderate; one side low	convex; slightly convex	uniface	Chert–mottled brownish gray (w/cortex)
Side	BIBE1118	A	25113	75.6	51.1	12.4	43.7	one side moderate; one side low	both slightly convex	uniface	Chert–mottled dark purple (w/cortex)
Side	BIBE1133	A	25163	75.2	48.7	13.6	50.2	both sides moderate to low	both convex	uniface	Chert–light gray (w/spots and cortex)
Side	BIBE1145	A	25178		41.3	8.4	27.8	one side moderate; one side low	straight; convex	biface	Chert–banded white and light grayish brown
Side	BIBE1184	B	25256	62.6	49.6	18.4	53.4	both moderate	convex; concave	uniface	Hornfels–black (w/patina and cortex)
Side	BIBE1184	B	25259	35.5	35.3	8.6	9.6	both moderate	both convex	uniface	Chert–banded purple and brownish purple (w/cortex)
Side	BIBE1200	B	25269	94.5	58.5	17.1	98.8	low	convex	biface	Hornfels–black (w/patina)
Side	BIBE1215	B	25569	78	34	11.1	27.2	both moderate	convex; recurved	uniface	Chert–brown (w/cortex)
Side	BIBE1264	B	25652	64.1	41.2	8.2	23.5	both low	both convex	biface	Chert–mottled purple and brown
Side	BIBE1264	B	25656		52.8	10.9	45.2	both low	both convex	biface	Hornfels–black (w/patina and cortex)
Side	BIBE1264	B	25661	127.3	50.5	20.2	134.5	one side moderate; one side low	convex; recurved	biface	Hornfels–black (w/patina)
Side	BIBE0296	JQ–2	25759	44.1	50.1	6	13.5	both steep	straight; slightly convex	biface	Chert–brown (w/spots)
Side	BIBE0296	JQ–2	25760	78.7	49.5	12.9	52.5	one side moderate; one side low	both convex	uniface	Hornfels–black (w/patina)
Side	BIBE1459	D	25795	75.2	40.5	13.3	43.2	both moderate	straight; convex	uniface	Hornfels–black (w/patina)
Side and End	BIBE0418	A	25004	110.6	58.8	14.2	114.3	both sides moderate; end low	convex and slightly convex; slightly convex	uniface	Hornfels–black (w/patina and cortex)
Side and End	BIBE0418	A	25006	71.4	58	16.7	71	both sides moderate; end steep	sides concave and slightly convex; end convex	uniface	Chert–mottled brown and gray (w/cortex)
Side and End	BIBE1167	A	25231	102.5	100.2	37.4	449.6	all sides and end steep	sides convex and recurved; end straight	uniface	Rhyolite–brown (w/cortex)
Side and End	BIBE1189	B	25266	76	47.4	26.8	102.3	all sides and end steep	both sides and end convex	uniface	Chert–mottled light gray and bluish gray (w/patina)
Side and End	BIBE1203	B	25277	52	41.8	10.8	26.3	side and end moderate	side and end convex	biface	Chert–mottled brown and gray (w/cortex)

Side and End	BIBE1203	B	25282	41	26.6	7.3	7.4	side low; end moderate	side and end convex	uniface	Agate–brown
Side and End	BIBE1216	B	25574	53.6	32.2	8	13.5	all sides and end steep	both sides recurved; end convex	uniface	Chert–mottled brown
Side and End	BIBE1218	B	25580	58.5	38.4	17.7	35.4	all sides and end steep	sides recurved and convex; end convex	biface	Chert–banded brown, white, and gray
Side and End	BIBE1218	B	25590	57.7	51.2	14.5	52	side moderate; end steep	side and end convex	uniface	Chert–brownish gray (w/spots and cortex)
Side and End	BIBE1232	B	25607	73.4	91.2	16.8	120.4	all sides and end low	sides convex; end straight	biface	Hornfels–black (w/patina)
Side and End	BIBE1268	B	25667	57.9	35.2	9.6	23.8	all sides and end steep	sides convex and straight; end convex	uniface	Chert–banded gray and brown
Side and End	BIBE0124	B	25682	94.2	58	44	279.8	all sides and end steep	sides recurved; end convex	uniface	Hornfels–black (w/patina and cortex)
Side and End	BIBE0124	B	25683	46	28.6	12.8	14.8	all sides and end steep	sides recurved; end convex	biface	Chert–mottled white and gray
Side and End	BIBE1278	B	25689	94.4	57.6	15.6	118.4	side and end moderate	side straight; end convex	uniface	Hornfels–black (w/patina and cortex)
Side and End	IF 038	B	25710	46.5	69.5	13.7	43	side low and steep; end steep	sides straight and concave; end slightly convex	uniface	Chert (fossiliferous)–mottled brown (w/cortex)
Side and End	BIBE1308	JQ–1	25729	39.2	32.7	8.8	11.6	all sides and end steep	sides slightly convex; end convex	uniface	Chert–mottled purple (w/spots)
Side and End	BIBE1308	JQ–1	25730	53.2	24.9	8.6	10.3	all sides and end steep	sides recurved; end convex	uniface	Chert–mottled gray and white (w/patina and cortex)
Side and End	BIBE1310	JQ–1	25732	89.6	62.6	20	113.7	side steep and low; end moderate	sides recurved; end convex	biface	Hornfels–black (w/patina)
Side and End	BIBE1313	JQ–1	25733	53.4	39.2	9.6	23.5	side and end steep	side and end convex	biface	Chert–mottled purple and pink (w/spots)
Side and End	BIBE1313	JQ–1	25734	51.9	34.8	13.8	27.5	side steep and moderate; end steep	sides recurved and convex; end convex	biface	Chert–mottled purple and pink (w/spots)
Side and End	BIBE1316	JQ–1	25740	43.5	24.4	10.3	9.3	all sides and end steep	sides straight and convex; end recurved	uniface	Chert–mottled purple and pink
Side and End	BIBE1391	C	25778	68.7	46	14.2	47	all sides and end steep	both sides and end convex	uniface	Hornfels–black (w/patina)
Side and End	BIBE1594	F	25838	61.1	21	8.9	10.9	side moderate; end steep	side recurved; end convex	uniface	Chert–mottled brown (w/cortex)
Side and End	BIBE1829	G	25944	53.6	37.4	11.7	22.1	all sides and end moderate	sides straight and convex; end convex	uniface	Chert–mottled brown (w/spots)
Side and End	BIBE1982	F	26505	87	32	9.3	31.6	both sides moderate; end steep	sides recurved and convex; end convex	uniface	Hornfels–black
Side and End	IF 445 (2 of 2)	I	26758	43.6	26.5	12.2	13.6	all sides and end steep	both sides recurved; end convex	uniface	Chert–mottled purple and pink

Table 6-II.36 Dimensions and Descriptions of Scrapers. *(continued)*

Scraper Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Bit Angle	Bit Morphology	Lithic Type	Material Type
Side and End	BIBE2428	O	26888	49.2	66.7	12.8	42.5	all sides and end steep	sides convex and straight; end slightly concave	uniface	Chalcedony–mottled gray, red, and brown
Subcircular	BIBE1113	A	25091	47.2	38.1	23.7	34.8	steep all the way around	convex edges	uniface	Agate–mottled brown and red
Subcircular	BIBE1647	E	25345	36.7	30	7.6	10.7	sides moderate; end steep	convex edges	uniface	Chert–banded grayish purple, white, and brown
Subcircular	BIBE1257	B	25636	59.3	50.5	21.2	68.7	steep all the way around	recurved edges	uniface	Hornfels–black (w/patina and cortex)
Subcircular	BIBE1257	B	25638	41.7	34.1	18.4	30.8	steep all the way around	convex edges w/recurved edge	uniface	Chert–gray (w/speckles and cortex)
Subcircular	BIBE1303	JQ-1	25726	45.8	41.2	14.7	28.8	steep all the way around	convex edges	uniface	Chert–mottled brown and brownish red
Subcircular	BIBE1324	JQ-1	25751	59.8	50.2	11.1	39.1	moderate all the way around	convex edges	uniface	Chert–light gray (w/speckles)
Subcircular	BIBE0296	JQ-2	25761	47.4	43.2	11.8	28.9	steep all the way around	convex edges	uniface	Chert–mottled white, brown, and tan
Scraper Fragment	BIBE1203	B	25275	32.2		11.2	7.8	moderate to steep	convex	uniface	Chert–mottled brown, gray, and red (w/patina)
Scraper Fragment	BIBE1257	B	25634			15.2	67.1	moderate to steep	convex	biface	Hornfels–black (w/patina)
Scraper Fragment	BIBE1257	B	25643			12	26.9	moderate and steep	convex	biface	Silicified Wood–mottled brown and gray
Scraper Fragment	IF 051	B	25714			16.1	33	steep	convex	uniface	Chert–mottled brown (w/patina)

Sub-Circular Scrapers (7 specimens; Figure 6-II.82; Table 6-II.36)

Seven specimens are classified as sub-circular scrapers. These unifacial scraping tools have sub-circular shapes and working edges around their entire circumference. They have a "hump-backed" appearance, with flaking on the dorsal face and a flat, unworked ventral face. These tools are made on variously sized tertiary and secondary flakes and include five with formal appearances. Bit angles range from moderate to steep and all but one have convex bits; the lone exception has a recurved bit.

Scraper Fragments (4 specimens)

Four specimens are classified as scraper fragments—fragmentary specimens that could not be reliably placed in any of the other scraper subcategories. These fragments, like the other scrapers in the collection, were manufactured from flakes of various sizes and thicknesses. All four specimens have remnants of convex bit edges, including one also containing a spokeshave bit. Two specimens have unifacially trimmed bit edges, while the other two bits exhibit bifacial workmanship. Bit angles range from moderate to steep. All four of these fragments appear to be remnants of either side-scrapers, or side- and end-scrapers.

Adzes/Gouges (3 specimens; Figure 6-II.83; Table 6-II.37)

Adzes/gouges are distinctively shaped tools thought to have been used for woodworking tasks. They typically have

Figure 6-II.80 Scrapers: (a–e) Side-scrapers.

steeply angled bit edges and triangular shapes, with rounded or pointed proximal ends and distal working edges that are concave, convex, or straight. Most evidence bifacial workmanship, but some earlier forms from the Early Archaic period were large and unifacial with a hump-backed dorsal face and flat ventral face (Turner et al. 2011:225). Adze and gouge forms are found across most of Texas and have been given the following type names: Clear Fork Tools, Dalton Adzes, Dimmit Adzes/Gouges, Guadalupe Tools, Nueces Bifaces and Unifaces, and Olmos Bifaces (Nunley and Hester 1966:233–253; Turner and Hester 1985; Turner et al. 2011).

Three specimens in the BBNP collection are classified as adzes/gouges. Two of these are unifacially worked with steep to moderately angled bits that are straight to slightly convex. These two examples are very similar to an early form of the Clear Fork type. Another specimen is bifacially flaked and appears to be a reworked biface—a hinge snap was reworked into a slightly concave bit and utilized as an adze/gouge.

Spokeshaves (4 specimens; Figure 6-II.84; Table 6-II.38)

Spokeshaves are unifacial concave scrapers with steep bits thought to have been used for woodworking tasks, such as straightening dart and arrow shafts or removing bark from other wooden implements. Single tools can have multiple spokeshave bits and some examples occur on other tool forms as well, resulting in multi-functional tools. Spokeshaves come in a variety of shapes and sizes, most occurring as expedient tools.

Four specimens in the BBNP collection are classified as spokeshaves. Two of these are unifacial and two are bifacial. The unifacial specimens have single

Figure 6-II.81 Scrapers: (a-i) Side- and End-scrapers.

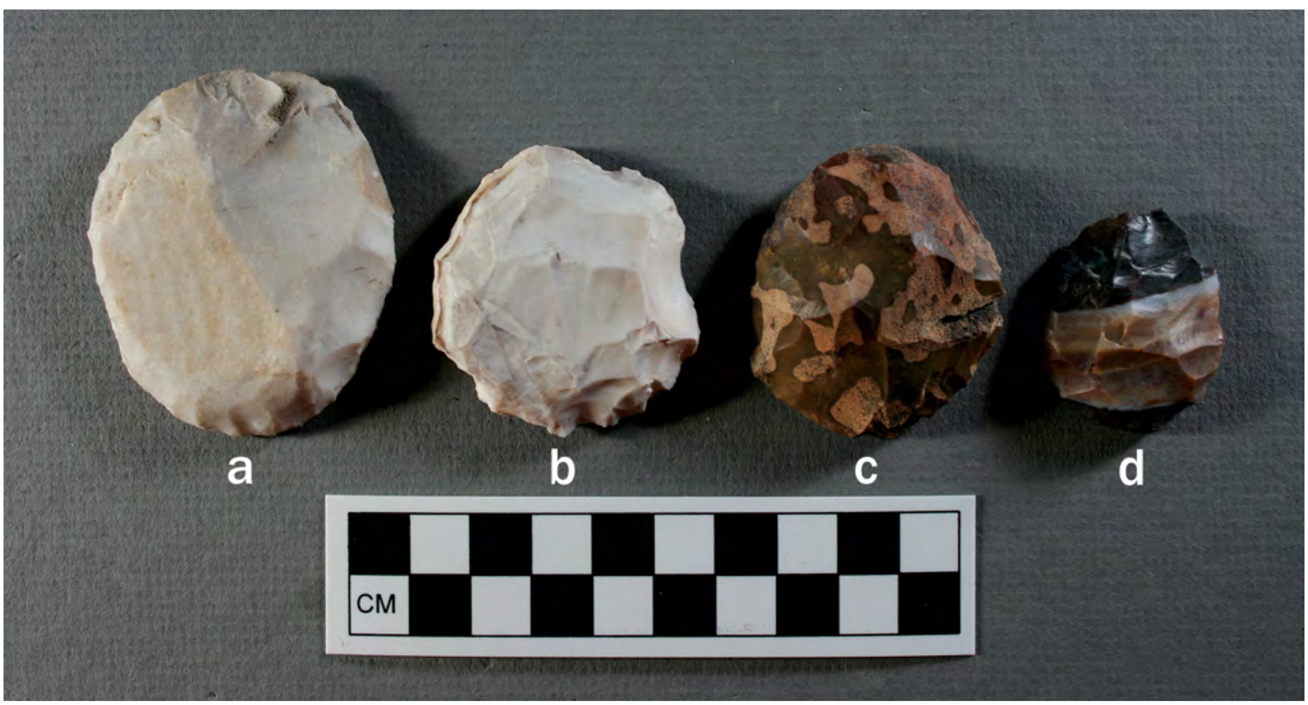


Figure 6-II.82 Scrapers: (a-d) Sub-circular scrapers.

bits and one of the bifacial specimens has three concave bit edges. The latter is unusual in that the bits are bifacially trimmed. The remaining spokeshave is complete, bifacially worked, and has a formal crescent shape. With a relatively long concave bit, it appears to have been used on larger pieces of wood compared to the other spokeshaves. Use wear in the form of rounded edges, micro-flaking, and small step fractures is evident on all of the spokeshave bits.

Net Sinkers (2 specimens; Figure 6-II.85; Table 6-II.39)

This tool type was originally termed a "sinker" and described by Sayles (1935:76–77, 79) as a distinctive artifact of the Jumano phase found exclusively on sites along either the Rio Grande or Rio Conchos drainages within the Big Bend region of Texas and adjacent northeastern Chihuahua. Kelley et al. (1940:32) later called these tools "sinkerstones" and described them as associated artifacts of the Bravo Valley aspect—agricultural village sites in the La Junta district during the Late Prehistoric and Protohistoric periods. They are also known to occur with contemporary Cielo complex sites, but only such sites within the Rio Grande Valley (Mallouf 1999). Net sinkers were made from flat, oval-shaped, river-worn pebbles. Notches occur on opposing ends, formed by the removal of flakes from one or both faces, and are occasionally worn smooth (Kelley et al. 1940:32). These distinctive artifacts have an estimated age of ca. A.D. 1200–1700/1800.

Both net sinkers in the BBNP collection were found on a terrace above the Rio Grande at site BIBE1520. Each is made from a flat, oval-shaped, river-worn pebble. The largest specimen is fashioned from desert-varnished quartzite, is bifacially notched on both ends, and exhibits wear or smoothing within one notch, all typical attributes of La Junta style sinkerstones. The smaller specimen is made of limestone and has a less

Figure 6-II.83 Adzes/gouges: (a–c).

Table 6-II.37 Dimensions and Descriptions of Adzes/Gouges.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Bit Angle	Bit Morphology	Lithic Type	Material Type	Comments
BIBE2126	I	26754	65	46.1	13.2	42.9	steep	slightly concave	biface	Hornfels–black (w/patina)	Reworked biface into gouge
IF 437	I	26756	71.6	46.2	16.4	55.5	moderate	slightly convex	uniface	Hornfels–black (w/patina)	Clear Fork style
BIBE0415	U	27147	53.8	40.7	13.1	31.4	steep	straight	uniface	Quartzite–dark brown	Clear Fork style

formal appearance. It is unifacially notched on one end and bifacially notched on the other. Although these artifacts have not been proven definitively to be net weights associated with fishing, the bulk of evidence strongly suggests they were.

Choppers (2 specimens; Figure 6-II.86; Table 6-II.40)

Choppers are heavy artifacts, typically core-based tools, used to chop through various resistant materials. They can have either a unifacial or bifacial bit/chopping edge, while the opposite edge often remains unmodified and covered with cortex. Most of these heavy tools can be conveniently held in one hand although they vary in overall dimensions.

Both specimens in the BBNP collection are fashioned from hornfels, but have different sizes and shapes. One has a sub-circular shape, is bifacially flaked along the convex bit edge, and exhibits cortex remnants on one face. The bit on this specimen is characterized by dulling and numerous battering marks. The other chopper in the collection is a tabular piece of stone with an elongated shape and cortex remnants. The chopping edge is flaked bifacially, while additional bifacial workmanship on the opposite end likely facilitated a hand-hold.

Other Bifaces (55 specimens; Figure 6-II.87 to 6-II.90; Table 6-II.41)

Other bifaces represent bifacially worked specimens that cannot be reliably placed within a specific tool category. Made on flakes, blades, and chips, they have a variety of shapes and sizes. Most examples are incomplete and relatively thick, while a few are thin and well made. For descriptive purposes, these 55 bifaces have been separated into five categories based on shape: bi-pointed, triangular, elongated, teardrop-shaped, and fragmentary.

Bi-Pointed Bifaces *(4 specimens; Figure 6-II.87; Table 6-II.41)*

Four specimens are classified as bi-pointed bifaces and are characterized by pointed ends located at both their proximal and distal ends. They are mostly complete, moderately thinned, fairly small, and exhibit convex lateral blade edges. Two specimens may have originally been projectile points that were subsequently refurbished. The smallest and most complete specimen is thickest at its proximal end, likely a result of having been broken and then reworked.

Triangular Bifaces *(2 specimens; Figure 6-II.88; Table 6-II.41)*

Two specimens are classified as triangular bifaces. They are characterized by straight proximal ends and pointed distal tips. Both specimens are nearly complete, moderately thick, and exhibit convex lateral blade edges. The longest and thinnest specimen has a bevel along one lateral blade edge and appears to be an unfinished knife. The other specimen exhibits some limited use-wear along a slightly concave section of the proximal edge, similar to that seen on spokeshave tools.

Elongated Bifaces *(7 specimens; Figure 6-II.89; Table 6-II.41)*

Seven specimens are classified as elongated bifaces, recognized for their relatively long and slender shapes.

Figure 6-II.84 Spokeshaves: (a-c).

Table 6-II.38 Dimensions and Descriptions of Spokeshaves.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Lithic Type	Material Type	Comments
BIBE0651	E	25319	75.22	49.71	18.05	51.56	biface	Hornfels-black (w/patina)	Single bit
BIBE1205	B	25540	34.1	21.4	11.6	5.9	uniface	Chert-mottled bluish gray and brown	Single bit
BIBE1594	F	25835	27	24.2	10.6	7.5	uniface	Chert-brownish gray	Single bit
BIBE1942	F	26307	47.7	35.2	7.9	13.7	biface	Hornfels-black (w/patina)	Three bits

Figure 6-II.85 Net Sinkers: (a-b).

Table 6-II.39 Dimensions and Descriptions of Net Sinkers.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type	Comments
BIBE01520	F	25425	57.8	57.2	17.3	83.4	Quartzite	River-worn pebble with desert varnish; bifacial notches with smoothing on one
BIBE01520	F	25427	43.9	41.4	14.1	35.1	Limestone	River-worn pebble; small bifacial notch and one small unifacial notch

Figure 6-II.86 Chopper.

Table 6-II.40 Dimensions and Descriptions of Choppers.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type	Comments
BIBE1218	B	25587	74.2	68.7	35.5	208.4	Hornfels–black (w/patina and cortex)	Sub-circular; multiple bits
IF 026	E	27388	318.8	72.6	43.1	1648.5	Hornfels–gray (w/patina and cortex)	Elongated; one bit edge

All are nearly complete and approximately of the same length. With the exception of one specimen, they are relatively thick and exhibit poor workmanship. Convex lateral blade edges predominate, although a single specimen has one straight edge. Another specimen is characterized by an alternately beveled blade. Proximal ends lack symmetry, but are generally convex, while one is straight.

Teardrop-Shaped Bifaces
(12 specimens; Figure 6-II.90; Table 6-II.41)

Twelve specimens are classified as teardrop-shaped bifaces. Recognized for their teardrop shapes—broad and rounded proximal ends with pointed distal tips—these bifaces have convex lateral blade edges and are all nearly complete with one exception. Eleven of the specimens are relatively small, practically of the same size,

Figure 6-II.87 Other bifaces: (a-d) Bi-pointed bifaces.

and almost finished. Four of these could be projectile point preforms. The fragmentary specimen is unique in this category, much larger than the other specimens and moderately thick in cross-section. However, it is well-flaked and appears to have been broken in half as it was being thinned. Although unfinished, it probably would have served as a knife in finished form.

Biface Fragments
(30 specimens)

Thirty specimens are classified as biface fragments due to their broken condition and because they could not be reliably placed in any of the other biface subcategories. These specimens have been divided into small (n=23) and large (n=7) categories, although all have similar thicknesses. Of the small fragments, 9 are distal tips, 4 are mid-sections, 1 is a proximal end, and 9 are unknown. At least two of these could be fragmentary projectile points. Three of the large fragments have attributes suggestive of use as knives when complete. The remaining large bifaces are thick, very fragmentary, and fairly nondescript.

Edge-Modified Debitage (36 specimens)

Debitage has been defined as the residual lithic material that results from tool manufacture (Crabtree 1972:32); these 36 pieces of debitage have one or more edges that have been modified through trimming and/or utilization and have been divided into two categories based on the type(s) of edge modification present: (1) trimmed and utilized debitage (n=22), and (2) utilized debitage (n=14). While this class of artifacts was not chosen for intensive collection during the project, select examples were collected from various contexts for com-

Table 6-II.41 Dimensions and Descriptions of Other Bifaces (Except Fragments).

Biface Type	Field Site No.	Block	Catalog No.	Length (mm)	Max Width (mm)	Max Thickness (mm)	Weight (g)	Material Type and Color	Comments
Bipointed	BIBE1110	A	25081	36.5	20.8	6.7	4.6	Chert–pinkish gray	Ovate shape; tip at thickest end missing
Bipointed	BIBE1520	F	25426	37.5	17.7	8.2	5.2	Chert–tan-gray mottled	Snap fracture: small distal tip missing; lanceolate shape
Bipointed	BIBE1695	F	25476	39.1	22.8	7.5	7.0	Chert–black (w/ patina)	Complete
Bipointed	BIBE1259	B	25651	56.7	37.2	10.3	18.2	Hornfels–black (with brown patina)	Complete; angular diamond shape
Triangular	BIBE0123	B	25624	63.1	31.3	10.6	21.0	Hornfels–black (w/ light brown patina)	Snap fracture: Small distal tip missing; triangular
Triangular	BIBE1304	JQ-1	25727	52.5	35.9	14.9	21.2	Agate–red/orange	Complete; triangular; thick
Elongated	BIBE1604	E	25302	45.5	17.3	7.9	6.8	Chert–white	Incompete; proximal tip missing; lanceolate shape
Elongated	BIBE1218	B	25594	50.9	20.5	6.5	7.0	Chert–tan	Complete; slender
Elongated	BIBE1321	JQ-1	25747	68.7	21.2	11.5	16.4	Hornfels–black (w/ light patina)	Complete; beveled blade
Elongated	BIBE1404	C	25779	51.5	28.6	17.2	24.0	Agate–red/orange	Complete; crude; thick
Elongated	BIBE1919	F	26042	58.0	22.6	8.8	13.6	Silicified wood–dark brown	Complete; crude; lanceolate shape
Elongated	IF 714	L	26849	61.7	24.4	14.0	18.9	Chert–white (w/ Patina)	Complete; crude and thick; small and slender
Elongated	BIBE2394	R	26897	55.3	24.3	12.2	12.0	Chert–banded white & purple	Complete; crude & chunky; possible dart point preform
Teardrop	BIBE1114	A	25093	45.0	28.0	3.0	5.1	Chert–tan	Incomplete; broken in 2 pieces; thin; possible preform
Teardrop	BIBE1157	A	25204	55.2	30.0	13.6	15.9	Felsite?–reddish/brown	Thick; crude flaking; use wear on proximal end
Teardrop	BIBE1200	B	25268	54.2	32.7	8.7	16.7	Hornfels–black (w/ light patina)	Complete; crude; thin
Teardrop	BIBE1203	B	25281	46.1	17.0	6.3	3.4	Chert–tan/beige banded	complete; uniformly worked edges
Teardrop	BIBE1628	E	25312	42.3	22.1	6.2	6.3	Chert–white mottled	Incomplete; small fragment of proximal end missing
Teardrop	BIBE1270	B	25672	38.1	22.6	7.4	5.8	Hornfels–black (w/ light patina)	Complete; triangular; beveled blade
Teardrop	BIBE1891	F	26029	48.6	25.0	8.0	9.8	Chalcedony–white	Complete; slender ovate shape
Teardrop	BIBE1909	F	26036	44.2	20.1	6.1	3.9	Chert–mottled white & tan	Incomplete; missing distal tip; slender; convex basal edge
Teardrop	BIBE2254	L	26813	42.2	21.6	7.3	5.9	Chert–white	Complete; very small; ovate shape
Teardrop	BIBE2486	Q	26893	119.1	89.1	21.4	210.6	Hornfels–black (w/ Patina)	Complete; broken in 2 pieces; large & oval shape
Teardrop	BIBE2699	2010-I	27289	48.1	30.6	6.8	8.9	Chert–mottled gray	Complete; ovate shape
Teardrop	BIBE2717	2010-HH	27306	38.2	19.9	8.0	5.2	Chert–tan	Complete; ovate shape; convex basal edge; thick

parative purposes. Thus the number of edge-modified debitage specimens reported here is not a reflection of overall trends in the park for this artifact class.

Trimmed and Utilized Debitage (22 specimens)

This category of debitage is distinguished by edge modification on one or more edges through both trimming/flaking and use-wear and contains 22 specimens. Typical patterns of use-wear include step-fractures, micro-flake scars, edge rounding, and polish. Edge modification occurs on multiple edges of 12 specimens, while the remaining 10 specimens have single edges modified. Of the trimmed and utilized specimens, convex edges are the most common edge-shape modified. These specimens represent debitage trimmed before and/or after use as expediency scraping or cutting tools.

Utilized Debitage (14 specimens)

These 14 pieces of debitage, including one recovered during excavation of the Lizard Hill Cache, exhibit evidence of use-wear on one or more edges. Ten of these specimens have been used

Figure 6-II.88 Other bifaces: (a–b) Triangular bifaces.

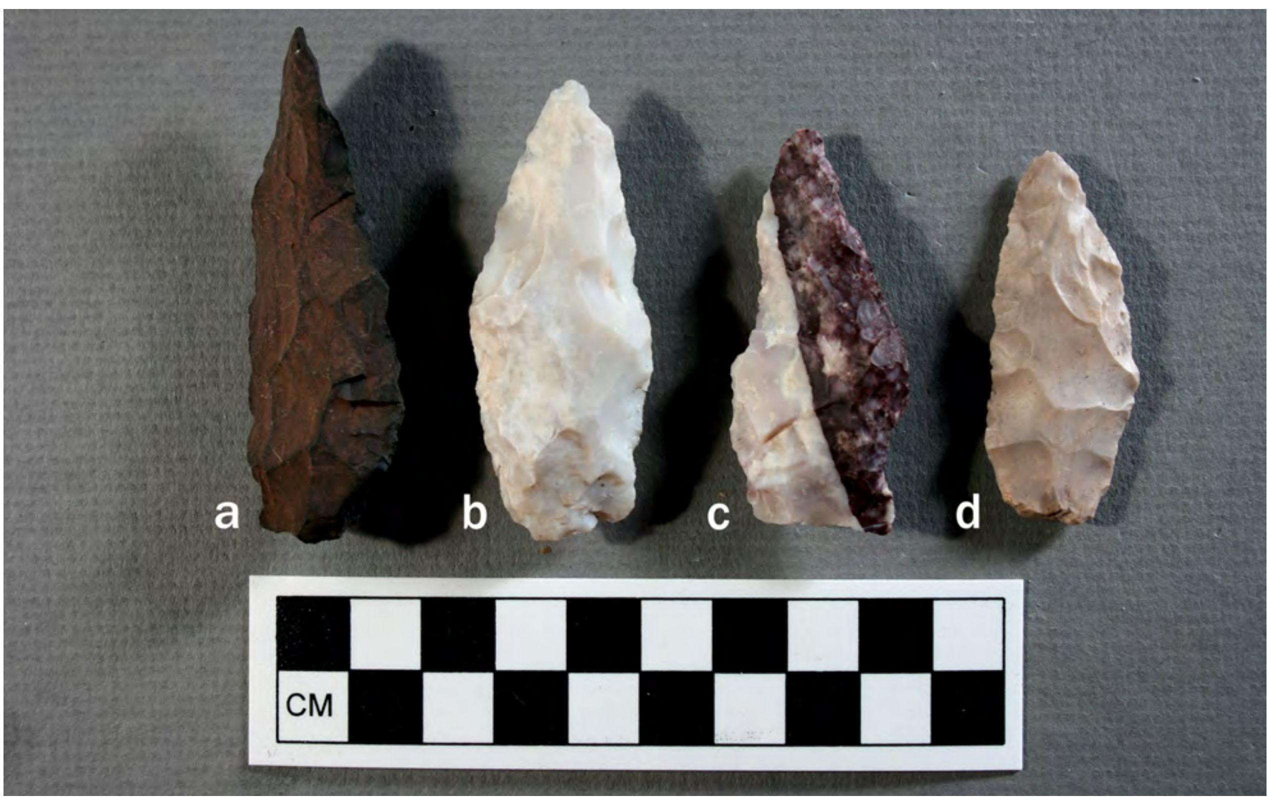


Figure 6-II.89 Other bifaces: (a–d) elongated bifaces.

Figure 6-II.90 Other bifaces: (a–i) teardrop-shaped bifaces.

on multiple edges, while the remaining four have use-wear on single edges. Modified edge shapes consist of convex, concave, and recurved. These examples represent expediency scraping or cutting tools that were not trimmed/refurbished before or after use.

Cores and Unmodified Debitage
(28 specimens; Figures 6-II.91 to 6-II.92; Table 6-II.42)

Materials representative of the lithic tool manufacturing process in the assemblage consist of 11 cores and core fragments and 17 pieces of unmodified debitage. Cores are the raw pieces of knappable stone from which flakes have been detached during stone toolmaking/lithic reduction activities. Unmodified debitage is defined as stone waste debris that lacks evidence of use or alteration. Only unmodified specimens of debitage are included in this category, while debitage with modified edges are discussed as a separate category (see above).

Cores *(11 specimens; Figures 6-II.91 and 6-II.92; Table 6-II.42)*

The 11 cores in the collection have been subdivided into specific morphological types, based primarily on the different strategies involved in flake removals. The specimens in this category consist of 1 unidirectional core, 2 bidirectional cores, 6 multidirectional cores, and 2 core fragments. The unidirectional core has negative flake scars indicating removals around the circumference, creating a circular shape in plan view. Bidirectional cores are those with negative flake scars emanating in opposing directions from a single edge; both bidirectional cores in the collection are of hornfels. Multidirectional cores have multiple platforms and negative flake scars indicating removals in various directions.

The core fragments represent detached portions of cores that retain some negative flake scars.

Unmodified Debitage *(17 specimens)*

The 17 specimens in this category were collected to provide a sample of the highly diverse lithic material types that occur on archeological sites in BBNP. Some of these were collected because of unusual colors or inclusions, others due to their rarity. In the latter category are two pieces of obsidian and two pieces of clear quartz crystal. The other 13 specimens are of various materials more commonly found at sites in the park and consist of chert, chalcedony, agate, silicified wood, jasper, and claystone.

Ground- and Pecked-Stone Artifacts (56 specimens; Figures 6-II.93 to 6-II.101; Tables 6-II.43 to 6-II.49)

Fifty-six specimens in the collection are placed in the ground- and pecked-stone category. These items consist of 3 manos, 1 metate, 4 shaft abraders, 3 pigment stones, 1 incised stone, 9 hammerstones, and 35 ornaments. As with edge-modified debitage, this class of artifacts was not chosen for intensive collection during the project, thus the number of ground- and pecked-stone specimens in the collection is not a reflection of overall trends in the park for this artifact class.

Manos (3 specimens; Figure 6-II.93; Table 6-II.43)

Manos are hand-held stone tools that were used in tandem with a larger stone—a metate—or another stone surface, such as a segment of bedrock or the top of a boulder, to process or grind foodstuffs and other mate-

Figure 6-II.91 Core: (a) unidirectional core.

Table 6-II.42 Dimensions and Descriptions of Cores and Core Fragments.

Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type–Color	Comments
Unidirectional	BIBE2316	L	26854 b	57.2	44.4	19.6	57.1	Chert–mottled tan and red	Depleated; heat treated
Bidirectional	BIBE1184	B	25258	77.7	69.5	50.6	320.1	Hornfels–black (w/patina)	Cortex backing
Bidirectional	BIBE1226	B	25606	81.5	71.5	38.7	263.3	Hornfels–black (w/patina)	
Multidirectional	BIBE1188	B	25264	104.4	74.4	44.3	272.1	Andecite–black (w/patina)	
Multidirectional	BIBE1216	B	25575	71.2	51.7	50.1	219.4	Andecite–black (w/patina)	
Multidirectional	BIBE1218	B	25582	94.8	67.8	44.4	422.1	Hornfels–black	
Multidirectional	BIBE0135	B	25684	97.3	90.8	55.1	660.1	Hornfels–banded black	
Multidirectional	BIBE1366	C	25775	52.9	46.1	24.7	54.4	Hornfels–gray (w/patina)	Rejuvenated
Multidirectional	BIBE2316	L	26854 a	58.7	35.4	32.6	54.5	Chert–mottled tan and red	Depleated; heat treated
Core Fragment	BIBE1176	B	25254	54.8	36.9	18.8	40.2	Hornfels–black (w/patina)	
Core Fragment	BIBE1185	B	25260	46.2	28.9	16.3	20.2	Chert–light gray	

Figure 6-II.92 Cores: (a-b) bi-directional cores.

rials. Stones chosen for this task were typically stream-rolled cobbles, usually of a size for single-handed use, although larger specimens that would require both hands were also used. Manos often are disc-shaped and exhibit use-wear on both faces, although utilized sides and edges are not uncommon. The working faces are flat, convex, or slightly convex. Some examples also exhibit pecking or battering that could have resulted from use as hammerstones/anvils, or rejuvenation of the working face.

In the BBNP collection, all three specimens collected are of the single-handed variety. Fashioned from vesicular basalt, the smallest of the three is disc-shaped with use-wear on both flat faces. Light polish on the edges around its circumference attest to a somewhat different use from that displayed on the faces. Another of the manos is a two-sided, oval-shaped (in plan view) quartzite specimen with additional use-wear on two edges and peck marks on one face. The remaining mano is an unknown igneous loaf-shaped specimen with use-wear on one face and battering marks on both ends. Manos and mano fragments are one of the most common artifacts found on sites across BBNP.

Metate (1 specimen; Figure 6-II.94; Table 6-II.44)

Metates are the stone slabs used as stationary bases in conjunction with hand-held manos for grinding purposes, especially for foodstuffs. Both unaltered, generally flat slabs, and larger, well-shaped small boulders with deep central depressions were used for these grinding tools. Although lacking definitive evidence, researchers in the region believe repeated long-term grinding rather than shaping processes created the depressions in the latter. These specimens were generally transportable, compared to stationary metate

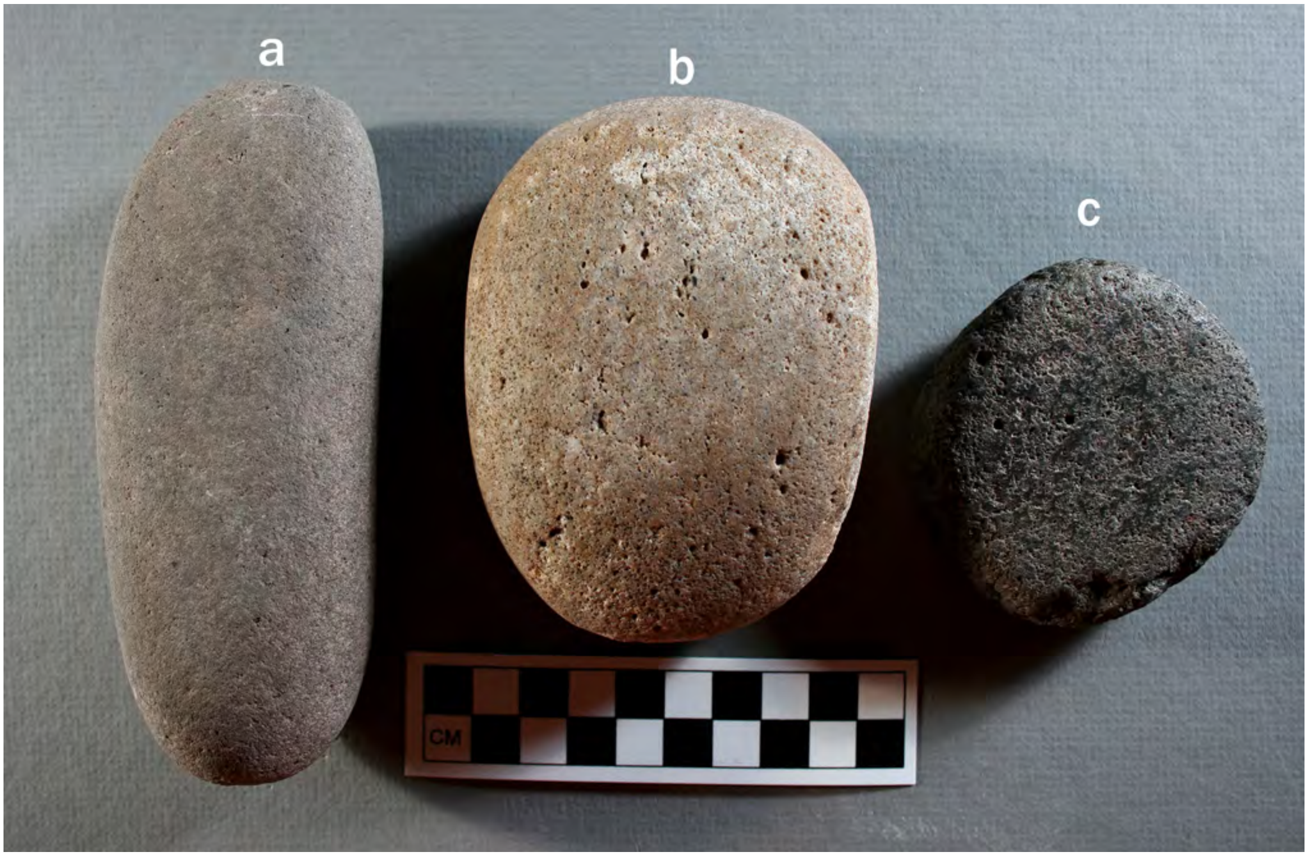


Figure 6-II.93 Ground-stone: (a-c) manos.

Table 6-II.43 Dimensions and Descriptions of Manos.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type	Comments
BIBE0338	JQ-2	25293	136.3	52.9	42.3	463.1	Quartzite	One sided; loaf-shaped; both ends used as hammerstone
BIBE1234	B	25608	105.7	78.3	43.3	571.1	Quartzite	Three sided; one face pecked; two edges used as hammerstone
BIBE1732	F	25899	72.3	68	25.5	202.6	Vesicular Basalt	Two sided; shaped

grinding surfaces found on bedrock outcroppings and larger boulders.

The single specimen in this category is a one-sided metate fragment fashioned from indurated sandstone. Although fragmentary, its thinness suggests that it was transportable when whole. The intact portion of the grinding surface is flat and lightly polished. Peck marks and striations on this surface likely resulted from an intentional effort to rejuvenate the working face. Like manos, metates commonly occur on sites across BBNP.

Shaft Abraders (4 specimens; Figure 6-II.95; Table 6-II.45)

Shaft abraders are grooved stones thought to have been used to smooth and shape wooden dart and/or arrow shafts, although they may have also been used to debark or shape other wooden items. These tools are typically characterized by shallow U-shaped grooves on a single face. Granular stones with abrasive matrices were usually chosen for this tool type.

In the BBNP collection, three of the shaft abraders were fashioned from vesicular basalt, the remaining one from indurated sandstone. Of the U-shaped grooves on the vesicular basalt specimens, two are well-formed and highly polished, whereas the third contains a natural groove with a very light polish. The smallest of these three specimens was also used as a mano or grinding stone, exhibiting moderate polish positioned on the face opposite the shaft abrader. The indurated sandstone specimen also served as a multi-purpose tool. In addition to a well-formed and highly polished U-shaped groove, this specimen contains grinding facets on both faces from use as a mano and battering marks on both ends of the long axis from apparent use as a hammerstone. Wear on the face opposite the groove is extensive and indicates this side was used more extensively for grinding than the other.

Pigment Stones (3 specimens; Figure 6-II.96; Table 6-II.46)

Pigment stones, sometimes called "paint stones," are defined as faceted minerals from which powdered pigment was obtained. These stones were ground against harder stones, creating facets; the resulting powder was mixed with water and other binding ingredients, such as fat, blood, or egg yolk, to form paint. Softer versions of these minerals may have been used in their natural state, like a crayon, but these typically lack the well-defined ground facets. These artifacts facilitated the production of rock art (pictographs) and/or other purposes, such as body decoration or ornamentation of weaponry/ritual objects. Minerals typically selected for pigments were hematite and limonite, although gypsum, manganese, and clay ochres were also used. All three of the BBNP pigment stones are relatively small pieces of hematite and exhibit multiple grinding facets. Two of the specimens are dark red and the other is reddish-brown.

Incised Stone (1 specimen; Figure 6-II.97; Table 6-II.47)

An incised stone is defined here as a portable stone that has been etched or cut with a harder stone, typically one with a "V-shaped" edge such as a knife blade.

Figure 6-II.94 Ground-stone: slab metate fragment.

Table 6-II.44 Dimension and Description of Metate.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type	Comments
BIBE2117	I	26745		134.8	18.2	418.9	Sandstone-Indurated	Portable; one sided with possible pecking

The resulting incised line/s can create an image that might be considered ritualistic rock art although such lines could also be related to tool edge rejuvenation, as re-sharpening first requires an edge to be dulled to create a suitable platform for flake removals. The level of complexity of the etchings or design created can sometimes help in determining whether these are ritual or utilitarian incisions.

The single specimen in this category is a small, portable, indurated sandstone cobble exhibiting five short and shallow incised lines on one face. The lines are parallel to one another and arranged in a row. The simplicity of the lines suggests they were created during tool edge rejuvenation rather than for ritual purposes. However, the fact that they are parallel and evenly spaced may indicate a means of counting.

Hammerstones (9 specimens; Figure 6-II.98 to 6-II.100; Table 6-II.48)

Hammerstones are hard cobbles or other stones used to strike flakes from stone masses during the process of lithic reduction. Larger specimens were used on bedrock outcrops and cores for initial reduction, while smaller examples facilitated shaping, finishing, and refurbishing tools. Most hammerstones have ovoid shapes, typically to provide a better fit to the hand and to allow more targeted blows. Through use, these stones develop distinctive battering marks on one or more edges.

Five of the nine hammerstones in the BBNP collection have ovoid shapes and exhibit extreme battering on multiple edges. Interestingly, and breaking from the norm, these specimens are of chert and hornfels, materials typically fashioned into chipped stone tools. One of the chert specimens is cortex-free, while the other four in this grouping have remnants of

Figure 6-II.95 Ground-stone: (a-b) shaft abraders.

Table 6-II.45 Dimensions and Descriptions of Shaft Abraders.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type	Comments
BIBE1647	E	25346	69.2	53.2	36.7	165.3	Vesicular Basalt	Opposite face used as mano
BIBE775	I	26824	99.9	66.8	42.1	318.5	Vesicular Basalt	
IF 762	R	26896	94.8	74.2	48.2	534.3	Indurated Sandstone	Formally shaped; used as mano on both faces; battering on both ends
BIBE1257	B	25633	95.3	52.1	35.6	116.2	Vesicular Basalt	Natural groove with light polish

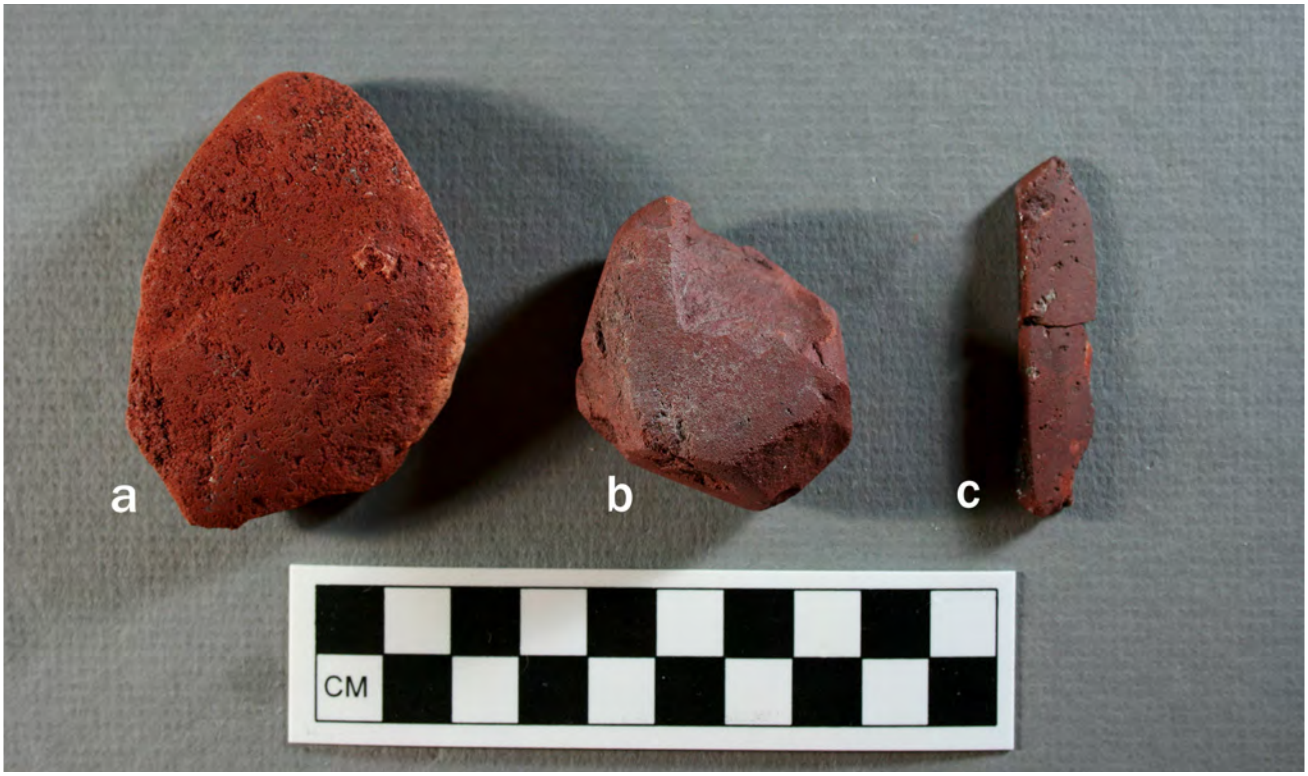


Figure 6-II.96 Ground-stone: (a-c) pigment stones.

Table 6-II.46 Dimensions and Descriptions of Pigment Stones.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type–Color	Comments
BIBE1684	F	25462	45.3	36.4	21.6	42.8	Hematite–dark red	Ground on five facets
BIBE1702	F	25497	52.7	12.5	5.5	4.1	Hematite–dark red	2-pieces refit; ground on four facets
BIBE1210	B	25553	66.7	45.9	19.2	57.6	Hematite–red	Ground on two facets

cortex across their surfaces. The remaining four specimens are more traditional hammerstones—river-worn cobbles of indurated sandstone with loaf or elongated shapes. Three of these are relatively small and exhibit battering on one or more marginal ends. The other is much larger and exhibits battered areas on each end of one face, possibly from use as an anvil, although one marginal end exhibits battering more typical of the other hammerstones.

Stone Ornaments
(35 specimens; Figure 6-II.101; Table 6-II.49)

Stone ornaments are objects of stone fashioned for adornment, the most common of which are beads and pendants. Beads are typically small, discoidal- or tubular-shaped, and contain a perforated center. Pendants are variably sized, typically have a triangular or rectangular shape, and contain a perforated suspension hole near one end. The process to shape each of these ornaments usually involved a combination of cutting, abrading, grinding, polishing, and drilling.

Ultimately, beads would have been strung together or separately on necklaces or bracelets, or may have been sewn into clothing.

Stone ornaments in the BBNP collection are separated into four types: beads, pendants, preforms, and unknown fragments. The 35 specimens consist of 12 beads, 11 pendants, 9 preforms, and 3 unknown fragments. Most of the beads have discoidal shapes, although three specimens are cylindrical or tubular-shaped. The pendants have various shapes—triangular, rectangular, oval, elongated, and fragmentary—and all except one have suspension holes. The lone pendant lacking such a hole is incised, with a groove around the circumference near one end. This likely served as an anchoring groove for a piece of cordage. The specimens classified as preforms are all complete and have various shapes. They represent stone ornaments in different stages of processing, including one that has an unfinished suspension hole. The three unknown specimens are too fragmentary for identification, but are probably portions of pendants. Most of the stone ornaments are made from the clay mineral kaolinite, one source of which outcrops in BBNP within the Burro Mesa National Register Archeological District (Alex 1990). See the shell and bone artifact sections below for additional specimens classified as ornaments.

Ceramics (43 specimens; Figure 6-II.102)

A total of 373 ceramic artifacts were collected during the project but only 43 sherds representing approximately 12 vessels are known or suspected of being prehistoric in age. Three of the sherds collected during the project are definitely prehistoric and represent two well-established tradewares: Chupadero black-on-white (from BIBE1676) and Rockport black-on-gray (from BIBE1702). In addition to these 3 specimens, 4 plainware sherds (from BIBE859, BIBE1684, and BIBE2030), 13 polished plainware sherds (from BIBE1910) and 23 red-slipped sherds (from BIBE859, BIBE1738, and BIBE1910) are suspected of being both prehistoric in age as well as locally made. One additional sherd—an El Paso brownware sherd—was collected prior to the project during testing of a site near Santa Elena Canyon

Figure 6-II.97 Ground-stone: incised stone.

Table 6-II.47 Dimension and Description of Incised Stone.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type	Comments
BIBE1908	F	26034	71.6	45.7	28.9	136.6	Indurated Sandstone	Desert varnish; one sided with five incised lines

Figure 6-II.98 Pecked stone: (a-b) hammerstones.

Table 6-II.48 Dimensions and Descriptions of Hammerstones.

Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Max. Thickness (mm)	Weight (g)	Material Type-Color	Comments
BIBE1520	F	25419	81.1	42.7	21.4	106.1	Indurated Sandstone	River pebble with desert varnish; battering on marginal end of one face
BIBE1520	F	25423	57.5	22.9	13	23.3	Indurated Sandstone	River pebble with desert varnish; battering on marginal end of one face; small size of pebble suggestive of finishing tool
BIBE1520	F	25424	72.9	25.2	17.8	56.4	Indurated Sandstone	River Pebble with desert varnish; battering on two faces
BIBE1695	F	25477	136.5	59.8	44.7	575.5	Indurated Sandstone	River cobble with desert varnish; battering on two marginal ends of one face for hammerstone or anvil; one edge used as hammerstone
BIBE1218	B	25585	60.1	44.3	41.4	141.7	Hornfels-black	Ovoid; extremely battered
BIBE1204	B	25693	62.9	53.6	50.4	249.4	Hornfels-black	Ovoid; extremely battered
BIBE1287	B	25698	73.8	63.9	55.3	357.9	Hornfels-black	Ovoid; extremely battered
BIBE1324	JQ-1	25764	78.8	75.5	54.6	389.2	Chert-dark gray	Ovoid; extremely battered
BIBE497	D	25793	67.2	64.3	55.4	269.3	Chert-gray	Ovoid; extremely battered

Figure 6-II.99 Pecked stone: (a–c) hammerstones.

Figure 6-II.100 Pecked stone: hammerstone/anvil.

Figure 6-II.101 Ornaments: (a–g) stone pendants; (h) shell pendant; (i–o) stone beads; (p–s) stone ornament preforms; (t–u) possible shell ornaments—turtle carapace.

Table 6-II.49 Dimensions and Descriptions of Stone Ornaments.

Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Diameter (mm)	Max. Thickness (mm)	Weight (g)	Material Type–Color	Shape	Comments
Pendant	BIBE1655	E	25354	16.9	11.4		5	1.8	Kaolinite–white	Rectanguloid	Moderate polish
Pendant	BIBE1655	E	25367				3.1	0.3	Kaolinite–white	Fragmentary	Very fragmentary; lateral edge exhibits incised notches (3); high polish; portion of suspension hole visible
Pendant	BIBE1676	F	25436				1.8	0.1	Turqoise–green	Fragmentary	Very fragmentary; high polish; portion of suspension hole visible
Pendant	BIBE1840	G	25946	14.9	9.9		3.5	0.8	Kaolinite–white	Rectanguloid	High polish; worn through suspension hole; opposite end exhibits new suspension hole
Pendant	BIBE1854	F	26022	24.1	22.8		4.2	3.1	Kaolinite–gray	Ovoid	High polish; suspension hole exhibits extreme use wear; drilled from one face
Pendant	IF 253	F	26041	26.5	21.6		3.8	3	Kaolinite–white	Ovoid	High polish; suspension hole exhibits extreme use wear
Pendant	BIBE2155	I	26779	27.3	14.8		3.7	2.5	Kaolinite–white	Rectanguloid	Extreme polish
Pendant	BIBE0246	2010–D	27196	21	6.7		5.4	1	Kaolinite–white	Elongated	Incised around one end for attachment; high polish
Pendant	BIBE1554	C	27213				2.7	1.8	Kaolinite–white	Fragmentary	Fragmentary; broke in half with drill hole in center; extreme polish
Pendant	BIBE2623	2010–G	27234	17.1	9.7		3	0.8	Kaolinite–white	Rectanguloid	High polish
Pendant	BIBE2634	2010–C	27243	33.6	21.3		4.7	4.9	Kaolinite–white	Trianguloid	Extreme polish
Bead	BIBE0418	A	25013					0.2	Kaolinite–white	Tubular	Fragmentary; extreme polish
Bead	BIBE1203	B	25278				1.8	0.4	Kaolinite–white	Discoidal	Very thin; high polish
Bead	BIBE1655	E	25380			7	3	0.2	Kaolinite–white	Discoidal	Very small; extreme polish
Bead	BIBE1520	F	25415			8.5		0.7	Kaolinite–white	Tubular	High polish
Bead	BIBE1594	F	25834			11.2	4.6	1.1	Kaolinite–white	Discoidal	Extreme polish
Bead	BIBE1849	F	26004	19.3	17.2		4	2	Kaolinite–white	Discoidal	Illregular shaped; extreme polish
Bead	BIBE2155	I	26784			*19.6	6.2	2.5	Fossilized Bone–mottled gray and brown	Discoidal	High polish
Bead	BIBE2394	K	26909			24.8	8.2	4.8	Stone (unknown)–white	Discoidal	Moderate polish; broke in half
Bead	BIBE0760	T	26971					0.8	Kaolinite–white	Tubular	Fragmentary; high polish
Bead	BIBE2716	2010–HH	27294			12.7	3.6	0.7	Kaolinite–gray	Discoidal	Extreme polish
Bead	BIBE2716	2010–HH	27295			9.8	3.1	0.4	Kaolinite–white	Discoidal	Extreme polish
Bead	IF 904	2010–D	27310			13.4	3.3	1	Kaolinite–white	Discoidal	Extreme polish
Preform	BIBE0338	JQ–2	25292	28.6	24.8		9.4	8.7	Kaolinite–white	Ovoid	Early stage; illregular corners and thickness; moderate polish
Preform	BIBE1702	F	25494	26.2	14.1		13.3	7.5	Kaolinite–white with red inclusions	Elongated	Early to Mid-stage; very thick; high polish

Table 6-II.49 Dimensions and Descriptions of Stone Ornaments. *(continued)*

Type	Field Site No.	Block	Catalog No.	Length (mm)	Max. Width (mm)	Diameter (mm)	Max. Thickness (mm)	Weight (g)	Material Type–Color	Shape	Comments
Preform	BIBE1702	F	25501			22.3	6	4.1	Volcanic Tuff–white	Discoidal	Late stage; probably for pendant; high polish
Preform	BIBE1849	F	25992	29.9	23.2		6	7	Kaolinite–white	Ovoid	Late stage; probably for pendant; extreme polish
Preform	IF 585	K	26787	50.2	20.8		6.8	10.8	Kaolinite–white	Trianguloid	Early stage; moderate polish
Preform	BIBE2195	K	26788			13.2	4	1.1	Kaolinite–white	Discoidal	Late stage; probably for bead; high polish; thin
Preform	BIBE0760	T	26975			17	6.6	3	Kaolinite–white	Discoidal	Late stage; probably for bead; high polish; thick
Preform	BIBE0760	T	26978			13.8	1.9	0.5	Kaolinite–white	Discoidal	Late stage; probably for bead; extreme polish; very thin
Preform	BIBE2634	2010–C	27245	20	15.7		3.5	1.6	Kaolinite–white	Ovoid	Bifacial drill holes started but not finished; light polish
Unknown	BIBE2030H	H	26592		22.8		6.5	5.3	Kaolinite–white	Fragmentary	Light polish; heavy striations
Unknown	BIBE0970	V	27049				4.2	2.7	Kaolinite–mottled purple and gray	Fragmentary	Fragmentary; high polish
Unknown	BIBE2697	2010–I	27275				4.3	1.8	Kaolinite–white	Fragmentary	Portion of probable larger pendant; high polish; both faces exhibit striations in the form of checker board design

(BIBE149). See Appendix 13 for detailed descriptions and metric data.

Perishable Artifacts (3 specimens; Figures 6-II.103 to 6-II.104)

Three specimens in the collection are classified as perishable materials. Due to exposure to the elements, principally rainwater, much of the rich material culture of past human cultures is missing from the archeological record. However, favorable conditions, such as those found in dry rockshelters, have helped to preserve some of these important and rare materials.

All of the perishable materials in the BBNP collection are small fragmentary pieces of cordage collected from rockshelters. Two of these have two-ply construction (Figure 6-II.103), the other four-ply (Figure 6-II.104). Although not confirmed, all three specimens are likely made from *Agave* sp. fibers. The two-ply specimens have 20–24 individual fibers wound together in each ply. After being formed, the individual plies were tightly twisted together. The four-ply specimen consists of four separate plies, each with 8–12 individual fibers wound together. Initial twisting created two sets of two-ply cordage, then the two sets were twisted together to create the four-ply form.

Shell Artifacts (6 specimens; Figure 6-II.101; Table 6-II.50)

Six specimens in the collection are classified as shell items. These consist of 4 ornaments and 2 possible ornaments. Metric data for these specimens are presented in Table 6-II.50.

Shell Ornaments
(4 specimens; Figure 6-II.101; Table 6-II.50)

The reader is referred to stone ornaments in the ground- and pecked-stone artifacts section above

Figure 6-II.102 Unglazed earthenware recovered during the project: (a-b) Chupadero black-on-white; (c) Rockport black-on-gray; (d-e) unglazed plainware; (f-g) red-slipped plainware. (Note: the top three sherds are known prehistoric types, with bottom four suspected of being prehistoric.)

for an overview concerning ornaments. Four specimens in the BBNP collection are classified as shell ornaments. Three of these, including two from the Lizard Hill Cache, are pendants, and the other specimen in this classification is a possible pendant fragment. The two pendants from the Lizard Hill Cache are relatively large freshwater mussel shells, each with a single drilled hole, suggesting they were personal or ritual items (Ohl 2011:77). Both shells from the cache are from the Unionidae family and likely represent yellow sandshells (*Lampsilis teres*), a species known to occur along the central and lower Rio Grande (Howells et al. 1996:69; Ohl 2011:77). The other pendant in the collection is a fragmentary freshwater mussel shell of an unknown species that retains part of the drilled suspension hole. Off-center now, the hole was probably positioned near the center of the shell when complete. The last specimen in the collection is a possible pendant fragment that has been formally shaped, but lacks a suspension hole. Although not identified to the genus or species level, it has distinctive attributes of a marine shell.

Possible Shell Ornaments (2 specimens; Figure 6-II.101; Table 6-II.50)

Two specimens in the collection are classified as possible shell ornaments. Both are fragmentary pieces of a turtle carapace that were found together at a site along the Rio Grande. Although a turtle carapace is comprised of bony elements and could be considered either bone or shell, it is classified as shell for the purposes of this analysis.

These specimens were probably connected and part of a single carapace when complete. Each has several small perforations along one or two outer edges of the shell. It is unknown what function these perforations served, perhaps to facilitate attachment as an ornament of some type.

Figure 6-II.103 Perishable item: cordage—two ply form.

Summary and Conclusions

This section detailed the prehistoric findings from the BBNP project, including the temporal affiliation of projectile points and sites, site distribution and density, site size, site types, feature types, and artifact types. Prehistoric projectiles collected during the survey represent some 12,000 years of time, from the Paleoindian period to the Late Prehistoric. However, later periods are much better represented, and the general trend was increasing number of points with each successive period. For those points that could be identified to subperiod (n=1,014), only 2 percent of points can be attributed to the Paleoindian period compared to 7 percent to the Early Archaic, 22 percent to the Middle Archaic, 32 percent to the Late Archaic, and 37 percent to the Late Prehistoric.

As a proxy for population estimates, this data suggests generally increasing population through time but with a significant spike during the Middle Archaic. The number of projectiles increased by 15 percentage points from the Early Archaic—the highest jump between any two periods. By comparison, the number of projectiles increased by only 9 percent in the Late Archaic and by another 6 percent in the Late Prehistoric. Diagnostic projectiles were collected from 284 sites; 259 of those contained points that could be identified to subperiod. Of these 259 sites, 143 (55 percent) are potentially single time period, meaning projectiles from only one time period were represented at the site.

A total of 1,566 sites were recorded during the project. Of these, 127 were either exclusively or predominantly

Figure 6-II.104 Perishable item: cordage—four ply form.

historic and 1,439 were exclusively or predominantly prehistoric. An additional 34 multi-component sites that were predominantly historic but that had substantial prehistoric components were included in the prehistoric site tally, bringing the total prehistoric site count to 1,473.

Table 6-II.50 Dimensions and Descriptions of Shell Artifacts.

Type	Field Site No.	Block	Catalog No.	Length (mm)	Max Width (mm)	Max Thickness (mm)	Weight (g)	Comments
Ornament	IF 181	F	25815	30.13	25.9	3.62	4.03	Incomplete; drilled mussel shell pendant
Ornament	BIBE 1853	F	25914	96.48	44.39	6.21	26.4	Incomplete; top mussel shell pendant from cache
Ornament	BIBE 1853	F	25916	116.96	53.55	8.04	40.6	Incomplete; bottom mussel shell pendant from cache
Ornament	BIBE 1942	F	26298	17.57	26.43	2.88	2.22	Incomplete; pendant, missing distal half
Possible Ornament	BIBE 1594	F	25843	37.56	22.47	2.48	1.27	Incomplete; pierced turtle shell
Possible Ornament	BIBE 1594	F	25846	27.31	37.87	3.05	2.24	Incomplete; pierced turtle shell

Prehistoric site density within the surveyed areas averaged 17 ha (42 ac) per site but ranged significantly between survey blocks—from the highest site density 6 ha (14 ac) per site to the lowest site density of 59 ha (145 ac) per site. Density was generally higher in the basin settings than in the mountains although this may be a result of visibility. Sites were found to cluster along the margins of some environmental zones, demonstrating a generally higher density in ecotones. Although the Rio Grande along with other riparian areas and springs were found to be good indicators of site presence, site patterning around such features varied significantly.

Sites ranged in size from 13 m^2 to 1,796,393 m^2 although the largest sites tended to be lithic procurement areas rather than habitation sites. Adjusting for this, sites averaged 1 ha (2.5 ac) per site.

Prehistoric sites were categorized by site type, six of which were identified. The vast majority (90 percent) was open campsites, followed by artifact scatters (4 percent), special use sites (3 percent), natural shelter sites (2 percent), food processing sites (1 percent), and stone enclosure sites (0.3 percent). In addition, 0.6 percent of sites could not be assigned a site type.

Six major feature classes were identified, each of which contains specific types of features. The major classes are thermal features, stone enclosures, other rock features, special use, interments, and redoubts and fortifications. Thermal features were by far the most commonly encountered feature type, constituting roughly 90 percent of all feature classes, followed by stone enclosures (4 percent), other rock features (3 percent), and special use, interments, and redoubts and fortifications—all less than 1 percent of the total number of features.

The most common feature type within the thermal feature class was hearths, representing 77 percent of all thermal features. This was followed by FCR concentrations and scatters (19 percent), and middens (3 percent). Four hearth types were identified during the survey although they were tallied individually only during the second half of the project. From this data subset, pavement hearths dominate the assemblage at 74 percent of the total, followed by ring hearths (13 percent), cobble-lined hearths (10 percent), and unspecified (4 percent). Two types of middens were also documented: ring middens, making up 58 percent of all midden features, and sheet middens making up the remaining 42 percent.

A total of 254 stone enclosures were recorded at 89 sites during the project. Thirty-percent of these were classified simply as generic stone enclosures, while another 33 percent were classified as wickiup rings, 23 percent as Cielo complex structures, and 11 percent as tipi rings—the least frequently encountered structure type. Four different types of "other rock features" were also documented during the project, although they were not individually tallied. These features consist of cairns, rock alignments, rock groupings, and rock clusters.

Special use features recorded during the project consist of vision quest and lookout structures as well as rock imagery. Within the latter category are several types: petroglyphs and pictographs, abraded lines and cupules, and petroforms. Three types of petroforms were documented: medicine wheels, linear alignments, and effigies. It is notable that, with one exception, all of these feature types documented within the park resulted from the present project.

Very few interments or possible interments were encountered during the project. Aside from the one confirmed burial documented at BIBE1849, the remaining six were speculative. These consisted of two stacked rock features within rockshelters, four stone filled boulder crevices, and one cairn on an open site. Only five sites documented during the project contained what were interpreted to be redoubts and fortifications—stone based prehistoric structures that suggested they were for defensive purposes.

Prehistoric artifacts documented during the project consisted of chipped stone artifacts, ground-stone artifacts, ceramics, ornamental items, and perishable artifacts. A total of 1,586 prehistoric artifacts were collected, nearly 80 percent of which were projectiles (n=1,236). Of these, 859 are dart points and 360 are arrow points. In addition, one dart point preform and 16 arrow point preforms were collected.

A total of 242 additional chipped stone artifacts were collected, consisting of perforators/drills, knives, scrapers, adzes/gouges, spokeshaves, net sinkers, choppers, bifaces, pieces of edge-modified debitage, and cores and unmodified debitage. Fifty-six ground- and pecked-stone artifacts were collected, consisting of manos, shaft abraders, pigment stones, hammerstones, ornaments, a metate, and an incised stone. Forty-three ceramic artifacts were collected that were known or suspected of being prehistoric. Six shell items were collected consisting of ornaments and possible ornaments. Finally, 3 perishable artifacts were also collected.

Taken together, these archeological findings represent the most comprehensive ever reported in BBNP. Documenting the range and variability of prehistoric material culture within the park provides a foundation upon which future researchers can operate and build on. As such, this data should help guide research as well as contextualize and facilitate interpretations of findings from future studies in BBNP and the greater Big Bend.

6-III

Euro-American and Mexican-American Archeological Findings

This chapter provides an overview of sites, features, and artifacts with Euro-American and Mexican-American historic affiliation recorded during the BBNP survey. However, historic Native American findings, limited to a metal tinkler and, possibly, to a Majolica sherd are also briefly addressed. For ease of discussion, these sites are hereafter referred to simply as "historic sites." The chapter begins with a discussion of the background of historic site investigations in BBNP. This is followed by an overview of historic site findings and the spatial distribution of historic sites within the park. The discussion then moves to functional categories, or site types, used to classify these sites, with specific examples of each type. The following two sections, forming the bulk of this chapter, detail the array of historic features and artifacts documented during the project. The final two sections briefly discuss site chronology and cultural affiliation. The chapter concludes with a summary of the historic findings.

Background of Historic Site Investigations

Prior to the present project, relatively little intensive work on historic sites had been conducted in BBNP. Because BBNP was established as a result of its geological, physiographic, and biological diversity, historic remains were afforded little regard. Early archaeological efforts in the park (e.g., Reed 1936, Cook 1937, and Campbell 1970; see History of Investigations, this volume) focused their efforts on prehistoric sites, largely neglecting historic sites altogether. Historic components within prehistoric sites were also frequently overlooked. Indeed, early official park policy was even hostile towards historic resources. Between 1944 and 1966, as a result of safety concerns and the then-official policy of restoring the park to its "natural condition," BBNP staff systematically destroyed many of the standing ruins within the park (see Impacts to Historic Sites below).

The National Historic Preservation Act of 1966, charging park units with evaluating all of their cultural resources (including historic sites) for inclusion in the National Register of Historic Places, finally forced a change in policy. In the late 1960s and early 1970s, historic resource studies were conducted to evaluate historic properties in BBNP for significance and structural integrity. This effort resulted in the listing of six historic sites (Castolon, Homer Wilson Blue Creek Ranch, Hot Springs, Sublett Farm/Rancho Estelle, Mariscal Mine and Luna's *Jacal*). In the years that followed, small compliance projects and other efforts resulted in additional documentation of historic resources. Still, prior to this project, only 111 historic sites had been recorded.

Today, a total of 552 sites containing historic components have been documented within BBNP. The 405 sites containing historic components recorded during the present project represent an overwhelming majority—78 percent—of that total. Additionally, the level of detail involved in recording these sites was far greater than in the past. This was especially true of unique historic sites such as the village sites of San Vicente and Pantera as well as the U.S. Cavalry camp at Neville Spring. Feature and artifact documentation within historic sites took on increased importance and collections of historic artifacts were conducted on a scale far greater than before—both for analytical purposes as well as an aid in future interpretive efforts. Consequently, this section represents another first of its kind in the history of archeological research in BBNP.

Site Findings

Of the 1,566 sites recorded during the present project, a total of 405 sites contained historic materials (amounting to one out of every 3.87 sites). An additional five sites probably contain historic components but lack sufficient evidence to assign affiliation and are excluded from the present discussion. Of the 405 sites with historic materials, only 60 sites were exclusively historic. The vast majority (345 sites) also contained prehistoric materials. Of these multi-component sites, 67 are considered primarily historic with a lesser prehistoric component. Conversely, 278 sites are primarily prehistoric but contain some historic materials (in many cases, a single artifact). For purposes of the present report, only those sites that are exclusively or predominantly historic will be discussed, a total of 127 sites.[1]

Because of the attractiveness of certain landforms and locations in BBNP through time, most sites recorded during the project were multi-component, often representing occupations spanning thousands of years. This likewise applies to historic sites that so often overlay prehistoric sites. Only a small minority of historic sites (n=60) contained strictly historic materials. Most of these sites also tended to be less complex and more ephemeral than other historic sites simply because they were frequently sited at locations less than ideal for habitation. These include sites such as cemeteries, wax camps, single-event "spike" camps, mining sites, topographic survey sites, dump sites, quarry sites, dam sites, bridge sites, and special-use historic sites.

The 127 sites that contained historic materials spanned some 259 surveyed park hectares (640 acres [ac]), an average of 2 ha (4.9 ac) per site. This figure is misleading, however, because most of these sites also have prehistoric components that in many cases cover extensive areas. For example, the boundaries of BIBE2531 were greatly expanded due to a prehistoric hearth field adjacent to the historic site. Adjusting slightly for known additional "prehistoric area" (excluding two sites whose sizes were influenced largely by their prehistoric component), a more accurate figure for the total project historic site area comes to 211 ha (521 ac) for 127 sites, or an average of 1.66 ha (4.1 ac) per site.

Site Distribution and Density

Park-wide, historic site locations are well patterned. Although when considering all sites containing historic components (n=405), the distribution is fairly uniform across the park, when examining only the purely or predominantly historic sites, the distribution takes on a much less uniform appearance. This patterning is most pronounced between the northern and southern halves of the park, with more than double the density of historic sites in the southern half (141 ha [348 ac] per site) compared to the northern

1. This breakdown is based on the presence or absence of historic structures, the relative number of historic to prehistoric features, and the nature of the artifact assemblage. Historic structures trumped other feature types, and diagnostic artifacts trumped other artifact types. Consequently, the breakdown, while based on the data, remains somewhat arbitrary.

half (302 ha [746 ac] per site). However, historic sites are only slightly more dense in the eastern half of the park than the western (175 ha [432 ac] per site vs. 242 ha [598 ac] per site, respectively). At a slightly higher resolution—by dividing the park into quadrants—results are even more revealing. Site density is significantly higher in the southeast quadrant at 117 ha [289 ac] per site, compared to the southwest (183 ha [452 ac] per site), northwest (474 ha [1,171 ac] per site) or northeast (263 ha [4.1 ac] per site) quadrants.

These differences in historic site density may have been conditioned by a number of factors (such as physiography or access to roads), but may be best explained by the greater presence of water in the southern half of the park, which contains most of the springs (roughly 65 percent of the total number of springs in the park), in addition to the Rio Grande along the park's southern periphery. The significantly greater density in the southeast quadrant is due primarily to the presence of San Vicente and sites associated with Glenn Springs. Density was least in the northwest quadrant of the park—a portion of the park that contains abundant badlands and relatively few historic sites.

By Survey Block

There was far greater variability in the density of historic sites between survey blocks (Table 6-III.1). In fact, of the 58 blocks that were surveyed, the majority (n=30) contained no significant historic sites—an absence that was primarily a function of block size; all but one were less than 300 ha (741 ac). Of the 28 blocks that did contain historic sites, there was an average of 4.5 sites per block, and a range of 1 to 27 sites per block; density ranged from 29 to 2,043 ha (72 to 5,048 ac) per site (Figure 6-III.1). Only 5 blocks contained 10 or more historic sites; only 2 contained more than 20.

Table 6-III.1 Historic Sites by Block.

Block	Hectares Surveyed	Historic Sites	% of Total	HA Per Site	Sites Per HA
A	2040	1	0.79%	2,040.34	0.0005
B	2044	1	0.79%	2,043.51	0.0005
C	2025	11	8.66%	184.10	0.0054
D	100	0	0.00%	0.00	0.0000
JQ-1	228	2	1.57%	113.95	0.0088
JQ-2	231	2	1.57%	115.45	0.0087
JQ-3	228	8	6.30%	28.53	0.0350
E	2501	11	8.66%	227.32	0.0044
F	3078	22	17.32%	139.92	0.0071
G	877	2	1.57%	438.45	0.0023
H	1402	27	21.26%	51.94	0.0193
I	1567	10	7.87%	156.69	0.0064
J	935	1	0.79%	935.44	0.0011
K	535	4	3.15%	133.81	0.0075
L	2009	5	3.94%	401.89	0.0025
M	200	1	0.79%	199.53	0.0050
N	65	0	0.00%	0.00	0.0000
O	56	0	0.00%	0.00	0.0000
P	145	3	2.36%	48.31	0.0207
Q	98	0	0.00%	0.00	0.0000
R	213	0	0.00%	0.00	0.0000
S	203	0	0.00%	0.00	0.0000
T	204	0	0.00%	0.00	0.0000
U	239	2	1.57%	119.40	0.0084
V	205	2	1.57%	102.63	0.0097
W	205	1	0.79%	205.20	0.0049
X	296	2	1.57%	148.15	0.0067
Y	339	1	0.79%	338.79	0.0030
Z	302	0	0.00%	0.00	0.0000
AA	138	0	0.00%	0.00	0.0000
BB	59	0	0.00%	0.00	0.0000
CC	77	0	0.00%	0.00	0.0000
DD	228	1	0.79%	227.71	0.0044
EE	203	1	0.79%	203.10	0.0049
FF	93	1	0.79%	92.85	0.0108
GG	44	1	0.79%	43.71	0.0229
2010-C	196	0	0.00%	0.00	0.0000
2010-D	60	0	0.00%	0.00	0.0000
2010-E	55	0	0.00%	0.00	0.0000
2010-F	41	0	0.00%	0.00	0.0000
2010-G	87	0	0.00%	0.00	0.0000
2010-H	54	0	0.00%	0.00	0.0000
2010-I	87	0	0.00%	0.00	0.0000

Table 6-III.1 Historic Sites by Block. *(continued)*

Block	Hectares Surveyed	Historic Sites	% of Total	HA Per Site	Sites Per HA
2010-N	173	0	0.00%	0.00	0.0000
2010-O	58	0	0.00%	0.00	0.0000
2010-P	74	2	1.57%	37.15	0.0269
2010-Q	118	1	0.79%	117.75	0.0085
2010-U	93	0	0.00%	0.00	0.0000
2010-V	54	1	0.79%	54.29	0.0184
2010-W	63	0	0.00%	0.00	0.0000
2010-X	83	0	0.00%	0.00	0.0000
2010-Y	16	0	0.00%	0.00	0.0000
2010-AA	57	0	0.00%	0.00	0.0000
2010-BB	41	0	0.00%	0.00	0.0000
2010-FF	45	0	0.00%	0.00	0.0000
2010-GG	45	0	0.00%	0.00	0.0000
2010-HH	52	0	0.00%	0.00	0.0000
2010-II	28	0	0.00%	0.00	0.0000
Totals	24,996	127	100.00%	N/A	N/A

By Physiographic Zone

At the coarsest physiographic level, historic sites documented during the project occurred primarily in the Basin Zone, with a lesser number of sites in the mountainous zones. A total of 101 historic sites occurred wholly within the Basin Zone whereas an additional four sites occurred primarily in the Basin Zone, with some overlap into the Mountain Zone. Eighteen historic sites occurred wholly within the Mountain Zone with an additional four sites primarily in the Mountain Zone with some overlap into the Basin Zone.

When divided into more detailed physiographic units, historic sites occurred in 15 out of the 23 zones that were surveyed (Table 6-III.2).[2] The majority of historic sites occurred in just four zones. In descending order of prominence these were Pediments/Piedmont Slopes, Erosion Remnants, Erodible Clay from Mudstone, and Fan Remnants on Piedmont Slopes. The former zone dominated, with nearly 15 percent of historic sites occurring on pediment surfaces. When controlling for acreage surveyed, however, actual historic site density was greatest (ranging from 53 to 124 ha [131 to 306 ac] per site) in Scarps, Alluvial Fans, Terraces, and Low Hills from Tuff (Figure 6-III.2). Representing only 5.15 percent of the total area sur-

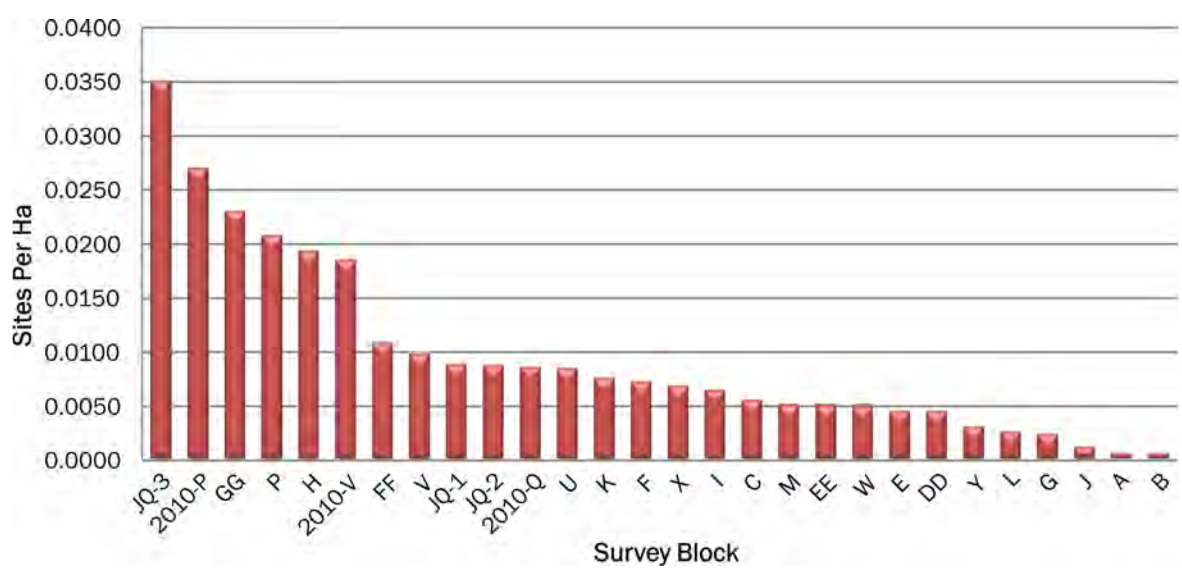


Figure 6-III.1 Historic site density by survey block (only showing blocks that contained historic sites).

2. Because sites frequently spanned more than one zone, each site was assigned the zone that predominated.

Table 6-III.2 Historic Sites by Environmental Zone.

Env. Zone	Hectares Surveyed	% of Total	Historic Sites	% of Total	Sites Per HA	HA Per Site
Pediments, Piedmont Slopes	4,542.69	18.25%	19	14.96%	0.0042	239
Fan Remnants on Piedmont Slopes	3,411.26	13.70%	13	10.24%	0.0038	262
Erosion Remnants	3,212.76	12.91%	18	14.17%	0.0056	178
Erodible Clay from Mudstone	2,253.08	9.05%	17	13.39%	0.0075	133
Alluvial Flats	1,616.97	6.50%	11	8.66%	0.0068	147
Mountain Slopes	1,545.21	6.21%	10	7.87%	0.0065	155
Fan Remnants	1,520.95	6.11%	11	8.66%	0.0072	138
Alluvial Fans on Piedmont Slopes	1,305.00	5.24%	1	0.79%	0.0008	1305
Side & Lower Slopes	1,258.27	5.05%	2	1.57%	0.0016	629
Plateaus	1,055.94	4.24%	7	5.51%	0.0066	151
Igneous Hills in Basin	731.71	2.94%	0	0.00%	0.0000	0
Terraces	608.14	2.44%	6	4.72%	0.0099	101
Scarps	474.15	1.90%	9	7.09%	0.0190	53
Arroyos	422.34	1.70%	1	0.79%	0.0024	422
Floodplains	336.91	1.35%	0	0.00%	0.0000	0
Steep Mid-Slopes	201.24	0.81%	0	0.00%	0.0000	0
Low Hills from Tuff	123.55	0.50%	1	0.79%	0.0081	124
Limestone/Shale Hills in Basin	122.25	0.49%	0	0.00%	0.0000	0
Alluvial Fans	77.23	0.31%	1	0.79%	0.0129	77
Hillslopes	72.86	0.29%	0	0.00%	0.0000	0
Moist Meadows	1.62	0.01%	0	0.00%	0.0000	0
Total	24,894.12	100.00%	127	100.00%	N/A	N/A

veyed (and 13.39 percent of sites), however, some of this prominence can be attributed to sampling bias due to low survey coverage of those zones. Site density was lowest (ranging from 1,305 to 262 ha [3,225 to 647 ac] per site) in Alluvial Fans on Piedmont Slopes, Side and Lower Slopes, Arroyos, and Fan Remnants on Piedmont Slopes.

Although patterns are revealed by arraying historic sites against environmental variables, because historic use of the land differed significantly from prehistoric use, environmental variables are less useful as analytical units. At least as significant were the cadastral land surveys that divided the landscape into regular units (blocks and sections) to facilitate orderly settlement. By the 1880s when the Big Bend began to be settled by Euro-Americans, the State of Texas and a handful of railroads were the largest landholders. As an inducement to improve intrastate transportation, Texas offered railroad companies 16 sections for every mile of track laid. Because most of the remaining unappropriated land was in the Trans-Pecos, the railroad grants were primarily located there. The result was a checkerboard pattern of land ownership where various railroad companies owned odd-numbered sections while the state retained even-numbered sections. Railroad land could be purchased outright by settlers, but state lands came with conditions of settlement and improvement. Despite widespread fraud in meeting these requirements, landownership patterns and the location of homesteads were far more random than they otherwise would have been.

Aside from survey blocks and land laws, the most important elements influencing early land settlement were access to water, roads, and markets, the quality of farm and rangeland, the availability of economically significant plants (such as candelilla), and the prospect of valuable minerals—in this region, primarily mercury. Consequently, the nature of industry in the

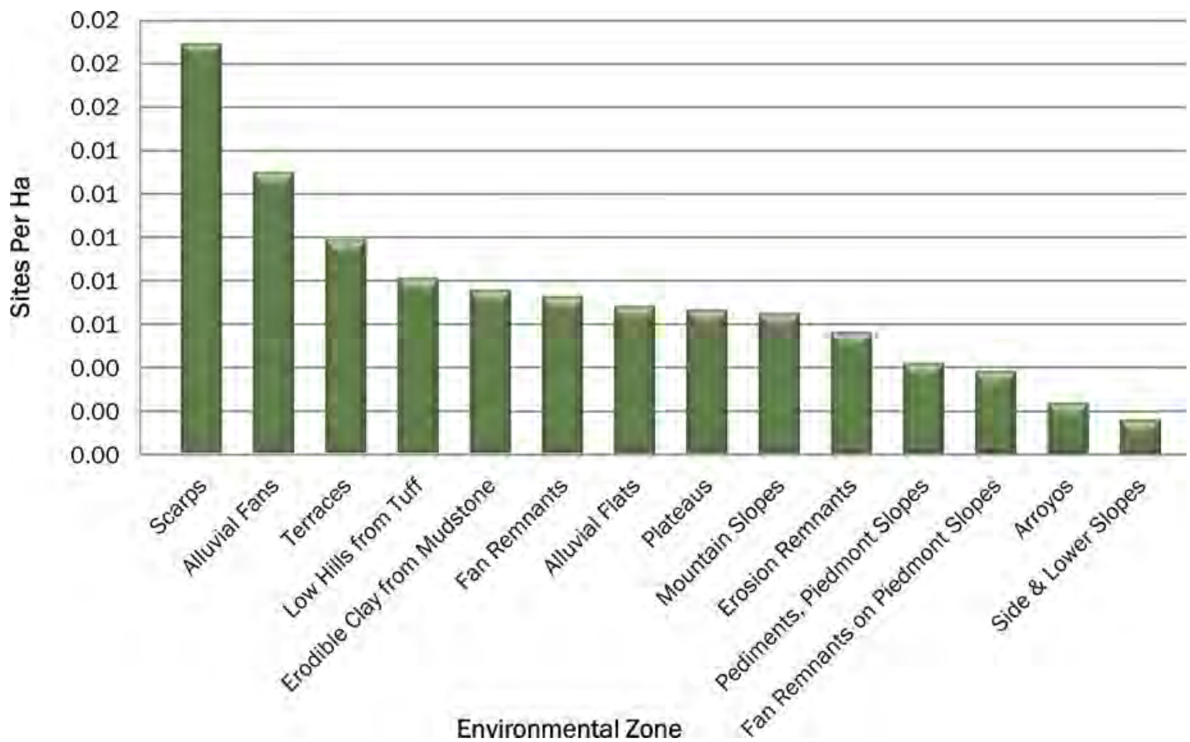


Figure 6-III.2 Historic site density by environmental zone (only showing zones that contained historic sites).

region was perhaps the single-most important factor in historic site location. For example, most of the historic sites near Castolon are related to floodplain agriculture that predominated there between 1900 and 1940. Similarly, sites around Glenn Springs are mostly related to the large candelilla wax operation sited there. The correlation was strongest for large scale intensive ventures (like mercury mining), and much less so for smaller ones (such as Hispanic sheepherders). As a general rule, however, industry played a major role in historic site distribution and density.

Site Types/Function

Historic site types were most often inferred based on the material culture present on the site. Because historic features and artifacts often have more interpretive "weight," such inferences were more applicable to historic sites than prehistoric ones. In some cases, site type could also have more than one designation—a primary, secondary, and tertiary type. For example, if the site was primarily a historic homestead, but also had a historic military component and a prehistoric campsite, the site would carry all three designations. This was fairly rare, however. Only seven sites carried all three while 46 sites carried two such designations. The remaining 81 sites were defined by a single site type. For this discussion, with a few exceptions the focus will be on the primary site type.

A total of 23 different historic site types were assigned (including "undetermined") to the combined 127 sites that were purely or predominantly historic (Table 6-III.3). Of the 60 sites that were purely historic (containing only historic materials), 10 were homesteads, 9 were campsites, 5 were dumps, 4 were cemeteries, 4 were dams, 4 were artifact scatters, 4 were mining related, 3 were quarries, 2 were graves, 2 were

Table 6-III.3 Historic Sites by Type.

Type	Count	% of Total
Campsite	29	22.83%
Homestead	28	22.05%
Ranching	11	8.66%
Cemetery	6	4.72%
Dump	6	4.72%
Community	5	3.94%
Dam	5	3.94%
Hist Artifacts	5	3.94%
Undetermined	5	3.94%
Mining	4	3.15%
Grave	3	2.36%
Military	3	2.36%
Quarry	3	2.36%
Survey	3	2.36%
Tank	2	1.57%
Wax Camp	2	1.57%
Bridge	1	0.79%
Farm	1	0.79%
Kiln	1	0.79%
School	1	0.79%
Store	1	0.79%
Tracking	1	0.79%
Well	1	0.79%
Total	127	100.00%

survey-related sites, 2 were water tank sites, 2 were wax camps, and there was one each of a bridge, a community, a lime kiln, a ranching site, a water well, and a civil aeronautics administration tracking station. In addition, 3 sites were of undetermined types.

Of the 67 multi-component sites that were *primarily historic* with a lesser prehistoric component, 20 were historic campsites, 18 were historic home sites, 10 were ranch-related sites, 4 were communities, 3 were military, 2 were cemeteries, and there was one each of artifact scatter, farming-related, gravesite, school, store, topographical survey, dam site, and dump site. In addition, two sites were of undetermined types. The prehistoric component of about half of these sites was solely artifactual (49 percent), with 15 sites containing temporally diagnostic projectiles. Twelve of these sites contained less than 10 projectiles although three sites (BIBE415, BIBE1942, and BIBE1594) contained 11, 51, and 52 projectiles respectively. In addition, 28 sites contained prehistoric thermal features and/or feature remnants and 19 sites contained other prehistoric feature types—most often cairns (n=8) and/or rock groupings (n=10).

Taken together, the majority of the 127 historic sites (54 percent) fall in only three categories: historic campsites (22.83 percent), home sites (22.05 percent), and ranching-related sites (8.66 percent), with the remaining sites distributed among the other 20 site types (Figure 6-III.3). Descriptions of these 23 categories of historic sites follow in descending order of frequency.

Historic Open Campsites

Twenty-nine sites were categorized as historic open campsites, interpreted as being only temporarily inhabited (Figure 6-III.4). These sites were generally characterized by the absence of a permanent habitable structure although 12 sites (BIBE1108, BIBE1254, BIBE1429, BIBE1646, BIBE1658, BIBE1674, BIBE1707, BIBE2023, BIBE2071, BIBE2198, BIBE2367, and BIBE2531) contained structures or structural remnants of some kind. These included depressions and berms, probable tent pads, foundation remnants, stacked rock structures, a possible half dugout, and a wooden structural remnant believed to be a hunting blind. None were interpreted to have been permanently occupied. Other common feature types included historic hearths, rock clusters, rock "benches," and similar ephemeral features. Artifactual remains at these sites typically included items consistent with short-term occupation such as baking powder tins, tobacco tins, fruit, vegetable, and meat tin cans, bottles, wire, firearm cartridge casings, horseshoes, and similar items.

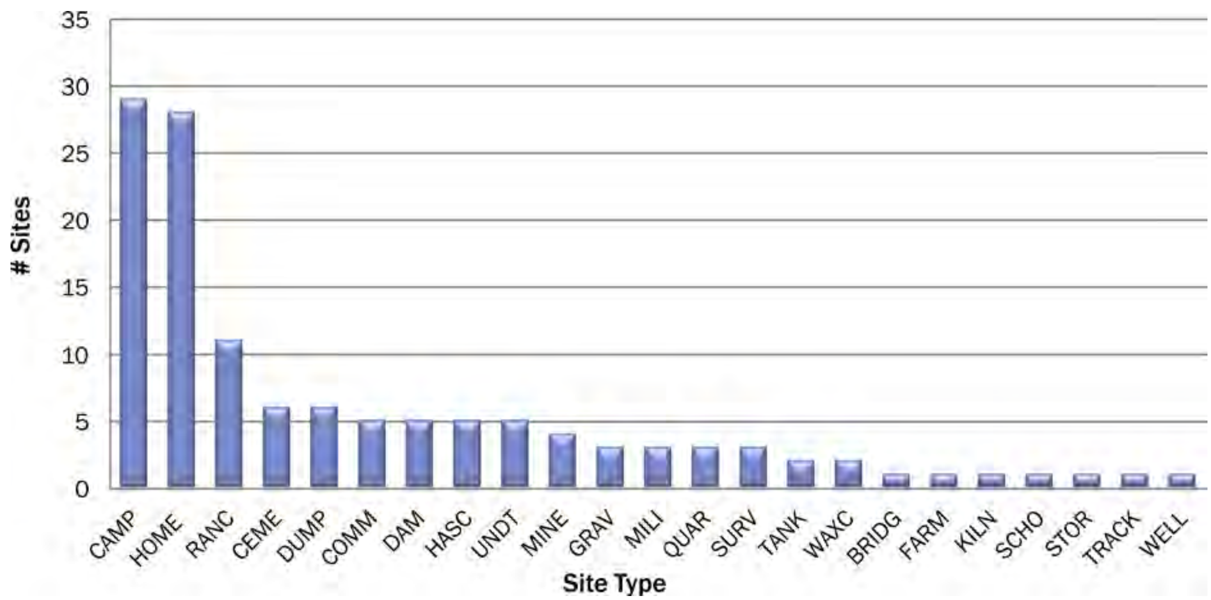


Figure 6-III.3 Number of historic sites by type.

Figure 6-III.4 Crewmember recording BIBE1707 (41BS1640), a historic open campsite on a pediment above the Rio Grande; note rock alignment in foreground. Photo by C. Covington.

Additional affiliation could be assigned 10 of the historic campsites. Five of the 29 sites (BIBE1629, BIBE1646, BIBE1740, BIBE2130, and BIBE2531) were believed to have been ranching related, such as range camps for tending livestock, or camps for specific ranch-related tasks (such as branding or shearing). In addition, three sites (BIBE1108, BIBE1658, and BIBE1707) were interpreted as hunting camps and three sites were interpreted as being recreation-related following the establishment of BBNP (BIBE1384, BIBE2031, and BIBE2540). One additional site was a camp for the Civilian Conservation Corps (CCC) in the Chisos Basin occupied from 1934 to 1941 (BIBE1462). Further affiliation of the remaining 17 historic campsites could not be determined with confidence.

Homesteads

Twenty-eight out of the 127 historic sites were categorized as homesteads. These sites are characterized by one or more historic structures or structural remnants as well as a range of domestic artifact types (Figure 6-III.5). Most sites included a number of outbuildings (sheds, outhouses, chicken houses, etc.) in addition to the primary dwelling. With the exception of a few sites where further affiliation could not be determined (such as BIBE1912—an anomalous site consisting of a thin concrete slab, tent pads, and the rear panel of an automobile among other things), most all these sites were associated with ranching and farming prior to the establishment of BBNP. Because of the range of feature and artifact types, these (along with the community sites) were among the richest interpretively. In most cases, temporal and functional affiliations could be determined with relative ease.

In addition to habitable structural remnants, homesteads also often included trails and roads, corrals or corral remnants, threshing circles, expedient lime kilns, dumps, and stone clusters and alignments. Often such features were spread across a considerable area.

Figure 6-III.5 Historic homesite remains at BIBE1726 (41BS1659) near the Rio Grande. Photo by C. Covington.

Artifact assemblages at homestead sites tended to be a mix of domestic artifacts and work-related items. In addition to the near ubiquitous tin cans, bottles, wire, cartridge casings, and horseshoes were items such as ceramics, buttons, buckles, children's toys, pots and pans, flatware, and drinking vessels as well as construction-related items such as woodstove parts, door hardware, window glass, nails, and similar items.

Ranching Sites

Eleven of the historic sites were primarily ranching-related sites. In most cases, these were interpreted to be ranching activity areas such as staging areas for branding, shearing, or doctoring livestock. In a number of cases, they included an historic open campsite—such as a line camp or sheep camp. Ranching sites were characterized by the absence of permanent habitable structures although one site (BIBE856) contained a number of crude historic stacked rock structures. Most of these sites contained ranching-related features such as windmills, wells, water troughs, and fence or corral remnants. Probable tent pads were also common.

Artifactual remains tended to be fairly sparse, but included tin cans, tobacco tins, horseshoes, barbed wire, straight wire, cinch rings, bridle buckles, shearing blades, cartridge casings and, in some cases, ceramics. One site (BIBE991; Figure 6-III.6) included four distinct activity areas: one was a series of water troughs beside a hand-dug well, another was a corral and work area (with shearing blades and sheep medicine bottles),

Figure 6-III.6 Remains of probable sheepherder's wagon at ranching site BIBE991 north of Glenn Springs (41BS2286). Photo by D. Petrey.

the third was a historic campsite—complete with the remains of what appeared to have been a sheepherders trailer, and the fourth was a historic artifact scatter that probably represented another campsite area or an extension of the camp. Because livestock raising was the predominant industry in the area that became BBNP, these sites typically have strong interpretive value.

Dumps

Six of the historic sites were dumps. These sites were characterized by historic artifact concentrations indicative of one or more dumping episodes, and included both formal and informal dumps. A "dumping episode" was characterized by spatially discrete artifact concentrations as well as temporal or functional similarity of the items. Two of these sites (BIBE2028 and BIBE2033) represented a single discrete dumping episode and one site (BIBE2086) represented three discrete dumping episodes (Figure 6-III.7). Three of the dump sites were more "formal," established dumping areas. One (BIBE1442) was affiliated with the Civilian Conservation Corps' occupation of the Chisos basin (1934–37 and 1940–42) and consists of thousands of tin cans, bottles, glass, wire, auto parts and other items. Another (BIBE1445), also located in the Chisos Basin, was less extensive and is of unknown affiliation. The other (BIBE2679) was associated with the U.S. Cavalry occupation of Glenn Springs between 1916 and 1920. This dump is composed of many discrete dumping episodes of tens of thousands of artifacts including tin cans, bottles, cartridge

Figure 6-III.7 Discrete historic dumpsite BIBE2028 (41BS2245). Photo by L. Weingarten.

casings, “stripper clips,” sleeping cot parts, military buttons, tent stakes, mess kit fragments, buckles, and similar items.

Cemeteries

Six of the 127 historic sites were cemeteries—spatially discrete areas containing two or more graves. Two of the sites (BIBE1903 and BIBE2010) contained only two graves. One site (BIBE1707) contained six graves; one site (BIBE1615) contained eight graves; one site (BIBE2022) contained 28 or more graves; and one site (BIBE2060) contained 38 graves. Graves within cemeteries were typically placed uniformly close together although groupings of graves in some cases were set apart suggesting a single family. Very small graves, presumed to be infant burials, most often occurred along the periphery of the cemetery and, at least in one case, was far removed.

Two of the cemeteries were associated with small communities. BIBE2022 was associated with lower San Vicente and BIBE2060 was associated with upper San Vicente (Figure 6-III.8). These were also the largest, most significant cemeteries recorded during the survey. Although BIBE2060 contained more—and more elaborate—graves, BIBE2022 is believed to be older, and may have included interments from the Mexican portion of San Vicente. The graves here appear more deteriorated in general and occur on a unique landform that is naturally shaped like a cross. Both cemeteries are located below prominent buttes.

Figure 6-III.8 Cemetery at San Vicente (north) BIBE2060 (41BS1947). Photo by B. Dailey.

Historic Artifact Scatters

Five of the historic sites were historic artifact scatters. These sites are distinguished from isolated "Historic Scatters" simply by the number of artifacts present (more than 10). In cases where no other function could be discerned, this category became something of a "catch-all" for historic sites not otherwise affiliated. As the name implies, these sites were characterized by the presence of historic artifacts and the absence of features that would indicate habitation or camping (such as structural remnants, tent pads, or firepits). In addition, artifacts tended to be dispersed rather than concentrated as would be the case in a dump. By far the most common artifacts at these sites were tin cans although firearm cartridge casings, bottles, wire, ceramics, nails, metal, and milled lumber were also common.

Communities

Five of the 127 historic sites recorded during the project were communities or portions of communities—herein defined as a concentration of structures suggesting occupation by multiple households. These sites were by far the richest in both features and artifacts and offered the highest interpretive value of any other historic site category. These sites were also the largest of all historic sites, averaging 5.93 ha (14.65 ac) compared to the average of all (predominantly) historic sites (1.89 ha [4.67 ac]). In terms of site characteristics, these sites tended to be very similar in composition to historic homesteads and, in fact, were generally little more than amalgamations of a number of homesteads in relatively close proximity. As such, the array of feature types tended to be very similar, composed of a primary structure and a number of auxiliary structures and animal pens. Artifacts also tended to be similar to homesteads, composed of a range of domestic and work-related items. Because of the significance of these sites, they are addressed individually below.

San Vicente (BIBE859, BIBE2030, BIBE2044)

Although recorded as separate sites, three of the community sites (BIBE859, BIBE2030, and BIBE2044) are actually different sections of the larger community of San Vicente, Texas, that existed in various forms from the 1890s to the late 1950s when the property was acquired by the National Park Service (NPS). Although considered part of the same community, these sites are spatially discrete (in fact, BIBE859 and BIBE2030 are more than a kilometer apart). The size and composition of the community changed over time as people settled in or left the area and/or the river changed course. Because the primary economy was farming and small-scale livestock raising, much of the surrounding lands were at one time composed of fields and clusters of farmsteads.

Located along the Rio Grande just east of Sierra San Vicente, the sparsely settled farming community of San Vicente, Texas was one of the earliest (if not the earliest) permanently inhabited areas within what is now BBNP (Figure 6-III.9). It was a village that, like many along the border, spanned both sides of the Rio Grande. The Presidio San Vicente in Coahuila, Mexico was established in 1774, located along a major river crossing of the Comanche Trail. The presidio was short-lived, however, and was deactivated in 1782 and abandoned completely a few years later. At least one civilian family was reported to have lived near the presidio in the 1700s although it is believed the area was completely depopulated during most of the nineteenth century (Ivey 1990:2–4). When the U.S. Boundary Survey passed by in 1857, the ruins of the presidio were mentioned, but there was no indication of any settlement on either side of the river (Emory 1857:84).

The Mexican village of San Vicente, composed of several discontinuous clusters of habitations east of the old presidio, probably began to be settled between 1870 and 1890 as the threat of Indian attack subsided.

Figure 6-III.9 Doctoring a horse at San Vicente ca. 1930s. Courtesy of National Park Service, BBNP.

The U.S. portion of San Vicente was reportedly established in 1895 when 17 Mexican pioneer families moved there with their wagons and animals from Comanche, Coahuila (some 140 miles to the south-southwest), naming their settlement after the twin village across the river. The families, almost all of whom were related, presumably gained citizenship as they staked claims on state-owned land and began farming and raising horses, burros, and a few goats and cows. Within a matter of years many of the families held deeds to their land (Miles 1993:28–30).

By the 1930s, Tom Miller was the principal farmer along with a dozen or so Mexican-American families living along the adjacent hillsides. Each family tended their own small field, a herd of goats, and a few cattle. By 1940, however, most inhabitants had drifted away, and the property was controlled by the Juan Macias-Simon Celaya families and J.W. Gilmer of Alpine. Because of a defective land title, it remained private property until the late 1950s when it was acquired by the NPS. Presumably shortly thereafter, the NPS—citing safety concerns—systematically demolished the remaining structures within the old village (Maxwell 1985:32).

The material culture at San Vicente—or what remains of it—supports the date range indicated by the literature. Collectively, the three sites that made up the core of the village (there were also many outlying homesteads recorded separately) consisted of a total of 39 structural remnants and 145 features, representing at least 3 dozen individual homesteads. Because the site had been so heavily impacted by the NPS, features were generally in extremely poor condition. Many of the adobe and *jacal* houses had been reduced to rubble and push-piles from the actions of bulldozers. Consequently, many features were damaged beyond recognition and the site recording effort suffered significantly as a result.

Nevertheless, the crew was able to identify the remains of many of the features, including the foundation for the old schoolhouse, a blacksmith shop, and a number of residences (Figure 6-III.10). Structural remains consisted of a variety of construction styles including adobe, *jacal* (wattle and daub), mud mortared stone, and wood frame. In addition were a number of outlying features including animal pens constructed of upright ocotillo stalks (in some cases the ends were visible in the ground), dump sites, stone pavements, various rock alignments, kid goat shelters, artifact concentrations, and crude lime kilns.

Artifactual remains at San Vicente were among the richest, and earliest, historic items recorded during the survey. A total of 162 artifacts were collected from the three sites. Because of the wide array of ceramic types present, a focused effort was made to collect a representative sample. Consequently, a total of 67 ceramic

Figure 6-III.10 Mud mortared stone structure at San Vicente (north), BIBE2044 (41BS2261). Photo by B. Dailey.

sherds were collected consisting of 5 unglazed earthenwares, 11 Euro-American ceramics, 32 Mexican glazed ceramics, and 19 unclassified ceramics. Among these were four sherds believed to be prehistoric and eight that were believed to be protohistoric to early historic in age. Among the other most common artifacts collected were buttons, cartridge casings, nails, baking powder lids, children's toys, and personal items such as a brooch, a comb, and a ring. Special samples were also taken including a coal sample, slag, and a plaster sample.

Rock House Camp (BIBE1625)

Rock House Camp, located along Middle Tornillo Creek, was a historic laborer "village" for the nearby candelilla wax operation (BIBE1621). The site consists of some 38 dry-laid stacked-stone structures scattered among a number of low-angle cuestas just west of the McKinney Hills. Based on artifactual evidence, these structures were inhabited—almost certainly by Mexican-American laborers—probably around 1923 when the William Green candelilla wax factory was in operation, although they may also be associated with previous wax production efforts that took place as early as 1912 (Weedin 1994:44). One centrally located structure was much more carefully constructed than the others, consisting of mud-mortared sandstone slabs with walls extending to near full height (Figure 6-III.11). The remaining 37 structures, however, appear to have been hastily constructed and were probably

Figure 6-III.11 Stone structure at BIBE1625 (41BS1558), a historic wax laborer village along middle Tornillo Creek. Photo by D. Keller.

occupied only briefly. Many of these were partial dugouts, utilizing the sides of low hills. The walls ranged from 2–12 courses of stone for a wall height of only 3–5 feet. All were square or rectangular in plan view and were generally between 8–12 feet long per side. The structures appear to have been substructures that were covered with makeshift roofs of tarps or vegetation such as ocotillo or lechuguilla stalks. One structure contained a metal pipe with baling wire attached suggesting it may have served as a ridgepole.

Other features include a lone grave lacking a marker, rock groupings, a burned rock midden, and road remnants leading to the candelilla processing area. Artifacts were fairly sparse supporting the idea of a brief occupation. Among the more common items were tin cans (especially lard pails, baking powder tins, and meat cans), bottles and bottle glass, ceramics, woodstove parts, wagon parts, cartridge casings, a washboard, and various tools or tool fragments such as shovels, an ash scoop, and a piece of iron barstock fashioned into a fire poker.

Pantera (BIBE1942)

Pantera (Spanish for panther) was in many ways the most pristine historic community site recorded during the survey—largely due to its remoteness and the fact it escaped the destruction the NPS wrought on other more visible historic sites. Spanning most of a high silt terrace just above the Rio Grande floodplain, Pantera was a small, loose-knit community—little more than a cluster of structures—that appears to have existed between 1890 and 1940. Little is known of Pantera aside from what was documented archeologically during the present survey. It does not appear on the earliest maps of the region, including the 1903 USGS Chisos Mountains quadrangle although roads and a single dwelling are indicated at its location. The 1931 USGS quadrangle indicates only two dwellings. Pantera—as a place name—does occur in later maps, including the 1966 geological map of the park as well as the 1971 USGS 7.5 minute quadrangle, although it's location is misplotted by approximately 300 meters. Based on both artifactual and documentary evidence, the Mex Tex Wax Company appears to have relocated from Cerro Chino downriver to Pantera around 1924 and operated there for an unknown period of time.

Pantera contained a total of 19 historic features, 12 of which were historic structure remnants. Of the nonstructural historic features, 2 were historic dumps, 2 were historic artifact concentrations, and 3 were historic ash pits/thermal feature remnants. The structural remnants consisted primarily of "adobe melt"—mounds of earth representing the eroded remains of adobe structures (Figure 6-III.12). The largest structural remnant, also believed to be the earliest (perhaps the one indicated on the 1903 map) consists of a series of linear clusters of rounded cobbles. As was common with adobes in the area, this was likely a mud-mortared stone "apron" built around the base of the adobe walls to protect them from erosion. However, the absence of adobe melt associated with this structure suggested substantial erosion indicative of its antiquity. Artifacts associated with the structure were also the earliest observed on the site.

Other structural remnants on site were more intact and appeared to be more recent, suggesting that the occupation of the structures on the site were not necessarily coterminous. Most of the other structural remnants consisted of adobe melt, but also included remains of animal pens (ocotillo stalks set in the ground and wired together), possible *jacales* (wattle and daub), and a strange structure constructed out of mortared recycled chunks of a concrete slab fashioned to form a low wall on three sides on top of a recessed concrete slab. This was presumed to be related to some kind of agricultural or small scale industrial activities although its function remains a mystery. In addition to the historic features, the site contained 25 prehistoric features, including 18 hearths.

A total of 205 artifacts were collected at Pantera, 151 of which were historic items. Among these were tin cans, bottles and bottle glass, cartridge casings, horseshoes, woodstove parts, cut and wire nails, milled lumber,

Figure 6-III.12 Remains of the village of Pantera above the Rio Grande at BIBE1942 (41BS1868); note outlines of melted adobes in foreground. Photo by L. Weingarten.

buttons, a wide variety of ceramics (including locally made earthenware), an 1893 Mexican coin, Mex Tex Wax company tokens, and a large number of children's toys (mostly marbles and cracker jack toys—see artifact section below). The range of temporally diagnostic historic artifacts suggests occupation from ca. 1890 to 1940. Among the earliest were the 1893 coin, cut nails, early bottle styles, and early ceramics. Among the latest were automobile parts and an electric terminal.

Dam Sites

Five of the historic sites were dams. These sites are associated with intermittent drainages in different areas of the park, including the McKinney Hills, near Dugout Wells, and at San Vicente. As is common across the region, four of the dams are earthen dams. The fifth dam is composed of mortared stone. Three of the dams represent stock tanks, intended to capture and retain runoff during flood events for watering livestock. The other two represent irrigation structures.

BIBE1642 is a mortared stone dam located across an unnamed drainage in the McKinney Hills. Although the area behind the dam has long since silted in, the dam itself remains in good condition. The dam measures 8 feet wide by 66 feet long and is 9 feet tall. Taking advantage of rainwater as well as a spring seep, the dam is composed of nearby quarried and shaped igneous stone ranging in size from 6 to 30 inches in maximum diameter set in a Portland cement-based mortar. Although no pipe was present, when operational there was likely a windmill and/or gravity fed pipe system to transport the water to nearby water troughs or holding tanks.

BIBE2097, BIBE2102, and BIBE2135 were all earthen dams associated with earthen stock tanks (Figure 6-III.13). Ranging from 50 to 130 feet long and 9 to 16 feet wide, this type of dam is by far the most common across the region. Used to collect runoff water for livestock, such dams came into widespread use at least by the early 1900s as more country was fenced and livestock movement became limited. Before heavy machinery was available, such tanks were constructed with the use a fresno—a crude but effective dirt scoop that was pulled by one or more mules. As a result, early tanks such as these tended to be of modest size. Very simple in construction, dirt excavated to create the tank was used to construct the dam.

BIBE2069 at San Vicente was by far the largest of the dams recorded during the project. Spanning some 230 feet, 130 feet wide at its base, and some 20 feet tall, this large dirt dam at one time created a lake some 6–7 acres in size. Although previous agricultural efforts at San Vicente relied on irrigation from the Rio Grande, this structure provided a reliable source of irrigation water further from the river. Its original date of construction is unknown, but it was in place at least by 1954 according to park records. Most of the dam remains in good condition although it has been breached

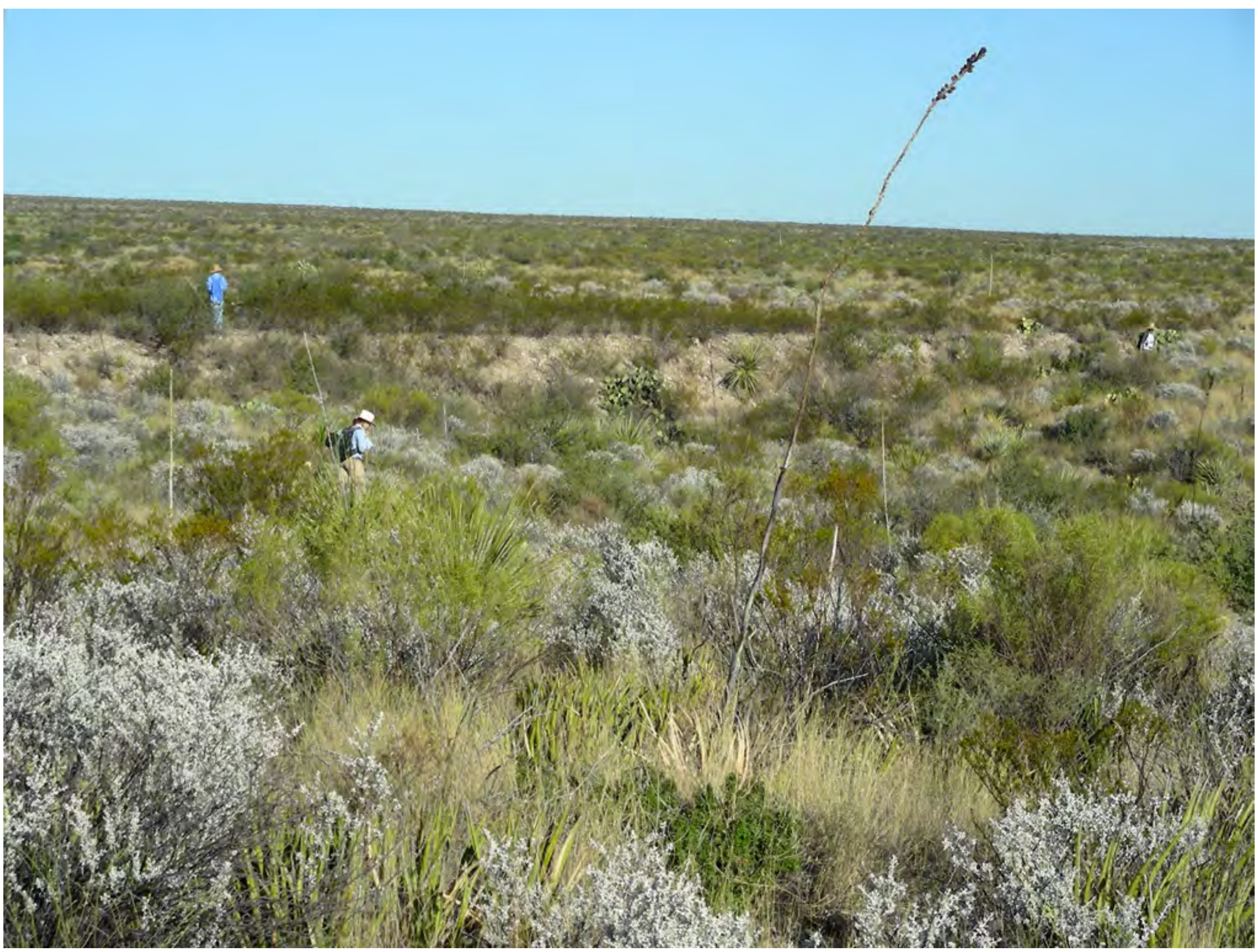


Figure 6-III.13 Earthen dam and stock tank at BIBE2097 (41BS1979). Photo by C. Covington.

by the drainage it once captured. Based on the level of deposition below the dam, it appears a massive amount of silt once contained behind the dam was redeposited by subsequent flood events.

Mining Sites

Four of the historic sites were interpreted as mining-related, but were prospects rather than actual mines. At one of the sites (BIBE1453), this affiliation was inferred based on the presence of an anomalous depression. Prospecting was very common across the region following the quicksilver (mercury) boom in the early 1900s. Although quicksilver was the most abundant precious mineral locally, other minerals such as silver and lead could be found in lesser quantities and were likewise sought. Prospects are often little more than a shallow vertical or horizontal shaft (adit) and associated backdirt, lacking any other feature or artifact types, and often occur in remote locations.

Two of the prospects occur in the Chisos Basin and the other two occur along the western flanks of Mariscal Mountain. Prospect shafts varied in dimensions from 4–5 feet in diameter and from 2–13 feet deep. Associated artifacts tended to be sparse, and usually consisted primarily of milled lumber and tin cans. Two of the sites (BIBE1837 and BIBE1838) were related—one included a mine shaft and a mortared brick furnace base (Figure 6-III.14). The other was a campsite located 150 m (492 ft) away, the two connected by an old two-track road. The campsite contained three tent

Figure 6-III.14 Mineshaft on the west side of Mariscal Mountain at mining site BIBE1838 (41BS1764). Photo by B. Dailey.

pads (large wall tent size), and an array of artifacts including tobacco tins, cartridge casings, tire rubber, ceramics, sheet tin, milled lumber and the same bricks used to construct the furnace base. The artifacts suggested a ca. 1935–40 occupation.

Grave Sites

Three of the historic sites were believed to represent lone graves, although only one was definite. These sites are characterized by a single, elongated rock cluster or cairn that range from 3 to 5 feet wide and 6 to 7 feet long, typically oriented east to west. Only one of the sites (BIBE1851) contained cross remnants. BIBE2024 included a larger rock at the west end of the cluster suggesting a headstone, but lacked any inscription. The third site (BIBE1663) was less certain, with only its shape to suggest a burial. Associated features were rare and artifacts few. Where present, they consisted of a ceramic sherd, bottle glass, and a horseshoe. All of these features appeared hastily constructed and, because they were not part of a cemetery or associated with homesteads, suggests the individuals may not have had families in the area.

Military Sites

Three of the historic sites were military-related. By far the most substantial of the three (BIBE593) was a U.S. Cavalry sub-post known as Camp Neville Spring occupied from 1885 to 1891 (Figure 6-III.15). The site, located near Grapevine Hills, consists of at least 11

Figure 6-III.15 Remains of U.S. Cavalry outpost Camp Neville (BIBE593/41BS2491) near the Grapevine Hills. Photo by D. Keller.

features including the remains of the officer's quarters, enlisted men's barracks, 2 historic dumps, 3 probable outhouses, a blacksmith shop, and several areas containing rock clusters or alignments suggesting structural remains. Artifacts were numerous and included .45-70 and .44 caliber cartridge casings, cut nails, hole-in-cap cans, various ceramics, bottles, baking powder tins, buttons, buckles, wagon parts, a curb bit, and numerous horseshoes among other items.

The other two sites were of a more ephemeral nature. BIBE2379 consists of one single-course stacked-stone enclosure, three cairns, and one rock cluster. Adjacent to the enclosure was one .30 caliber cartridge casing bearing the headstamp "WRA Co. 30 army." This site is presumed to be a military "spike-camp" or hunting blind built between 1894–1903 when this cartridge (.30-40 Krag) was in common use. BIBE2686 consists of 5 stacked rock walls, approximately 60–70 cm tall, located on a ridge above and northeast of the historic townsite and military encampment at Glenn Springs. This site is believed to be associated with the military occupation of Glenn Springs during the Mexican Revolution. The fortifications would have served as defensive breastworks in case of attack. The only artifacts were a number of .30-06 and .45 ACP cartridge casings, both standard military issue.

Quarry Sites

Three of the historic sites were gravel quarries—all of which are believed to be affiliated with BBNP road maintenance. BIBE2062 and BIBE2068, both near San Vicente, consist of bladed, leveled pads (40–50 m [131–164 ft] in maximum diameter) representing the removal of several meters of material from the top of two separate gravel pediments. The only artifacts were a piece of wooden lath and amber bottle glass. These quarries are believed to have been used in the 1950s and may be associated with nearby NPS campsite known as "La Clocha" where a rock/gravel crusher was in operation, and the adjacent NPS campsite known as Gravel Pit, that served as a storage and staging area for road maintenance.

The third quarry, BIBE2181, below Nugent Mountain, is a large gravel quarry and storage area. It consists of a leveled pad, a two-track road, gravel mounds, asphalt and concrete dump areas, and a trash dump. Based on artifactual remains—mostly mechanical parts, pipe, cable, mesh, oil filters, tin cans, and a centrifugal pump—the site is believed to date between 1945 and 1960.

Survey Sites

Three of the historic sites were related to the topographic surveys undertaken by the U.S. Geological Survey. BIBE1725 is the Glascock Triangulation Station, established in 1934 for horizontal control (Figure 6-III.16). Located at the highest point of a tall gravel pediment, the site consists of several rock clusters and three brass caps set in pipes extending approximately 12 inches above the ground surface. One of the caps is the triangulation station and the two others are reference marks, all stamped with the station name and date. Artifactual remains were few and included milled lumber, a wire nail, a metal strap, and a carbon battery core. The rock clusters are presumed to have served as anchors for the surveying equipment.

BIBE2059 is the San Vicente Triangulation Station, also established in 1934. The site consists of the same arrangement of three stamped brass caps in addition to a rock circle and a square cleared area. The rock circle is interpreted as an anchor for surveying equipment whereas the cleared area is interpreted as a tent pad. Artifactual remains include a tent stake, rebar, wooden stakes, a tarp grommet, a can lid, and a length of thick gauge wire strung with crushed tin cans (unknown function). Unlike the Glascock station, based on the probable tent pad and domestic artifacts, this one apparently included a campsite for the surveyors.

BIBE2125 is a benchmark stamped with the date 1943. The site, located along the old Marathon-Boquillas road approximately 3.5 km north-northwest of Dugout Wells, consists solely of a benchmark set into concrete mixed on site (based on discarded material)

Figure 6-III.16 U.S. Coast and Geodetic Survey Triangulation Station Datum, Glasscock, 1934 (BIBE1725/41BS1658). Photo by C. Covington.

and an historic artifact scatter. The artifacts present include tin cans, sardine tins, a clear glass jar, wire, and a piece of galvanized sheet metal approximately 12 inches square, with wire loops threaded through holes in the tin. Because the wire loops appear to have once fastened the metal plate to a pole, it suggests this might have been used as a "sighting plate" to aid visibility in long-distance surveying.

Wax Factories

Two of the historic sites were associated with candelilla wax processing. Candelilla is a desert shrub that is the source of valuable natural wax. The extraction and refining methods, however, were not developed until the first decade of the twentieth century. Starting in 1911, wax factories began operating in the region. The factory at McKinney Springs, one of the earliest, was established in 1912. Thereafter, and especially during the two world wars, the price of wax climbed and the business spread. In addition to several large wax operations in the region (Glenn Springs being the largest), there were smaller commercial operations like the William Green factory at McKinney Springs (see below) and numerous small, temporary backcountry wax camps that were established all across the plant's range (Tunnell 1981:7).

BIBE1375, located in Ernst Basin in the Dead Horse Mountains, was one of the primitive backcountry wax camps that was only briefly occupied.

Features consist of a stone-lined rectangular fire pit approximately 3 x 7 feet that apparently held the cooking vat, stacks of dry candelilla stalks, and a small hearth. Artifacts consist only of amber bottle glass and candelilla wire ties (3 foot lengths of wire with loops on both ends).

BIBE1621, along Tornillo Creek west of the McKinney Hills, is believed to be the William Green wax factory that operated in the early 1920s (Figure 6-III.17; Weedin 1994:44). The site consists of the remains of a dry-laid stone structure approximately 16 x 20 feet, a number of wooden piers set into the ground, a furnace constructed of firebrick, two rock piles, and a flagstone "pavement" of unknown function. Artifactual remains were numerous, and included iron pipes, pipe fittings, valves, metal buckets, hand-made sieves (cans punctured with holes), various tin cans, ceramics, bottle glass, wire nails, and milled lumber. This site is likely associated with two nearby homesites and a worker's "village" reported above (BIBE1625).

Tank Sites

Two of the historic sites were related to mortared stone or concrete water tanks—both located in the Chisos Basin. BIBE1455 consists of a single mortared stone tank approximately 10 feet in diameter fed by an iron pipe that likely extended to a nearby windmill, although no windmill remains were present. The only associated artifacts were a length of wire, a fencing staple, and the pipe itself. BIBE1452 consists only of an octagonal concrete pad that once supported The Basin water tank. Artifacts consist of brick, concrete block, and concrete fragments, tin cans, bottle glass, lag bolts, square nuts, and other assorted materials. Both sites are believed to date to the mid-twentieth century.

Miscellaneous Sites

In addition to the above site types documented during the survey, one bridge, one farming related site, one lime kiln, one school, one store, one tracking station and one well were documented. In most cases, these

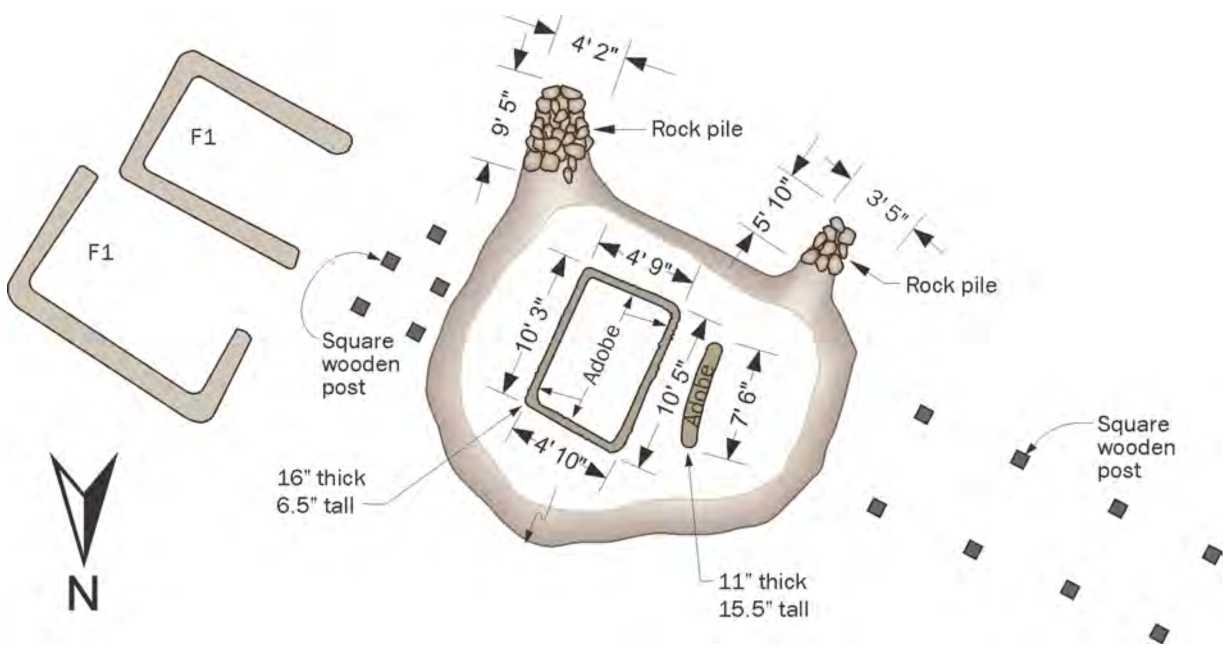


Figure 6-III.17 Plan-view sketch of the remains of a candelilla wax factory on Tornillo Creek (BIBE1621/41BS1554). by B. Gray. Illustration by L. Wetterauer.

sites were categorized according to the primary feature on the site, most of which are explained in detail in the following section. Also, five historic sites could not be assigned a site type due to the absence of identifying characteristics. These were categorized as "undetermined." Only the Civil Aeronautics Administration (CAA) Tracking Station (BIBE2182) needs further explanation. Established in 1940 by President Franklin Roosevelt, the CAA was charged with air traffic control, safety programs, and airway development. During World War II, the CAA extended its air traffic control system. Presumably, the tracking station in BBNP was part of this effort to utilize radar and other means to track aircraft from the ground. The artifact assemblage suggests the station was in use during the mid-1940s.

The site consists primarily of a couple of transit points set in concrete (bearing the CAA stamp), push piles, cleared areas, two-track roads, and rubble piles. Little else remains. The constructed portion of the tracking station was apparently removed when the CAA deactivated the station. Artifacts tend to be clustered suggesting discrete activity areas. Extensive wiring and light bulb remnants suggest a substantial lighting operation—probably to illuminate the makeshift aircraft runway. A significant number of large spark plugs were possibly used for aircraft or automotive maintenance. Big Bend National Park reacquired the acreage that had been used by the CAA for its tracking station in 1956 (Welsch 2002, 347). Further documentary evidence is needed to properly interpret this site.

Features

A total of 768 historic features were recorded during the BBNP survey, including 180 features on purely historic sites, 508 features on historic sites with a prehistoric component, and 80 features on prehistoric sites with a historic component. A total of 27 historic feature types in 6 different categories were identified during the present survey. The major categories consist of structures, ranching-related features, farming-related features, mining-related features, candelilla wax processing features, and miscellaneous features. Within each category are from one to eight different feature types. Because of the range of industries represented by historic sites in the park, a broader range of historic features exist than prehistoric ones. The following section offers a brief description of each of these feature types.

Feature Types

Structures

Among the most significant historic feature types encountered during the survey were historic structures. A total of 197 structures or structural remnants exist at 64 historic sites, including buildings constructed of adobe, stone, *jacal* (wattle-and-daub), wood, or concrete as well as dugouts, rock walls, dams and other similar constructed features. Of these, adobe construction or remnants occurred at 17 sites, stone construction occurred at 38 sites, *jacal* construction occurred at 3 sites, dugout construction occurred at 15 sites, wood construction occurred at 7 sites, and concrete construction occurred at 9 sites. Thirty sites contained more than 1 structure, although only 10 sites contained 4 or more structures. Four sites (BIBE1942, BIBE859, BIBE2030, and BIBE1625) contained 12, 14, 23, and 38 structures or structure remnants, respectively.

Adobe Structures

The most common construction method regionally (and, historically, worldwide) is that of sun-dried adobe brick. It is a technology that has been used for thousands of years and is still common in much of Latin America, Africa, the Indian subcontinent, the Middle East, and parts of Asia and Southern Europe. Even today, as much as 30 percent of the world's population lives or works in earthen buildings (World Housing Encyclopedia 2012).

The thermal efficiency of adobe is most effective in dry, arid climates—such as the Big Bend—where the difference between nighttime lows and daytime highs is most pronounced. Known as the "thermal flywheel effect," it is essentially thermal lag that makes adobe effective—allowing indoor temperatures to remain cooler during the day and warmer during the night than outdoor temperatures. Because it is so well suited to desert climates, as well as the ubiquitous nature of the building materials and relative ease of construction, adobe historically has been the most popular building method across the Big Bend.

Adobe bricks are made by pouring wet adobe mud into wooden molds. The molds are then pulled, and the bricks allowed to sun dry. Once dried, these bricks are laid in a mud mortar in a running bond (overlapped) to create the walls. Door and window opening are spanned with thick wooden lentils. The roof structure is made of *vigas* (commonly cottonwood trunks or milled lumber) which rest upon a wooden bond beam on top of the uppermost course of adobe brick. *Latillas* (typically ocotillo or sotol stalks) are laid on top, perpendicular to the *vigas*. Adobe mud is troweled on top to create a roof that is slightly pitched and shaped to direct water to *canales* (water spouts) that extend outward from the wall to safely channel water away from the building.

Despite its many advantages, of all building types, adobe is one of the least durable when exposed to the elements. Consequently, once roofs are no longer present and the walls erode away, adobe ruins tend to become little more than mounds of earth, known as "adobe melt," often with no recognizable structural elements (Figure 6-III.18). This archeological signature

Figure 6-III.18 Subtle imprints of adobe bricks from a collapsed and eroded wall at BIBE1942 (41BS1868). Photo by L. Weingarten.

was among the most common encountered at homestead sites. In fact, no substantial standing adobe walls were noted during the entire survey. With sixty or more years of erosive forces at work, most walls had long since "melted" away. Because in many cases even the mounds themselves had eroded away, some adobe ruins were likely undetected.

Even though preservation tended to be poor, in some instances brick outlines could be recognized within the mound—sometimes on the surface, at other times, visible only after light surface troweling. In certain cases (such as at BIBE1942), outlines or remains of ceiling structures, such as latillas were also observed. Roof timbers (such as vigas), however, were virtually always absent. Because lumber is among the scarcest of commodities in the region, and heavy timbers even scarcer, such wood was readily scavenged for other uses. Most of them were pressed into service in other construction projects. Some of them were probably burned as fuelwood.

Rock Structures

Structures constructed out of rock are the second most common indigenous historic structures in the region and, in areas where building stone was readily available, was often the preferred method. Consequently, stone construction was as common, if not more common, than adobe in the lower Big Bend due to the prevalence of a wide variety of stone sources. In addition to its use in constructing buildings, stone was used to build foundations, walls, dams, corrals, and a variety of expedient shelters.

Because of the nature of the material, rock structures tend to preserve better than their adobe counterparts, especially once roofs are removed. Unlike adobe structures, which can erode rapidly, well-built stone structures can remain standing for a century or more. Because only the mud mortar tends to erode out from between mortar joints, stone walls can remain standing indefinitely if the stones were well-placed or tightly fitted.

Stone structures in the region are made out of both cut (quarried) stone as well as undressed fieldstone and can be found both dry-laid as well as mortared. In building construction, the walls are most often two courses wide, with rubble infill. In this way, the flattest side of a stone would be facing out. The stones are laid in a mud mortar, with smaller rocks used to chink or otherwise fill voids. Wood or metal is used to span window and door openings. Roofs tended to be similar to those used for adobe (flat) although they might be pitched and shingled or covered with corrugated tin roofing.

Where stone structures had not been destroyed by the NPS, those encountered during the survey often retained standing walls (Figure 6-III.19). Even in cases where deterioration was advanced, the archeological signature (rock rubble) was always much more obvious than with adobe. Consequently, stone ruins were easily identifiable and always reported. Because some of the 38 sites reporting stone structures included stone foundations, corrals, and other stone construction, this construction method significantly surpassed cases of adobe construction reported during the survey.

Jacal Structures

Jacal (wattle and daub) construction is the oldest indigenous architectural style in the region aside from the portable or temporary structures of nomadic groups. The agricultural villages at La Junta, established around A.D. 1200, were often little more than collections of pithouses—houses made of wattle and daub constructed over shallow pits. Large support posts were set into the ground inside a square or circular pit which were used to support a heavy earthen roof. Smaller poles were secured to the posts, and branches woven in between to create walls. This latticework of posts and branches (the wattle) was then plastered with adobe (daub) creating a quick and effective, if crude, habitation (Figure 6-III.20).

The technology remained a part of the vernacular architecture throughout the nineteenth and twentieth

Figure 6-III.19 Mud mortared stone structure at Woodson's (BIBE1594/no trinomial). Photo by J. Bush.

Figure 6-III.20 Historic (1945) photo of jacal structure at Hannold's lechuguilla rope factory; note the use of ocotillo uprights and the remains of daub (earth plaster) along the top of the walls. Courtesy of National Park Service, BBNP.

centuries in spite of access to lumber and the technological advantages of rock and adobe. Because *jacal* construction could be made quickly with readily available materials, it was often the structure of choice for temporary habitation until a more substantial—and time consuming—structure could be built. *Jacal* construction also remained a common method for building animal sheds and other outbuildings on ranches and farms.

Because of the relatively fragile nature of *jacal* structures, they preserve more poorly than even adobe. Lacking the mass of adobe bricks, or the permanence of rock, the stick and mud structures quickly erode and rot away, leaving a diminutive erosional mound, if any at all. Consequently, only three sites contained remains substantial enough to assign to this building type—and two of these were believed to be ramadas or animal pens.

The only site containing a definite *jacal* structure that appeared to serve as the primary dwelling was at BIBE1920 (Figure 6-III.21). What remains is an elongated rectangular mound of earth over a stone footing. Because of irregularities in the floor plan, it appears to have been built over several different episodes. Light troweling revealed burnt daub just below the adobe melt (presumably the eroded earthen roof) with clean imprints of the sticks it once covered. Some areas also showed the remains of upright ocotillo stalks. Had the structure not burned, creating fire-hardened daub,

Figure 6-III.21 Remains of a jacal structure at BIBE1920 (41BS1846); note burned posts and ends of ocotillo stalks. Photo by B. Dailey.

it is unlikely it would have been recognized for what it was—but could have been interpreted as an adobe structure in advanced stages of erosion. Consequently, although *jacal* construction was very common historically, because of its poor preservation it is undoubtedly under-represented in the archeological record in BBNP.

Dugouts

Dugouts are structures that are located partially or completely within an earthen excavation. Although pit-houses are technically a form of dugout, most historic dugouts in the Big Bend region were excavated horizontally into the sides of hills rather than vertically below the level ground surface (Figure 6-III.22). Because the term only references its subterranean aspect, any construction method could be coupled with it—most commonly *jacal*, rock, and adobe. Utilizing the earth for one or more walls of a structure lends tremendous thermal efficiency, especially in the desert. Although daytime temperatures can rise to 71°C (160°F) at the ground surface, several feet below temperatures remain near constant 10–13°C (50–55°F) (Hart 2012).

Fourteen sites were recorded that contained ruins of one or more dugouts. Often little more remained than an excavation into a hillside with little left to indicate the actual construction. It is likely that at some of the sites, these excavations were simply covered with canvas or brush and served as expedient, temporary structures. In other cases, however, it appeared that the structures were more substantial, utilizing adobe or mortared stone.

Figure 6-III.22 Remains of a dugout along Alamo Creek (BIBE1082/41BS1932). Photo by C. Covington.

At BIBE2044, for example, two partial dugouts extend several feet into the sides of east-facing cuestas. The rectangular structures, measuring approximately 13 x 20 feet and 14 x 28 feet respectively, were built of blocky mud-mortared Aguja sandstone ranging from 6 to 24 courses in height. Door and window lintels were made of milled lumber. Set within the walls were forked posts that once supported the roof structure. Although the roofs were missing, pieces of corrugated tin suggested the roof had been metal rather than earthen.

Wood Framed Structures

Following the arrival of the railroad in 1882 to the northern part of the Big Bend region, milled lumber became readily available. Because the vast majority of homesteading took place after this date (and especially after the 8-Section Act of 1905), many of the "prove-up" shacks built to satisfy state requirements for improvements and occupancy were constructed out of wood. This was less the case in the southern Big Bend where cheap labor was available and natural building materials were free for the taking.

When framed structures were located in the park, they were rarely if ever abandoned in the same way a stone or adobe house would have been. Because of the scarcity of milled lumber, if possible the structure would be moved to a new location. If not, the building was dismantled and the materials sold. Any such structures that remained unoccupied would be reinhabited or quickly scavenged.

Consequently, only eight sites recorded during the survey contained evidence of wood framed buildings—although rarely did any remnants of the structures remain. Three of these were schoolhouses—two at San Vicente and one at Dugout Wells (Figure_6-III.23). Beyond that were a couple of ranch homes, a sheepherder's wooden trailer, and a small structure remnant believed to be a deer blind. In most cases, the telling signature of a wood framed structure was simply two or more rows of stone piers, concrete foundations, or rectilinear cleared areas lacking evidence of any other building type. Often, wire nails, window glass, and hinges might be present although many times, not a trace of the original structure remained.

Concrete

No housing structures encountered during the survey were built strictly out of concrete although such structures do exist in the park (notably at the Mariscal Mine). However, concrete was a common component to a number of other feature types. In habitations, concrete was most commonly encountered as slabs—usually upon which a framed structure was located. Concrete was also commonly used to construct water tanks and troughs. Portland cement, which is the principal binder in concrete, was also commonly used for mortaring stone and, in some cases, as an exterior plaster (stucco). In only one case (BIBE1942) was concrete the sole building material used, and the resulting feature remains an anomaly (Figure 6-III.24). By mortaring chunks of concrete together, a low, three-walled structure was built on top of a sloping concrete slab. Although its purpose is uncertain, it is believed to have been used for some type of processing.

Ranching-Related Features

Corrals

Corrals were a basic necessity of any livestock operation or homestead. Such pens had many uses—from keeping horses at the ready to containing sheep, goats, or cattle for branding and doctoring. Before wire was readily available, corrals were constructed out of stone—one of which was recorded during the survey (BIBE1003). Roughly square, 30 feet to a side and 4.5 feet tall, these corrals opened to the south and were composed of multiple courses of tabular and blocky limestone.

Because wood or wire corrals were much easier to construct, they were also much more common (Figure 6-III.25). Whereas cattle operations typically used wood or barbed wire, sheep and goat operations utilized

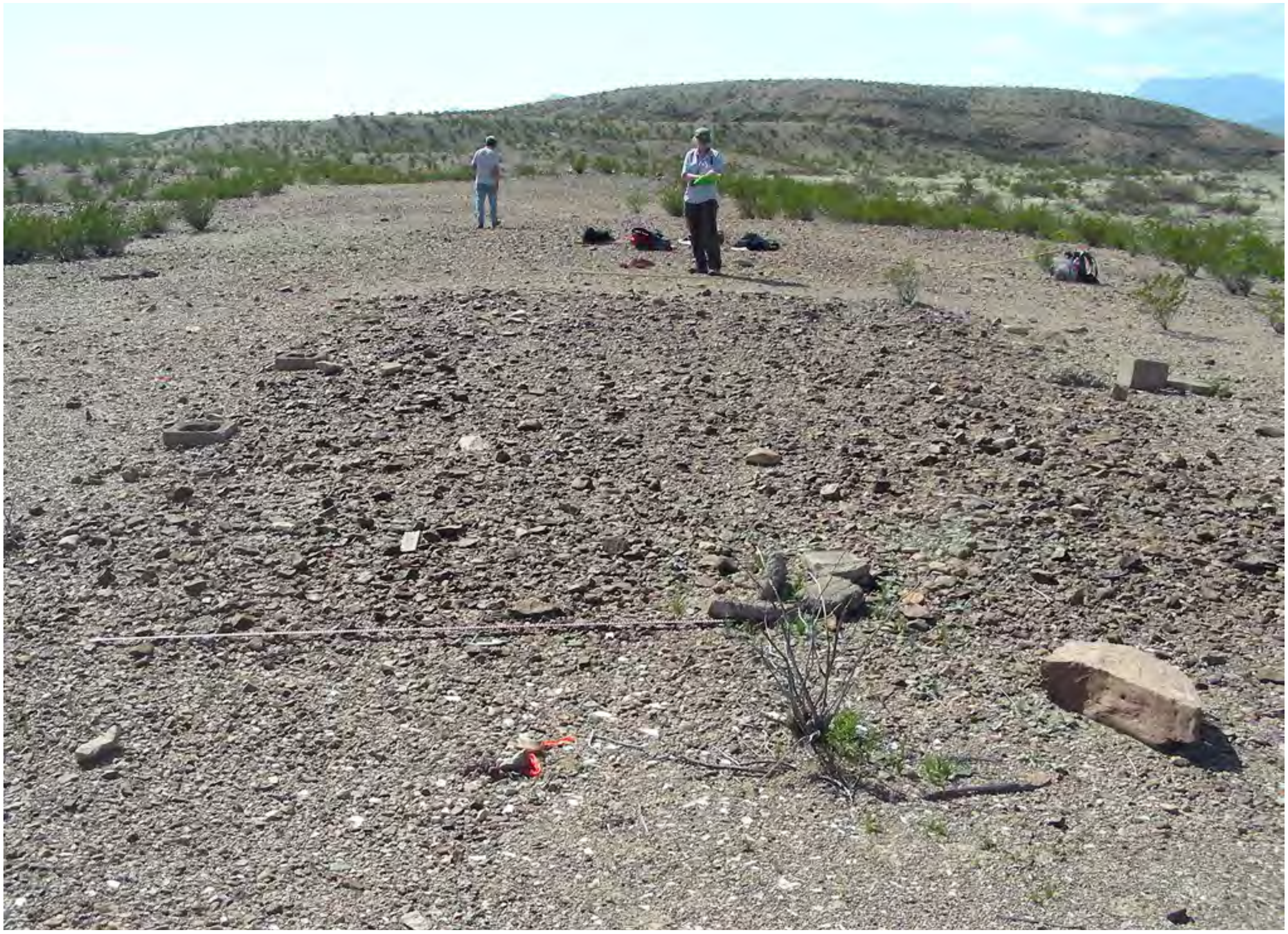


Figure 6-III.23 Rectangular outline of San Vicente School house (BIBE2025/41BS2242); note concrete piers. Photo by B. Dailey.

netwire fencing to contain these smaller animals. Such wood and wire corrals, or remnants of corrals, were commonly encountered during the BBNP survey. These corrals were built in many shapes and sizes but were most typically circular or square. Most also contained smaller pens within them.

Although most of the interior fences, including corrals, were dismantled and used to fence off the park's perimeter, fenceposts, wire, and wire staples frequently remained to indicate their original location. Such features could be expected to be found at every homestead and community, but were also found in locations far removed from other historic sites. In these cases, the corrals were probably used as remote work areas to attend to livestock far from headquarters.

Dipping Vats

Dipping vats were used to submerse livestock in an insecticide solution to control external parasites, notably the tick that causes Texas Fever. Typically consisting of a long trough extending below ground level with a ramp on one end, livestock were driven though a chute into the vat, then swimming through the solution, would climb out the other side where the solution, dripping off their bodies, drained back into the vat.

Although common at ranch sites across the region, only one dipping vat was recorded during the survey (Figure_6-III.26). BIBE990 contained a sheep dipping vat 19 feet long, 4.5 feet wide, and 3 feet deep. On the far end was a triangular shaped concrete slab "dripping

Figure 6-III.24 Historic structure of unknown function composed of repurposed concrete slabs set on end and mortared together at BIBE1942 (41BS1868). Photo by B. Dailey.

floor" that sloped downward to the vat. Around the perimeter of the slab upright stones were laid forming a low curb.

Fencing

Even though all interior fences were dismantled following the creation of the park (much of it used to fence the perimeter boundary), fence remnants were frequently encountered during the survey. These typically took the form of a line of fenceposts lacking wire although sometimes short stretches of fence retained one or more strands. In other cases, all that remained were fencepost supports—rock clusters that occurred at regular intervals along a linear course.

Although netwire and smooth wire was sometimes encountered, the most common was barbed wire—of which five or more varieties were noted, including variations in the number of barbs (2–4), whether they were round or flat, the distance between barbs, and the method of attachment. When encountered, fences were waypointed and a bearing was taken on their course.

Kid Goat Shelters

Kid goat shelters, locally known as *chiquiteros*, are small stone structures used to protect kid goats and lambs from the desert sun (and, likely, from birds of prey). Typically found at homestead and ranching sites, these are usually constructed of limestone or sandstone slabs

Figure 6-III.25 Corral remains at a sheepherder's camp (BIBE991/41BS2286). Photo by D. Petrey.

Figure 6-III.26 Dipping vat partially concealed by brush at Robber's Roost (BIBE990/41BS1901). Photo by D. Hart.

between 30–60 cm maximum diameter (Figure_6-III.27). The most basic construction method was to place two or more slabs on end (sometimes embedded into the ground) creating walls, and one on top to serve as a roof. Because these were expediently built, however, there were many variations upon this theme. For example, some utilized pieces of wood or sheet metal to serve as a roof.

When the goats were herded out to graze for the day, the kids who were too young to travel remained behind under the protection of such shelters. Kid houses were often enclosed in a pen constructed of upright ocotillo stalks or mesquite poles to also serve as protection against predators. In other cases, they were arranged in long rows, but in such a way that they could be continually monitored (Maxwell 1985:22).

Kid goat shelters were documented at two sites recorded during the present survey. At BIBE859, nine kid goat shelters were documented arranged along the slope and at the base of an east-west running cuesta. At BIBE140, rows of hundreds of such shelters were arrayed along the base of the west side of a north-south running cuesta (Figure 6-III.28). In both cases, the shelters were made of sandstone slabs, many of which remained intact.

Dams

As discussed above, five sites were recorded during the survey that contained dams. Two of these sites (BIBE1642 and BIBE2069) impounded water for use in irrigation or to fill remote water troughs. The remaining sites, however, were the much more common "dirt tanks" that are ubiquitous across the region and a critical component of ranching.

Dams recorded during the survey were of two types: mortared stone and earthen. BIBE1642 contained the only mortared stone dam (Figure 6-III.29). Measuring 8 feet wide by 66 feet long and 9 feet tall, the dam is composed of nearby quarried and shaped igneous stone ranging in size from 6 to 30 inches in maximum diameter set in a Portland-based mortar. Because of its construction, this dam remains in good condition.

The smaller earthen dams recorded during the survey range from 50 to 130 feet long and 9 to 16 feet wide, and were constructed of rocks and dirt removed

Figure 6-III.27 Historic photograph of kid goat shelters at San Vicente ca. 1940 (BIBE859/41BS391). Courtesy of National Park Service, BBNP.

Figure 6-III.28 Rows of kid goat shelters at Casa de Piedra (BIBE 2084/no trinomial). Photo by L. Weingarten.

Figure 6-III.29 Portland cement-mortared stone dam at BIBE1642 (41BS1575) in the McKinney Hills. Photo by D. Keller.

from the intended reservoir. These dams spanned small drainages to capture surface flow during flood events, the water used on site for livestock. Damming small drainages was relatively easy, required minimal engineering, and was frequently done with little more than a mule and a fresno—a mule-drawn, manually operated dirt mover. Once heavy machinery became available, the work was made even easier.

Although also of earthen construction, the dam at BIBE2069 (San Vicente) is much larger than typical dirt tanks and was by far the largest of the dams recorded during the project. Spanning 230 feet, 130 feet wide at its base, and some 20 feet tall, this large dirt dam at one time created a lake some 6–7 acres in size. Based on the presence of fishing gear, the lake was presumably stocked with fish at one time. Its primary use, however, appears to have been to irrigate crops on the fields below. Because of its earthen construction and lack of maintenance, the dam was breached at some point and is now little more than a chute for the water to pass through.

Windmills

Windmills were the groundwater counterpart to dirt tanks. Soon after settlers arrived, hand-dug wells and windmills became the primary method for obtaining water where springs were absent—both for household use as well as for livestock. Since groundwater was far more reliable than surface water, especially during droughts, unless one had access to the Rio Grande, wells were often basic necessities of life.

Even though hand-operated windlasses could be employed for light, household use, windmills were required for deeper wells and higher volume output required for livestock operations. Consequently, any homestead or ranch operation of any size had one or more. However, few remain today. The park maintains two modern windmills—one at Dugout Wells and one at the Sam Nail Ranch. But the ones that existed prior to the park were typically dismantled and removed or scavenged.

Although it is probable that many of the homesteads recorded during the survey had windmills when occupied, only two sites had actual windmill remains. At homestead site BIBE415 the metal tower remained standing though the actual head, wheel, and vane were on the ground beside it. At BIBE990, only a dilapidated wooden tower remained (Figure_6-III.30). In addition, at BIBE991, footings surrounding a well indicated that a windmill had been present at one time.

Water Tanks / Troughs

Water tanks were typically used in conjunction with windmills to store water which could then be gravity-fed to the point of use. These were typically made of concrete or metal, round or square in shape, and open at the top. Such tanks were noted at many of the homestead and ranching sites. In addition to tank sites mentioned above (BIBE1452 and BIBE1455), concrete tanks were present at BIBE415 and BIBE991 and a metal tank was documented at BIBE990.

Water troughs for livestock were also common to most any ranching, farming or homestead site and generally accompanied windmills and water tanks, although they can also occur alone. Typically of concrete construction, they could be built in a variety of dimensions although most were around 12 feet long, 3-4 feet wide, and about 18 inches tall. In some cases these occurred singly while in others they occurred inline (two or more abutting each other at one end). At BIBE991, for example, three such troughs were located one after another (Figure 6-III.31). A 2-inch steel pipe ran between them so that the water level of all three troughs remained the same.

Farming-Related Features

Fields

In general remains of cultivated fields were unrecognizable except in isolated cases. Most, if not all, of the fields that were once within the Rio Grande floodplain today are overgrown with dense thickets of mesquite and salt cedar and cannot be accessed much less documented. Fields associated with farmsteads along Alamo Creek were more easily identified. Although no furrows remain, and the fields have been reclaimed by the desert, signs of historic fields were recognized by changes in vegetation density or composition, field-clearing rock piles, or by irrigation structures. At BIBE2280, for example, a large rock pile, a probable irrigation ditch, and an historic artifact scatter were all that was left to suggest the area was once a field (Figure 6-III.32).

Figure 6-III.30 Remains of a windmill tower at BIBE990 (41BS1901). Photo by D. Hart.

Irrigation Structures

Relatively few irrigation structures were recorded during the present survey. This is due to two factors. The first is that many of the flood-prone areas where these features were most prominent are now so heavily vegetated that they were not surveyed. The other is due to the poor preservation of these diminutive earthen structures. Traces of irrigation ditches and berms were clearly evident at only two sites and, even here, due to erosion and deposition, only segments of these structures remained visible. At BIBE2280, a linear depression flanked by a berm from 6 to 16 inches tall, extended for approximately 60 m (197 ft). At BIBE2030, two probable irrigation ditches were identified. One was 170 m (558 ft) long and consisted of two parallel berms on either side of the depression, ranging from 3 to 8 feet in total width. The other was similar in composition, but was only 95 m (312 ft) long.

Threshing Circles

Threshing circles are crude historic features that were used for threshing wheat. The remains are typically a

Figure 6-III.31 Concrete water troughs connected in series at BIBE991 (41BS2286). Photo by D. Petrey.

perfectly circular stone alignment with the interior of the circle cleared of larger rocks and debris. Often the inside ground surface is recognizably more compacted than outside. These features were commonly encountered at homestead sites and communities, especially those located near the Rio Grande that were associated with farming.

When in use, threshing circles had a central post and the interior circle floor was lined with hard-packed clean adobe (sun dried clay-rich dirt). The rocks forming the perimeter were plastered with adobe to form a low wall to retain the grain. Threshing circles were operated by "loading" the circle with the harvested wheat then tethering two burros to the central post. The burrows were then driven around in a circle, their hooves separating the grain from the chaff. The straw, chaff, and dirt were then winnowed away, leaving clean grain (Maxwell 1985:27).

Three threshing circles and one possible threshing circle were recorded during the survey (BIBE1594, BIBE1726, BIBE2030, and BIBE2067). The best example was at BIBE1594 where the threshing circle was located on an isolated and elevated, flat surfaced landform away from the main cluster of historic structures (Figure 6-III.33). Perfectly circular and outlined in rocks, the interior was more compacted and had been cleared of larger gravels. At BIBE2067, only the top of the rocks that created the circle were visible. These

Figure 6-III.32 Rock pile from cleared field reclaimed by the desert at BIBE2280 (41BS2156). Photo by C. Covington.

were sandstone slabs set on end, and angled away from the circle's interior. The threshing circles ranged from 26 to 38 feet in diameter, with an average of 32 feet, diameter.

Mining-Related Features

Mine Shafts

Mining-related excavations, including vertical shafts and horizontal adits, in the form of prospects, are fairly common features in the lower Big Bend, especially in the Terlingua mining district. Although the park is peripheral to the district, which extends from Study Butte westward into eastern Presidio County, prospecting in the entire region was active following initial quicksilver discoveries made around 1900, including the discovery of deposits at Mariscal Mountain in 1903 (Johnson 1946). Prospects are often little more than a shallow vertical or horizontal shaft and associated backdirt, lacking any other feature or artifact types, and often occur in remote locations. Such excavations were used to investigate subsurface mineral deposits and to take samples for examination and testing.

Prospects were encountered at three sites during the survey, two of which occurred in the Chisos Basin and one of which occurred along the western flanks of Mariscal Mountain. These prospect shafts ranged from

Figure 6-III.33 Threshing circle on a pediment at BIBE1594 (no trinomial). Photo by C. Covington.

4–5 feet in diameter and from 2–13 feet deep. However, only at BIBE1446 and BIBE1838 were the excavations definitely mining related (Figure 6-III.34). At the other site (BIBE1453), this affiliation was inferred based on the presence of anomalous vertical shafts.

Smelting Furnaces

Quicksilver was separated from the ore by the process of smelting which heated the ore to a temperature sufficient to drive the mercury from the rock in the form of mercury vapor which was then cooled, condensed into liquid metal, and collected. Generally smelting furnaces are only located at productive mines, and are large, complex affairs. However, the base for a small smelting furnace was documented at BIBE1838, a small prospect on the western flanks of Mariscal Mountain (Figure 6-III.35).

The furnace base is a rectangular brick structure measuring 53 inches wide by 64 inches long and ranges from 16 to 25 inches tall. The long sides are made of mud-mortared firebrick, the short sides of Portland mortared red brick—in the center of which is a concave depression where the furnace once sat. The furnace itself, presumably of metal, was apparently removed.

Candelilla Wax Processing Features

Wax Vat Fireboxes

Although early candelilla wax operations were relatively complex operations that utilized steam to heat the candelilla vats, by 1935 new methods had been developed that allowed for much smaller operations. By firing smaller vats directly, the need for broilers was

Figure 6-III.34 Crewmember in mineshaft BIBE1838 (41BS1764). Photo by B. Dailey.

Figure 6-III.35 Foundation for small rotary furnace at BIBE1838 (41BS1764). Photo by B. Dailey.

negated and the industry became more mobile, allowing producers to move once the candelilla was played out. These operations had in common one or more cooking vats in which the candelilla was boiled along with a dilute mixture of acid. The wax would rise to the surface as a brown foam that was skimmed off using *espumadors* (skimmers) that were often little more than perforated tin cans. Because the metal cooking vats were critical to the operation, they were always taken when the camp was abandoned. The primary feature that remained, then, was the firebox or furnace over which the vat had been placed. Two such features were documented during the survey.

BIBE1375 was a short-term wax camp in the Dead Horse Mountains containing a rectangular firebox (approximately 3 x 7 feet) excavated into the ground and lined with rocks (Figure 6-III.36). At one end an opening was created using a car fender topped with additional rocks to serve as a chimney. In addition, BIBE1621, the William Green wax factory near the McKinney Hills, contained an elevated furnace constructed of mud-mortared firebrick.

Miscellaneous Features

Lime Kilns

Lime kilns are features used to calcine (cook) limestone, to create quicklime which was used for a variety of purposes. Chief among them regionally was to make lime mortar, lime plaster, limewash, and to process hard, flinty corn into *nixtamal*, or hominy. The process known as *nixtimalization*, which separates the outer hull from the grain, also increases the protein and vitamin availability, essentially allowing corn to be used as a primary food. Societies that attempted to rely primarily on corn without processing it suffered

Figure 6-III.36 Rectangular firebox for a short-term wax camp at BIBE1375 (no trinomial) with Ann Ohl for scale. Photo by M. Johnson.

severe outbreaks of pellagra, a niacin deficiency (Turrent and Serratos 2004).

In the process of calcining limestone, kilns are fired at a minimum of 800°C (1472°F) for two to three days, until all of the carbon dioxide has been driven out of the limestone, thus converting calcium carbonate to calcium oxide—also known as quicklime or burnt lime. The resulting quicklime would be scooped out once it had cooled for a sufficient period of time, after which it would have been slaked (re-hydrated) before use. If used as a building material, lime slowly hardens as it reverts back to calcium carbonate by absorbing carbon dioxide from the air in a process known as the "lime cycle" (Smith 1976, Eckel 1922).

Lime kilns were observed at three sites during the survey. At BIBE859 and BIBE2030 the "kilns" consist of little more than a pile of calcined and partially calcined limestone cobbles on the ground surface (Figure 6-III.37). Both are roughly circular concentrations of lime and burned limestone cobbles approximately 140–200 cm (55–79 in) maximum diameter and around 10–20 cm (4–8 in) high. Each contain roughly 25 or more burned limestone cobbles averaging 6–12 cm (2–5 in) in maximum diameter. The central stones lie within a solidified lime matrix. Approximately 60 percent of the cobbles are fire-cracked. This very informal type of kiln has been referred to as the "Mexican heap method"—simply calcining limestone on the ground surface in a heap with alternating layers of wood and limestone

Figure 6-III.37 Remains of a "heap method" lime kiln; note limestone cobbles and solidified lime at BIBE2030 (41BS2247). Photo by B. Dailey.

(Smith 1976). No associated features or modification of the ground surface was evident in either case.

At BIBE2072 a somewhat more sophisticated lime kiln was documented (Figure 6-III.38). Here, the remains of a subterranean lime kiln consisting of a solidified mass of lime and oxidized soil contained within a 1 x 1 m (3 x 3 ft) area were eroding out of a cutbank on a silt terrace. A significant portion of the kiln had eroded away, including about 1 m (3 ft) or more of material above it. However, the height of the terrace above suggests that the feature may originally have been 2 m (7 ft) or more in height. Surrounding the kiln remnant, and on the terrace above it, are some 400 or more limestone cobbles ranging in size from 5–25 cm (2–10 in) maximum diameter. The white patches on some of the rocks indicate they have been partially calcined. Because these were only partially "cooked," they were probably retained for a subsequent firing.

Although its original morphology has been obscured by erosion, this appears to be a type of kiln referred to as a "creekbank type" that utilizes an existing cutbank. These kilns are made by digging a vertical hole parallel to the cutbank, but set back several feet. Another hole is then dug horizontally into the base of the cutbank itself connecting to the vertical shaft, basically creating an L-shaped excavation. In this way, limestone can be added from the top, and wood added through the hole at the bottom.

Figure 6-III.38 Remains of a "creekbank type" lime kiln; note oxidized soil and partially calcined limestone cobbles at BIBE2072 (41BS1959). Photo by L. Weingarten.

No additional kilns were observed during the survey, although burned limestone concentrations are frequently observed on historic sites suggesting that this technology was widely employed.

Historic Hearths

Historic hearths, termed "cowboy hearths" in the field, refer to historic or modern surficial hearths made of a ring of stones that are typically not extensively thermally altered. Morphologically distinct from their prehistoric counterparts, these features often contain remnants of charred wood or charcoal in addition to historic or modern debris (glass, wire, tin cans, etc.) with which these features are almost always associated.

Historic hearths were documented at 16 historic sites and ranged significantly in size and intactness. A fairly representative hearth documented at BIBE1082 consists of a circular arrangement of ca. 60–70 rounded to subangular igneous cobbles, with the interior devoid of rocks (Figure_6-III.39). The maximum interior dimension is 100 cm (39 in) and the maximum exterior dimension—accounting for displaced rocks—is 200 cm (79 in). Only about 5 percent of the rocks are fire cracked. Associated artifacts include a tobacco tin.

Select Pebble Concentrations

During the survey, a number of anomalous rock features were encountered that largely defied explanation.

Figure 6-III.39 Remains of a historic ring style hearth at BIBE1082 (41BS1932). Photo by C. Covington.

Although they were observed in a variety of forms, the common element was a concentration of aesthetically pleasing pebbles—often rounded pebbles of agate and chalcedony not more than 5 cm (2 in) in diameter (Figure_6-III.40). In some cases, these choice pebbles were mixed in with the desert gravels, but concentrated within a discrete area. In most cases, however, the pebbles were contained within a circular rock cluster.

Similar features, clearly modern, are often observed near campsites, trails, and roads—what are often termed "New Age" features. These, however, all occurred in remote areas, and were often associated with historic sites. Although such features could have been created at any time in the past, most are believed to be historic. Their function remains a mystery, and some could have held spiritual significance. Most, however, are presumed to have been made by children based on aesthetic principles.

Petroforms

As described in the preceding Native American archeological findings section, petroforms are simply intentional patterns made by arranging stones on the ground surface. These features are very common in BBNP and have likely been associated with human occupation throughout time. They can be affiliated with prehistoric occupations, historic occupations,

Figure 6-III.40 Isolated select pebble concentration near Pettits on the Rio Grande. Photo by C. Covington.

or modern occupation—the latter sometimes taking the form of "New Age" medicine wheels, peace signs, crosses, or hearts.

Although nearly every historic site had some form of rock alignment that could be interpreted as a petroform, these are frequently the remains of other feature types—often structural foundation remnants, fence supports, beehive lid weights, and the like. Thus, only in cases where the patterns seemed intentional and not affiliated with other features were they categorized as historic petroforms.

Petroforms were recorded at only two historic sites during the present project. BIBE2010, a multi-component site whose historic component contains only two graves, has a cross petroform some 3 m (10 ft) in total length consisting of 26 igneous rocks from 10–60 cm (4–24 in) in maximum diameter. BIBE2030, the lower portion of the community of San Vicente, contains a small, possibly anthropomorphic, petroform located on a south-facing slope on a gravel pediment above the Rio Grande floodplain (Figure_6-III.41). A maximum of 3 m (10 ft) in diameter, the feature is composed of approximately 300 rocks and—despite being partially eroded—appears to represent a human figure.

Tent Pads/Cleared Areas

Small square or rectangular areas that have been cleared of stones or otherwise disturbed were most frequently recorded as tent pads, especially when associated with

Figure 6-III.41 Probable historic petroform (effigy) at BIBE2030 (41BS2247). Photo by K. Baer.

historic features or sites. Larger ones (9–10 feet per side) were most likely associated with wall tents like those used by the military. Smaller ones were most likely associated with lighter tents, including modern types seen today.

Cleared areas presumed to be historic tent pads were documented at six sites. In some cases, their identification was fairly certain. At BIBE2030, for example, two rectangular cleared areas—one measuring 11 x 14 feet, the other 8.5 x 9.5 feet—were located on a low gravel terrace adjacent to a historic site (Figure 6-III.42). A clearly demarked trail led from the cleared areas to the main portion of the site. In certain other cases, historic hearths or historic artifacts supplied further evidence. In some cases, however, cleared areas occurred in isolation or in possible association with prehistoric sites. In these cases, their function was uncertain.

Graves

Some 86 graves and 3 possible graves were documented at 9 sites during the survey, including lone graves as well as those contained within cemeteries. Graves almost uniformly consisted of oval-shaped mounds of earth capped with rocks, usually rounded cobbles although in some cases flagstone or even FCR from a prehistoric hearth was used (Figure_6-III.43). In only one case were graves more elaborate. At BIBE2060 (upper San Vicente cemetery) three graves had been plastered with Portland stucco creating crude crypts. Otherwise, graves typically measured around 3–4 feet

Figure 6-III.42 Rectilinear and circular cleared areas (tent pads) at BIBE2030L (41BS2247L). Photo by L. Weingarten.

Figure 6-III.43 Mounded historic cairn burials at BIBE1704 (41BS1637).

wide and 6–8 feet long. Very small graves, presumed to be infant burials, most often occurred along the periphery of cemeteries and, at least in one case, was far removed. Almost all graves were oriented to the east (headstone on the west side) as is customary in many cultures, especially in the Judeo-Christian tradition.

The majority of graves located within cemeteries had crude wooden crosses, typically with decorative cuts on their upper ends. In some cases, a larger stone served as a makeshift headstone although inscriptions were absent except in two cases. At BIBE2060 (upper San Vicente cemetery) two cast concrete headstones contained inscriptions that had been scratched into the wet cement—one in the shape of a cross bearing the inscriptions "*Niño Simon Sanchez – fallacio el día 3 de otubre de 1932*" ["The child Simon Sanchez died on the 3rd day of October, 1932"]. The other, rectangular in shape, contained the words, "*Aqui yacen los restos de el niño Mariano Marrufo fallecio el dia 8 de Otubre de el año de 1910 Edad 14 años. Recuerdo / Padre y Madre*" ["Here lies the remains of the child Mariano Marrufo who died on the 8th day of October of the year of 1910 age 14 years . . . in memory of / father and mother"]. The identity of the remaining 86 graves is unknown.

Graves that were located outside of cemeteries—typically two graves, sometimes only one—tended to be more hastily constructed and very rarely included crosses. Likewise, associated features were rare and artifacts few. These isolated graves may represent individuals lacking families in the region. Some may represent individuals who died from injuries sustained while working. Others may represent those who succumbed to violent death, as homicides were not uncommon in the region's early history.

Quarries

Three gravel quarries were documented during the survey—all of which are believed to be affiliated with BBNP road maintenance. BIBE2062 and BIBE2068, both near San Vicente, consist of bladed, leveled pads that measured 40–50 m (131–164 ft) in maximum dimension representing the removal of several meters of material from the top of two separate gravel pediments. The third quarry, below Nugent Mountain, (BIBE2181) consists of a leveled pad around 18 x 30 m (59 x 98 ft) in size. Associated features and artifacts were largely absent at the first two sites whereas BIBE2181 included an array of ca. 1950s mechanical parts, pipe, cable, mesh, oil filters, and similar items.

Two-Track Roads

A great many small two-track roads once existed that were closed when the park was established. Most of these road traces can be found on the older USGS maps of the area, although many were too ephemeral to be included. Dozens of these road traces were recorded during the survey. As crews passed over any two-tracks not on current maps, they were waypointed and noted. In this way, roads indicated on historic maps as well as more ephemeral ones that were not, were documented. In many cases, the space between the tracks and the narrowness of the tracks themselves indicated whether they had been made by wagons and/or early automobiles.

Material Culture

Historic material culture recorded during the survey was as diverse as it was abundant. Historic artifacts located within sites were selectively documented depending on their interpretive value. Artifacts that were functionally or temporally diagnostic, as well as those that were unique or rare, were always provenienced and recorded. Others received mention on site forms but were not always individually documented. The full range of artifact types present on a site, however, was always noted. All historic artifacts encountered outside of sites, regardless of significance, were recorded as isolates.

As would be expected, artifact diversity was greatest at homestead and community sites and lowest at camps and historic artifact scatters as well as single-use sites such as quarries, graves, cemeteries, tanks, and similar sites. Artifact density generally followed the same trend with the exception of some single-event dump sites that tended to contain dense artifact concentrations but were also among the least diverse. In several cases these sites contained only one or two types of artifacts (tin cans alone or tin cans and bottles) although within those classes might be hundreds of items.

Artifact types most frequently encountered at the 127 sites that were purely or predominantly historic, in descending order of frequency, were tin cans (84 sites), glass (82 sites), bottles (69 sites), ceramics (67 sites), milled lumber (56 sites), cartridge casings (55 sites), nails (54 sites), wire (52 sites), tobacco tins (36 sites), horseshoes (22 sites), and buttons (26 sites)(Figure 6-III.44). Of the 655 historic artifacts documented as isolates outside of sites, the frequency presented a different pattern. Although tin cans (n=221) still topped the list, they were followed by horseshoes (n=97), cartridge casings (n=81), tobacco tins (n=39), metal (n=42), bottles (n=35), and glass (n=24)(Figure 6-III.45). For a complete discussion of isolates, see Chapter 6-IV.

Collected Artifacts

Relatively few historic artifacts were collected during the BBNP survey as most items could be readily identified and documented in the field. However, there were exceptions: unique artifacts, especially those that could not be readily identified, temporally or functionally diagnostic artifacts that would benefit from further analysis in the lab, artifacts at risk of unauthorized collection, and "museum quality" artifacts that

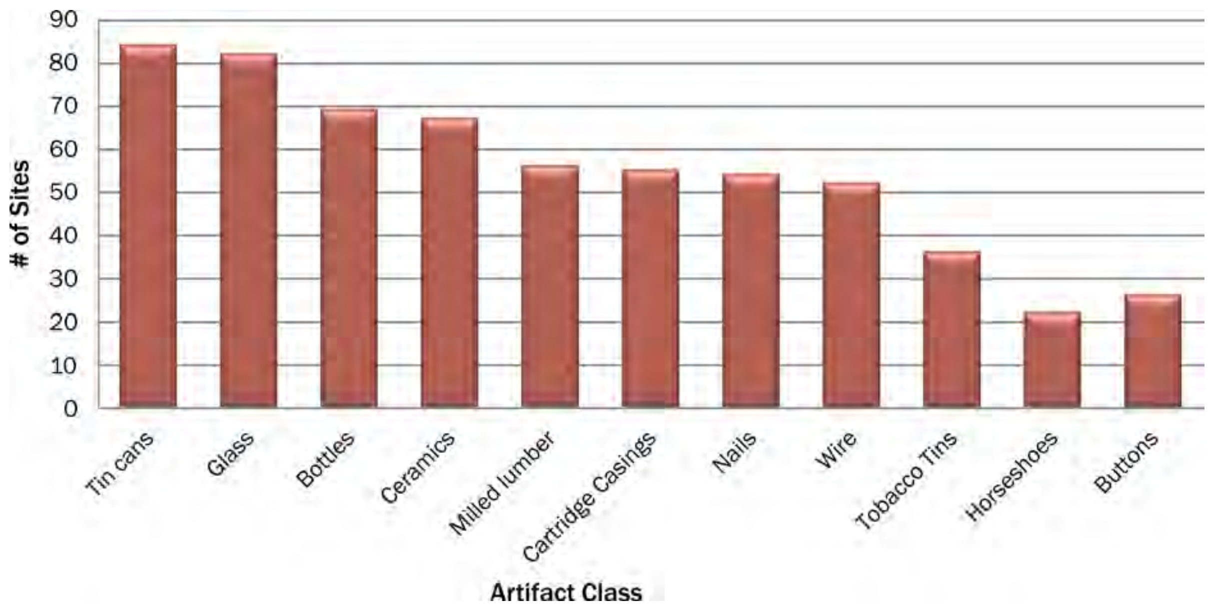


Figure 6-III.44 Number of each artifact class represented at historic sites.

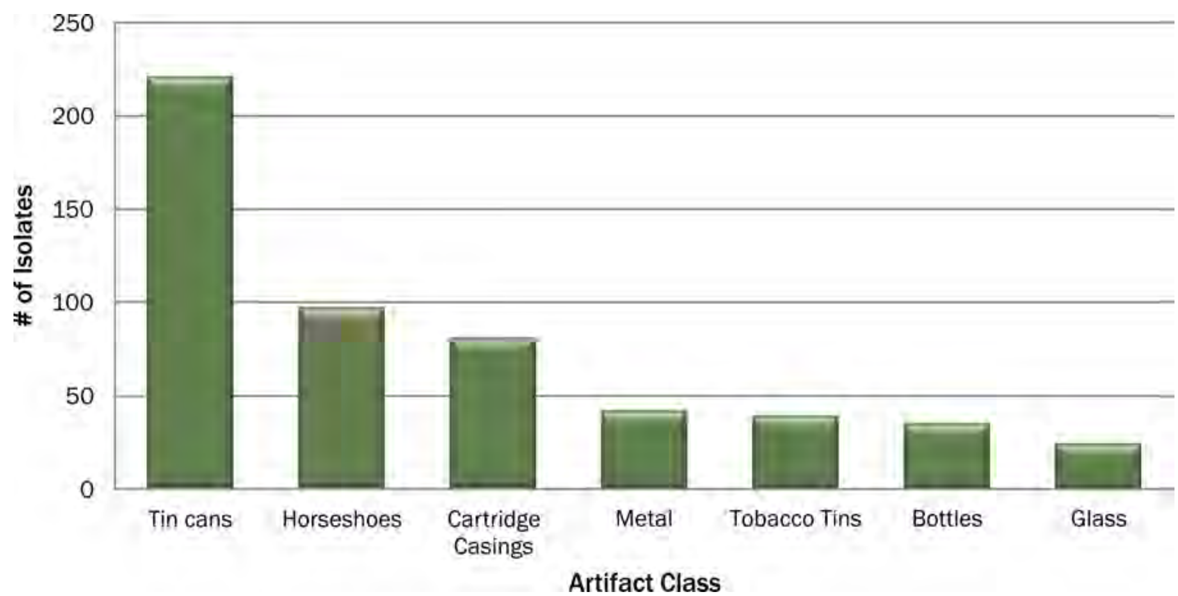


Figure 6-III.45 Number of each artifact class recorded as isolated finds (IFs).

could be used for NPS display or interpretation. By far the largest collected historic artifact category—representing a concerted collecting effort—was ceramics. At a few early historic sites, a representative range of ceramics was selected to build a type collection, and to allow for a more comprehensive analysis. That so few ceramics—historic or prehistoric—had been collected previously in the park played largely into this decision. It was believed that such a collection would help address significant gaps in our understanding of the range of styles and temporal affiliations of locally made ceramics.

A total of 895 historic artifacts were collected, consisting of 866 artifacts from within sites and 29 that were isolates. These artifacts have been placed into discrete categories according to function. After a brief discussion of the classification strategy, the artifacts are described within their respective groups.

Artifact Categories

The collected historic artifacts from the BBNP project have been organized into functional categories. With some modifications, they are based on the Sonoma Historic Artifact Research Database (SHARD) coding system which, itself, is loosely based on Stanley South's classification system (Gibson and Praetzellis 2009; South 1977:95-96). The scheme used here is tailored specifically to the BBNP history and the collected artifact assemblage. The primary difference from SHARD's classification system is splitting out ranch and farm items as well as horse gear and automotive categories.

SHARD is a hierarchical system with *group* being the first order, *category* the second order, *type* the third order, and *description* (the specific artifact) the fourth order. The major groups used in the present breakdown are Domestic, Personal, Structural, Activities, and Miscellaneous. Under these primary headings, artifacts are divided into 19 categories such as Food and Furnishings under the Domestic group. Type refers to the type of artifact (such as Container or Trunk) and description refers to a specific artifact, such as "baking powder can" or "trunk corner brace." The following section organizes all collected historic artifacts according to this hierarchy.

Domestic

At 445 items, the Domestic group embraces the largest body of artifacts collected during the project, and includes two categories, Food and Furnishings, that together make up half of all collected historic artifacts. More than 97 percent of these artifacts fall in the food category, with only a minor few in the latter. This relative imbalance is a result of intentional efforts to build a historic ceramic type collection that resulted in the recovery of some 330 ceramic artifacts that are protohistoric-historic or historic in age.

Food

At 436 artifacts, food-related items were by far the single largest collected artifact category from the project. Some 330 ceramics, 78 bottles and jars (including fragments), 5 bottle/jar closures, 15 tin cans, 6 pieces of flatware, 1 can opener, and 1 pot handle were collected. The following section addresses these artifacts in this order.

Ceramics

A total of 330 ceramic artifacts, including 54 protohistoric-historic ceramics representing some 29 vessels and 276 historic ceramics representing some 156 vessels, were collected during the project. These are addressed in detail in Appendix 13 and are only summarized here. The protohistoric-historic ceramics represent a body of locally made vessels that follow a tradition believed to have persisted from at least ca. A.D. 1450 to ca. 1950 along the Rio Grande corridor, primarily in the La Junta district, but also, clearly, for some distance downriver as well. Excluding redundant sherds from the same vessel, this body of ceramic artifacts consists of 12 plainware sherds, 6 red-on-brown sherds, 4 "massive-ware" sherds, 2 mold-made plainware sherds and one each of a hand-molded miniature bowl, a hand-molded object, a mold-made earthenware, and a mold-made incised earthenware. These ceramics were collected from only nine sites, all of which are located along the Rio Grande. These protohistoric to early historic ceramics reflect the relative antiquity of these sites, notably San Vicente and Pantera.

Of the historic ceramics, 71 are Euro-American, 70 are Mexican Glazed, 12 are unclassified, and 3 are unglazed earthenwares. This body of ceramics is believed to have been made outside the region. Of the four categories, the Mexican Glazed wares are the oldest, with dates as early as ca. A.D. 1600 (Presidios Green), although some varieties, such as the Galera Tradition, extend into modern times. The Euro-American ceramics range from an early date of ca. A.D. 1825 for Albany Slip Stoneware to the present-day, as represented by White Ironstone. Dates for the unclassified and unglazed are unknown but are estimated to range from ca. A.D. 1800 to 1940. For detailed descriptions and plates of recovered ceramics, see Appendix 13.

Bottles and Jars

A total of 78 bottles, jars, and bottle/jar fragments were collected during the survey consisting of 17 complete bottles, 57 bottle fragments, 1 complete jar, and 3 jar fragments. In addition, five bottle or jar closures were collected and are addressed in this section. For ease of discussion, the four jars and jar fragments will be included with this discussion of bottles and bottle fragments rather than being treated separately. Of the complete bottles, the majority (n=10) are medicine bottles and the remainder are of a variety of types, including a food jar, a milk bottle, a ribbed sauce bottle, a log cabin syrup bottle, a mentholatum jar, a perfume bottle, a liquor bottle, and a "teapot" salt shaker.

The following discussion separates collected bottles and fragments into two primary categories based on method of manufacture: earlier mouth-blown bottles, and later machine-made bottles. Under these broad headings, bottle and bottle fragments are further classified by morphological characteristics based on the finish (lip) style when present (as it is one of the better diagnostic elements that often allows for temporal and functional classifications). For bottles lacking the neck and lip, characteristics of the base, body, or color are used as a basis for classification. The following breakdown includes 33 bottles and fragments that were mouth-blown, 27 that were machine made, and 22 of unknown manufacture.

Unless otherwise indicated, this section is based upon the comprehensive Historic Glass Bottle Identification & Information Website maintained by the Society for Historical Archaeology (Lindsey 2010).

Mouth-Blown Bottles and Fragments

Thirty-three bottles and bottle fragments were identified as being mouth-blown. These bottles were handmade by skilled craftsmen using a blowpipe to gather the hot glass before forming the bottle with air pressure by mouth, typically with the aid of a mold. Although the glass bottles were made as early as 1500 B.C. in the Middle East, their production and use in the U.S. was limited until the mid-nineteenth century when screw-top mason jars and patent medicine bottles began to be marketed widely. Almost all mouth-blown bottles were manufactured prior to 1900 and—because the Big Bend was settled relatively late—are far less common in the region than machine-made bottles. Generally, historic sites in the Big Bend that pre-date 1900 tend to have more ceramics than glassware, a trend that is reversed with more recent sites.

Of the 33 mouth-blown bottles and fragments, 5 have applied lips, 27 have tooled lips, and 1 is unknown. These lip types represent variations in manufacturing of mouth-blown bottles (a temporal trait), rather than the lip "style" which is more indicative of the bottle's function. Applied lips are a finish type in which the glass for the lip was "applied" to the bottle after it was severed from the blowpipe. This earlier method of lip making was most common between 1820 and 1890 and bottles of this type represent the very earliest of those collected during the survey. By contrast, tooled lips are made in a mold, along with the rest of the bottle, and then are refired and "tooled" to create a more uniform opening. This method of finishing was most common between 1890 and 1920 and represents the more recent of the mouth-blown bottles. Both methods became obsolete when the industry transitioned to machine-made bottles.

Applied Lip

All five of the bottles with applied lips are fragmentary, and two of the fragments refit to form a single bottle (downsizing the tally of applied finishes to only four vessels). Two of these bottles have a "patent" style finish, or flat finish—where the lip is in the form of a band that is wider than the neck and has been rounded or squared off. The first of these, collected from BIBE1920 (Figure 6-III.46a), is lightly amethyst colored and, like a great many collected or observed during the survey, is made of "solarized" glass also known as "sun colored amethyst" (SCA) glass—a type that used manganese dioxide as a decolorizing agent. With exposure to the sun, this glass turns varying shades of purple depending on the amount of manganese used and the degree of sun exposure. Because most of these bottles were manufactured between 1890 and 1920, they serve as useful temporal diagnostics.

The second applied lip bottle fragment with a patent finish, collected from BIBE1204, is of aqua colored glass—a color resulting from iron impurities in the sand used to make the glass (Figure 6-III.46b). With the exception of soda bottles, this glass color became uncommon after 1920 when colorless (clear) glass began to replace it.

The last three applied lip bottle fragments all have a "brandy finish"—one that is tapered towards the top and has a ring just below the main lip. This style was common on bottles manufactured between the 1860s and the 1920s—when external threaded closures began to dominate the market. It was used primarily for liquor bottles and flasks as well as larger medicine bottles. The first of these, collected from BIBE1942, is amber in color (Figure 6-III.46c). The last two applied lip fragments with a brandy finish were collected from BIBE1842 and refit to form a single vessel.

Tooled Lip

Of the 27 mouth-blown bottles and fragments with tooled lips, 7 have patent finishes, 6 have brandy finishes, 6 have oil finishes, 2 have champagne finishes, and there is one each of a blob finish, a bead finish, a club sauce finish, a crown finish, an external thread finish, a spring and cap finish, and one body sherd of unknown finish style.

Figure 6-III.46 Mouth-blown, applied lip bottles: (a) patent finish, SCA; (b) patent finish, aqua; (c) brandy finish, amber.

Patent Finish

The first of these, and the only complete tooled lip bottle with a patent finish, was collected from BIBE1942. It is amber in color and the body has twelve vertical panels forming a dodecagon shape and the base has three small dots around its edges (Figure 6-III.47a). The remaining tooled-lip bottles with patent finishes are fragmentary, missing both the bodies and bases. Three of these bottles are of SCA glass, two of which were found at BIBE1920. One of these has turned a very deep shade of purple and the other is a light translucent purple (Figure 6-III.47b and c). The third SCA bottle in this category was also collected from BIBE1942 (Figure 6-III.47d). Another tooled-lip bottle with a patent finish made of colorless glass was collected from BIBE1318 (Figure 6-III.47e).

The last two tooled lip bottle fragments appear to be variations of the patent finish. An amber bottle fragment found at BIBE1920 has a small rounded collar directly underneath the lip (Figure 6-III.47f). The second, found at BIBE1910, is wider than is typical of bottles with this style of finish (Figure 6-III.48). The inside of the bore measures about 2.5 inches in diameter suggesting it might have been part of a vase or other decorative vessel. This fragment also has "straw marks" on the outside of the neck and what remains of the shoulder—wavy lines that result from gathering or blowing the glass when the vessel was made.

Brandy Finish

Six fragmentary mouth-blown bottles with tooled lips collected during the survey have a brandy finish. This is

Figure 6-III.47 Mouth-blown, tooled lip, patent finish bottles: (a) Dodecagon amber; (b) dark SCA; (c) light SCA; (d) light SCA; (e) colorless, (f) amber.

Figure 6-III.48 Mouth-blown bottle with tooled lip, wide-mouth, patent finish, SCA glass.

characterized by a lip that is usually taller than it is wide and flares slightly from top to bottom. Just below the lip is a narrow collar. The first two, from BIBE1920, are of SCA glass—one a light purple (Figure 6-III.49a) and one a dark purple (Figure 6-III.49b). The former is in two pieces consisting of the finish and a small body fragment with "MADE" embossed on it. Part of the "M" is missing and no other identifying marks remain. Two of the tooled lip bottles with brandy finishes are amber in color. The first came from BIBE1942 (Figure 6-III.49e) and the second one is a small fragment from BIBE1842. The last two brandy finishes are both of colorless glass—one from BIBE1910 (Figure 6-III.49c) and the other from BIBE1942 (Figure 6-III.49d).

Oil Style Finish

Six of the tooled lip bottles have oil finishes—a finish whose height is equal to or greater than its width, with a gradually widening taper towards the base. Very similar to the brandy finish, it is distinguished by the absence of a ring below the lip. The oil finish was used on a wide array of bottle types between the 1830s and the 1920s and was most commonly used on proprietary and patent medicine bottles. Five of the oil-finished bottles are of amber colored glass. Two came from BIBE1842, two from BIBE1942 (Figure 6-III.50a and c), and one was collected at BIBE0593 (Figure 6-III.50b). The last oil-finished bottle, of aqua colored glass, came from BIBE1920 (Figure 6-III.50d).

Champagne Finish

Two of the tooled lip bottle fragments have a champagne finish (Figure 6-III.51a and b), characterized by a flat band of glass "wrapped" around the outside perimeter of the neck just below the lip. This band was used to secure the wiring for a cork, critical for

Figure 6-III.49 Mouth-blown, tooled lip bottles: (a) brandy finish, SCA; (b) brandy finish, SCA; (c) brandy finish, amber; (d) brandy finish, colorless; (e) brandy finish, colorless.

Figure 6-III.50 Mouth-blown bottles with tooled lip and oil style finish: (a) amber; (b) amber; (c) amber; (d) aqua.

Figure 6-III.51 Mouth-blown bottles with tooled lip and champagne finish.

carbonated beverages—such as champagne and beer. It is most commonly seen on wine and champagne bottles dating from the early nineteenth century to the present. Both bottle fragments came from BIBE1942 and are of green glass, one of which still has a complete neck and part of the upper bottle body intact.

Blob Style Finish

One of the tooled lip bottle fragments has a blob finish that, as the name suggests, consists of an outwardly rounded "blob" of glass (Figure 6-III.52a). It is a style that has many variations and is most commonly found on soda and mineral water bottles from the 1840s to the 1920s. Collected from BIBE1942, this bottle fragment is made of green glass.

Crown Finish

One of the tooled lip bottle fragments has a crown finish intended for a crown cap closure (Figure 6-III.52b). This finish is characterized by a rounded narrow "bead" around the lip and a rounded or flattened lower part which can vary in size and shape. First patented in 1892, this style—most commonly found on soda and beer bottles—did not become popular until the early twentieth century and persists to this day. This amber bottle fragment was collected from BIBE1318.

Bead Finish

One of the tooled lip bottle fragments has a variation of the bead finish— characterized by a rounded

Figure 6-III.52 Mouth-blown bottles with tooled lip: (a) blob style finish; (b) crown finish; (c) bead finish; (d) club sauce finish; (e) external thread.

ring of glass—but which, in this case, has a flattened lower edge (Figure 6-III.52c). It is the top part of a cylindrical "ring shoulder cone" ink bottle made out of SCA glass. This style of bottle is typified by a body that tapers inwardly from the base upwards, terminating below a flared shoulder ring. Collected from BIBE1920, this type of ink well was popular from about 1870 to the 1920s. This fragment may be the top to a Carter's ink well base that was also found at BIBE1920 and will be described in further detail in the section on bases.

Club Sauce Finish

Another of the tooled lip bottle fragments, found at BIBE1942, is aqua colored with a club sauce finish (Figure 6-III.52d). There is a cork seat just inside the bore where a club sauce style stopper would sit. This type of finish has three parts to it: a small rounded lip, a longer middle section that tapers slightly outward, and a small rounded bottom collar. This finish was most commonly used by Lea & Perrins sauce bottles, and the company may have originated the style as early as the 1850s.

External Threads

One of the mouth-blown bottles had external thread closure, characterized by a ridge around the outside surface of the finish intended for a cap that tightened when twisted. This type of closure appears in the 1890s although it became much more common after 1920 with the advent of machine-made bottles. The fragmentary, colorless tooled-lip bottle, from BIBE1910, was probably a ketchup bottle based on the vertical panels visible on the fragmentary neck.

Cap and Spring

One cap and spring closure bottle is a wide-mouthed canning jar from BIBE1910 (Figure 6-III.52e). This jar style dates back to the invention of the Mason fruit jar in 1858 and continues to the present. The last bottle fragment that was mouth-blown, was collected from BIBE1910. It is a decorative body fragment of SCA glass but lacks diagnostic elements of the neck or finish.

Machine-Made Bottles and Fragments

Twenty-seven of the collected bottles and bottle fragments showed evidence of machine manufacturing—bottles that were made using a glass mold and machine-supplied air pressure. Although semi-automatic machines were in use by 1898 and the first fully automated bottle making machine was introduced in 1905, the transition from mouth-blown to machine-made bottles was gradual. However, by 1917, approximately 90 percent of all U.S. bottles were machine-made.

Of the 27 machine-made bottles and fragments, 16 are complete bottles and 11 are fragmentary. Twenty-four of the machine-made bottles or bottle fragments retain their finish, 11 of which have external threads, 4 of which have a patent finish, 2 of which have a bead finish, 2 of which have a brandy finish, one of which has an oil finish, one of which has a capseat finish, one of which has a crown finish, one of which has a doublering finish, and one of which has a reinforced extract finish.

External Threads

Eleven machine-made glass bottles and bottle fragments were collected that have external thread finishes, intended for a screw-top lid. Five of these bottles—all complete, colorless glass bottles—were collected from BIBE1442, a dumpsite in the Chisos Basin that was affiliated with a Civilian Conservation Corps (CCC) Camp occupied either between 1934 and 1937, during the first CCC occupation, or between 1940 and 1942, during the second occupation. The artifactual evidence actually supports both.

The first bottle from BIBE1442 has a very small bore (top opening) called a "sprinkler top" that is typically used for toiletry items such as colognes or hair tonics (Figure 6-III.53a). The second bottle has a conventional wide-mouth screw top (Figure 6-III.53b). Both bottles were made by the Owens-Illinois Glass Co. established in 1929 at which time the "Diamond IO" maker's mark began to be used on their bottle bases. The first of these two bottles has a base stamp of "S-P Laboratories/ N.Y./Dallas/ Diamond-IO/ 7/6/3" and the second has a "Diamond IO/7/0/7" stamp on its base. The first "7" on these bottles indicates that they were made at the plant in Alton, Illinois. The middle number "6" on the first bottle signifies the production date as 1936. Although the "0" on the second could stand for either 1930 or 1940, based on context, it was most likely the latter. By 1942, the company began adding a period after the digit to set it apart from the 1930s bottles (Lockhart 2004).

The third screw-top bottle from BIBE1442 is another toiletry bottle (Figure 6-III.53c). The base is embossed with "3 Rivers" and a five-pointed star emblem, below which is a "15" and a "1." This bottle was made by the Three Rivers Glass Company located in Three Rivers, Texas that manufactured bottles from 1922 to 1937. Because all the bottles produced in their first two years were mouth-blown, this machine-made bottle was likely manufactured between 1925 and 1937 (Hinson 1996).

The fourth bottle from BIBE1442 has "3i" embossed on one side of the body and a "B" and a "3" in circles stamped on its base (Figure 6-III.53d). The B in a circle was first used in 1925 by the Brockway Machine Bottle Company located in Brockway Pennsylvania. The company later changed their name to Brockway Glass Company in 1933 and remained in business until 1988 when it was purchased by the Owens-Illinois Glass Co. The "3" could possibly represent the plant number or the year but in this case it is unknown (Whitten n.d.).

Figure 6-III.53 Machine-made bottles with external threads: (a) sprinkler top toiletry; (b) wide-mouth; (c) 3 rivers toiletry; (d) Brockway Machine Bottle Co.

The last bottle recovered from BIBE1442 retains its metal screw-on cap that covers a sprinkler top finish which indicates it was a toiletry item (Figure 6-III.54). The base is embossed with a "6," an "N" in a square, and an "82-B." The "N" in a square indicates the bottle was made by the Obear-Nester Glass Company that operated from 1894 to 1978 in East St. Louis, Illinois. In 1915 the company started using an "N" inside of a square as their maker's mark which persisted until 1978 when the plant closed. Thus, this bottle was made sometime between 1915 and 1978 (Whitten n.d.).

The remaining six machine-made screw-top bottles include four complete bottles and two bottle fragments. Three of the complete bottles are colorless. The first of these was collected as an isolated find (IF009) and has a "3," and an "N" in a square embossed on its base indicating it was made by the Obear-Nester Glass Company (Figure 6-III.55a).

The second complete colorless bottle was recovered as IF097 and was made by the Log Cabin Syrup Company that was founded in 1887 by Patrick J. Towle (Figure 6-III.56; logcabinsyrups.com). This bottle retains its metal screw on cap and has a "5," a Log Cabin emblem, a "7" and "Log Cabin Syrup" stamped on its base.

The third colorless screw-top bottle was recovered as IF017 (Figure 6-III.57). This bottle has a base stamp that reads "R-224" / "68-4" / "1." One side of the bottle's body bears an embossed bulls-eye and arrow emblem and the opposite side is embossed with "ONE

Figure 6-III.54 Machine made bottle with external threads, sprinkler top toiletry, Obear-Nester Glass Co.

PINT" and "Federal Law Forbids Sale or Re-Use of This Bottle." This statement was required of all liquor bottles sold in the U.S. between 1935 and 1964.

The last complete screw-top bottle is a Mentholatum jar made out of milk glass collected as IF024 (Figure 6-III.55b). This jar retains its metal lid on which is stamped "Mentholatum." On the base of the jar is embossed "Mentholatum" and "Reg / Trade / Mark." The Mentholatum Company was established by Albert Alexander Hyde in Wichita, Kansas in 1889 (mentholatum.com n.d.).

The remaining two screw-top bottles are incomplete fragments that have missing bases. The first, found at BIBE1910, was from a small colorless glass jar in which a small portion has started to turn amethyst giving it a date between 1890 and 1920. The final artifact in this category was an amber bottle fragment recovered from BIBE1942.

Patent Finish

Four machine made bottles collected during the survey have "patent" or flat finishes, three of which are complete. The first of these, found at BIBE1942, is of amber glass and bears an "8" with a Diamond-dot stamped on its base—a variation of the maker's mark used by the Illinois Glass Co (Figure 6-III.58). Other variations include diamonds with an "I" either with or without serifs. All were used from 1915 until 1929 at which point the company merged with the Owens Bottle Co. to create the Owens-Illinois Glass Co. (Lockhart et al. 2005).

The second complete bottle with a patent finish is a colorless bottle collected from BIBE1726 (Figure 6-III.59 a). It is a small medicine vial that still has its rubber stopper and a base stamp of "TCW" / "CO" / "USA." This stamp was the trademark used by the T.C. Wheaton Company founded by Dr. Theodore Corson Wheaton in 1888. This stamp remained in use until

Figure 6-III.55 Machine made bottles with external threads: (a) Obear-Nester Glass Co.; (b) Milk glass mentholatum jar.

1946 when the company name changed to Wheaton Glass Company at which time the marker's mark was also modified (wheaton.com n.d.).

The last complete bottle with a patent finish came from BIBE2267 (Figure 6-III.59b). Made of colorless glass, the base stamp reads "W-1" / "73" and part of a label remains on the side of the bottle although no print can be seen. This bottle is of unknown manufacture. The last patent finish bottle, recovered from BIBE1942, is fragmentary (Figure 6-III.59c). Made out of green glass, the neck is mostly intact and only a small portion of the body remains.

Bead Finish

Two machine-made bottles have a bead finish, both of which are complete. The first, from BIBE1726, is a small, faceted medicine bottle of amber glass that still has its rubber stopper (Figure 6-III.60a). Embossed on the body of the bottle is "—15 mils" and "—10 mils" and a diamond-IO above a "7" / "2" / "5" stamped on the base. This stamp indicates that it was made by

Figure 6-III.56 Machine made bottle with external threads, Log Cabin Syrup Co.

Figure 6-III.57 Machine-made bottle with external threads, embossed liquor bottle.

Figure 6-III.58 Machine-made bottle with patent finish, amber.

Figure 6-III.59 Machine-made bottles with patent finish: (a) medicine bottle; (b) round colorless; (c) green bottle, incomplete.

Figure 6-III.60 Machine-made bottles with bead finish: (a) amber medicine bottle; (b) colorless, octagonal.

the Owens-Illinois Glass Co. in either 1932 or 1942 at the plant in Alton, Illinois (Lockhart 2004).

The second bottle with a bead finish is from BIBE2071 (Figure 6-III.60b). It is of colorless glass with eight vertical panels forming an octagonal shape. The base is stamped with an "8" beside an "O" inside a box and a "0." This bottle was made by the Owens Glass Co. which used the "Box O" as a maker's mark from 1919 to 1929. The number to the left of this mark indicates the factory in which it was made and the number to the right indicates the year of production. Thus, the bottle indicates it was made in 1920 at Factory #8 at the Glassboro, New Jersey #2 location. The Owens Bottle Machine Co. was established in 1903 when Michael J. Owen produced the first automatic bottle-making machine (Lockhart et al. 2010).

Brandy Finish

Two machine-made bottles, both fragmentary, have a brandy finish. The first, IF098, only lacks a small part of the finish but is otherwise complete (Figure 6-III.61a). This light SCA bottle has a base stamp that reads "W.W." in script lettering but is of unknown manufacture. The second brandy finish bottle is also SCA but has only a very light hint of purple (Figure 6-III.61b). Found at BIBE1910, it has a "cork seat"—a small ledge just inside the bore where a club sauce stopper would sit.

Oil Style Finish

Only one machine-made bottle recovered during the survey has an oil style finish—a colorless glass fragment that came from BIBE1920 (Figure 6-III.62a). As indicated previously, these were used on a wide array of bottle types between the 1830s and the 1920s, most commonly on proprietary and patent medicine bottles.

Capseat Finish

One machine-made colorless glass milk bottle was recovered from BIBE1445 that has a capseat finish—a finish used almost exclusively for milk bottles (Figure 6-III.62b). The mouth is wide with a ledge just inside the opening where a wax-coated paper cap would sit. Embossed on the top side of the bottle is "One Half Pint" / "Liquid" and an "L.G." is embossed on the heel.

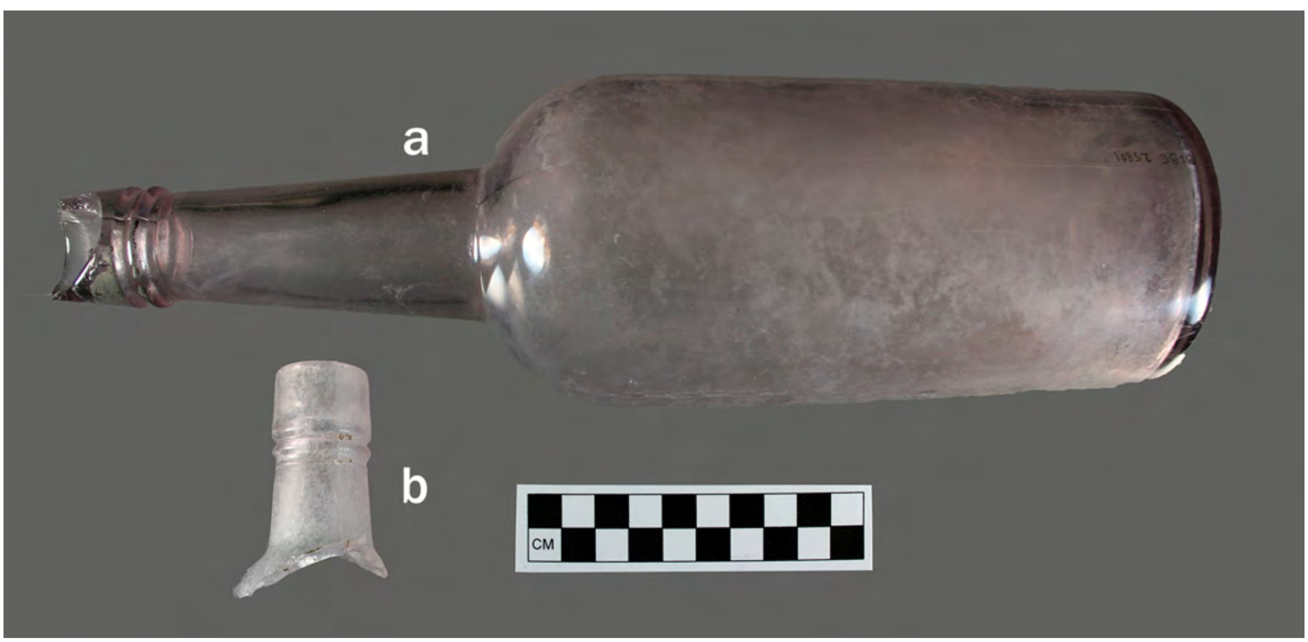


Figure 6-III.61 Machine-made bottles with brandy finish: (a) large SCA; (b) cork seat.

Figure 6-III.62 Machine-made bottles with various finishes: (a) oil style finish; (b) capseat finish; (c) crown finish; (d) reinforced extract finish; (e) double-ring finish.

In the center of the body is a circle with embossed words "Phone 151" / "Orient/Alpine, TX" inside of it. Embossed on the back of the bottle is "Sealed" / "52." There is no base stamp.

This bottle was manufactured by the Liberty Glass Co. based out of Liberty, Oklahoma. Established in 1918, the company produced only milk bottles until 1935. The L.G. maker's mark was used between 1924 and 1934 and, starting in 1928, date codes were added to the bottle. Because this bottle lacks a date code, it likely dates between 1925 and 1927 (Lockhart 2004). The Orient Dairy was established in the early 1920s in Alpine, Texas by Flora Matthews, later joined by her husband Walter Matthews who ran the dairy for many years (Matthews interview 1988).

Crown Finish

Only one machine-made bottle recovered during the survey has a crown finish (Figure 6-III.62c). Collected from BIBE1942, this fragmentary bottle is made out of green glass. There are no other identifying features.

Double-Ring Finish

One machine-made bottle has a double-ring finish which consists of two rounded rings on top of each other (Figure 6-III.62e). The top ring, forming the lip, is slightly wider than the bottom ring and both are rounded in profile. The bottle, collected from BIBE185, is complete and has a base stamp that reads "7" / "U" / "460". The entire length of the body has horizontal ribs with a round "window" on one side, likely for a label. This style of bottle, a condiment bottle known as a "ring pepper sauce" or "oval ring pepper sauce" style, was first made in the late 1890s and continued to be produced up through the early 1930s.

Reinforced Extract Finish

One complete, machine-made bottle collected from BIBE1825 has a "reinforced extract finish" characterized by a small squared-off lip with a slightly longer lower collar (Figure 6-III.62d). This type of finish was used primarily on proprietary medicine and druggists bottles. It bears a base stamp of "N" indicating it was made by the Obear-Nester Glass Company although its date of manufacture is unknown (Whitten n.d.). On the side of this bottle are measurement markings indicating that it was possibly a medicine or vaccine vial.

Unknown Manufacture/Miscellaneous

A total of 20 bottle/glass fragments were collected that are of unknown manufacture, including 9 bottle bases and 11 body sherds. These are further classified by glass color. In addition, one saltshaker and four different bottle closures—two stoppers, one lightning closure, and one mason jar lid—are discussed.

Bottle Bases

Nine bottle bases and base fragments were collected during the survey, which are organized here by glass color. Four of these bases are SCA glass, two are amber, two are colorless, and one is blue. The first SCA base was recovered from BIBE1920 and has a "Carter's" / "N" / "5" / "1" / "Made in U.S.A." embossed on it (Figure 6-III.63a). This is the base from a Carter's ink well

Figure 6-III.63 Bottle bases: (a) Carter's Ink; (b–c) Armour's; (d) St. Louis, Mo; (e) Diamond dot; (f) 14/18; (g) Vick's Vaporub; (h) Charles Boldt Glass Co.; (i) 1548.

and might be the bottom half of the ink well described under machine-made, bead-finished bottles described above. This ink was first sold in 1858 by William Carter under the name "Carter's Combined" (cambridgehistory.org; Whitten n.d.). The "N" indicates it was made by the Obear-Nester Glass Company. The "5" might indicate the date and, considering that it is SCA glass, it was likely made in 1905 (Whitten n.d.).

The next two SCA base fragments were both found at BIBE1318 and, when refitted, read "Armour's" / "Top Notch Brand" / "Chicago" (although the "T" is missing for the word "top") (Figure 6-III.63b and c) This bottle, made for the Armour Company of Chicago Illinois, was most likely for Armour's Grape Juice, as seen in a 1912 advertisement (National Association of Retail Druggists 1912:52). However, Armour and Company, founded in 1867 by the Armour borthers, was better known as a major American meatpacking company. The last SCA base just has a very light tint of purple (Figure 6-III.63d). It was found at BIBE0593 and bears a base stamp but, because it is fragmentary, only "Smith" and "St Louis Mo" is legible.

Two of the collected bases are made of amber glass. The first, from BIBE1709, has a "Diamond-dot" stamp on its base which used by the Illinois Glass Co. between 1915 and 1929 (Figure 6-III.63e; Lockhart et al. 2005). The second amber base, recovered from BIBE1658, is fragmentary and only a "14" and "18" are legible (Figure 6-III.63 f).

Two additional bases are made of colorless glass, both collected from BIBE1910. The first is stamped with a "B" with serifs and is oval in shape suggesting that it was a whiskey flask (Figure 6-III.63h). The Charles Boldt Glass Company used the "B" with serifs on their whiskey bottles from 1910 to 1919. The company was founded by Charles Boldt in 1900 in Cincinnati, Ohio. By 1909 the company was using Owens automatic bottling machines to produce liquor bottles, a practice that came to an abrupt halt in 1919 with Prohibition (Lockhart et al. 2007).

The second colorless glass base from BIBE1910 only has a stamp of "1548" (Figure 6-III.63i). No other information could be found on this base. The last base, collected from BIBE1942, is blue in color and has a triangle within a triangle trademark indicating it is a Vicks Vaporub bottle. The Vicks Company was started in the 1890s by Lunsford Richardson and continues to be a household name today (Figure 6-III.63g; vicks.com n.d.).

Bottle Body Fragments

A total of 11 bottle body fragments were collected during the survey. Like the bases, these are organized by color: 3 are colorless, 2 are SCA, 2 are purple, and there is one each of amber, aqua, green, and blue-green glass. Of the colorless bottles, all are fragmentary and one is edge modified. The first was collected at BIBE1920. Embossed on one side is "mberlain's . . . ic . . .Cholera and . . . hea Remed . . ." which, if complete, would read "Chamberlain's Colic Cholera and Diarrhea Remedy" (Figure 6-III.64a). The Chamberlain Medicine Co. was started in 1872 by Lowell Chamberlain. Based in Des Moines, Iowa, it began nationwide distribution in 1892. The artifact dates between this date and 1925 when the company was sold (chamberlainlotion.com n.d.).

The remaining colorless bottle fragments are both from BIBE1910. The first has horizontal ribs, and may have come from a sauce bottle (Figure 6-III.64b). The last colorless bottle fragment is edge-modified on one side, one of only two edge-modified glass fragments discovered during the survey (Figure 6-III.64c).

Both SCA colored bottle fragments were collected from BIBE1920. The first retains a portion of its double-ring finish. Although not enough of the bottle remains to know its method of manufacture, its SCA coloration indicates a date between 1890 and 1920. The second SCA colored fragment is a piece of a Vaseline jar (Figure 6-III.64d). Although most of the embossing is missing, it would have read "VASELINE / CHESEBROUGH / NEW-YORK." This bottle would have been machine-made with an external thread closure.

Figure 6-III.64 Bottle body fragments: (a) Chamberlain's Colic Cholera and Diarrhea Remedy; (b) ribbed; (c) edge-modified, colorless; (d) Vaseline; (e–f) floral embossed; (g) bifacially edge-modified, amber; (h) teal sherd.

In 1859, chemist Robert A. Chesebrough discovered a waxy material found on drilling rigs that workers would use to heal their wounds. Intrigued by this, he took a sample and eventually was able to establish a petroleum jelly from it that he called Vaseline. By 1870 it was being sold to the general public and went on to enjoy worldwide success to the present day (vaseline.com n.d.).

Of the two bottle fragments that are purple, both were found at BIBE1942. These bottle fragments have floral embossing and are made out of a deep purple glass (distinct from SCA glass) with a shiny iridescent patina (Figure 6-III.64e,f). It appears they came from the same vessel. The next body fragment is an amber bottle sherd collected from BIBE1658 that has been bifacially edge-modified (Figure 6-III.64g). This is the second of two sherds collected during the survey that exhibited edge modification. Amber colored glass has been in use since the early nineteenth century and remains one of the most common bottle colors.

One aqua bottle fragment was collected. Although it retains part of its base, given that the embossing on the sides of the bottle provide more identifying features it is included in this section. Found at BIBE1709, this fragment consists of nine aqua glass pieces that refit to form part of the body of a square-shaped bottle (Figure 6-III.65). Although the embossing is fragmented, it would have read "J.H. McLean's / Volcanic / Liniment" with each side of the square showing a different word. Dr. James H. McLean got his start with "Mexican Mustang Liniment" in the early 1850s and continued on to produce his own line of remedies including McLean's Volcanic Oil Liniment (Matthews 1927). The base stamp has the "Diamond-I" from the Illinois Glass Co., a maker's mark that was used between 1915 and 1929 (Lockhart et al. 2005).

Figure 6-III.65 J.H. McLean's Volcanic Liniment body fragments.

One green bottle fragment was collected from BIBE1942 consisting of four refitted bottle sherds with applied color lettering indicating it to be from a Royal Crown Cola bottle (Figure 6-III.66). In 1905 Claud A. Hatcher started the Union Bottling Works in Columbus, Ohio, and began producing sodas. In 1934, Royal Crown or RC Cola was introduced and quickly became a top seller and a household name that is still produced today (R.C. Cola International n.d.). The last bottle fragment is a blue-green or teal colored glass sherd from BIBE859 that has no identifiable markings (Figure 6-III.64h).

Miscellaneous

Six artifacts are addressed under the miscellaneous heading, consisting of 1 complete salt shaker, 3 bottle closures, and 2 jar lids. Collected as IF922, the salt shaker is approximately 2.25 inches in maximum width and 3 inches tall (Figure 6-III.67). The bottom half is made of decorated colorless glass consisting of a beaded base and an outward bulging top with curved rib design. The top half is made of nickel or silver plated aluminum and resembles a teapot, complete with handle, spout, and lid. The body of the teapot has a floral design. The top of the shaker has five shaker holes that occur asymmetrically. This shaker was made by the Century Metalcraft Corp. of Los Angeles for Guardian Service Cookware. Matching salt and pepper shakers like this one were given as hostess gifts for cookware parties in the 1940s and 1950s. A fire in 1956 marked the end of the brand (Rubylane Website n.d.; Guardian Service Website n.d.).

The last five artifacts are types of bottle or jar closures. The first two are versions of glass and cork bottle stoppers. With this style of closure, the shank of a stopper was placed into a cork shell which provided a tight seal against the bore of a bottle. The first, collected from BIBE1910, is a club sauce stopper (Figure 6-III.68a). Used with bottles having a cork seat, this artifact is made of amber glass with a horizontally round head

Figure 6-III.66 Royal Crown Cola bottle body fragments.

Figure 6-III.67 Century Metalcraft teapot saltshaker.

Figure 6-III.68 Bottle and jar closures: (a) glass club sauce stopper; (b) glass peg stopper; (c) glass lightning closure lid fragment.

and a tapered shank. As the name suggests, this closure was typically used on sauce bottles and occasionally other bottles dating from the mid-1800s through the mid-1900s.

The second stopper, known as a peg stopper, was found at BIBE2030 (Figure 6-III.68b). Made of SCA glass, it is relatively close in style to the club sauce stopper except it has a straight shank with mold seams, or ridges, that would secure it to the cork. Characteristic of peg stoppers, it has an ornate head which, in this case, resembles a crown. This style of stopper was used for toiletry items such as perfumes or cologne bottles during the last part of the 1800s and the first portion of the 1900s.

The third closure, collected from BIBE1942, is a lightning-style closure with a raised groove and only the words "The / Patented M" remain on its top (Figure 6-III.68c). This style of lightning closure was used for canning jars and consisted of a neck tie-wire that secured it to the jar, a bail that went over the top and between the raised grooves on the lid, and a lever wire that was pushed down securing the lid into place. Such closures were used from the 1880s through the mid-1900s.

The last two closures are Mason jar lids. Although not made of glass, they are included in this section based on function. The first lid was collected from BIBE2025 and, although slightly deformed, it measures 2.7 inches in diameter (Figure 6-III.69a). It is made of ferrous metal and retains vestiges of gold paint. Stamped on the top of the lid is "BERNARDIN" curving around the top, "MASON CAP" in the middle, and "EVANSVILLE, IND" curving around the bottom. The Bernardin Bottle Cap Company was established in 1881 and specialized in metal closures. Its founder, Alfred L. Bernardin, invented a number of closure types including crown caps and metal screw caps. After WWI, the company began producing the Bernardin two-piece mason caps for home canning (Barnhart and Carmony 1954).

Figure 6-III.69 Mason jar lids: (a) Bernardin Mason cap; (b) "Genuine Boyd Cap."

The second Mason jar lid, from BIBE1920, is made of zinc and, although partially crushed, measures approximately 2.75 inches in diameter and 0.63 inches tall (Figure 6-III.69b). The top of the lid has one circular indented area approximately 1.5 inches in diameter. Around the perimeter of the top of the lid is stamped "GENUINE BOYD CAP" at the top and "FOR MASON JARS" at the bottom. These are separated on both sides of the cap by a barbell like design with an "X" through it on either side of which is a teardrop shaped design.

This lid is part of a two-part capping system for mason jars that was patented by Lewis R. Boyd in March of 1869. Metallic lids, such as this one, were used in conjunction with glass inserts in order to address the problem of corrosion of metallic caps that came in contact with food in mason jars (as well as the off flavor imparted to the food). Boyd's hybrid system incorporated both elements of a cheap metal cap with an inert glass insert. Although the writing stamped on the lid apparently changed through the years, this particular wording is believed to date from ca. 1900 to 1910 (Boyd 1869; Roller 1990).

Cans

Because most diagnostic elements of tin cans can be readily identified in the field, relatively few were collected. Those that were had either interpretive value or were collected based on unique attributes. A total of 15 tin cans and can lids were collected, consisting of 11 baking powder tin lids, 2 other can lids, and 2 sardine tins. The following discussion will address them in this order.

A total of 11 baking powder lids were collected during the project, consisting of 5 KC Baking Powder lids, 2 Clabber Girl Baking Powder lids, 2 Calumet Baking Powder lids, 1 Royal Baking Powder lid, and 1 Dr. Price's Cream Baking Powder lid. Baking powder tins (and lids) are an artifact type that is ubiquitous at regional historic sites in general and nearly synonymous with historic campsites in particular. Although earlier forms had been used since ancient times, modern baking powder, a combination of bicarbonate of soda ($NaHCO_3$) and an acid, was introduced around 1850 as a leavening agent in baked goods. These two substances react by effervescing, producing carbon dioxide, which causes bread to rise without the use of yeast. Because yeast had to be tended and cared for, baking powder offered a less labor intensive, and much faster, alternative. It became popular, especially in the American West, where it was used as a key ingredient for "quick bread" made over an open fire, a frequent staple of pioneers and cowboys (Davidson 1999:73; Mariani 1999:17).

Five KC Baking Powder lids were collected during the project. Three lids, recovered from BIBE2030D[3], BIBE1942 and BIBE1709, are all of the same style (Figure 6-III.70 c and d), stamped with "KC" in the center of the lid with "Baking" above it and "Powder" below it. "True Height Can" is stamped around the top and "Guaranteed" around the bottom. This style is believed to have been produced between 1925 and 1945. A second lid, found at BIBE2030D, has "KC Baking Powder" stamped across the center with "25 CTS" above and below it, "Satisfaction" at the top of the lid and "Guaranteed" at the bottom (Figure 6-III.70j). The final KC lid was from BIBE1976 and has "KC" in the center with "Baking" above it and "Powder" below it and "10 cts" on both sides (Figure 6-III.70b). Although KC Baking Powder was first manufactured in 1890 by Jaques Manufacturing Co., it was not patented until 1911. From that time until ca. 1945, lids were stamped with a variety of different word configurations. The company remained in business until 1950 when it was sold to Clabber Girl Corporation (Rike and Rock 1989).

Two Clabber Girl Baking Powder lids were also collected, one from BIBE2030 and one at BIBE0859. The first has "Clabber Girl Baking Powder" stamped around the edge of the lid and "Double Acting" stamped in the center (Figure 6-III.70h). The latter has "Clabber Girl Full Strength" stamped around the edge of the lid and "Air Tight Seal" in the center (Figure 6-III.70e). The Clabber Girl Corporation originally started in 1879 as Hulman & Company. In 1899 the company started producing "Clabber" brand baking powder and in 1923 it was given the name "Clabber Girl Baking Powder." Thus both of these tin lids date to sometime after 1923 although the product was not marketed in Texas until after 1931 (Fiero 2006; clabbergirl.com n.d.).

Two Calumet Baking Powder lids were collected from BIBE2030. One has "Calumet" and "5lbs" at the top, "Baking Powder" across the center and "Full Weight Absolutely Pure" stamped on the bottom (Figure 6-III.70a). The other has "Calumet" at the top, "Baking Powder" across the center and "1 lb Absolutely Pure" at the bottom (Figure 6-III.70f). Calumet Baking Powder was created by William Wright in 1889. He remained in business until 1929 when he sold his company to General Foods who continued to produce the brand (kraftfoods.custhelp.com n.d.).

One Royal Baking Powder lid was found at BIBE593 (Figure 6-III.70i). Embossed on the lid is "Royal Baking Powder" across the center, "Full Weight 1/3 lbs" around the top and "Absolutely Pure" around the bottom. The Royal Baking Powder Company was founded by brothers Cornelius and Joseph Hoagland with two investors in 1873 and remained an independent company until 1929 when it merged with four other companies to form Standard Brands Incorporated (Stradley 2004).

The last baking powder lid, collected from BIBE593, is stamped "Dr Price's Cream Baking Powder" across the center of the lid, "The Most Perfect Made" around the top and "1 lb Full Weight" around the bottom (Figure 6-III.70 g). Invented in the 1850s by Vincent C. Price, Dr. Price's Cream Baking Powder became the world's first cream of tarter baking powder. It was

3. Note that some sites, such as BIBE2030, had a number of subsites—or areas—within them that were sequentially designated by letters.

Figure 6–III.70 Baking powder lids: (a) Calumet 5 lb.; (b) KC Baking Powder 10 ₵; (c–d) KC Baking Powder True Height; (e) Clabber Girl Airtight; (f) Calumet 1 lb.; (g) Price's Cream Baking Powder; (h) Clabber Girl Double Acting; (i) Royal Baking Powder .5 lb.; (j) KC Baking Powder 25 CTS.

first manufactured in the 1860s and quickly became a household name (Price 1999).

In addition to the baking powder tin lids, one cocoa lid and one shaker lid were collected. The first, recovered from BIBE1910, is rectangular, roughly 1 x 2 inches, with a downturned lip 0.38 inches wide (Figure 6-III.71c). On the top of the lid is stamped "LOWNEY'S / $^{1}/_{5}$ lb. / COCOA." This is an external friction lid for a Lowney's Cocoa sample, or advertising, tin. The regular size was ½ pound. Based on examples on websites featuring vintage tins, this tin lid probably dates to around 1910. The Walter M. Lowney Company was established in 1890 in Boston, Massachusetts. Its first chocolate plant was built in Mansfield, Massachusetts in 1903 and the company continued operation until the early 1930s (Mulligan 2010).

One small metal pivoting shaker lid was collected from BIBE1942 (Figure 6-III.71d). It is circular, one inch in diameter, with a small (thumb) tab protruding from the edge. Inside is a center pivot hole, a series of smaller shaker holes on one side, and one larger oval pour hole adjacent. This lid was most likely attached to a round spice tin.

One 2.5 x 3.25 inches rectangular tin can was collected from BIBE2067—probably a sardine tin (Figure 6-III.71b). The tin is 0.77 inches deep and is complete except for the lid which appears to have been a side key-strip opening type based on the clean-cut edge. Stamped on the middle of the base of the tin are words, only some of which are legible. At the top, curving downward is the word "ARGENTINA" below which is stamped "M. de A. / ESTAB. No 1." Below that,

Figure 6-III.71 Sardine tins and lids. (a) Sardine tin, soldered seams; (b) sardine tin stamped "Argentina"; (c) Lowney's Cocoa lid; (d) Pivoting shaker lid.

curving upward is the word "INSPECCIONADO." No information could be found on this tin.

The last sardine tin was collected from BIBE2030 that, based on its construction, is probably quite early (Figure 6-III.71a). The tin is crushed and rusted through in places on the bottom side, but is otherwise intact. Originally, it would have measured approximately 3 inches wide by 4 inches long and approximately 0.8 inches tall. It is composed of three separate pieces of sheet metal: one forming the base, one forming the sides, and one forming the top. All seams are soldered lap seams which, based on the irregularities in the soldering, may have been hand soldered. Stamped on the bottom is a one-inch diameter circle surrounded by a raised rib. This may have contained words or symbols at one time but are undetectable now. The tin had no key or score lines and was opened with a knife.

Other

Flatware

A total of six pieces of flatware or flatware fragments were collected, including two complete spoons and four spoon or fork handles. The first, from BIBE1903, is a plain spoon lacking any decoration or ornament, with "M. W. & Co. Panama Silver" stamped on the underside of the handle (Figure 6-III.72a). This spoon was manufactured by Montgomery Ward & Co. and was offered in their 1895 catalog as the "Winsor" pattern of their "Panama Silver" line of tableware, advertised as "the metal of the century . . . solid not plated . . . equal to sterling silver for durability" (Montgomery Ward & Co. 1895:190).

The second, collected as IF025, has "Made in U.S.A." and "900-WB-W" on the underside of the handle

Figure 6-III.72 Flatware and flatware fragments: (a) "Panama Silver" spoon; (b) tin utensil handle; (c) plain utensil handle; (d) cartouche utensil handle; (e) ornate utensil handle; (f) "plain tipped" spoon.

(Figure 6-III.72f). This is a silver plated metal spoon. The handle is thinner near the spoon end, wider towards the end of the handle, with two arches as a decorative element. This spoon pattern is identical to ones offered in the 1902 edition of the Sears and Roebuck and the 1895 Montgomery Ward catalogs, referred to as "plain tipped." The maker's mark indicates it was made by Thomas Bolsover & Sons (ca. 1855–1919) but because they were British and it was made in the U.S., this could be in error (Woodhead 1991:32).

Four flatware fragments were also collected, all of which appear to have been handles to either forks or spoons. In the order of least to most ornate, the first, collected from BIBE1910, is made of thin gauge metal (tin) shaped into a handle—only about two inches of which remains (Figure 6-III.72b). Although it is rusted and corroded, stamped on the front are portions of a series of patent dates, some of which are legible, among them "Mar . . . Pat. June 23 86 . . . Nov . . . 6 . . Dec. 21 86." These seem to indicate the design was patented over a series of months in 1886. This handle most likely went to a spoon intended for camping or picnicking due to its cheap and lightweight construction.

The second handle, from BIBE1942, is very plain lacking any ornament (Figure 6-III.72c). It is broken near the spoon end, at the thinnest part of the handle. It is partly rusted but retains some of its original plating. On the underside is stamped "065" and "L & G." On the front is scratched the initials "W D" and on the underside is scratched "W"—most likely the initials of its owner. This spoon could not be definitely identified, but may have been made by Lamson & Goodnow of Shelburne Falls, Massachusetts, organized in 1856 (industrialhistory.org n.d.).

The third handle, from BIBE1920, is cuprous and is also broken along the narrow part right before the spoon (Figure 6-III.72d). It has a fairly ornate cast design at the end of the handle, similar to a cartouche. On the underside is stamped "Rogers Nickel Silver." This piece was made by the Rogers Brothers Silver Company, established in 1847 in Hartford, Connecticut. The company became famous for their perfection of the electroplating process. Silver nickel is an alloy of copper, nickel, and often zinc (Adler n.d.).

The fourth handle, from BIBE1942, is made of a cuprous metal and is also broken along the narrowest part of the handle (Figure 6-III.72e). It is highly ornate with floral designs along the length of the handle. On the underside, near the thinnest part of the handle, is stamped "R & B." This flatware was also made by Rogers Brothers of Hartford, Connecticut.

Can Opener

One "church key" can opener/piercer was collected from BIBE1646 (Figure 6-III.73). The opener is made of nickel plated steel and is 4.88 inches long and .75 inches wide. One end has the can punch and

Figure 6-III.73 Canco can opener from BIBE1646 (41BS1579).

the other end has a side-open crown cap lifter and a hanging hole. On the face of the opener is stamped "FOR BEER IN CANS MARKED" below which is "CANCO" inside an oval followed by "KEGLINED" below which is "TRADE MARK AM CAN CO." Below the "CANCO" is stamped "PATENTED . . . . 550." On the reverse side is stamped "FOR OPENING / PABST / TAPA CAN / MADE IN UNITED STATES OF AMERICA." This can opener was made by the American Can Company, and was patented in 1935 for use in opening early beer cans before pull tabs were invented (U.S. Patent and Trademark Office n.d.).

Pot/Pail Handle

One possible lightweight pail handle was collected from BIBE593 (Figure 6-III.74). It consists of a thick wire handle bent into a long U shape that is 4.82 inches long and 1.05 inches wide. A piece of sheet metal, 1.97 inches wide, spans the distal part of the handle. Stamped into this are partially legible words "PUSH TO PAIL / WEBER'S PATENT . . ." This artifact is rusted and partially bent. It is unknown if it is complete or was permanently attached to the pail. Because this was found at Neville Spring, it is most likely related to the late 1800s military occupation.

Woodstove Pipe Damper

One pipe damper to a woodstove was collected from BIBE2067 (Figure 6-III.75). This damper is made of nickel-plated sheet metal, is roughly square with rounded corners, approximately 7 by 7 inches in size. Four slotted bolts remain within the screw holes near the intake's four corners—all of which are retained by a square nut. In the middle of the intake is the valve plate—a round piece of sheet tin with three triangular shaped air intake openings. The valve pivots on a center pin and a small metal thumb tab protrudes from the edge of one intake opening. Turning the valve "wheel" causes the intake holes to broaden or narrow to regulate airflow. Although part of the tin plating remains, most of the intake valve is rusted—in one place it has rusted through. Otherwise, this artifact is complete and intact. This damper assembly is one that appeared on Acme Triumph 6-hole steel woodstoves sold by Sears Roebuck around 1912 that had elaborate decorative nickel plated accents around doors, valves, and cleanout trays (Sears Roebuck Catalog 1912:970).

Trunk Pressed Tin Panel

One piece of pressed tin was collected from BIBE2044 (Figure 6-III.76). It is approximately 5 by 11 inches

Furnishings

A total of 9 artifacts of 6 different types were placed under the furnishings category, consisting of 1 woodstove pipe damper, 1 trunk pressed tin panel, 1 kerosene lamp burner, 1 key escutcheon, 1 trunk handle cap, and 4 ferrous keys.

Figure 6-III.74 Wire pail handle from BIBE593 (41BS2491).

in size with one of the long edges downturned at a right angle to create a small lip. Two small cut clinch nails remain in two of the eight holes around its perimeter. The tin is very thin and is stamped with an elaborate floral design of vines, leaves, and flowers. Although rusted through in a few places and perforated in others (nail holes indicating re-use), the artifact appears complete. This piece of pressed tin most likely came from a tin-covered wooden trunk of the type that was very popular during the latter part of the 1800s and early 1900s and could be purchased through mail order companies such as Montgomery Ward and Sears Roebuck (Sears Roebuck Catalog 1902:1018).

Kerosene Lamp Burner

One brass kerosene/oil lamp burner was collected from BIBE1910 (Figure 6-III.77g). This dome-shaped metal object

Figure 6-III.75 Woodstove pipe damper from BIBE2067 (41BS1954).

Figure 6-III.76 Pressed tin panel for trunk from BIBE2044 (41BS2261).

Figure 6-III.77 Various metal furnishings: (a) long skeleton key; (b) short skeleton key; (c) flat steel key; (d) trunk strap handle cap; (e) small skeleton key; (f) ornate key lock escutcheon plate; (g) brass kerosene/oil lamp burner.

has an opening at the top through which the wick would have been raised or lowered to control the flame height. Although the wick ratchet (knob) and the remaining parts of the lamp are missing, this artifact is complete.

Key Escutcheon

One ornate key lock escutcheon plate was collected from BIBE1920 (Figure 6-III.77f). The escutcheon is a flat piece of cast brass with ornate scrollwork designs, and is complete. It has two screw holes for mounting and a keyhole in the center. This type of escutcheon would have been used for trunks, writing desks, or bookshelves.

Trunk Handle Cap

One trunk strap handle cap was collected from BIBE1920 (Figure 6-III.77d). This part would have been used to secure a leather strap handle to the side of a wooden trunk. This cap is a plate with a boxed opening, inside which is a central stud that would have secured the leather strap. This cap is made of cast iron and is complete except for one of the attachment screw holes—a part of the plate that has broken off. There is a decorative design on the face of the cap—a series of raised ribs radiating outward from the center of the open side of the cap—much like the spiral ribs of a seashell.

Keys

Four ferrous keys were collected during the survey, all of which are heavily rusted. Three of these are skeleton keys and one is a flat steel key. Of the skeleton keys, one was collected from BIBE1920 and two from BIBE1942. The former key is thick and short, the shaft only 1.25 inches long (Figure 6-III.77b). The bit extends downward at the distal end of the shaft creating a "C" shape. Part of the bow (the part grasped when in use) is broken. The second key is complete but smaller with a shank measuring only one-inch-long (Figure 6-III.77e). A small, simple bit extends downward at the end of the shank, terminating in an "L" shape. This key was most likely used for a trunk or desk lock. The last skeleton key is the longest, with a shank measuring 2.75 inches in length (Figure 6-III.77a). The bit extends downward to create a square with three notches—one on each upper edge and one in the bottom center. Half of the bow is missing but the key is otherwise complete. This type of key would have been used in a mortise lock in a house door. Skeleton keys are very simple keys with a cylindrical shaft and a single toothed end used to open warded locks, or locks that use obstructions (wards) to prevent the lock from opening unless the correct key is used.

The last key collected is a flat steel key which is solid except for a hole in the top of the bow (Figure 6-III.77c). The shank is flat and is 1.5 inches long. Six small notches are located along the shank, three on each lateral edge. At the end of the shank is a small "nipple" that would have served as a pivot point for the key to turn smoothly. This type of key was used in padlocks commonly available in the early twentieth century (Zork's Hardware Company 1930).

Personal

A total of 213 artifacts in five categories were placed under the "Personal" group which, comprising 24 percent of the total number of collected artifacts, represents the second largest group after "Domestic." The five categories consist of 123 clothing-related artifacts, 34 adornment-related artifacts, 4 grooming/health-related artifacts, 11 social drugs-tobacco-related artifacts, and 41 toys. These artifacts are discussed in this order.

Clothing

The clothing category consists of three major types, or classes, of clothing-related artifacts: "Buckles, Clips, and Clasps"; "Buttons"; and "Other" for a total of 123 artifacts.

Buckles, Clips, and Clasps

A total of 14 buckles, clips and clasps were collected during the BBNP survey. Of these, 7 are suspender buckles, 3 are slide buckles, 2 are clips, 1 is a belt buckle, and 1 is a hook-and-eye clasp.

Of the seven suspender parts recovered during the survey, three of the buckles (technically suspender strap adjusters) are chrome-plated and have markings. The suspender buckle from BIBE1083 has "Shirley President" stamped across the front of the buckle (Figure 6-III.78e). This buckle dates to the early nineteenth century and was made by the C.A. Edgarton Manufacturing. Co. in Shirley, Massachusetts. The company was established in 1881 but merged with The George Frost Co. in the 1930s (Parno 2009; Marcinkewicz 2001). The suspender buckle from BIBE1920 has "Crown Mark "stamped on its reverse side (Figure 6-III.78g). No information could be found about this buckle. Another suspender buckle, also from BIBE1920, has an ornate decoration on top—a ship steering wheel framed within a crown-shaped banner (Figure 6-III.78a).

The remaining suspender buckles, all from BIBE1920, are various parts of suspenders that lack identifying characteristics. One is a suspender strap adjuster, but lacks the rear locking mechanism (Figure 6-III.78f). Another is a suspender hook or loop which attached to a button on the pants (Figure 6-III.78c). The third is a tri-bar slide, used to adjust the length of suspender straps (Figure 6-III.78b). All of these are rusted metal. The last suspender part, however, is chrome plated and has a strap loop on top and a pivoting strap loop on the bottom (Figure 6-III.78d). This was probably used to connect the suspender to straps that ended in tabs that connected to pant buttons.

Three small slide buckles were also collected during the survey, two with teeth and one without.

Figure 6–III.78 Buckles, clips and clasps: (a) Steering wheel buckle; (b) tri-bar slide; (c) suspender hook; (d) pivoting chrome plated suspender buckle; (e) "Shirley President" suspender buckle; (f) suspender strap adjuster; (g) "Crown Mark" suspender buckle; (h) slide buckle; (i) slide buckle; (j) probable necktie clip; (k) brass spring clip; (l) brass slide buckle, 1903 patent; (m) hook from hook-and-eye clasp.

The toothed buckles, from BIBE1910 and BIBE1920, measure about 0.75 inches in diameter and are of box-frame style with a center bar and teeth along one end of the frame (Figure 6-III.78h,i). These buckles have many uses, for shoes, clothing, or anything that required strap tensioning. The third slide buckle, from BIBE1920, is smaller (0.63 inches in diameter), is made of brass, and is similar to those used on women's garment such as a bra (Figure 6-III.78l). Stamped on one side is "pat 4-28-03" indicating a patent date of April 28, 1903.

Two clips and part of a clasp were also collected during the survey. One, from BIBE1910, is a clip with an articulated clip arm. Although heavily rusted, this appears to be a clip for a clip-on necktie (Figure 6-III.78j). The other clip, from BIBE1920, is a spring-clip made of brass and is of unknown function (Figure 6-III.78k). One hook from a hook-and-eye clasp was collected from BIBE1942 (Figure 6-III.78m). This type of light-duty clasp was often used to secure skirts, bras, corsets, and similar garments.

Only one of the buckles collected was used on a standard belt, collected from BIBE1083 (Figure 6-III.79). This is a box-frame style buckle made of silver/copper alloy with a stamped decoration on the face of the buckle. On the reverse side "Giant Grip" is stamped on the slide and "Silver Two Tone" on the side of the belt guide, below which is stamped "Pat 12-13-21," indicating a patent date of 1921. Although little information could be found on the Giant Grip company, based on various internet sources, their belt buckles were popular and widely advertised from the 1910s through at least the early 1940s.

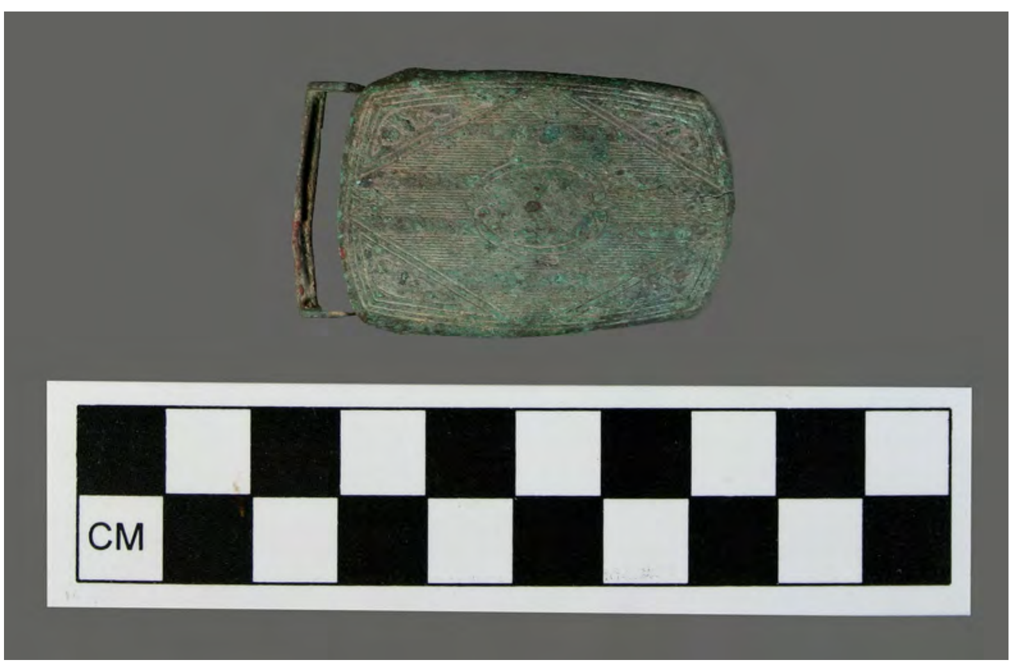


Figure 6-III.79 Box-frame belt buckle.

Buttons

A total of 100 buttons and button fragments were collected during the survey. For the following discussion, the artifacts have been grouped into two major categories based on their style: rivet buttons and sew-on buttons. They were further categorized by their material type and, in the case of the sew-on buttons, the shank style or number of sew-through holes.

Rivet Buttons

The most common style of button collected during the survey was the rivet button, with a total of 40 collected. Patented by Levi Strauss in 1872, these buttons are most commonly associated with blue jeans and overalls (Race 2011). Meant for hard use, the buttons are attached by driving a rivet nail through the clothing and into the back of the button. These particular buttons were collected because most have unique designs or logos stamped onto their face, making them useful diagnostics. However, largely because of the proliferation of such designs, not all of them could be identified.

Of the 40 rivet buttons, 25 are made of brass. Two of these, both from BIBE1942, have a wreath and star emblem around the center indentation. Four rivet buttons, from BIBE1920, 1726, 0985 and 1942, bear the stamp "The Ranger" around the outside of the center indentation (Figure 6-III.80b). Three additional rivet buttons were stamped with the words "Alamo Brand." Two of these, from BIBE1726 and BIBE1920, have the image of the Alamo Mission (in San Antonio, Texas) stamped into the center surrounded by the words "Alamo Brand" in block letters (Figure 6-III.80l). A similar one from BIBE1942 lacks the image of the Alamo Mission and instead has "Alamo Brand" wrapped around the outside of the center indentation (Figure 6-III.80j). These buttons were manufactured by the Carl Pool Manufacturing Company in San Antonio Texas and are possibly from a canvas hunting vest dating to the 1930s (vintageworkwear.com n.d.).

Of the remaining brass rivet buttons, each is unique. Two buttons were collected from BIBE2030K. The first has the word "Texan" in stretched letters that cover the top half of the button (Figure 6-III.80g). On the bottom half is a wavy fishbone-like design. The second, which is missing both the back and rivet nail, bears a stippled design.

Five unique rivet buttons were collected from BIBE1942. One of these has the word "Horseshoe" above a star emblem (Figure 6-III.80i). The second button has the words "Ward Brand" written in elongated letters around the indention (Figure 6-III.80m). The third has an image of a locomotive engine with a plume of smoke trailing from its smokestack (Figure 6-III.80q). The fourth button bears the words "Eagle MFG. CO" with an Eagle holding three arrows in one claw and a branch in the other (Figure 6-III.80r). This emblem is very similar to the Great Seal of the United States except the eagle is looking in the opposite direction, the items in the claws are reversed, and the badge on the chest, the banners, and the glory above the head are missing. The Eagle Manufacturing Company was established in 1851 in Columbus, Georgia, by William H. Young. The textile mill was destroyed in 1865 in Wilson's Raid during the Civil War. Afterwards, it was reorganized as the Eagle and Phoenix Manufacturing Company and by 1883, it was the largest mill in the south. This button probably predates the 1883 reorganization (Payne 2010).

The last rivet button from BIBE1942 has the words "Hawk Brand" wrapped around the center indentation in block-style lettering (Figure 6-III.80k). This button came from Hawk Brand Overalls and Pants manufactured by The Miller Manufacturing Company in Fort Worth, Texas. The company was organized in 1903 and was reputedly the first factory in Fort Worth to manufacture overalls and pants, and the first to employ union labor. By 1910, the company employed 125 people with a daily output of 1,200 garments. The company went into receivership in 1929 and was reorganized as the Texas Textile Mills, Inc. of Dallas, Texas (Kline 2010).

Six additional brass rivet buttons came from BIBE1920. The first has the logo "Bargman El Paso" printed on its face in block letters (Figure 6-III.80a). Reported to be the first apparel business in El Paso, Texas, Bargman Shirt and Overall Company was established in 1902 or 1903 to supply the local area with work clothes (Corrales, Luby, et al. 2004; Cross 2008). The second button from 1920 bears a Maltese cross with an "S" inside a circle at its center and a wreath that appears in the space between the arms of the cross (Figure 6-III.80n). It is made of brass but in the cracks where the emblem was stamped is a gold sheen suggesting it was originally gold plated. On the back of the rivet nail is stamped "Pat. June 11, 1889." The third button has the name "A.L. Pierson" written in block letters that wrap around the center indention (Figure 6-III.80e). The fourth button has a plain face lacking markings. The fifth button has a plain face with a rivet nail that has scalloped edges and fits tightly against the back of the button. The sixth brass rivet button, from BIBE1920, has "Engineer Make" stamped on its face (Figure 6-III.80c). "Engineer" is stamped in stretched

Figure 6-III.80 Rivet buttons: (a) "Bargman El Paso" button; (b) "The Ranger" button; (c) "Engineer Make" button; (d) "The Texas" button; (e) "A. L. Pierson" button; (f) "Lone Star" button; (g) "Texan" stretched letter button; (h) "Sweet Orr & Co." button; (i) "Horseshoe" button; (j) "Alamo Brand" button; (k) "Hawk Brand" button; (l) "Alamo Brand" button with image; (m) "Ward Brand" button; (n) Maltese cross "S" button; (o) "Sun Play" button; (p) "Big Smith" button; (q) Locomotive button; (r) "Eagle MFG. Co." button; (s) 5 row dot button; (t) "Muncie Carmen Co." button; (u) "La Fama" button.

letters that wrap around the top of the center hole with the word "Make" stamped in block lettering at the bottom.

The last four brass rivet buttons are all incomplete, missing both their backs and rivet nails. The first button, from BIBE2030L, has "Big Smith" written in stretched letters around the top edges and a star emblem at the center bottom (Figure 6-III.80p). The second button, from BIBE859I, has the words "The Texas" stamped in cursive on its face (Figure 6-III.80d). "The" is located at the top with "Texas" across the bottom. The third brass button, from BIBE2071, bears the words "Wizard So. Bend" (Figure 6-III.80b). "Wizard" is written in stretched letters across the top and around a center hole. "So. Bend" is along the bottom of the hole in block style lettering.

The last button, from BIBE1910, has the company logo of "Sweet Orr & Co." stamped on its face (Figure 6-III.80h). The words stretch around the center and there is a single star emblem in the space between the first and last letters of the logo. Sweet Orr and Company was established in 1871 in Wappingers Falls, New York, by James A. Orr and Clayton E. and Clinton W. Sweet—the first factory in the U.S. for manufacturing overalls. By 1880, the company was successful enough that it built a new state-of-the-art factory in Newburgh, New York. In the late 1930s, a new line of sportswear was developed. The company remains today a popular manufacturer of blue jeans, denim shirts, utility suits, and other work clothes (Valenti 1987; Sweet Orr Webpage n.d.).

The next largest material group for rivet buttons is carbon steel with a total of five artifacts, all of which are complete. Four of these buttons were recovered from BIBE1910. Three of these have "Muncie Carmen Co." stamped around a center indention (Figure 6-III.80t). The other button, from BIBE1910, has a pattern of dots laid out in four rows (Figure 6-III.80s). The fifth carbon steel rivet button, from BIBE2030E, has "La Fama Monterey" in block letters written around the center (Figure 6-III.80u). A raised rim wraps around the outside edge and around the center hole.

Two additional rivet buttons are unique in their material type. The first, from BIBE1987, was the only copper alloy rivet button recovered. It is still complete and has a center hole with the words "Sun Play" stamped in block letters around the outside (Figure 6-III.80o). The second button, from BIBE1920, is made of carbon steel but appears to have the face plated in aluminum (Figure 6-III.80f). "Lone Star" is stamped around the top of the button in block lettering and at the bottom is a star emblem.

In addition to the rivet buttons, seven blue-jean rivets were recovered during the survey. These much smaller rivets were driven through multiple layers of denim as reinforcing fasteners for pocket corners or other areas of high stress. This reinforcing innovation was patented on May 20, 1873, by Jacob Davis and Levi Strauss. Five of the collected rivets—all made of brass—were manufactured by Levi Strauss between 1873 and the early 1900s. Three of these from BIBE1942 and one from BIBE0859C, are made in the same style and have the same markings. Each has a raised snap-like center (known as the sombrero style) on the front and a flat back. "L S & Co -SF-" is shown in raised letters on one side (Figure 6-III.81c) and stamped on the other (Figure 6-III.81d). The fifth rivet, from BIBE1942, resembles the front stamp of the others but the back contains the letters "L S & CO-SF-May 1873"—presumably the patent date (Figure 6-III.81b; Vintage Levi's Jeans Guide n.d.). Two additional brass rivets, both from BIBE1942, are larger than the others discussed and both are stamped with a five-point star (Figure 6-III.81a).

Sew-On Buttons

The other major button category is the sew-on button, 60 of which were collected. The following styles to be discussed are shank buttons, two-hole sew-through, and four-hole sew-through. Measurements for these buttons, with the exception of the snap, will be given in

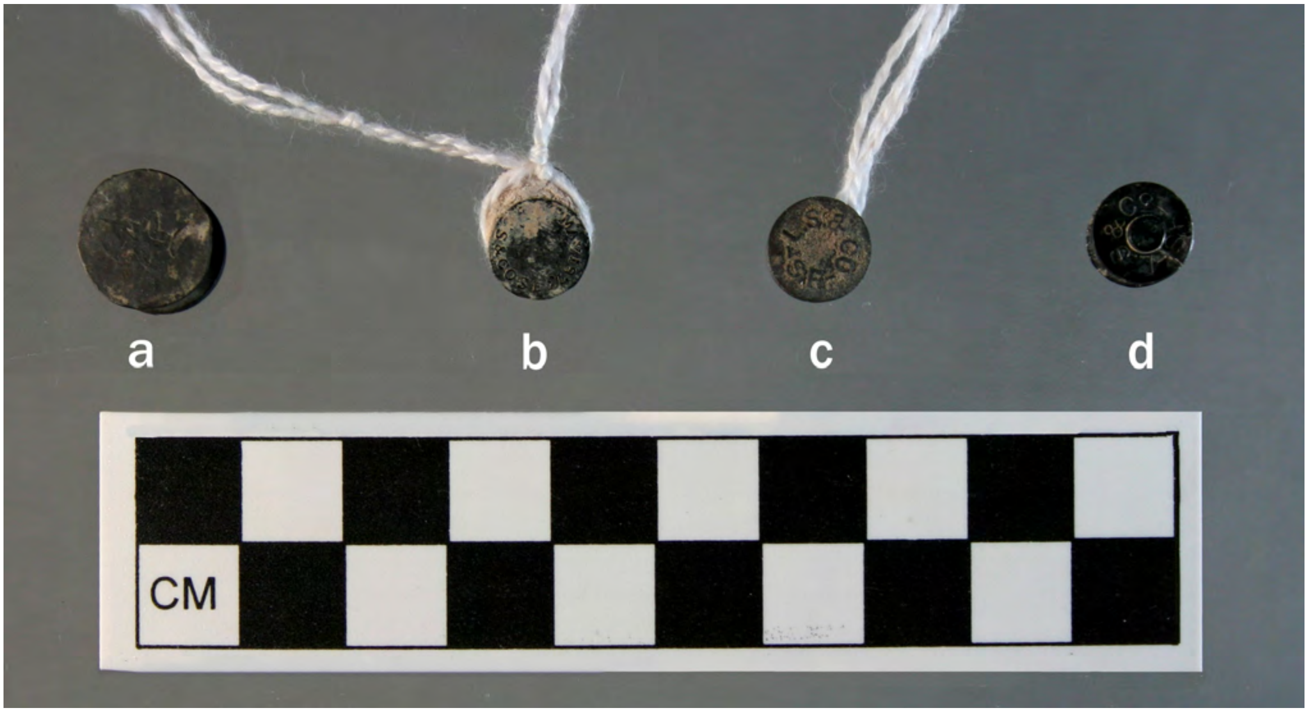


Figure 6-III.81 Blue jean rivet buttons: (a) rivet with 5-point star; (b) "L S & CO-SF-May 1873" button; (c) "L S & Co -SF-" button (obverse); (d) "L S & Co -SF-" button (reverse).

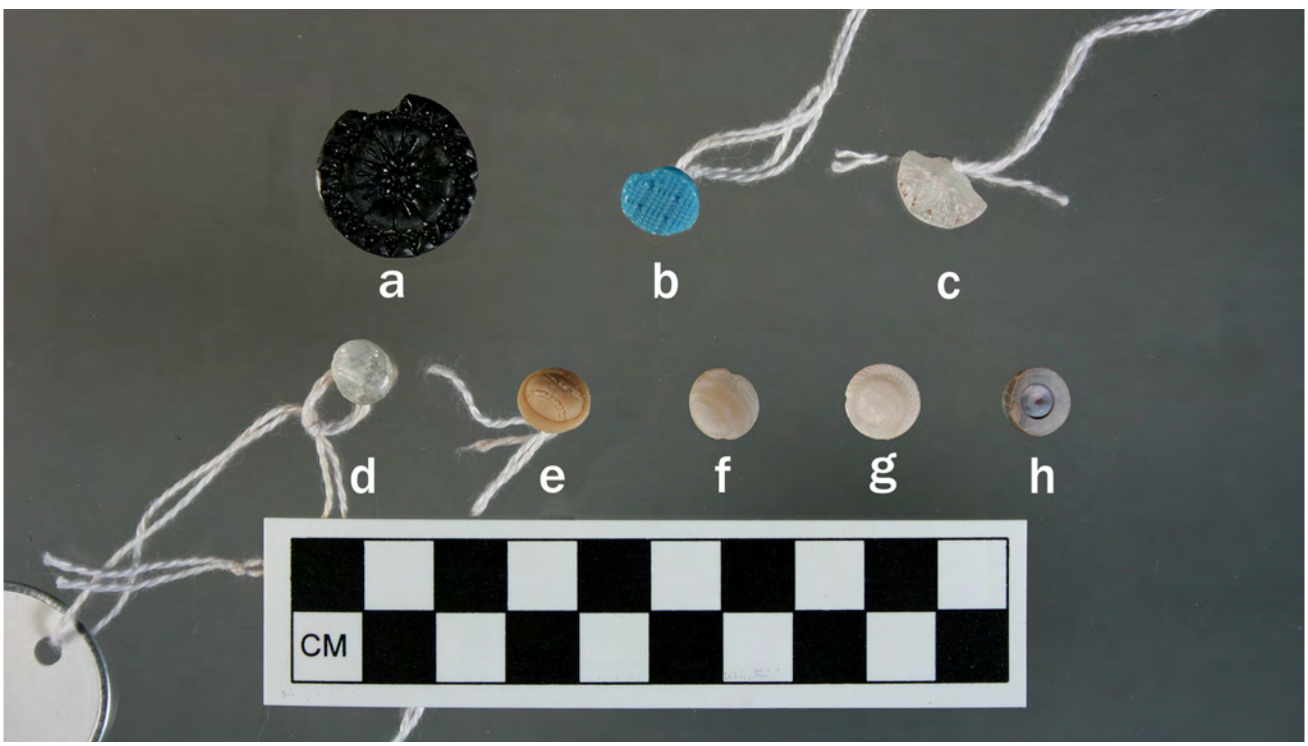


Figure 6-III.82 Carved shank buttons: (a) Black glass button; (b) Blue glass button; (c) Flower design glass button; (d) Clear glass button with facets; (e) Glass baseball button; (f) Plain mother-of-pearl button; (g) Line-edged mother-of-pearl button; (h) Mother of pearl button missing shank.

lignes, a French word that is the international standard for button dimensions (one inch equals 40 lignes).

Seventeen shank buttons were recovered during the survey. A shank is a hollow extension located on the back of the button by which it is sewn onto a garment. Shanks can be carved onto the back (referred to as "self-shank") or added as a separate piece. Seven buttons have carved shanks and one additional button probably had a carved shank. Of these, five from BIBE2044, BIBE859B, BIBE 1910, BIBE 2030K, and BIBE 1707 are made of glass. The first is 16 lignes (L) in diameter and is opaque tan with an oval-shaped baseball design carved into its face (Figure 6-III.82e). Another, from BIBE0859B, is clear with a flower design etched into it (Figure 6-III.82c). Although broken in half, it would have been a size 22L. The third, from BIBE1910, is also clear and measures to 14L (Figure 6-III.82d). It is dome-shaped with triangular facets across it. The fourth, from BIBE2030K, is a size 36L made of opaque black glass containing a flower design in the center with dots and arrows that point inward around the outer edge (Figure 6-III.82a). The fifth glass shank button, from BIBE1707, is opaque blue with a checker design on its face that measures to size 18L (Figure 6-III.82b).

The remaining three carved shank buttons are made of mother-of-pearl—the hard, pearly inner layer produced by some species of mollusks. The first, from BIBE2044, is 17L with curved lines carved around the outside edge (Figure 6-III.82g). The second, from BIBE0985, has a plain shell face and measures to 16L (Figure 6-III.82f). The third button, from BIBE1942, is 15L and although it is missing the shank, its similarity to the other mother-of-pearl buttons suggests it was also a one-hole carved shell (Figure 6-III.82h).

There were three two-piece buttons with a looped wire shank that had been soldered to the back. One button collected from BIBE1910 and one from BIBE1942 are both 24L two-piece brass military buttons that have a raised cast of the Great Seal of the United States (Figure 6-III.83a). The seal is a bald eagle with outstretched wings. There is a shield on its chest with the right talon holding 13 arrows and the left talon holding an olive branch. The head is turned to the left with a banner flying from its mouth. Above the head is a ringed circle, also known as a glory, with

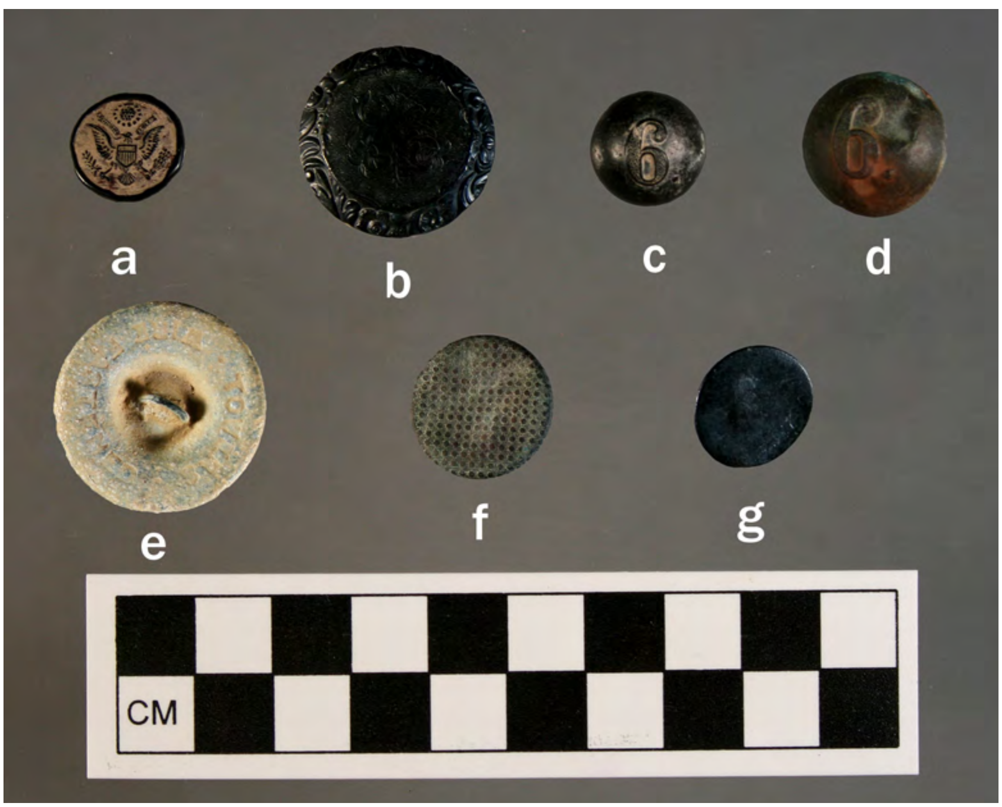


Figure 6-III.83 Two-piece shank buttons: (a) Brass military buttons; (b) Brass button with floral design; (c) Brass "6" button, small; (d) Brass "6" button, large; (e) Towers aluminum button; (f) Stippled brass button; (g) Plain brass button.

13 stars in the center. These two buttons were small regulation army buttons that would have been used on uniforms belonging to officers and enlisted men between 1902 and 1918 (Steffen 1978:106).

Although both uniform buttons are identical, they were manufactured by different companies. The button from BIBE1910 was made by Scovill Manufacturing Company and has "Scovill MF'G CO *Waterbury*" stamped on its back. Although established in Waterbury, Connecticut, in 1802 it was not until 1850 that it became known as Scovill Manufacturing Company (scovill.com). The button from BIBE1910, on the other hand, bears the logo "J.R. Gaunt & Son LTD *ENGD*" on its back—a London company established in 1884 by John Richard Gaunt and his son, Charles Frederick (Dix Noonan Webb Ltd.). The last looped wire shank button was IF 319. It is a large (size 40L) brass button with a three flower design in the center of the face and additional floral elements around its edges (Figure 6-III.83b). The back has "Double Platet" [sic] written in block style lettering.

Three unique two-piece shank buttons came from BIBE1942. All are made of brass, are dome-shaped, and have "6." stamped on their faces, with the enclosed portion of the "6" containing a stippled design. Two buttons measure to a size 24L but both are missing their shanks (Figure 6-III.83c). The third is slightly larger (size 30L) and although its shank is broken, enough remains to see that it was made of twisted wire that was soldered to the back (Figure 6-III.83d). These buttons most resemble the Model 1891 Spanish buttons made in France and used by the Spanish Volunteer Infantry in Cuba during the Spanish-American War (Casewick Antiques Website n.d.). Another two-two-piece shank button was collected from BIBE1325. This 40L aluminum button has a recessed center and retains part of the original wire shank (Figure 6-III.83e). Around the outside edge is stamped "TOWERS WIRE FASTENED."

The last two-piece shank buttons have variations of drilled eye shanks. One button from BIBE1987 is a 28L two-piece button with the back having a raised center circle with a drilled eye through the middle (Figure 6-III.83f). Although its back is made of carbon steel, its face is made of a copper alloy with a stippled pattern. The last of the shank buttons, from BIBE0856, is one piece cast out of brass (Figure 6-III.83g). It measures to size 26L and has a plain face and a basic drilled eye shank on the back.

A total of 18 two-hole sew-through buttons were also collected. Within this group are five different materials types: mother-of-pearl, aluminum, carbon steel, brass, and glass. Eight of the buttons are mother-of-pearl, four of which were found at BIBE1942. Two of these are size 24L and have a carved hexagon on their faces with a center oval indentation (Figure 6-III.84b). The third measures 20L and the fourth measures 18L, neither of which have any identifiable markings or carvings. Two additional mother-of-pearl buttons were found at BIBE1920, both of which have a circular center indentation and measure 20L (Figure 6-III.84c and d). The last two mother-of-pearl two-hole sew-through buttons are from BIBE1987 and 0859 G. One of these has a center oval indentation and is size 20L (Figure 6-III.84e). The second is 30L and has a carved circle about midway between the center and the outside of the button (Figure 6-III.84a).

Four two-hole aluminum buttons were also collected. Two of these buttons are size 22L although the button from BIBE1942 has a circular center indentation (Figure 6-III.84g) whereas the one from BIBE1987 has an oval center indention (Figure 6-III.84h). Buttons recovered from BIBE2030K and 0859 G both measure 34L with the company name "A.J. Tower Co." stamped around the front edge of the button (Figure 6-III.84i). These were manufactured by the A.J. Tower Company of Boston Massachusetts sometime between 1873 and 1956—a popular maker of rain slickers and other oiled clothing. A piece of metal was sewn through the holes

Figure 6-III.84 Two hole sew-through buttons: (a) Mother-of-Pearl with circular recess, large; (b) Mother-of-Pearl with hexagon; (c) Mother-of-Pearl with circular recess, small; (d) Mother-of-Pearl with circular recess, small; (e) Mother-of-Pearl with oval recess; (f) Mother-of-Pearl, plain; (g) Aluminum with circular recess; (h) Aluminum with oval recess; (i) Aluminum "A.J. Tower Co."; (j) Metal with circular recess; (k) Metal with rope design; (l) Brass with "Kiddies M-W"; (m) Glass cream-colored; (n) Glass, white, rectangular recess; (o) Glass, white.

and was used to fasten the button onto the raincoats or slickers (Cruse 2008).

Three of the two-hole buttons are made of metal. Two of these are made of carbon steel. One, from BIBE1910, is size 22L with a rope-like design on the front and a domed back (Figure 6-III.84k). Another, from BIBE1987, has a circular center recess and is size 22L (Figure 6-III.84j). The last two-hole sew-through button is made of brass. Recovered from BIBE0859 G, this button is a 24L with the words "Kiddies M-W" stamped on the front around a center rectangular indention (Figure 6-III.84l).

Three of the two-hole buttons are made of glass. One of these buttons, from BIBE1910, is translucent white and measures 13L (Figure 6-III.84o). It has a raised outer ring with a slight center depression. Another button, from BIBE0859D, is also white but more opaque than the first (Figure 6-III.84n). It also has a center rectangular recess and is size 20L. The last glass button is from BIBE1942. It measures 22L and is an opaque cream with two very large center button holes (Figure 6-III.84m).

Twenty-five four-hole sew-through buttons were recovered during the survey. The material types, in order of abundance, include glass, mother-of-pearl, carbon steel, brass, aluminum, plastic, and copper alloy. Glass buttons, with a total of seven specimens, were the most common four-hole sew-through button collected. Three of these were collected from BIBE1920.

One is an opaque light cream color with a raised outer ring. Although broken in half, it measures to 17L. The second, size 16L, is opaque white and has a slight circular center recess (Figure 6-III.85a). The third measures to 28L and is a shiny opaque white with a wedge-like design around the outer edge (Figure 6-III.85b). Three additional glass buttons, all from BIBE1942, also have a common design and color. They are all opaque white with a wedge-like design around their outer edges. The only difference in these three buttons is their size. Two are size 13L whereas one is an 18L (Figure 6-III.85c and d). The last glass four-hole sew-through button was found at BIBE1707. It is an opaque white size 20L and has a circular center recess (Figure 6-III.85e).

The next largest category of four-hole sew-through buttons is mother-of-pearl with a total of six recovered artifacts. Of these, three were found at BIBE1920. The first, with a size of 48L, is the largest of the mother of pearl buttons collected (Figure 6-III.85f). It has both an outer ring and a center circle recess. The other two have a circular center recess but one is size 17L and the other is size 18L (Figure 6-III.85g). The remaining mother-of-pearl buttons were all found at separate sites. One, from BIBE1910, has a center recess. Although broken in half, it would have been size 20L. Another button, from BIBE1942, has an outer ring with center circular recess and measures to size 28L (Figure 6-III.85h). The last mother-of-pearl button, from BIBE1987, is size 24L with a center circular recess (Figure 6-III.85i).

Four additional four-hole sew-through buttons are made of carbon steel. Three of these were found at BIBE1910. Two of these, size 22L and 28L, have back edges that have been crimped to leave space for a cardboard or leather back (Figure 6-III.85j). The third is a 26L plain button with indented triangular-shaped button holes (Figure 6-III.85k). The fourth carbon steel button, from BIBE0593, is 28L with a center circular recess (Figure 6-III.85l).

Three four-hole sew-through buttons were made of brass. These may have originally consisted of two pieces due to their crimped back. Two of these, from BIBE1987 and 1942, are both 28L and have "Sweet Orr" stamped on their front, indicating they were manufactured by Sweet Orr & Company (see above discussion of Sweet Orr & Company) (Figure 6-III.85m). The last of this button group is also from BIBE1942 but has no identifiable markings.

One four-hole sew-through button is made of a copper alloy. This button, from BIBE2044, measures 22L and is a two-piece button retaining the original cardboard backing, suggesting it dates to sometime after 1890 (Figure 6-III.85n; Gillio, et al. 1980). Two four-hole sew-through buttons are made of aluminum—both from a 1918 World War I Army Uniform. The first, from BIBE2030E, is 28L and has "U.S. Army" stamped on the front of it (Figure 6-III.85o). This style would have been used as the front button on uniform pants. The second, from BIBE2071, has the letters "U.S.A." stamped on its face. Slightly smaller than the other Army button (22L), this would have been used to button the fly (Figure 6-III.85p; Military Items.com n.d.).

Two additional four-hole sew-through buttons are black with a grainy shimmer and appear to be made out of Bakelite, an early form of plastic. The first, from BIBE0859G, is 26L but has cracks along its edges and has been severely sunbaked to the point of crumbling. The second, from BIBE2030E, is in better condition although a small chunk has broken off its edge and there are cracks along its remaining rim. It is size 28L and has a raised edge along the outside of the button (Figure 6-III.85q).

Other

Nine artifacts are addressed in the "Other" category, consisting of 1 shoe sole, 1 thimble, 3 safety pins, and 4 pocket watch parts.

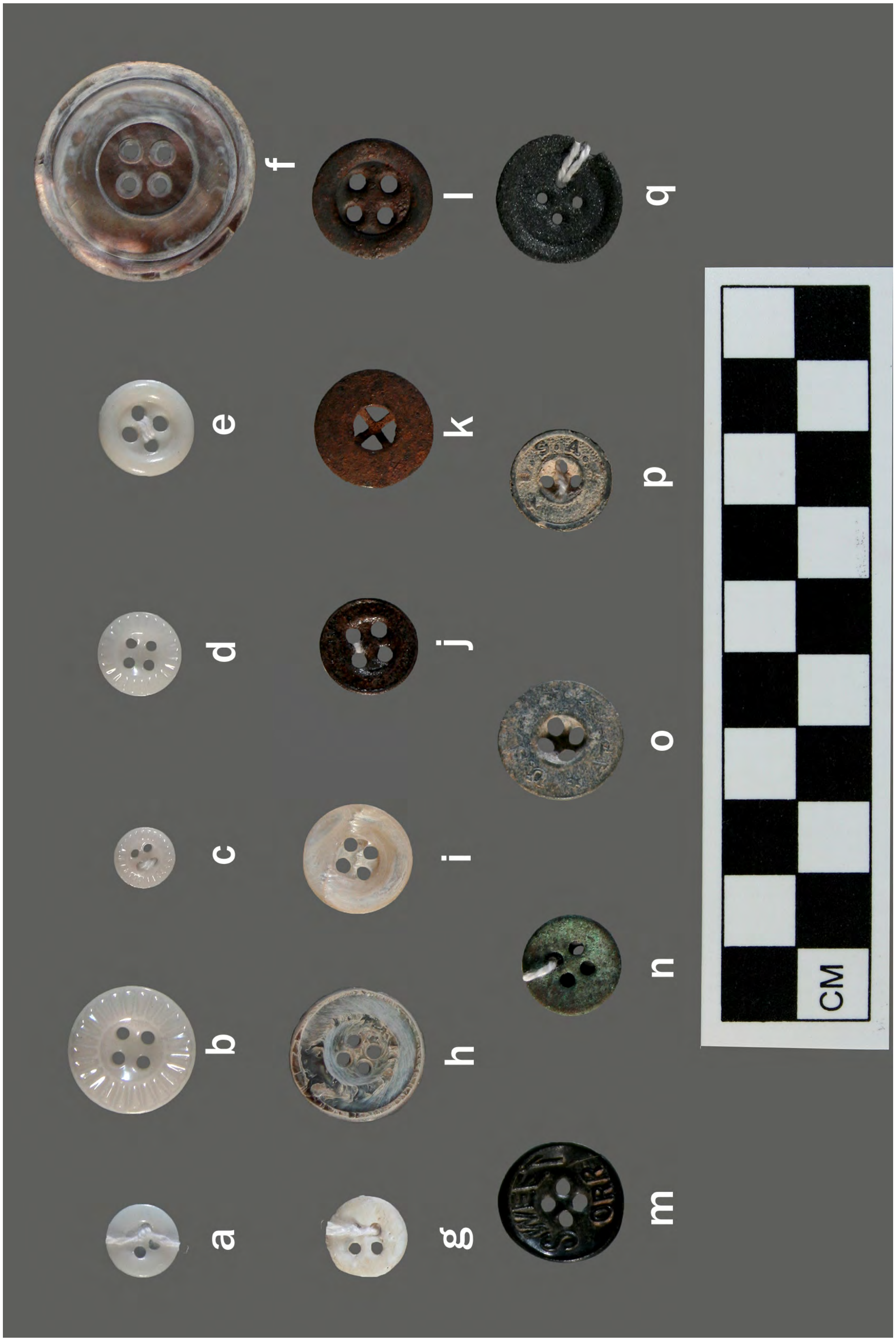


Figure 6-III.85 Four-hole sew-through buttons: (a) Opaque white glass; (b) Opaque white glass with wedge design, 28L; (c) Opaque white glass with wedge design, 13L; (d) Opaque white glass with wedge design, 18L; (e) Opaque white glass, recessed; (f) Mother-of-pearl, 48 L; (g) Mother-of-pearl, 18L; (h) Mother-of-pearl, 28 L; (i) Mother-of-pearl, 24 L; (j) Carbon steel, backed, 22L; (k) Carbon steel, 26L; (l) Carbon steel, recessed, 28L; (m) Brass, "Sweet Orr," 28L; (n) Copper alloy, 22L; (o) Aluminum, "U.S. Army," 28L; (p) Aluminum, "U.S.A.," 22L; (q) Bakelite, 28L.

Shoe Sole

One piece of a rubber shoe sole was collected from BIBE1829 (Figure 6-III.86a). The piece is roughly rectangular in shape around 1 x 1.25 inches in dimension with a hole in the center. The black rubber is dry, brittle, and pitted from exposure. No other identifying features are evident.

Thimble

One brass thimble was collected from BIBE2030 (Figure 6-III.86b). It is bent and dented but otherwise complete, measuring about 0.75 in tall and 0.5 inches in diameter. The thimble has a series of small holes in a circular pattern around the top. A series of concentric stippled rings extend outward from the holes. Along the sides is the patterned indented surface consisting of a series of stamped depressions. Thimbles were used to protect the finger that pushes the needle in sewing.

Safety Pins

Three safety pins were collected during the survey, all from BIBE1920. The first is nickel plated and is one inch in length (Figure 6-III.87a). The clasp is open, rather than solid, and is formed of the same wire used to fashion the pin. These were advertised in early Sears Roebuck catalogs as "Lindsey Blanket Pins" (Sears Roebuck 1912:1,231). The second pin is made of brass and, although fragmentary, is 1.38 inches in length (Figure 6-III.87b). The clasp bears a series of stamped grooves running parallel to the long axis of the pin. The pin itself is broken just above where the spring coil would have been. The third pin is two inches in length, is nickel plated and is like modern safety pins in every respect (Figure 6-III.87c).

Pocket Watch

A total of four pocket watch parts were collected during the survey. The first watch part, collected from BIBE185, is the middle case (or frame) of a triple-hinged hunter case pocket watch (Figure 6-III.88a). This style of pocket watch has three covers that close to protect the watch. Both the front and back watch covers are hinged as well as an inner back lid called a cuvette (Haute Horlogerie website n.d.). The second watch part, recovered from BIBE2030K, is a brass

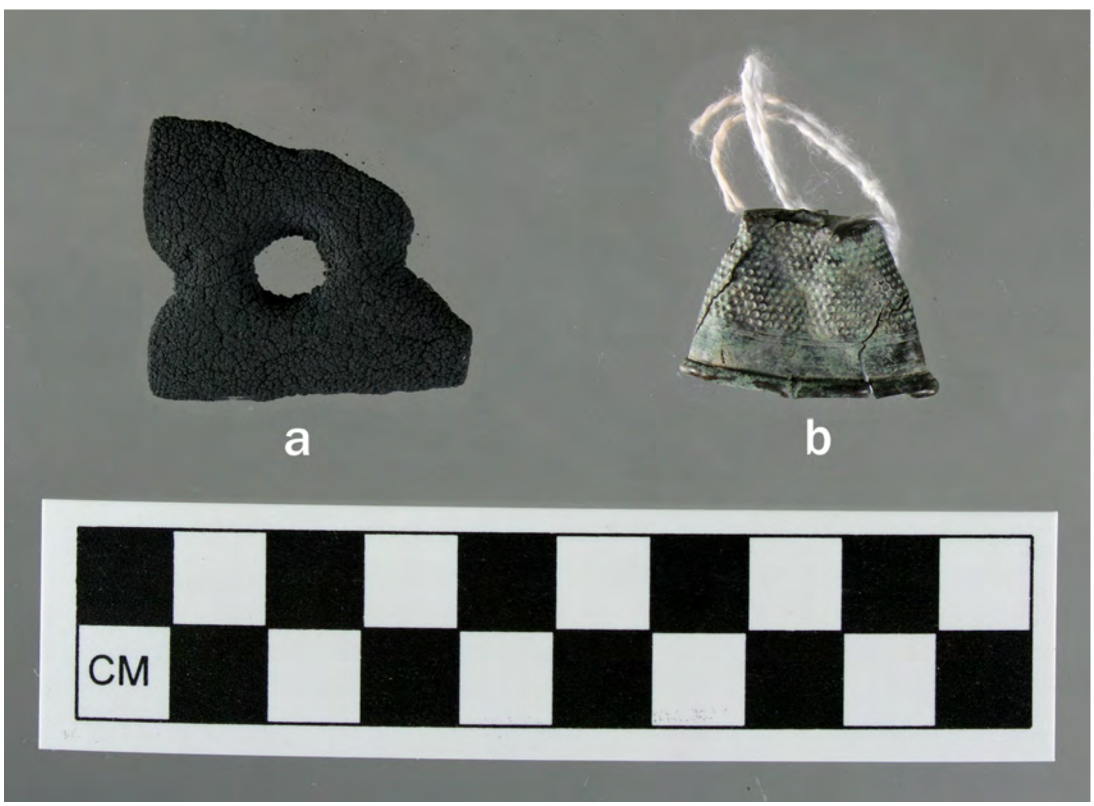


Figure 6-III.86 Other, clothing: (a) Rubber shoe sole fragment; (b) Brass thimble.

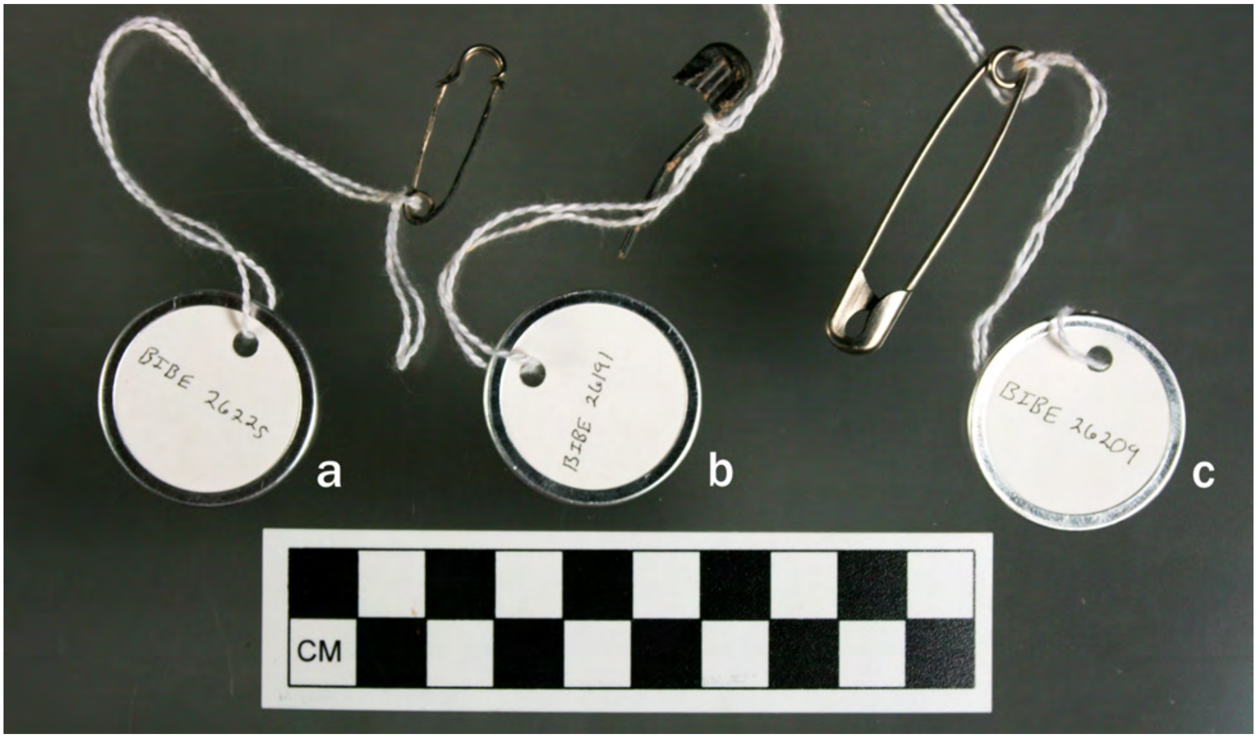


Figure 6-III.87 Safety pins: (a) Nickel plated with open clasp; (b) Brass, broken; (c) Nickel plated, modern style.

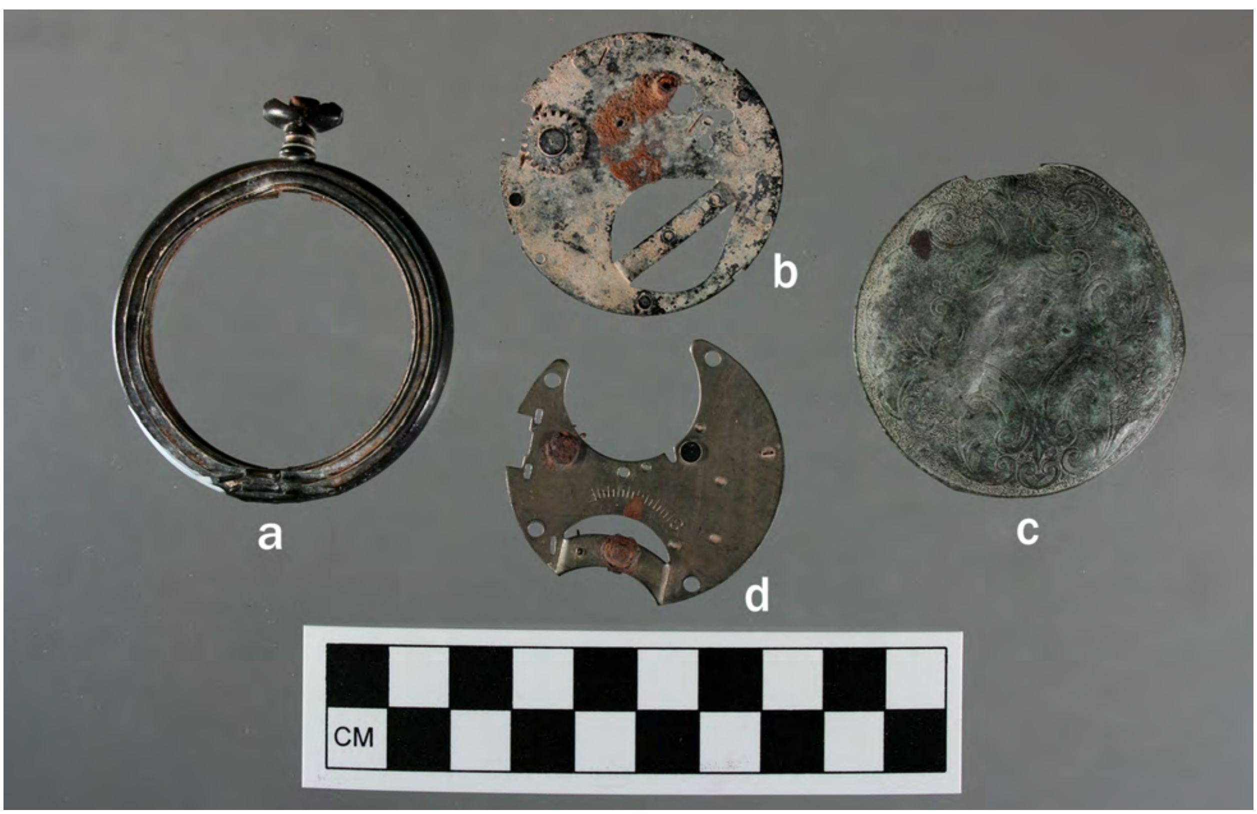


Figure 6-III.88 Pocket watch parts: (a) Frame, triple-hinged hunter case; (b) Pillar plate; (c) Watch cover with floral design; (d) Barrel bridge.

pocket watch cover with a stamped ornate floral design surrounding a central crest (Figure 6-III.88c).

The remaining two watch parts, collected from BIBE1920, are internal mechanisms known as the watch movement. The first is the pillar plate (Figure 6-III.88b). It has four pillars which was common in older pocket watches. These pillars attached the plate to the bridge, between which the rest of the watch's movement was housed (Haute Horlogerie website). The second watch part, recovered from BIBE1920, is a barrel bridge which is a plate that the ratchet wheel and crown wheel are attached to (Figure 6-III.88d). This particular bridge also has the index built into it which regulates the watch. Written on the face of the bridge are an "S" (for slow) and "F" (for fast) with index marks in between. The watch's rate is controlled by adjusting the balance spring on this index scale.

Adornment

A total of 34 pieces of jewelry or jewelry fragments were also collected during the survey. These include 15 glass beads or glass setting stones, 3 earrings, 2 finger rings, 2 stick pins, 2 cufflinks, 1 brooch, 1 pendant, 1 ear cuff, 1 tinkler, and 1 brass frame. The remaining five pieces of jewelry could not be identified as to type and are addressed under "Miscellaneous." The following discussion is based on this breakdown.

Beads

Of the 15 glass beads collected, 13 are various colored drilled glass beads and 2 are probable setting stones. Of the drilled beads, 4 are faceted, 3 are round, 2 are oval, 2 are seed beads, 1 is a pony bead, and 1 is disk-shaped. All except for the disk-shaped bead are center drilled. Of the four faceted beads, three—from BIBE2030J, BIBE859E, and BIBE1942—are rounded with facets. Two of these are translucent green, one of which is fractured on one end (Figure 6-III.89a), whereas the other is fractured on both ends (Figure 6-III.89b). The third faceted bead is translucent red and is complete (Figure 6-III.89c). The fourth faceted bead, from BIBE1942, is oval shaped, light translucent blue with a small fracture on one end (Figure 6-III.89d).

Of the three round beads, one from BIBE2063 is translucent red (Figure 6-III.89e) and one from BIBE1942 is translucent purple (Figure 6-III.89f). The third, collected from BIBE2030K, is opaque blue and is fractured down the middle (Figure 6-III.89g). In addition, two oval beads were collected from BIBE2044 and BIBE1942. One of these is a light translucent blue with one end missing (Figure 6-III.89h). The other is opaque orange and is fractured down the middle (Figure 6-III.89i).

Two seed beads (tiny beads that have been cut from a rounded tube) were collected from BIBE2030J, both of which are opaque turquoise colored (Figure 6-III.89j). An opaque blue pony bead (the same style but slightly larger than a seed bead) with a small fracture on its side was collected from BIBE2063 (Figure 6-III.89k).

The only glass bead that is not center-drilled was collected from BIBE0859G. It is disk-shaped (about 0.75 inches in diameter) made to resemble a flower (Figure 6-III.89l). It is fashioned from an opaque tan glass and has a drilled hole that enters along the margin of the disk but exits at an oblique angle at the back of the bead, likely a manufacturing error.

The two remaining glass artifacts are probably setting stones for costume jewelry. The first, collected from BIBE185, is translucent red and cut in a bi-cone style (as if two identical cones were joined at their bases) (Figure 6-III.89m). The final stone, from BIBE1707, is also translucent red but has been cut in a circular "cabochon style" (Figure 6-III.89n). This style refers to a cut that is flat on the bottom with a convex top. All of its edges are fractured (Rings & Things website n.d.).

Earrings

Of the 19 remaining pieces of jewelry, three were earrings. Two of these were collected from BIBE2030J. The first is a brass earring with a wire that would have

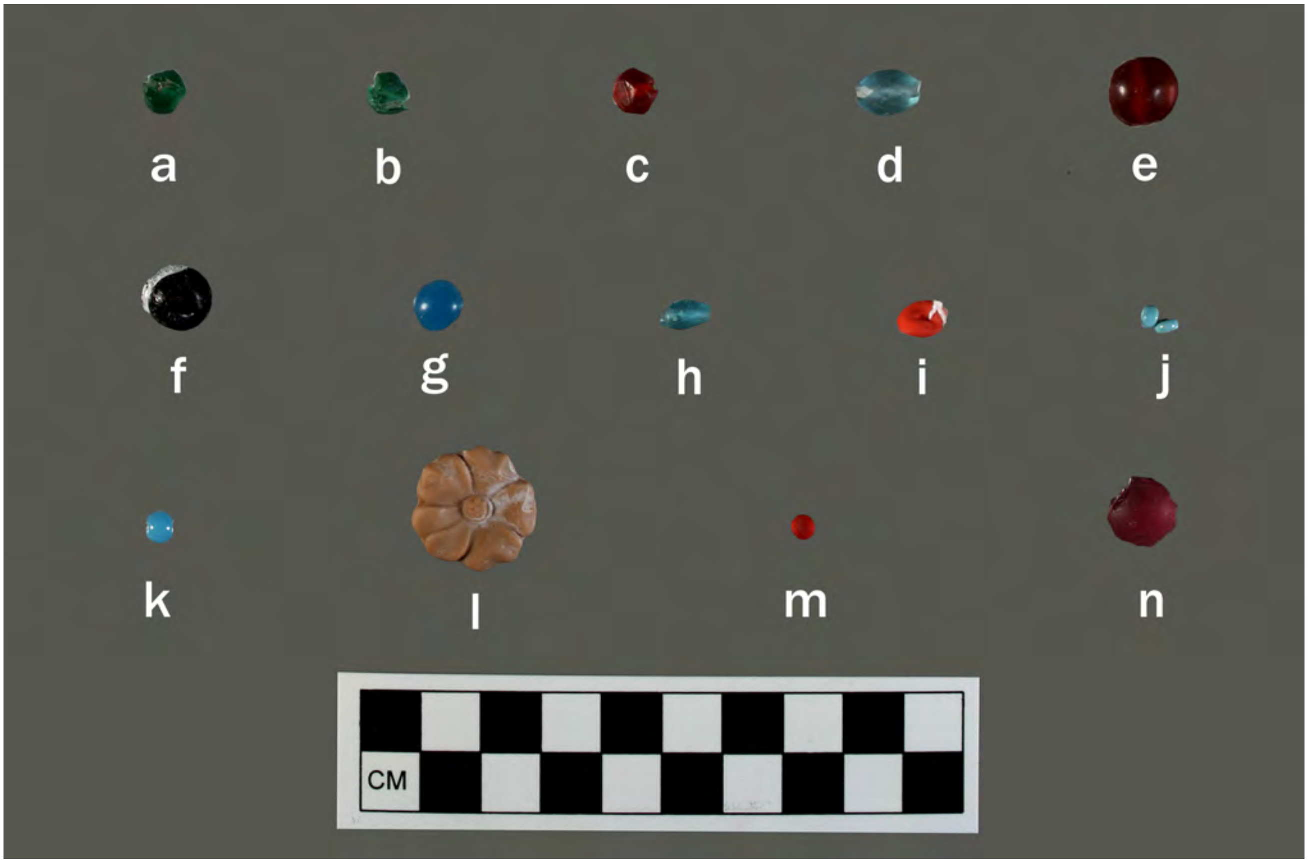


Figure 6-III.89 Glass beads: (a) Faceted translucent green; (b) Faceted translucent green; (c) Faceted translucent red; (d) Faceted oval translucent blue; (e) Round translucent red; (f) Round translucent purple; (g) Round opaque blue; (h) Oval translucent blue; (i) Oval opaque orange; (j) Seed beads, turquoise; (k) Pony bead, opaque blue; (l) Disk shaped flower; (m) Setting stone, translucent red; (n) Setting stone, "cabochon style."

been used as a hook for pierced ears (Figure 6-III.90a). On the front of this wire is a small decorative shield. At the lower end of the wire are three stone settings that are joined to form a triangle. The settings are prong style that hold round diamond-cut glass stones. One red and one blue stone still remain, while the third is missing. The second earring from 2030J also has a small wire attached to the back for use with pierced ears. It is a brass circle with a gold colored center piece in the shape of a small insect resembling a bee (Figure 6-III.90b). The insect is attached to the brass plate by two wires that have been inserted through holes in the front and twisted together on the backside. The third earring, from BIBE1942, is an ovoid brass earring that has a decorative center with a setting where a jewel would have been (Figure 6-III.90c). On the backside of the earring is a metal post. A hinge would have been attached to this piece making the earring a clip-on for unpierced ears.

Rings

Two rings were also collected during the survey. The first, from BIBE0859I, has a band made of twisted copper alloy but there is a small fleck of gold along the edge where the setting might have been, suggesting it could have been gold-plated (Figure 6-III.90d). This ring is broken in the center where a setting for a stone might have been. The other ring, from BIBE2030L, is a homemade twisted metal band (Figure 6-III.90e).

Figure 6-III.90 Jewelry: (a) Brass earing with three stone settings; (b) Brass earing, circle with bee; (c) Brass earing, ovoid, missing jewel; (d) Copper ring, broken; (e) Homemade ring; (f) Lady Liberty stick pin; (g) Teardrop stick pin; (h) Brass ovoid cufflink; (i) Brass ovoid cufflink with fleur de lis; (j) Brass brooch; (k) Brass pendant with turquoise colored stone; (l) Cupreous ear cuff; (m) Brass picture frame; (n) Tin tinkler; (o) Brass flower, layered petals; (p) Brass flower with dots; (q) Brass dragonfly; (r) "America" lapel (?) pin; (s) Cupreous rectangle with flower.

It was crafted out of a single piece of thin copper-alloy wire. Three coils of wire form the central part of the band which is secured by twisting the remaining length of wire around the three coils.

Stick Pins

Two stick pins were also recovered. The first, from BIBE1920, is a rare 1872 octagonal California gold charm stick pin of "California fractional gold" bearing the profile of Lady Liberty with 13 stars surrounding her head and "1872" stamped beneath (Figure 6-III.90f). During the California gold rush, the booming economy required coinage to satisfy commercial needs. In response, smaller denominations, or "fractional" coinage was minted. The shortage eased around 1856 with later coins apparently fashioned into souvenirs such as this one. (Wikipedia, California Gold Coinage n.d.). The second stick pin, from BIBE2030F, has two brass setting mounts connected by a brass "ribbon" to form an inverted teardrop shape (Figure 6-III.90g). Both mounts are round and likely held round glass stones although both are now missing.

Cufflinks

Two decorative shank-style cufflinks were also collected. The first, from BIBE1942, is ovoid with a swirl design standing in relief in the center (Figure 6-III.90h). It is made of brass but has a gold colored surface. The second cufflink, from BIBE2254, is also oval shaped and made out of brass (Figure 6-III.90i). Within the face of the oval is a center oval with two circles inside it within which is a *fleur de lis*. All of the face contains a stained blue glass inlay except for where the two circles in the center meet. This spot forms two triangular shapes within the center oval that has been inlaid with a yellow-gold stained glass.

Brooch

One brooch was collected from BIBE1920 that is made of brass. The brooch consists of two circles connected by a cross bar bearing three small decorative dots (Figure 6-III.90j). Each circle is lined with ten round prong settings with red glass stones (although four are missing). In the center of each circle is a stud that appears to have been a mount for a center stone. The hinge is still attached to the back, but the pin and catch are gone.

Pendant

One small brass pendant was collected from BIBE2030G (Figure 6-III.90k). This pendant has a central prong setting with scalloped edges and a small loop by which it was likely suspended from a necklace. In the setting is a round diamond-cut turquoise-colored glass stone.

Ear Cuff

One cupreous ear cuff was collected from BIBE1920 (Figure 6-III.90l). The cuff is C-shaped with a maximum diameter of 0.50 inches It is made of a narrow band of copper (or copper alloy) 0.17 inches in width and 0.04 inches thick. One side of the cuff and both ends are beveled while the other (long) side exhibits shear marks. The irregularities in its construction indicate it was handmade but there are no decorative elements or other identifying features. Although there is no known precedent for this kind of jewelry in the region, its form and shape leave little to doubt as to its identity.

Brass Frame

A small round brass frame was collected from BIBE2030 that possibly held a small portrait (Figure 6-III.90m). The outside border is composed of stamped decorative designs of small flowers and swirls. Small tabs on the back would have held a glass front. The absence of a hook for a chained necklace makes it more likely that this item was part of a brooch. Small frames such as this one used on brooches and necklaces were very popular during the late 1800s to hold pictures of iconic people, nature scenes or, more commonly, portraits of loved ones (Kaplan 1990).

Tinkler

One tin tinkler was collected from BIBE1647 (Figure 6-III.90n). It measures approximately 0.75 inches in length and 0.19 inches in maximum diameter and consists of a rolled piece of thin ferrous metal fashioned into a long cone. An unsoldered butt seam extends along one side of the cone. Although rusted, the artifact is in good condition and is complete. This artifact is interpreted as a "tinkler," also known as a "jingle"—a common adornment item popular with many historic Indian tribes. It is notable that this is the only artifact believed to date to the historic Indian period that was collected during the survey.

Miscellaneous

The last five artifacts were not categorized due to the lack of diagnostic characteristics. Two of these are brass flowers collected from BIBE2030K that probably served as brooches. One of these has two layers of petals with the top petals slightly smaller than the bottom layer (Figure 6-III.90o). Each petal on the top layer has been stamped with decorative flower details. In the center of the flower is a single prong setting where a jewel would have been placed. In the center of the back is a hole where a stick pin was likely mounted. The second flower artifact has a stamped flower design of lines and dots (Figure 6-III.90p). On the reverse side in one of the petals is a round depression where a stick-pin appears to have been attached.

A small brass dragonfly was collected from BIBE1920 that had been stamped out of sheet metal (Figure 6-III.90q). The inside portions of the wings appear to have held some other material (perhaps glass or plastic). Whether this served as a necklace or a part of some other piece of jewelry is unknown. A very small decorative pin, possibly a lapel pin, made of brass or a copper alloy was collected from BIBE859E (Figure 6-III.90r). The pin consists of a straight bar of metal, approximately one inch in length, with "America" stamped on its face. Two pointed pins extend upward from the bar that probably would have attached to clothing. The final jewelry artifact, from BIBE0859E, is a tiny rectangular-shaped box made of copper alloy that may have been a cufflink (Figure 6-III.90s). Within the face is a square outline with a flower design in the center. On the back is a small hole where a post would have been attached.

Grooming/Health

Only five items are included in this artifact category, consisting of a lipstick tube, a comb fragment, a squeeze tube, a squeeze tube fragment, and a mirror fragment.

Lipstick Tube

One probable lipstick tube was collected from BIBE2071 (Figure 6-III.91a). This tube, approximately 2 inches long, is a hollow brass cylinder open at both ends but slightly tapered on one. Although dented and partially crushed, it would have measured approximately 0.38 inches in diameter. This tube probably held the actual lipstick, but would have been seated in another part that probably had a mechanism to push the lipstick up and would have had a separate brass tube cover.

Comb

One bakelite comb fragment was recovered from BIBE859D (Figure 6-III.91b). This is a one-inch-long fragment of a black bakelite (early plastic) comb consisting of part of one end of the spine that retains tiny remnants of the teeth. Based on the size of the teeth fragments, this would have been the coarse end of the comb.

Squeeze Tube

One squeeze tube from BIBE1987 and one squeeze tube top fragment from BIBE1910 were collected during the survey. The first is a flattened aluminum tube, severely crushed and dented but, except for a small portion of the bottom of the tube, is complete

Figure 6-III.91 Grooming/health products: (a) Brass lipstick tube; (b) Bakelite comb fragment; (c) Aluminum squeeze tube; (d) Aluminum squeeze tube top.

(Figure 6-III.91c). The tube is approximately 4 inches long and would have been about 0.75 inches in diameter. At the top, around the screw top cap is stamped "MENNEN SKIN BALM." The cap itself is flat, has a serrated grip around the lateral edge and is stamped with an "M" with a "C"-like character and a small circle within it. This skin balm was commonly seen in advertisements from the late 1920s (see, for example, the November 19th edition of the *Saturday Evening Post*, 130). The second artifact is fragmentary, retaining only half of the top of the tube and the screw cap although it would have been of similar dimensions as the first (Figure 6-III.91d). Stamped around the edge of the cap is ". . . Louis." and "Co." separated by a star. No information could be found on this artifact.

Mirror

One mirror fragment was collected from BIBE1910. Although it retains reflective material on one side, there are no other identifying characteristics.

Social Drugs – Tobacco

A total of 11 artifacts were collected that fall within the social drugs—tobacco category. Although tobacco was well represented in the total historic artifact assemblage encountered during the project, the vast majority of these were tobacco tins which were documented but not collected. There were some exceptions, including the seven tobacco tins reported below, each collected due to unique attributes or to good preservation. Aside from these tobacco tins and a striker plate, one cigarette paper dispenser, one cigarette rolling machine, and one tobacco can lid opener were collected.

Of the seven tobacco tins collected during the project, all are upright pocket tins, five with hinged lids and two with external friction lids. The first of the hinged lid tobacco tins is a Prince Albert tin, collected from BIBE1910 (Figure 6-III.92a). The tin is complete and the hinged lid is still attached. It retains some of the original yellow and white lettering as well as the red background on the lid and one face. Prince Albert tobacco tins were introduced by the R.J. Reynolds Tobacco Company in 1909 and continued to be produced until the mid-twentieth century (Horn 2005; Seay n.d.).

The second hinged lid tobacco tin is a Twin Oaks Mixture tobacco tin collected from BIBE2030i (Figure 6-III.92b). It is smashed and is missing the hinged lid but is otherwise complete. Twin images of oak trees are stamped on the front on either side of an outlined area, the top part of which contains two stamped images of acorns. Beneath this are the words "Twin Oaks" and just below that "Mixture." The back has a wreath with two acorns in the center and at the bottom "Twin Oaks" is repeated. Twin Oaks tobacco was produced by Monopol Tobacco Works, one of many small Turkish tobacco companies in New York during the 1890s. The company was purchased by the American Tobacco Company in 1899. Advertisements for similar tins can be found in ca. 1910 magazines (Shaw 2010; Smith 1911)

No identifying information could be found for the remaining five tobacco tins. The first of the last three of the hinged tobacco tins was collected as IF712. It is complete and has a striker plate on the bottom (Figure 6-III.92c). The second was collected from BIBE2357. It is smashed, with the lid and base both missing but is otherwise complete. A design of diamond shapes is stamped around a center circle on the back (Figure 6-III.92d). The last of the hinged tobacco tins, collected at BIBE1524, is much smaller than the others (measuring 2.75 by 3.5 inches whereas the others

Figure 6-III.92 Hinged tobacco tins: (a) Prince Albert tin; (b) Twin Oaks tin; (c) Tin with striker plate; (d) Tin with diamond stamp; (e) Small tin with striker plate.

average 4.5 by 3.5 inches) and has a striker plate on its base (Figure 6-III.92e).

The remaining two tins have external friction lids. The first was recovered from BIBE2030K and is smaller than any other of the collected tobacco tins (Figure 6-III.93 a). Measuring 2.5 inches by 3.25 inches, it might have been an early cigarette case. The last tobacco tin with an external friction lid was collected from BIBE1942 (Figure 6-III.93b). It has a brick pattern stamped across the entire body. A large oval frame is stamped on the front and a small center circle on the back. The shape of this tin is unique, being more oval-shaped then the other tobacco tins.

In addition to the tobacco tins, one "striker plate" (consisting of a series of thin, parallel stamped ribs) was also collected during the survey (Figure 6-III.93c). This striker plate, collected from BIBE2357, originally served as the base of a tobacco tin. It is oval with a slight kidney shape.

Cigarette Paper Dispenser

One small cigarette paper dispensing tin was collected from BIBE1910 (Figure 6-III.94a). It is rectangular, 1.6 x 3 inches and 0.3 inches deep. Although rusted, it is complete. One side of the top of the tin has a rectangular opening with an oval-shaped extension to dispense the papers. Inside is a wire spring mechanism to keep the papers pressed upward. One side of the dispensing slot is stamped "Genuine" and on the other side "French." Below the slot is stamped "DAMPEN FINGER / AND DRAW DOWN / SLICKS / CIGARETTE / PAPER." On the bottom is stamped "THE CASTERLINE / CO. / NEW YORK / & /

Figure 6-III.93 External friction tobacco tins: (a) Small tin / cigarette case; (b) "Brick" stamp tin; (c) Tin striker plate.

Figure 6-III.94 Tobacco products: (a) Tobacco paper dispenser; (b) Tobacco can lid opener.

SAN FRANCISCO / PAT. MAY 2 – 05 / U.S. AND FOREIGN." No further information could be found on this tin.

Tobacco Can Lid Opener

A metal tobacco can lid opener was also collected from BIBE991C (Figure 6-III.94b). It is a roughly rectangular piece of chrome-plated steel, rounded at one end and straight at the other. Near the distal end, a downward protruding tab served to catch the edge of the can to act as a fulcrum. On it is stamped "PATENTED RE. NO. 18447 / OTHER PATS PENDING / THE LEV-A-LIFT CO. / NEW YORK CITY." At the thumb end is stamped "TO OPEN LIFT" and at the lever end is stamped a long arrow pointing right, below which is stamped "SLIDE." These lid openers came with a variety of different brands of larger round tobacco tins containing internal friction lids—especially those popular in the 1930s and 1940s (such as Bugler, Prince Albert and others.)

Cigarette Rolling Machine

One mechanical cigarette rolling machine was collected from BIBE991C—the campsite portion of a larger sheep or goat shearing site (Figure 6-III.95). Known as a "humpback roller," this product was first produced by Brown and Williamson Tobacco Corporation in Louisville, Kentucky as part of their Bugler "Thrift Kit" released around 1934 and that remained popular at least through the 1940s. The kit, marketed largely in response to tighter budgets during the Great Depression, included two packs of Bugler tobacco, the rolling machine, rolling papers, and a carrying case for rolled cigarettes. It was the first rolling kit sold in the country (Kleber 2001:133).

Toys

A total of 41 toys were recovered during the survey project. Of these, 24 were made out of metal or metal alloys, one out of rubber and one out of wood. In addition, 12 marbles and 3 handmade toys were recovered. The following discussion is based on this breakdown.

Metal Toys

Out of the 24 metal toys collected, 17 are Cracker Jack "prizes" and 7 are from various manufacturers.

Cracker Jack Prizes

Seventeen of the metal toys are Cracker Jack prizes, the majority of which (n=14) were recovered from

Figure 6-III.95 Cigarette rolling machine.

BIBE1942. Because Cracker Jack prizes changed at least on a yearly basis, they serve as high-resolution temporal diagnostics as well as a general indicator of the presence of children, and thus domestic occupations. The prizes collected during the survey represent a time range of 22 years, from 1917 to 1938. The following discussion organizes these artifacts by site, and then by year of issue.

Although invented in 1893, the term "Cracker Jack" was coined in 1896 and was originally distributed to retailers in bulk. The popcorn treat was first boxed for individual sale in 1899 although it was not until 1912 that prizes began to be put in every box. Prior to that, prizes were only offered in select boxes, in exchange for a coupon, or were given out randomly by the dealer. Over the years several different toy manufacturers contributed to Cracker Jacks, including (among others) Akro Agate Company, Cloudcrest, and the Dowst Toy Company. In 1912, the Dowst Toy Company changed its name to Tootsie Toy and became one of several main suppliers of Cracker Jack metal prizes. The discussion of these prizes is based entirely on White (1997).

Fourteen of the Cracker Jack prizes, representing 82 percent of the total, were recovered from BIBE1942. The earliest prizes recovered from the site consist of a partridge and a badge, both introduced in 1917. The partridge, made of pot metal (inexpensive, soft alloys), stands on an eight-point star base and originally would have been painted gold (Figure 6-III.96a). Although the sheet metal sheriff's badge could not be definitively matched to known examples, it is very similar to the 1917 Cracker Jack series of "arrow-back badges," a type of toy badge utilizing a triangular tab in the back that would have hooked over a shirt pocket (Figure 6-III.96b).

Two of the prizes were a horse and a wagon that refit to make a U.S. Mail Horse and Wagon (Figure 6-III.96c). This prize, issued in 1921, was made of pot metal and bore the letters "USM" on both sides of the wagon just above the wheel. This mail wagon originally

Figure 6-III.96 Kracker-Jack toys from BIBE1942 (41BS1868): (a) Pot metal partridge; (b) Sheet metal sheriff's badge; (c) Pot metal horse and mail wagon; (d) Pot metal trolley car; (e) Pot metal ring; (f) Pot metal battleship; (g) Pot metal binoculars; (h) Sheet metal horse and wagon; (i) Sheet metal van; (j) Sheet metal whistle.

would have been coated in red or green lacquer paint. A fourth recovered toy is the first of a series of trolley cars introduced in 1923 as part of the "Transportation Continuation" series (Figure 6-III.96d). Made of pot metal that would have originally been painted red or green, the car is now missing its center part as well as a vertical back wire guide.

In 1923, Cracker Jack also introduced a series of rings, one of which was recovered from BIBE1942 (Figure 6-III.96e). This ring is made out of gray pot metal with a rounded band. The centerpiece is a spherical red stone placed in a setting with scalloped edges. In 1924, the third part of a battleship series was introduced, four of which were collected, making this the most common Cracker Jack prize recovered during the survey (Figure 6-III.96f). They are crafted out of pot metal and depict smoke billowing from their stacks and seven guns on either side of the hull. Originally they would have been painted with blue or red lacquer paint.

As part of a sports-related charm series, binocular charms were also released in 1924, one of which was collected (Figure 6-III.96g). It is cast out of pot metal and would have been painted gray or dark gray. A sheet metal horse and wagon introduced in 1925 was also collected (Figure 6-III.96h) as was a toy van that was part of Cracker Jack's 1931 transportation automobile series (Figure 6-III.96i). Although the exact automobile type could not be identified due to the lack of paint, it would have been either a delivery van, police van, or an ambulance which would have made it either first, third or tenth in the series, respectively. In 1934 Cracker Jack released a series of plain one- or two-tube whistles. The third in this series was also collected at BIBE1942 (Figure 6-III.96j). It has only one cigar-shaped tube and is made out of plain gray sheet metal.

The remaining three Cracker Jack toys were found at three different sites and were the only ones found outside BIBE1942. The first, from BIBE2063, could have been used as a cufflink or lapel stud (Figure 6-III.97a). It is part of a group of buttons introduced in 1926 that had words and pictures cast on their faces to form catchy sayings. This artifact bears the phrase "Can I Swing on Your" next to an image of a gate. The second is part of a series of people-shaped whistles released in 1934 (Figure 6-III.97b). Collected from BIBE2030D, the toy is made of sheet metal stamped to look like a man's face. It was originally colored gold.

Figure 6-III.97 Other Kracker-Jack toys: (a) "Can I Swing on Your [Gate]" button; (b) Sheet metal whistle, man's face; (c) Sheet metal dust pan.

The last Cracker Jack prize, from BIBE859G, is a dust pan made of sheet metal (Figure 6-III.97c). This toy was made in 1938 and came in blue, red, green, or red and white (White 1997; Toth n.d.).

Other Metal Toys

In addition to the Cracker Jack prizes, seven other metal toys were collected comprised of carbon steel, lead, pewter, brass, and tin. Three fragments of a carbon steel toy cap gun were recovered from BIBE2030 (Figure 6-III.98a–c). The left side grip has a circle around the letter "K," and the raised word "boy" at the top of the frame. "Made in USA" is cast on the right side of the barrel and "2D" is cast on the inside of the barrel. The left side of the barrel and right grip are missing. This cast iron Dough Boy cap gun was manufactured by Kilgore Manufacturing of Westerville, Ohio in the 1920s. Founded by Joseph D. Kilgore in 1917, Kilgore Manufacturing became the world's leading manufacturer of toy guns. The company also made flares, hand grenades, and land mines during World War II, and continued to make toy guns until the mid-1980s (Westerville Public Library 2010; Worthpoint Corporation 2011). The second carbon steel toy, from BIBE1942, is a double-pointed pickaxe of unknown manufacture (Figure 6-III.98d).

A lead candle stick holder whose top has been partially smashed was collected from BIBE1942 (Figure 6-III.98e). Two small tea cups were also found during the survey, one of which, from BIBE1942, is made of lead but has been broken in half and is partially deformed due to melting (Figure 6-III.98f). The other, from BIBE185, apparently made out of pewter, has a heart design but is missing its handle. According to

Figure 6-III.98 Other metal toys: (a–c) Carbon steel Dough Boy cap gun fragments; (d) Carbon steel pick axe; (e) Lead candlestick holder; (f) Lead tea cup; (g) Brass monkey head.

Wright (2007), pewter toys were made with a high lead content prior to 1900. Because the teacup from BIBE1942 is crafted out of lead, this may suggest it was made before 1900. The other teacup, containing less lead, was probably made after 1900.

One fragmentary toy made out of brass sheet metal from BIBE1920 is a monkey head wearing a small hat (Figure 6-III.98g). The last metal toy collected, from BIBE2030D, is a small tin washboard that was part of a laundry set made in the 1930s by J. Chein & Company (Figure 6-III.99). Founded by Julius Chein in 1903 in New York City, the company became known for toys manufactured out of stamped or lithographed tin (Wikipedia, J. Chein & Company n.d.; Wright 2007).

Rubber Toys

Only one rubber toy was recovered during the survey (Figure 6-III.100a. A small rubber ball (1.06 inches in diameter) collected from BIBE1942 probably went with a game of jacks (Historical Folk Toys n.d.). The ball is complete although it is desiccated and pitted.

Figure 6-III.99 Sheet metal toy washboard.

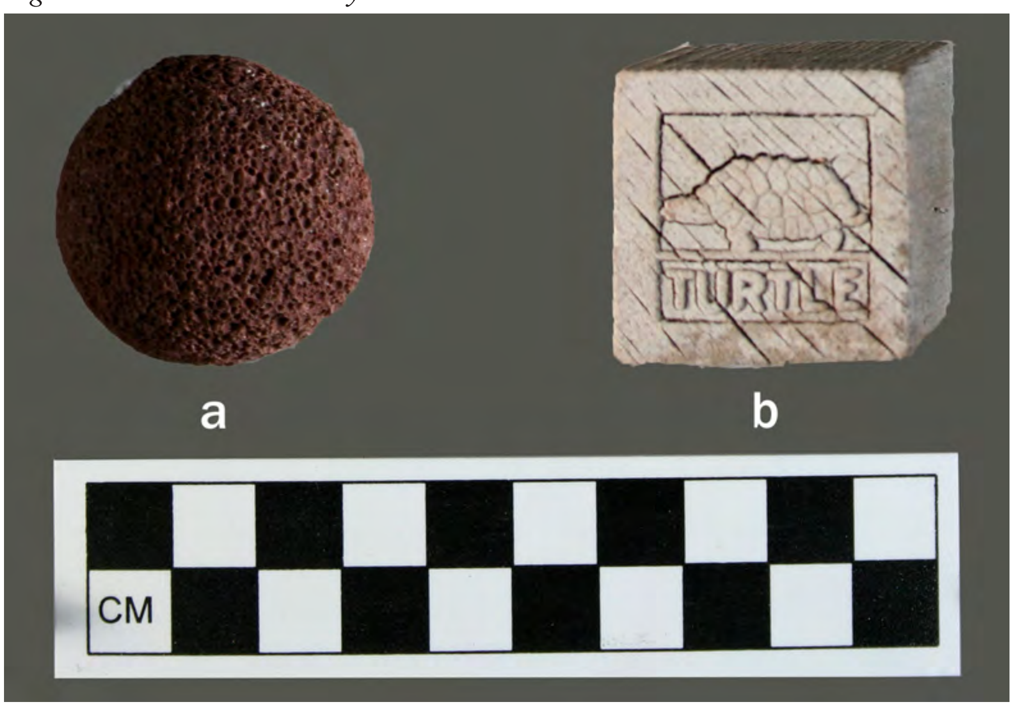


Figure 6-III.100 Rubber and wooden toys: (a) Rubber ball; (b) Wooden letter block.

Wooden Toys

The only wooden toy that was recovered was a learning block from BIBE2030 (Figure 6-III.100b). Two sides of the block have animals on them, a turtle and an ape, are depicted with the words spelled out under their picture. Two other sides have letters on them that might have been a "P" and an "R." The two remaining sides were blank or have subsequently worn off. No date or origin of manufacture could be assigned this artifact.

Marbles

A total of 12 marbles were also collected during the project. The most common were ceramic marbles, which can be broken down into three styles: Earthenware, Benningtons and China. Seven earthenware marbles were collected, ranging in size from 14.89 mm (0.59 inches) to 19.49 mm (0.77 inches) in diameter. Four of these marbles collected from BIBE1920, BIBE2030, and BIBE1083 are plain earthenware that still retain the natural clay color (Figure 6-III.101a–d). Three marbles from—two from BIBE1942 and one from BIBE0859—are earthenware that have been painted a tan color (Figure 6-III.101e–g). All of the earthenware marbles except for one are well rounded suggesting they were most likely commercially manufactured. The marble from BIBE2030, however, has several angular edges suggesting it was homemade (Figure 6-III.101b). Due to the ease of making them, homemade earthenware marbles are not uncommon, requiring little more than rolling and firing balls of clay.

Three glazed clay marbles, known as Benningtons, were collected from BIBE1920, BIBE1707, and

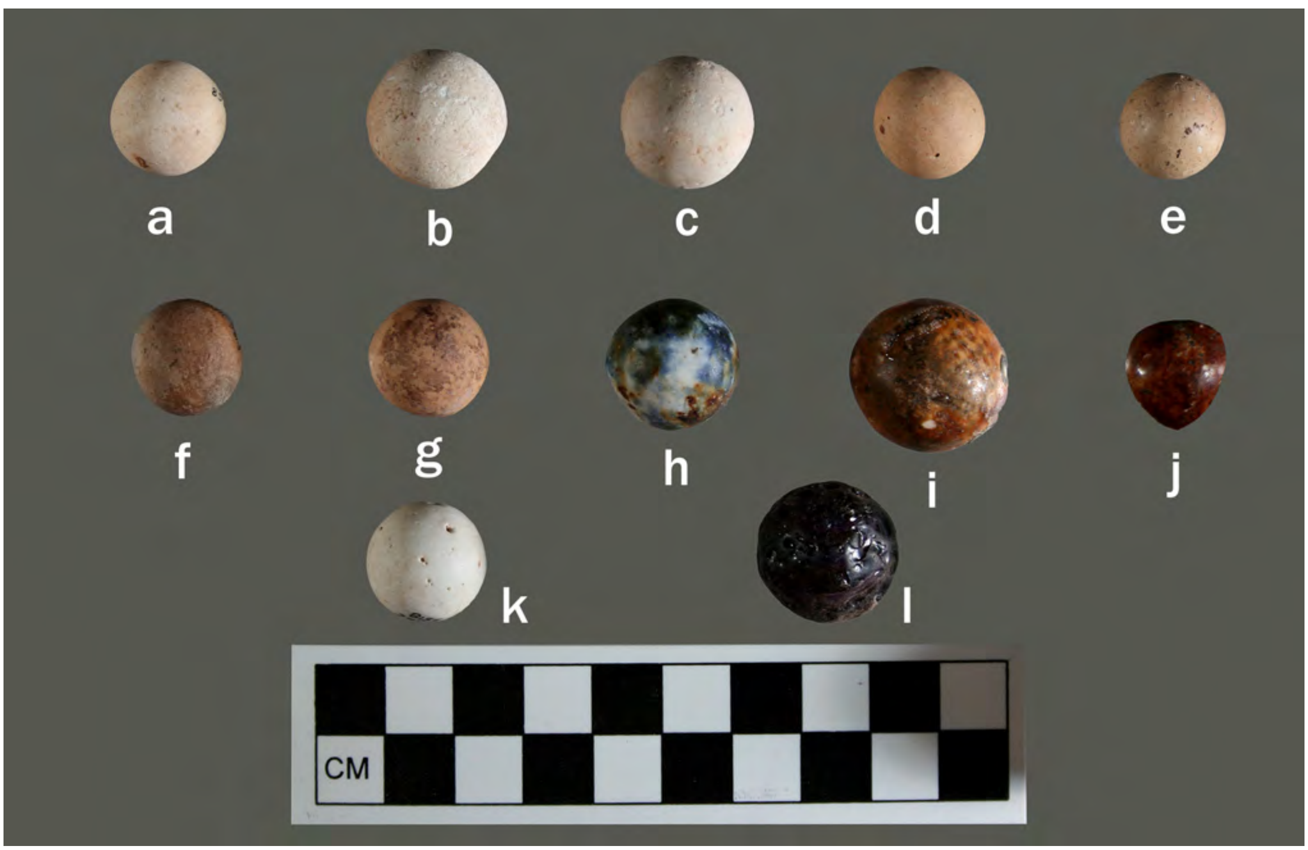


Figure 6-III.101 Marbles: (a–d) Earthenware marbles; (e–g) Painted earthenware marbles; (h–j) Bennington marbles; (k) Unglazed porcelain marble; (l) Purple glass marble.

BIBE1083 (Figure 6-III.101h–j)—one of which, due to its blue, green, and brown sponged appearance, is known as a "Bennington Fancy" (Figure 6-III.101h). Ranging from 15.74 mm (0.62 inches) to 22.37 mm (0.88 inches) in diameter, these marbles bear distinctive marks known as "eyes" which are spots created when two marbles came in contact during firing. Although Benningtons acquired the name because of their resemblance to pottery made in Bennington, Vermont, this style of marble was actually made in Germany between 1870 and 1910 (Gartley and Carskadden 1998:133–135).

The only porcelain marble recovered was collected from BIBE0415 (Figure 6-III.101k). It is a plain unglazed white China marble 17.18 mm (0.68 inches) in diameter. Chinas were first made in Germany in the 1840s and imported to the United States. Most were hand painted until the 1870s when unpainted China's became more popular. Very little is known about the production of these marbles in the United States although there were two possible companies from Ohio. One began production in 1894 and the other in 1916. Also listed in the 1895 issue of the Montgomery Ward Catalogue was an advertisement for "American Majolica Marbles" although the type and maker is not known (Gartley and Carskadden 1998:131–132; Randall and Webb 1988:17).

One glass marble was also collected from BIBE2130 that is 20.33mm (0.88 inches) in diameter although it has been heavily battered from extensive use (Figure 6-III.101l). Made of dark purple translucent glass, it has several ribbon-like strands of different colors that are twisted inside the marble—a type known as a divided core. This design is associated with the Akro Agate Company dating to sometime after 1929 when a modified machine began producing uniform spirals. Glass marbles were first made in Germany in 1846, although they did not become popular in the U.S. until years later. In the early 1900s Akro Agate Company became the largest manufacturer of glass marbles—producing over half of all marbles being sold. The company was founded by Horace C. Hill and two other partners in 1910. Marble production began in 1914 and the company continued to lead the marble industry until it went out of business in 1951 (Randall and Webb 1988:77–82).

Handmade Toys

In addition to the manufactured toys recovered during the survey, three hand-made objects were also interpreted as children's toys. Fired miniature "pinch pots" were recovered from both BIBE1920 and 2030 (Figure 6-III.102a–b), and a small fired amorphous lump of clay was recovered from BIBE1920 (Figure 6-III.102c). Characteristics in the paste and temper of these ceramics resemble that of other plainwares recovered from these sites, and are believed to be locally made. Although these may represent test-firing of clays by historic potters, it is perhaps more likely these represent handmade toys for children. Although such handmade objects are not uncommon in early historic sites, fired miniature ceramics are unique in the archeological assemblage (for further discussion, see Ceramics report in Appendix 13).

Structural

The structural group includes only a single category, Hardware, which contains only a single type, Fasteners. A total of 48 artifacts are addressed in this group, consisting of 5 percent of all collected historic artifacts. Unlike excavations of domestic sites in which recovery within this group may be substantial, due to the nature of archeological survey, structural items were very infrequently collected and, in this case, consist almost entirely of nails.

Hardware

Only 48 artifacts are addressed under the hardware category, all of which belong to the Fasteners type. Although items such as keys or a key escutcheon arguably could be addressed in this section, for the purposes of this report, they are discussed in the section on Furnishings in the Domestic group.

Figure 6-III.102 Handmade toys: (a-b) Clay pinch pots; (c) Fired amorphous clay lump.

Fasteners

Forty-eight fasteners were collected during the survey consisting of 44 nails, 2 fencing staples, 1 rivet, and 1 twist lock fastener. The following section addresses these items in this order.

Nails

Forty-four nails were collected during the survey project, consisting of 19 cut nails, 19 wire nails, 3 square boat nails, 2 wrought nails, and 1 soling nail. Three horseshoe nails were also collected that are addressed in the section on horse gear. The following discussion is based on this breakdown. Because most of the region was settled late (after 1880) and because wire nails had largely replaced the earlier cut nails by 1900, few sites in BBNP or across the region contain cut nails of any kind. Consequently, when present they are a quick indicator of early historic sites in the region. Although many hundreds of nails were observed during the survey, very few were collected and those that were tended to be disproportionately of the scarcer cut nail variety. Nail collections representing the range of observed nails were collected at three of the earliest historic sites: BIBE1910, BIBE1920, and BIBE1942. These were chosen for representative collections because they included a range of both cut and wire nails.

Aside from indicating whether a site likely predates or postdates 1900, nails are generally poor temporal diagnostics in the Big Bend. The earlier hand-wrought nails as well as hand-headed cut nails are virtually nonexistent locally except in very isolated cases (two of which are included here). Instead, cut nails are almost always made of steel rather than iron and are of the fully mechanized machine-cut and machine-headed variety common after 1830. In addition, because steel wire nails have changed little since their introduction over a century ago, they are not useful as temporal indicators. Nails are generally restricted, then, to serving as crude temporal identifiers on early sites and as functional diagnostics that indicate the type and scale of construction that took place on any particular historic site (Wells 1998).

Because all the recovered nails were rusted—some heavily so—certain attributes could not be determined with confidence (such as thickness, or gauge).

Other attributes (such as the direction of grain on iron nails) could only have been detected after completely removing all oxidation. However, because such destructive analysis would be unlikely to yield much additional data, it was not performed. Instead, the following physical descriptions are based on *pennyweight*, the standard measure of nail size used by retailers. Stories about the origins of the term pennyweight differ but it either referred to the price for a hundred nails in fifteenth century England (the larger the nail the greater the cost per hundred), or to mean the number of pounds per 1,000 nails. (Thus, 1,000 10-penny nails would weigh 10 pounds.) In any case, the system was later standardized to indicate the size of a nail. Size, then, is designated with a number and the abbreviation "d" for penny (such as 10d for a ten-penny nail). The larger the number is, the larger the nail. Thus 4d nails are 1.5 inches long whereas 8d nails are 2.5 inches long. Generally speaking, larger nails indicate more substantial construction (such as framing) and smaller nails indicate less substantial construction (such as trimwork) (Allen n.d.).

Cut Nails

Nineteen cut nails were collected from seven different sites during the survey (Figure 6-III.103a). Seven of the cut nails were collected from BIBE1910, four of which are complete—one 4d, one 6d, one 8d, and one 10d. The remaining three nails are incomplete (broken toward the tip) but based on head size and shank thickness, conform to what would have been one 6d, one 8d, and one 9d nail. Four complete cut nails were collected from BIBE1920—one 5d, one 7d, one 12d and one 1-inch-long finishing nail. Three complete cut nails were collected from BIBE1942—all of which are 8d. Two cut nails were collected from BIBE1204. One of these is fragmentary, missing almost half its shank

Figure 6-III.103 Nails: (a) Cut nail, 6d; (b) Wire nail, 8d; (c) Wire nail, 6d; (d) Wire nail, domed head, 2d; (e) Wire nail, large head, 8d; (f) Boat nail, 6d; (g) Wrought nail, 8d; (h) Brass soling nail.

from the distal end (opposite the head). Based on its thickness, it appears most like a 16d nail. The second cut nail is much smaller. Although this nail is slightly bent, it appears to be a 5d.

Two cut nails were collected from BIBE593, both complete. One of these is an 8d nail that is slightly bent near its midsection. The second is a 20d nail. This particular nail is unique among the cut nails collected during the survey. Because all cut nails are grasped by a clamp at the upper end of the shank during heading, they bear a slight deformation referred to as the "pinch" just under the head. Most cut nails manufactured before 1840 were pinched on the side of the nail (the cut sides). Those manufactured after 1840 are mostly face pinched (Wells 1998:91–93). All of the nails collected in BBNP are face pinched except this specimen, which is clearly side-pinched. This suggests an earlier date for this nail although based on the known history of Camp Neville Spring (BIBE593), it should be contemporaneous with the encampment which was only occupied from 1885 to 1891.

The last cut nail was collected from BIBE859. Although the distal end of this nail is missing, based on its thickness, it appears to be most like a 40d nail. Like other cut nails larger than 16d, this nail has a reinforced head, slightly thicker than smaller cut nail heads. Among the specimens, the face-pinch deformation on this one is better defined.

Wire Nails

Twenty wire nails were collected from five sites. Nine of these were collected from BIBE1942 as part of the nail sample, representing a range of sizes observed. One of the nails is 5d and another, although fragmentary and heavily rusted, also appears to be a 5d. The remaining nails from BIBE1942 are complete. There is one 6d nail (Figure 6-III.103c), one 7d nail, three 8d nails (Figure 6-III.103b), one 16d nail, and one 20d nail. Several of these nails, most notably the 4d, display manufacturing irregularities (nail head off-center and uneven grip marks) suggesting they might be fairly early (ca. 1890s).

Six nails were collected from BIBE1920, consisting of one 2d, one 3d, one 5d, one 6d, one 8d, and one 40d nail. Two of these, the 5d and 8d nail exhibit irregularities in the head with the former abnormally thin and the latter offset from center. The 2d nail head is dome-shaped, and—with the exception of the presence of gripper marks—appears most like an escutcheon pin (Figure 6-III.103d).

Three nails were collected from BIBE1910 consisting of one 2d, one 6d, and one 8d nail. The 2d nail is unique in that it tapers along half the length of the shank to a sharp point. This is most likely a clinch nail, intended for small work (such as for trunks) where the point was to be clinched for better holding power. Both the 6d and the 8d nails exhibit eccentric heads suggesting early manufacture. One wire nail was collected from BIBE1675. This 8d nail is unusually thick and with a larger head than normal (Figure 6-III.103e). It appears similar to a roofing nail except it is about twice as long as most on the market today. The head is also smaller than a regular roofing nail, but larger than a common nail. In addition, the head has two indentions along its edge—apparently a result of irregularities in the heading machine. The distal half of this nail is heavily rusted. The last wire nail was collected from BIBE1204—a small 5d ring-shank nail. Unlike modern ring-shank nails, however, the pattern down the shank of this nail more closely resembles a series of concentrically stamped divots rather than continuous concentric rings. This may be an early form of this type of nail which are used to increase holding power in wood.

Boat Nails

Two square boat nails were also collected during the survey (Figure 6-III.103f). These nails are square in cross section (as opposed to a rectangular cross-section like that of cut nails), have relatively small heads, gripper marks, and a diamond (4-way) taper at the point. This type of nail is preferred for the construction of boats due to its greater strength and holding power against the swell and contraction of wood.

Although it is unlikely that boat construction was taking place in the park, these nails may have been preferred for other applications (such as securing wood to masonry surfaces). Such nails today are very uncommon and are only available from specialty nail suppliers. Both of the square boat nails are 8d, one from BIBE1910 and one from BIBE1920.

Wrought Nails

Two wrought nails were collected during the survey. Both were found at BIBE859B—one of the subsites within the village of San Vicente. Such nails are basically unknown in the region (none have been noted previously by the author) and their presence here are strong indicators of antiquity. Had they been found anywhere else in the park, they would have been considered anomalous. However, given the village's proximity to the old San Vicente Presidio across the Rio Grande (manned from 1773-1784), and the likelihood of episodic early settlement in the areas adjacent, these nails suggest a link to these early historic events. Both nails are heavily rusted and only one is complete (Figure 6-III.103g). This nail, the larger of the two, would roughly correspond to an 8d nail (although such measurements are less useful for hand wrought nails). It measures 2.65 inches in total length and tapers sharply from 0.39 inches in maximum diameter at the head to 0.11 inches in diameter at the tip. The nail head is irregular, roughly oval in shape, and has three gently sloping facets on its face where the hammer blows struck when creating the head. Whether by accident or design, the tip of the nail is twisted a quarter turn clockwise. The second, smaller, nail is incomplete, broken roughly halfway down its shank. Although it measures 1.19 inches in total length, originally it was probably closer to 2 inches long. This nail tapers more gently, from 0.27 inches in maximum width at the head to 0.19 inches in maximum width at the break along the shank. The head displays two facets where the hammer blows created the head.

Soling Nail

One small brass soling nail was also collected from BIBE859B (Figure 6-III.103h). This tiny brass nail is rectangular in cross section (like cut nails), is 0.65 inches in length, has a thick, inverted-cone-shaped head, and gripper marks that extend half way down the shank. The tip is cut and bent in such a way that it forms a very sharp point at a right angle to the nail's face. This type of nail was used to attach soles to shoes.

Staples

Two fencing staples were also collected during the survey. One from BIBE1910 is exceptionally long and narrow, measuring 2 inches in length and 0.6 inches in maximum width. Although heavily rusted, it is complete. While similar in gauge and style to modern fencing staples, this might be a specialty staple. The second staple, from BIBE1920, is identical to modern fencing staples (Figure 6-III.104a). It measures 1.46 inches in maximum length and 0.63 in maximum width. One leg is slightly longer than the other, the shorter one measuring 1.29 inches long. It is lightly rusted and complete.

Rivets

One unused solid flatheaded brass rivet and a rivet washer were collected from BIBE1910 (Figure 6-III.104b and d). The rivet measures 0.75 inches long and the head and washer are both 0.44 inches in diameter. On top of the rivet head is stamped a *fleur de lis* or stylized lily. The rivet and washer are in good condition and complete.

Twist-Lock Fastener

One twist-lock fastener and the fastener receptacle—also known as "common sense fasteners" or "Murphy fasteners"—were collected from BIBE1942 (Figure 6-III.104c and e). Made of brass with a nickel finish,

Figure 6-III.104 Various fasteners: (a) Fencing staple; (b) Rivet; (c) Twist-lock fastener; (d) Rivet washer; (e) Twist-lock fastener receptacle.

these fasteners consist of a pivoting stud (male end) that is turned 90 degrees after passing through the grommet (female end) attached to the fabric (such as canvas or vinyl) effectively securing the two together. Typically, the male end is secured to wood or metal and the female end is secured to canvas. However, in this case, based on its attachment style (prongs rather than screws), both were intended to be attached to canvas. These fasteners were commonly used to fasten curtains on carriages or canvas or vinyl tops on early vehicles such as Model T Fords (Lang's Old Car Parts n.d.; Spivey 1979:79).

Activities

A total of 167 artifacts in 10 categories are addressed under Activities, representing 19 percent of the total collected artifact assemblage, making it the third largest group after Domestic and Personal. Of these 167 artifacts, 13 are ranching-related, 4 are camping-related, 1 is fishing-related, 4 are school-related, 31 are transportation-related, 5 are manufactured tools, 6 are handmade tools, 90 are firearm-related, 11 are commerce-related, and 2 are entertainment-related. The following discussion is based on this breakdown.

Ranching

The ranching-related category is represented only by five lengths of barbed wire and eight sheep-shearing blades. It is noteworthy that this is disproportionate to the wide array of ranching-related artifacts documented during the project that often included such things as windmill parts, netwire, and pipe segments that were not targeted for collection. While horse gear could conceivably have been included in this category, those items are dealt with in the Transportation section.

Barbed Wire

Only five lengths of barbed wire were collected during the survey which is far from a representative sample of the range of types documented during the project. In fact, most of the time barbed wire was documented with written descriptions or photographs which are generally adequate for proper identification. Thus, these artifacts represent just a small sample of the barbed wire encountered.

Two strands were collected from BIBE1325. Both of these are double-strand barbed wire—one of which has two-prong flat barbs and one of which has unusually long four-prong round barbs. The barb of the former consists of a single flat piece of wire, both ends of which have an angled cut to create the point (Figure 6-III.105b). This barb is wrapped around one of the two twisted strands of smooth wire—and prevented from spinning by contact with the second wire. This style most closely resembles "Baker's Barb, Perfect Variation"—a variation of a style patented in 1883 by George C. Baker of Des Moines, Iowa (Clifton 1970:90). The barbs on the second strand consist of two parallel round pieces of wire wrapped around the two-strand smooth wire to form four barbs. One of the four barbs extends between the two strands of smooth wire to lock the barb in place. This style resembles "Ross' Four Point" style which was patented in 1879 by Noble G. Ross of Chicago, Illinois (Clifton 1970:152).

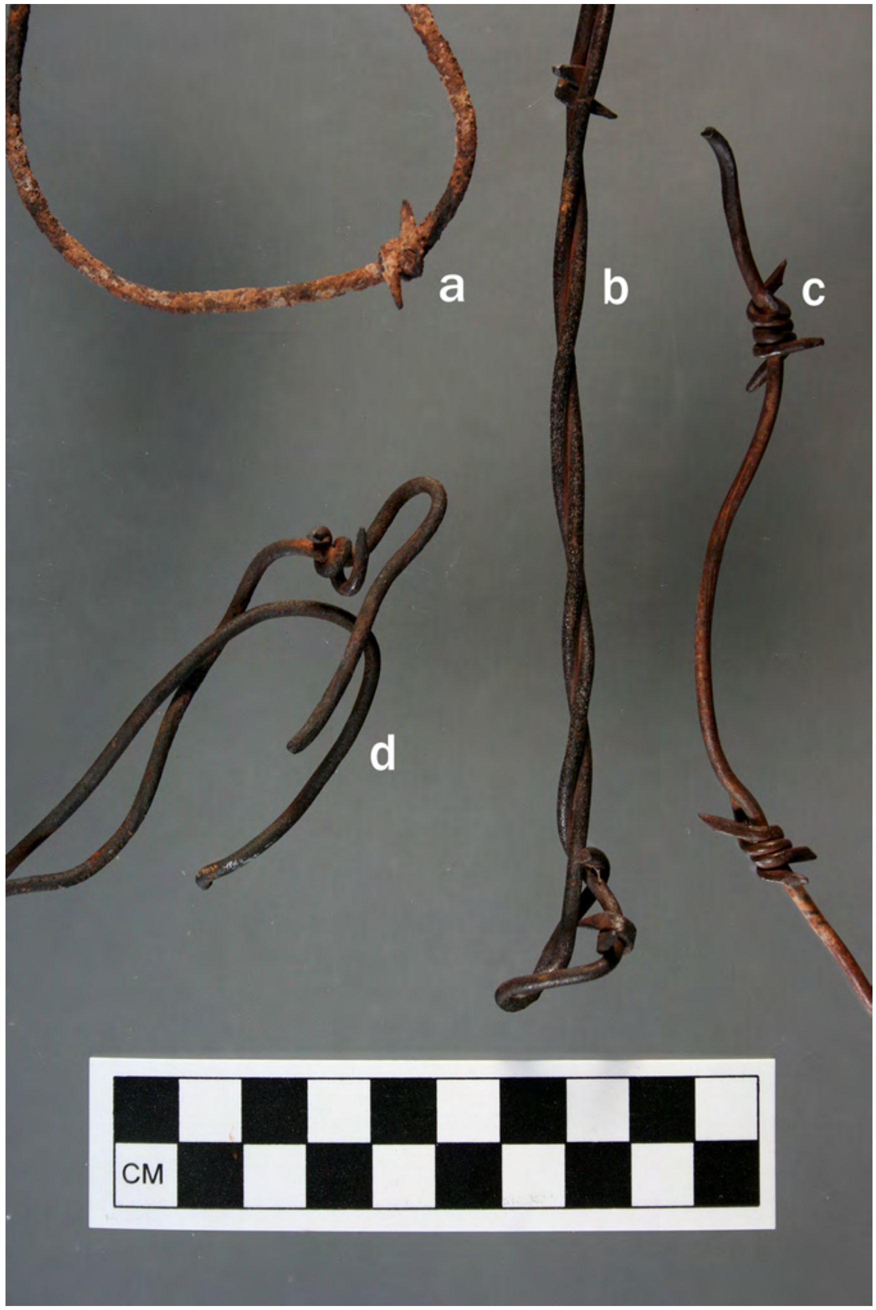


Figure 6-III.105 Barbed wire: (a) Flat barbed, two-pronged, single strand; (b) Flat barbed, two pronged, double strand; (c) Round barbed, four-pronged, single strand; (d) Round barbed, two-pronged, single strand.

Two strands were collected from BIBE1910. Although both strands are single-strand with round wire barbs, these were almost certainly originally double-strand wire that had been disassembled and reused. The first has a double round wire barb wrapped twice around the strand (Figure 6-III.105d). This style is most like "Glidden's Barb, Common Variation" – a variation on a style patented in 1874 by Joseph F. Glidden of De Kalb, Illinois. (Clifton 1970:99). The second has a four-prong barb wrapped three times around the strand (Figure 6-III.105c). The barb is somewhat flattened or faceted on two sides. This style most closely resembles the "Dodge-Washburn's Barb, Three Wrap Half-round Variation." This was a variation on a style patented in 1882 by Thomas H. Dodge and Charles G. Washburn of Worcester, Massachusetts (Clifton 1970:146).

The last barbed wire strand was collected from BIBE1848. This is also a single strand that most likely represents disassembly and reuse of double-strand barbed wire (Figure 6-III.105a). This strand is very similar to one collected from BIBE1325 except it is heavily rusted. The barb consists of a single flat piece of wire, both ends of which have an angled cut to create the point. The barb is wrapped once around the wire strand. This style most closely resembles "Baker's Barb, Perfect Variation"—a variation of a style patented in 1883 by George C. Baker of Des Moines, Iowa (Clifton 1970:90).

Sheep Shearing Blades

Eight sheep shearing blades were collected during the survey. Seven of these came from BIBE991A, five of which are top blades, or cutters, and two of which are bottom blades, or combs. The cutters are 1 inch tall and 2.5 inches wide and have four lanceolate blades extending out from a common base. Stamped along this base is "STEWART" between two four-point diamond patterns (Figure 6-III.106a). Below that is stamped "PAT. 1,697,304 MADE IN U.S.A." This cutter design was patented in 1929 by George Browning for the Chicago Flexible Shaft Company (U.S. Patent and Trademark Office n.d.). The two combs are 2.5 inches tall and 3.2 inches wide and have 13 long teeth attached to a flat metal base upon which is stamped "STEWART / U.S.A." (Figure 6-III.106c) One additional shearing blade was collected from BIBE1987. This is a cutter with slightly larger teeth than those from BIBE991A. Stamped across the top is "STEWART" (Figure 6-III.106b) The J.K. Stewart Manufacturing

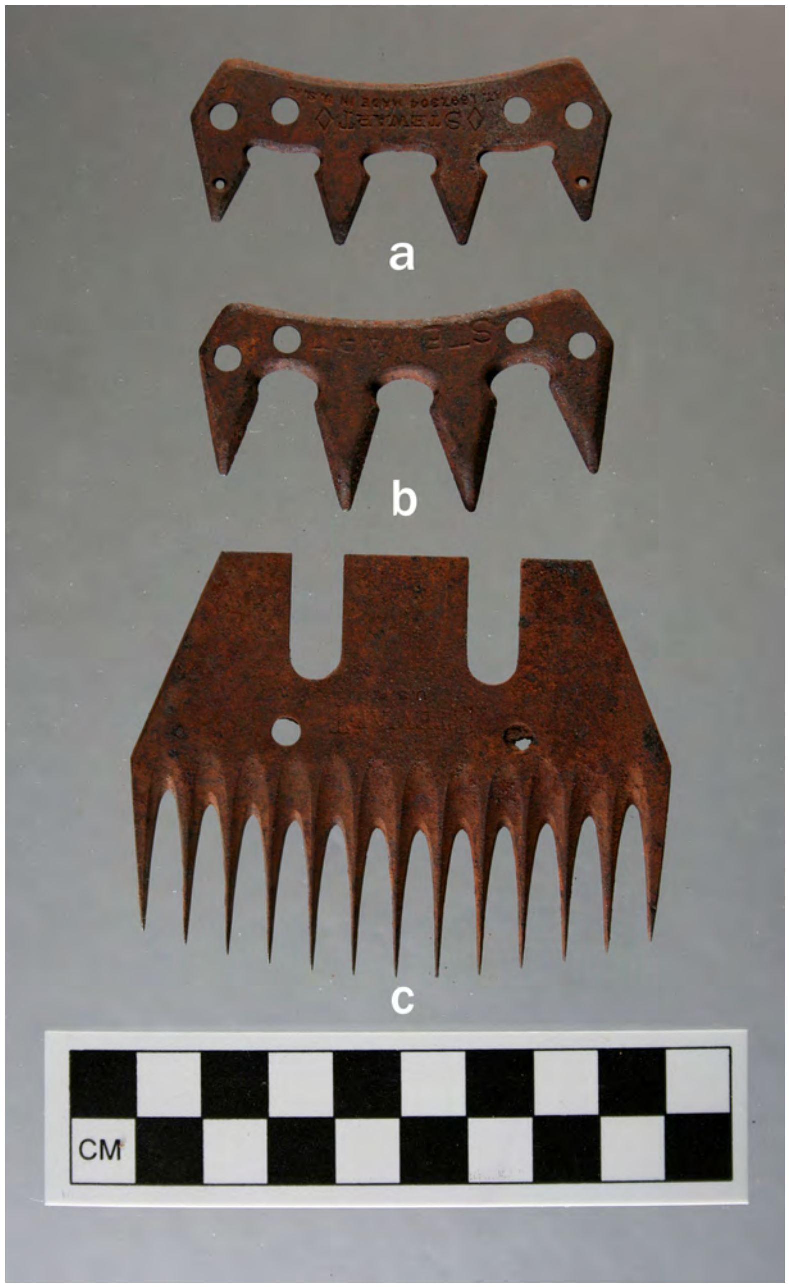


Figure 6-III.106 Sheep shearing blades: (a–b) Top blade (cutter); (c) Comb.

Company was organized in 1908 by John K. Stewart (Jordan 2018).

Camping

Although camping and national parks are almost synonymous, most camping-related artifacts documented during the survey date back to an earlier period. Recreational camping has occurred in the Big Bend since the early 1900s although most historic camping is related to economic pursuits (ranching, candelilla wax camps, etc.) or to military ones. Although the canteen was not military issue, the first aid kit corresponds to the years of the Mexican Revolution when the region was occupied by both National Guardsmen as well as the U.S. Cavalry. The tent rope tensioner is affiliated with an earlier military occupation, that of the U.S. Cavalry during the final years of engagement with Native Americans.

Canteens

Two identical tin drum canteens were collected, one from BIBE1987 and one as IF062. The former is missing both legs, part of the screw top spout is missing, and it has what appears to be a bullet hole in the lower left hand corner of one of its faces. Baling wire had been attached to both strap swivels. The latter canteen is complete and, with the exception of a few dings and minor rust, is in good condition (Figure 6-III.107). The canteens are round and made of galvanized metal. They are 7.5 inches in diameter. The sides are 1.75 inches in width and are crimped and soldered to the canteen's face. On both faces, around the perimeter of the seam, is a narrow "trough" which runs the circumference of the canteen. The faces flare outward from this trough, extending half an inch beyond the side seam. At the base of the canteen is a strip of tin soldered to the canteen body. Both ends of the strip are rolled into cylinders that serve as feet. On both sides of the canteen are metal swivels that would attach to a cloth or leather sling. At the top is a screw-type lid 1.25 inches in diameter. "BEAR BRAND" is stamped across the top of the lid. On one side, just below the spout is stamped "PATENTED OCT. 15, 1918."

Figure 6-III.107 Bear Brand tin drum canteen, patented 1918.

These canteens were manufactured by the Woolwine Metal Products Company of Los Angeles, California, which also produced steel ceilings, irrigation pipe, garbage cans, and ovens among other items. The company had previously produced canteens used by the U.S. military during the Civil War and Spanish-American War and later for the Boy Scouts of America. In 1909, the U.S. Army adopted aluminum canteens which were standard issue until 1962 when polyethylene canteens replaced them. The present canteens were intended for the civilian market and were advertised to outdoor laborers such as ranchers and farmers (Shearman 1921:157; Chriss 2017).

First Aid Kit

One World War I era field first aid kit lid was collected from BIBE1987 (Figure 6-III.108a). Although crushed, it is otherwise intact. The lid is rectangular, approximately 2.3 inches wide by 4 inches long with a downturned rim approximately 0.4 inches wide. The lid is made of a copper alloy and is stamped "FIRST AID PACKET – U.S. ARMY / CONTRACT OCT. 13, 1916 / BAUER AND BLACK / CHICAGO U.S.A. / TO OPEN-PULL RING / PATENT APPLIED FOR." These first aid kits were standard army issue and were one of many accessories in the pouches of utility belts.

Tent Rope Tensioner

One cast brass tent-rope tensioner was collected from BIBE593 (Figure 6-III.108 b). It is 2.85 inches in length and 0.64 inches in maximum width. It consists of a small open ended cylinder 0.5 inches long, with a 2.3 inches curved shaft extending outward from it with a 0.35 inch diameter hole at its far end. In raised letters along the top of the shaft is "PAT NOV 30 80." These were used to tension tent ropes between a tent grommet and the tent stake. The tent rope extended through the cylinder, around the tent stake, and its end was passed through the hole at the end of the extension. The tensioner sat at a 90-degree angle to the direction of the tent rope, which locked it in place, and could be adjusted by sliding more or less rope through the cylinder portion. This was patented by H.B. Thompson in 1880 and was a standard accessory used with military wall tents to tension their guy lines (U.S. Patent and Trademark Office n.d.).

Figure 6-III.108 First aid kit lid and tent rope tensioner.

Fishing

Fish Hook

One fish hook was collected from BIBE1920. Made of ferrous metal, the hook is rusted but complete, with the eye, point, and barb intact. It is 1.39 inches in total length, close to a standard size "1." This size of hook was likely used for catfish, the most commonly sought fish in the Rio Grande (Hurum 1977:76).

School

Slate Fragments

Two slate tablet fragments were collected from BIBE1920 (Figure 6-III.109a and b). One is 1 by 2.5 inches in maximum dimension, the other is 1.25 by 2 inches. Apparently from the same chalkboard writing tablet, both have a series of parallel scored grooves 0.44 inches apart, likely as guides for writing. This probably belonged to a child as part of his or her school supplies.

Brass Ferrules

Two brass ferrules from pencils were collected from BIBE2025 (the San Vicente Schoolhouse) (Figure 6-III.109c and d). Both are 0.625 inches in length and 0.38 inches in diameter but differ slightly in the pattern of lines that occur on the pencil side. Both flare outward in the middle such that the pencil diameter is smaller than the eraser diameter. Both ferrules contain remnants of the original erasers although the pencils are gone.

Transportation

The Transportation category consists of a total of 31 artifacts of two types: Horse Gear, consisting of 21 artifacts, and Automotive, consisting of 10 artifacts.

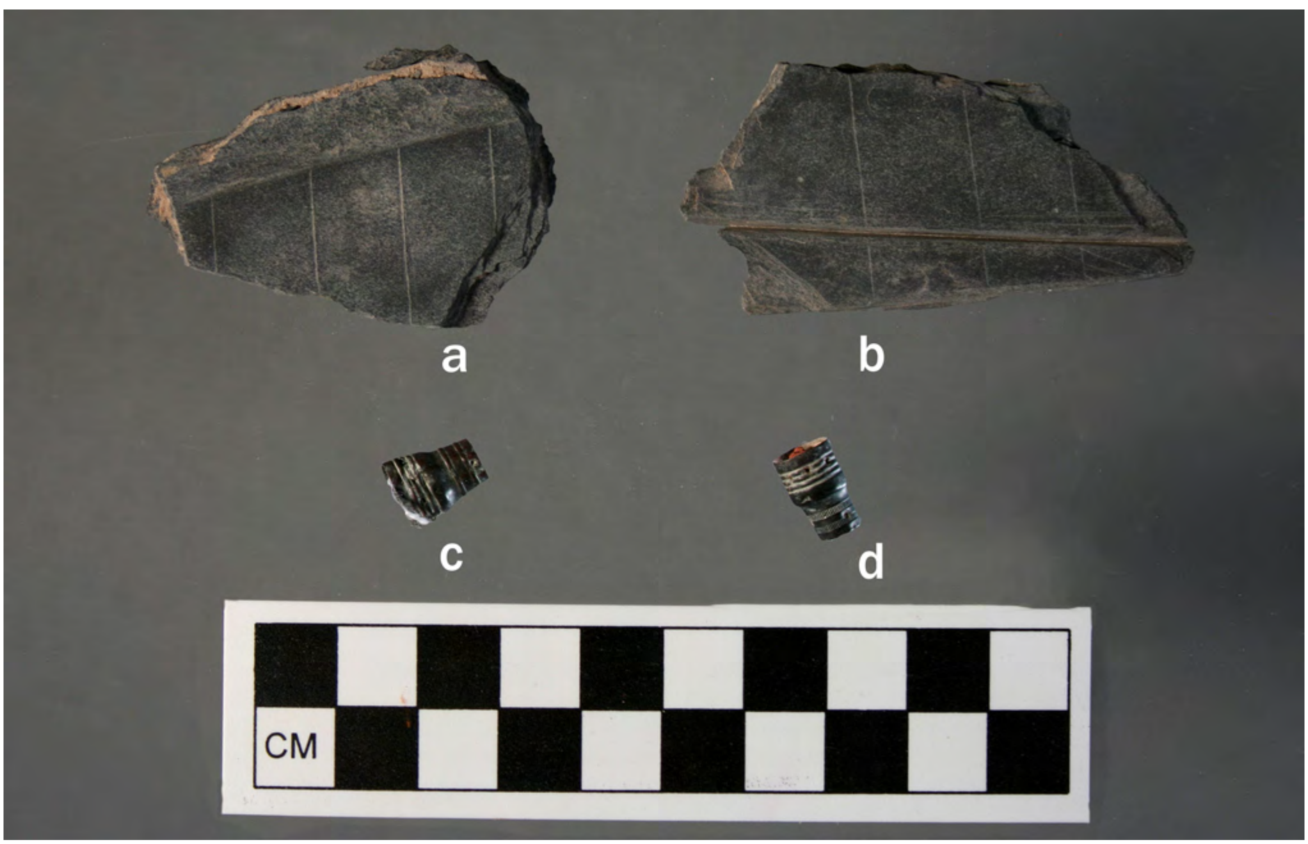


Figure 6-III.109 School supplies: (a–b) slate fragments; (c–d) brass ferrules.

Although horses (as well as mules and burros) were also used as beasts of burden and could be addressed within the Ranch or Farm categories, because they were primarily a mode of transportation, they are included here for ease of discussion.

Horse Gear

Before automobiles were commonplace, horses and mules served as the primary form of transportation in the region as well as being critical sources of power on farms and ranches. Because of this, as well as the substantial cavalry presence during the Mexican Revolution, horse gear—primarily in the form of horseshoes, but also other gear—were frequently encountered during the project, both from historic sites as well as isolated finds. A total of 21 horse-related artifacts were collected consisting of 6 bridle, halter, or harness buckles; 3 bridle bit fragments; 1 spur fragment; 1 halter loop and ring assembly; 2 lengths of trace chains; 4 horseshoes; 1 muleshoe; and 3 horseshoe nails. Unless otherwise indicated, this section is based on Ward (1983).

Bridle, Halter, or Harness Buckles

Six buckles were collected during the survey which were likely used on a bridle, halter, or harness. Two of these, from BIBE593 and BIBE1910, are simple D-frame heel-bar buckles made of carbon steel with the prong attached to one side of the frame (Figure 6-III.110a and b). The remaining buckles, from BIBE593, BIBE1910, BIBE1920, and BIBE2254, have center bars to which the prong is attached. All except one of the center bar buckles are made of carbon steel (Figure 6-III.110c–e); the remaining buckle is made of brass (Figure 6-III.110f).

Figure 6-III.110 Bridle, halter, or harness buckles: (a–b) carbon steel heel-bar buckles; (c–e) carbon steel center-bar buckles; (f) brass center-bar buckle.

Bridle Bits

Three horse bridle bit fragments were collected during the survey, all of which are made of ferrous metal and, consequently, are heavily rusted. One, from BIBE1920 is the left half of a curb bit, broken at the far end of the curved part of the bit—called a port (Figure 6-III.111b). The cheekpiece, or shank, of the bit is roughly "S" shaped, is 3 inches long, and is decorated with a series of drilled holes along the outer edge. The headstall ring, located nearest the bit, and the rein ring, at the distal end, are both intact. On the edge of the bit before the curb is stamped "ACA." This bit looks similar to cheap but somewhat ornate bits that were made in Mexico.

The second, from BIBE1978, is nearly identical to the one recovered from BIBE1920 except it is smaller and is the right half of the bit (Figure 6-III.111a). It is broken just before the curb of the bit. Like the other, holes are drilled along the edges of the cheekpiece (which is 2.5 inches long), and both the headstall and rein rings are intact.

The third, from BIBE2030G, is half of a straight jointed mouth bit, also known as a snaffle bit. It has one large (2.4 inches diameter) ring attached to the bit that served as the attachment point of both the headstall and reins. The bit itself was composed of a straight bar, hinged in the middle, only half of which remains. The remaining portion is a metal bar with eyes at either end which is 3.29 inches long. Baling wire has been attached to the eye and twisted around the remaining half of the bit either as a crude repair or in using it for some other purpose.

Figure 6-III.111 Bridle Bits: (a) Broken curb bit, left half; (b) Broken curb bit, right half.

Spur

One spur fragment was collected from BIBE185 (Figure 6-III.112). Made of ferrous metal, the rusted fragment consists of most of one half of the spur, including a 3.5 inches long segment of the heel band, and the two spur buttons. The top spur button—for the spur strap—is attached by a small band of metal that extends through a slot in the heel band allowing it to swivel. The lower button, fixed solid to the heel band, is for the heel chain. The spur is broken short of the shank which would have held the rowel. The band is made out of a single piece of cast metal. Along the side of the band is a decorative pattern of zigzag vertical lines on either side of two long intersecting horizontal lines.

Figure 6-III.112 Spur fragment.

Halter Loop and Ring

One halter loop and ring assembly was collected as IF683. It consists of one 2 inches diameter round ring attached to a roughly triangular shaped ring 1.11 inches tall and 1.62 inches wide. This ring is flat at the bottom with an oval slot intended for a leather strap to pass through. The top, or apex of the ring has another slot to hold the attached round ring. Although rusted, it appears complete. This assembly was advertised in Sears Roebuck catalogs for use in repairing or old halters or making new ones stronger; "used by all harness makers" (Sears Roebuck Catalog 1912:1228).

Trace Chains

Two lengths of trace chains were collected as IF657 (Figure 6-III.113a). Although different lengths, both chains appear to be complete. The following link measurements are outside diameters (maximum). Both chains have been "cobbled together" using a variety of different chain links, closure links, swivels, and hooks. One chain is 8 ft., 9 inches long with a 3.28 inch-long hook at one end and a 2.38 inch diameter ring at the other. The chain consists of 3 different sizes of chain links—5 links that are 1.14 inches long, 12 links that are 2.9 inches long, and 26 links that are 2.5 inches long in addition to 2 2 inch closure links and 1 S-shaped link 3.7 inches long. One swivel 3.26 inches long with "U.S." cast into the side is set six links back from the ring. The other chain is 10 ft. 8 inches long with a 2 inch-long chain link at one end and a 2.2 inch ring at the other. The length of the chain is composed of 5 different types of links—4 that have a half twist and are 2.07 inches long, 4 that are 3.6 inches long, 7 that are 3.5 inches long, 16 that are 1.6 inches long, and 21 that are 2.97 inches long. Three swivels are spaced out along the chain, all of which are 2.4 inches long. Also incorporated into the chain is a 4.5 inch- long snap ring and swivel, 1 S-hook 1.92 inches long, and 1 closure link 2.2 inches long.

These chains were used for attaching a draft animal (horse, mule, or burro) to a wagon or plow. One end was attached to the collar and the other to a singletree

Figure 6-III.113 Trace chains.

or wiffletree that balanced the differential pull of the animal as it walked. Although the cast "U.S" emblem on one of the swivels likely indicates cavalry equipment, the patched and irregular nature of the chains suggests they were repurposed, probably by a farmer using draft animals to pull a plow. Trace chains with the same "U.S." swivel were advertised in the 1930 Zork hardware catalog out of El Paso. Interestingly, there is no mention that these were surplus military chains, so it may be that these were commercially available (Zork Hardware Catalog 1930).

Horseshoes

Four horseshoes and one muleshoe were collected during the project. Such shoes are used to protect horse and mule feet and to provide better traction. Horseshoes were not commercially manufactured on a large scale until after the Civil War, prior to which horseshoes were the complete domain of the blacksmith. Horseshoes are not generally good temporal diagnostics, but can provide useful information about the kinds and relative size of animals that were used. Shoes can usually be distinguished between front and hind, with the former generally more rounded and wider at the toe and heel. Irregularities in the wear pattern or shape of a shoe can provide clues about the horse's confirmation and whether the shoe was "thrown" (detached from hoof) or "pulled" (where the rear hoof overreaches, catching the heel of the front shoe, pulling it off) or if it was removed by hand. Locational indicators (i.e., left or right) given below refer to the "hoof surface" of the shoe (the side that was in contact with the hoof) facing up—just as it would be when attached to the hoof.

Front

Three of the horseshoes collected are front shoes. One, from BIBE1204 is a machine-made 8-hole front shoe with heel calks that lacks maker's marks or other identifying characteristics (Figure 6-III.114a). The shoe is heavily rusted, enough so that the fuller is mostly obscured. The six heel-ward nail holes retain horseshoe nails which are all bent sharply outward except for one bent inward. Because the nails are still clinched, and because the right heel is bent lower than the left, this suggests that this shoe was pulled from overreaching, and that it was a left front shoe (the left hind hoof typically catches on the inside heel of the front foot) (Brent Husky, personal communication 2008).

The second front shoe was collected as IF087 (Figure 6-III.114b). This shoe is a machine made 8-hole shoe. At the toe of the hoof surface of the shoe is stamped "DIAMOND" set within a broad diamond shaped outline. Below that is stamped "DROP FORGED." On the left side heel is stamped "#0" and on the right side heel is stamped "B." These indicate the shoe size (0) which is roughly a "medium" sized shoe (typical size range is 000 to 3). The "B" may indicate that this is a plain "bronco" shoe as opposed to their "classic" or other lines. The Diamond Calk Horseshoe Company was founded in 1908 in Duluth, Minnesota. In 1912 the company added a full line of drop-forged horseshoes and soon added a line of forged tools. The company remains the largest supplier of horseshoes in the world (Apex Tools n.d.). This shoe retains parts of six horseshoe nails, all of which have been cut close to the hoof surface of the shoe, suggesting the shoe was removed by hand. The fuller groove is rusted over to such an extent that it is no longer visible and the nail heads on the ground surface of the shoe are barely detectable. The toe of the shoe is substantially worn such that it is around 0.1 inches narrower than the width of the shoe at the heel.

Figure 6-III.114 Horseshoes: (a) Machine-made 8-hole front shoe; (b) Machine-made Diamond 8-hole front shoe; (c) Handmade 6-hole front pony shoe.

The third front shoe was collected from BIBE1728 (Figure 6-III.114c). This shoe is a handmade 6-hole pony shoe that is substantially wider than it is long (by about half an inch). Significantly, on the inside edge of the shoe are a series of parallel, obliquely angled ribs that occur about one-third of an inch apart, suggesting it may have been fashioned out of rebar. The fuller grooves are misaligned in relation to each other. In addition, the outside edge of the shoe bulges outward where the fuller groove was stamped into the shoe. The right side of the toe is worn about one-fifth of an inch thinner than the rest of the shoe. One nail head, in the forward-most nail hole on the right side of the shoe, remains although its shank is entirely missing. This shoe was probably removed by hand. Of the dozens of horseshoes documented during the survey, this specimen is unique in two respects: that it is handmade and that it retains vestiges of the original rebar appearance. Using rebar to fashion horseshoes has been common in Mexico since at least the late 1800s and is still practiced today (Bob Smith, personal communication, 2013)

Hind

One hind shoe was recovered as IF215 (Figure 6-III.115a). This is a handmade 6-hole horseshoe that, in many respects, could be the rear counterpart to the shoe discussed above. Like that shoe, this one also has vestiges of ribs along the margin of the shoe. However, these ribs occur on both the outside as well as the inside edges of the shoe. They are also spaced substantially further apart, approximately 1.3 inches between ribs. The sides of this horseshoe also bulge outward where the fuller groove was stamped. The fuller groove itself also differs somewhat from the

Figure 6-III.115 Horseshoe and muleshoe: (a) Handmade 6-hole hind shoe; (b) Machine-made 8-hole muleshoe.

shoe above, extending beyond the front and rear nail holes unlike the above specimen in which the groove terminates at the nail holes. The heels of this shoe are irregular with metal burrs and shear marks evident from when it was cut. No nails remain in this shoe and, although it is worn and surface rusted, it is otherwise in good condition.

Muleshoe

One muleshoe was recovered as IF096 (Figure 6-III.115b). This machine-made 8-hole shoe is downturned at the heel to create heel calks. Like other muleshoes, the heels of this shoe are straighter and more parallel than horseshoes. It is also generally narrower and longer. Five of the original eight nails remain: the forward-most and second to last on the left side and all but the most heel-ward hole on the right side. Two of these nails are sheared off level with the shoe whereas the remaining three retain portions of their shank. Only one nail retains its clinch, however. This, along with the absence of asymmetry in the level of the heels and the slight amount of wear on the shoe suggest that this shoe was probably thrown rather than pulled or hand-removed. Of all the animal shoes, this one is the least worn and in the best condition.

Horseshoe Nails

Three horseshoe nails were collected during the survey. Horseshoe nails were made individually by hand by blacksmiths until the middle of the nineteenth century when horseshoe nail-making machines were invented. Since then, horseshoe nail sizes have become somewhat standardized although today great variation exists in nails, especially in the shape of the head (Breningstall 1998). Horseshoe nails in historic contexts present considerably less variability. Two horseshoe nails were collected from BIBE1920, one of which is 2 inches long, corresponding to a standard size 5 (Figure 6-III.116a). The second is bent in two places, but appears to correspond to a size 4 (Figure 6-III.116b). The third horseshoe nail was collected from BIBE1204 and corresponds to a standard size 6.

Automotive

Because of the remoteness, lack of roads, and exceptionally rough terrain, automobiles arrived relatively late to the region, and remained secondary to horses and wagons into the 1930s and—in some cases—beyond. A total of 10 artifacts are addressed under this heading, consisting of 6 license plates, 1 hubcap, 1 nameplate, 1 tire patch kit, and 1 fuse fragment.

Figure 6-III.116 Horseshoe nails: (a) Size 5; (b) Size 4, bent.

License Plates

A total of six vehicle license plates were collected during the survey—ranging in date from 1928 to 1944. A license plate, also known as a tag or vehicle registration plate, is a metal or plastic plate attached to a motor vehicle or trailer for identification purposes. In the United States, such registration is managed at the state level. The registration identifier is a numeric or alphanumeric code that uniquely identifies the vehicle within each state's database.

Vehicle registration was first required in the state of New York in 1901 although the first state-issued license plate did not appear until 1903 (in Massachusetts). Most other states soon followed suit. In Texas, the first license numbers were issued in 1907 to comply with Texas House Bill #93 requiring all motor vehicles on public roads to be registered with the county clerk. At this time, owners provided their own plates or, in some cases, painted the numbers on the vehicle itself. In 1917, the Texas Department of Transportation was established, taking over vehicle registration duties from the county and issuing the first official Texas state license plates (Texas Department of Transportation 1999:6–7; diFonzo 2012).

License plates serve two basic functions: they identify the vehicle and owner and provide proof that registration fees have been paid—most of which are dedicated to building and maintaining the state highway system. In 1918, county tax assessor-collectors became the official agents for the department, collecting all registration fees. Counties retained half for county roads and the state received the other half. In 1923, each vehicle was required to display two license plates which now also contained the word "Texas." In 1925, dates began to be placed on license plates (Texas Department of Transportation 1999:10,13).

The following discussion is ordered chronologically based on the year each plate was issued. The first plate, collected from BIBE1190, was issued in 1928 (Figure 6-III.117). On the left hand side is stamped "FRONT" and on the right hand side is "TEX-28"—both read from top to bottom. The license number, stamped in large block numbers and read from left to right is "108 & 283." Except for tears in two of the top bolt holes, this plate is complete. The second plate, collected from BIBE1987, was issued in 1929 but is highly rusted and fragmentary—consisting of three separate pieces (Figure 6-III.118). Only the last three digits of the license number ("286") can be read, along with the last two

Figure 6-III.117 1928 Texas license plate.

digits of the date ("29") along the lower margin of the plate. The left half of the plate is missing.

The third plate, collected from BIBE2030L, is mostly complete (portions of the upper two bolt holes are missing) but is badly corroded (Figure 6-III.119). Issued in 1933, this plate bears the license number "179 & 480" in large block numbers with the letters "C" and "M" occurring above and below the small star separating the license number. Just above the license number, in much smaller font, is "TEXAS-1933." The C-M indicates that this license was issued to a commercial vehicle. The fourth plate, from BIBE2030, was issued in 1934 (Figure 6-III.120). In large block numbers are "33" on the left and "704" on the right. They are separated by two stars on either side of a diagonally stamped "FARM," indicating the plate was issued to a farm truck. Below the license number, in smaller letters, is stamped "TEXAS – 1934." This plate is complete.

The fifth plate, from BIBE2025, was issued in 1939 (Figure 6-III.121). This plate, substantially taller than the others, bears the license number "11" on the left and "929" on the right separated by "FARM" read from top to bottom. Above the number is "TEXAS 1939" lacking the dash used formerly. This farm truck plate is complete but

Figure 6-III.118 1929 Texas license plate.

Figure 6-III.119 1933 Texas license plate.

Figure 6-III.120 1934 Texas license plate.

Figure 6-III.121 1939 Texas license plate.

bears several nail holes suggesting it was repurposed, possibly as an expedient patch or as decoration. The last plate, from BIBE2025, is a 1944 license plate tab (Figure 6-III.122). The tab is 2 inches square, with two bolt holes at the top-middle and bottom-middle part of the tab. On the left side of the upper bolt hole is an "F" and on the right side a "T." In block numbers across the middle of the tab is stamped "5592." On the left side of the lower bolt hole is "TEX" and on the right side "44." This tab is rusted but complete. Due to the metal shortage during World War II, the War Production Board restricted license plates not to exceed 4 inches square. Consequently,

Figure 6-III.122 1944 Texas license plate tab.

in 1943 and 1944, Texas issued much smaller license plate "tabs" instead of license plates. These tabs were to be affixed to the lower right bolt-hole of the 1942 plate (Texas Department of Transportation 1999:26–30).

Hubcap

One thick aluminum GMC hubcap was collected from BIBE2254 (Figure 6-III.123). The hubcap is badly deformed—ripped and smashed—but would have measured around 4 inches in diameter. Barely legible are the stamped letters "GMC" with both ends of the M extending underneath the G and C. This style of hubcap was used on 1940s era GMC pickups (Classic Parts U.S.A. n.d.).

Windshield Wiper Nameplate

One small round brass nameplate was collected from BIBE2030L (Figure 6-III.124a). The plate is 0.75 inches in diameter and has a recessed hole along the edge. About one-fifth of the left hand side of the plate is missing. On it is printed "TRICO / . . . UTOMATIC" at the top, and at the bottom "TRICO PRODUCTS / BUFFALO U.S.A." A series of patent dates follow, only some of which are legible, including the year "1923" and "OTHER PATENTS PENDING" at the bottom. Along the upper edge of the nameplate are a series of rectangular boxes, partly open at their bottom. Along the lower edge is a series of stars. This plate most likely went to a Trico Corporation automatic vacuum wiper motor released in 1921. Trico was established in 1917 and produced the first commercially available windshield wiper blades (Trico Products n.d.).

Tire Patch Kit

One small cylindrical tin can was collected, believed to have been a tire patch kit tin (Figure 6-III.124c). This tin is 3.43 inches tall and 1.04 inches in diameter and is complete except for a missing lid and end piece. It is open at both ends. One end has a stop-rib for an external friction lid. The other open end presumably had a piece of cardboard or paperboard as a cover. The inside of the tin is segmented into two chambers. The smaller chamber opens to the external friction lid opening and is approximately 1.15 inches deep. The other chamber is approximately 2.28 inches deep. No other identifying features were evident.

Fuse

One end-cap to a glass cartridge fuse was collected from BIBE1942 (Figure 6-III.124b). This small brass cap formed one end of a fuse whose element is contained within a glass cylinder. The end-cap is 0.40 inches tall and 0.42 inches in diameter. Part of the lightly solarized glass cylinder remains inside although the actual fuse wire is missing. A stamped code is partially visible on the outside of the end-cap—the letter "B" below which is either the number "30" or the number "80." Due to corrosion, it is difficult to discern

Figure 6-III.123 Aluminum GMC hubcap.

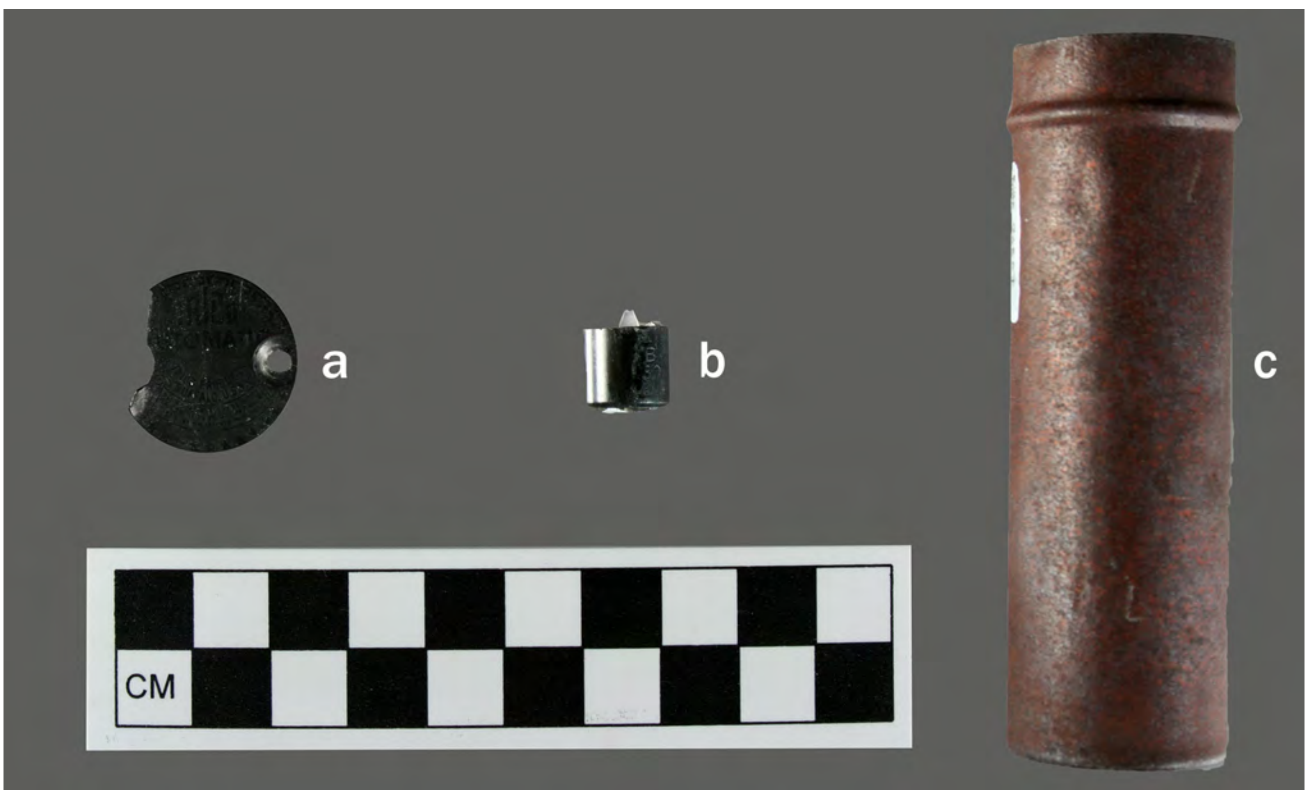


Figure 6-III.124 Various auto parts: (a) Windshield wiper nameplate, (b) Glass cartridge fuse; (c) Tire Patch Kit tin.

which, although based on its size, most likely the former. Fuses are sacrificial components that interrupt the flow of electricity when exposed to a large amount of current. A thin wire inside the fuse melts when the current exceeds the fuse's rating, breaking the flow of current. This is a safety measure that protects other electrical components and reduces fire hazards. This fuse was most likely part of an automobile's electronic components.

Manufactured Tools

Rock Pick

One rock pick was collected as IF223 (Figure 6-III.125a). The pick is 12.5 inches long and the head is 7 inches long. It is made of hardened steel and although rusted and missing its leather handle, is otherwise complete. The rock pick head is pointed at one end and blunt on the other. The handle portion retains two black plastic spacers that occur on either end of the handle. At the base of one side of the handle is stamped "23." On the bottom of the handle is stamped "ESTWING / ROCKFORD ILL / R / MADE IN U.S.A." This was made by Estwing Manufacturing, Rockford, Illinois, founded in 1923 by Ernest Estwing, which designed and manufactured a variety of striking and struck tools. The same hammer is still manufactured today (Estwing Manufacturing n.d.).

Fence Pliers

One pair of steel buttons pattern pliers were collected from BIBE1910 (Figure 6-III.125b). These pliers are complete despite a heavy layer of rust. The pliers are 8.13 inches long and 2 inches maximum width at the bulge of the handle. The pliers have a straight jaw with one wire cutter notch at the base of the jaws and one

Figure 6-III.125 Manufactured tools: (a) Estwing Rock Pick; (b) Fence Pliers; (c) Shovel tang.

on each side of the joint. Although the rust obscures any identifying stamps, these pliers are very similar to J.M. King's 8-inch Button Pattern Pliers that were patented in 1867. Button pliers were popular fencing pliers, advertised as wire cutters and pliers combined (Alloy Artifacts n.d.).

Shovel Tang

One rusted shovel tang was collected from BIBE1910 (Figure 6-III.125c). This tang is 8 inches long, 1.38 inches wide and is sheared at the distal end that would have attached to the shovel blade. The tang is convex along the short axis and has three attachment holes .25 inches in diameter. It is pointed at the proximal (handle) side, near which is stamped "XXX / HARD STEEL." No information could be found on this shovel tang.

Wool Sack Needle

One long steel needle interpreted to be a wool sack needle was collected as IF543 (Figure 6-III.126a). This needle is 9 inches long and is .375 thick. The proximal end has a large (.2 inches diameter) eye hole and the distal end tapers to a sharp point. Remnants of black paint occur along the shank. Although rusted, it is complete. Based on irregularities and hammer blow marks, this was hand-forged. Large needles such as this were used to sew burlap sacks closed after filling them with wool or mohair. The sewn bag would then be ready for shipment.

Folding Pocket Knife

One folding pocket knife was collected from BIBE1910 (Figure 6-III.126b). It is a two-bladed folding pocket knife with a wooden grip, 3.64 inches long and .81 inches in maximum width. One blade and part of the wooden grip is missing, but it is otherwise complete. The body of the knife is made of brass whereas the blade is made of ferrous metal and is rusted shut. A small decorative brass plate is affixed to one of side of the wooden grip but bears no stamp or identifying features.

Figure 6-III.126 Manufactured tools: (a) Woolsack needle; (b) Folding pocketknife.

Handmade Tools

Among some of the more interesting artifacts encountered during the survey were handmade objects, including handmade tools. The remoteness and lack of access to goods encouraged ingenuity and self-reliance, two traits that are reflected in this class of artifacts. A total of six items, consisting of a cold chisel, an S-hook, a hook and swivel, a hanging plate, a handmade blade, and a funnel are addressed in this section.

Cold Chisel

One hand-forged iron chisel was collected from BIBE593 (Figure 6-III.127a). The chisel is 3.37 inches long and 0.57 in maximum width. It is roughly rectangular in cross-section, but is irregular along the entire length of its shaft. The head is considerably mushroomed and the very end of the chisel tip is missing. This chisel was likely made and used by the blacksmith at Neville Spring where it was found.

S-Hook

One hand-forged iron S-hook made to look like a snake was collected from BIBE859I (Figure 6-III.127b). It is 1.6 inches long and 0.75 in maximum width. One end of the S-hook, which curves back to touch the middle portion of the "S," resembles a snake head. The other end, pointed like a tail, has a small gap between the tip and the "S." One side of the S-hook has a series of parallel grooves running across its width approximating snake scales. Although heavily rusted, the S-hook is complete.

Figure 6-III.127 Handmade tools: (a) Cold chisel; (b) S-Hook; (c) Hook and Swivel; (d) Hanging Plate; (e) Handmade brass knife.

Hook and Swivel

One handmade swivel was collected from BIBE1920 (Figure 6-III.127c). The swivel is fashioned from two wire nails whose heads have been seated inside a repurposed brass cartridge casing (with headstamp WRA Co 30 WCF). One nail shank extends out of the primer seat and the other out of the body of the case, which has been pinched closed. The swivel is 3.71 inches in total length and 0.77 inches in maximum width. One of the nails has been bent around to create an eye (tip contacts the shaft), whereas the other nail is open to form a hook. Both nails are heavily rusted. The specific use of this artifact is unknown although it was clearly intended to act as some type of swivel, perhaps used with a chain for some light application.

Hanging Plate

One handmade "hanging plate" was collected from BIBE1910 (Figure 6-III.127d). It consists of a rectangular flat metal plate, 1.37 by 3.4 inches in size, with three holes spaced out along the middle part of its length. Through these holes are three wire nails whose tips are bent around to form eyes. The middle nail extends upward and the two outside nails extend downward. The nails with eyelets are 1.52 inches long. Although the piece is rusted, it appears complete. The specific use of this artifact is unknown although it was probably used to suspend items, such as tools.

Brass Knife Blade

One handmade brass knife blade was collected from BIBE2312 (Figure 6-III.127e). This blade is fashioned out of a piece of sheet brass that has been cut to resemble a short but wide knife blade. It is 2.56 inches long and 0.81 inches in maximum width. A small rectangular extension would have been the part intended for hafting, but at only 0.4 inches long, appears as if it has been broken. The blade edge is flat and both the blade edge and back of the blade are parallel most of its length until near the end, the back of the blade curves downward at a sharp angle to the blade's tip. The blade has been sharpened along both edges. Aside from the probable broken hafting shaft and whatever may have formed the handle, this artifact is complete.

Funnel

One handmade funnel was collected from BIBE2030F (Figure 6-III.128). The funnel was made out of a repurposed baking powder lid (KC Baking Powder) for the top and the baking powder tin can body rolled to form the tapering lower part of the funnel. The rolled piece has a soldered seam along its length, the whole of which has been soldered to the baking powder lid. A crude cut was made through the lid which opens to the tapered part of the funnel. The funnel is rusted and crushed but is otherwise complete. The lid measures 4 inches in diameter and the rolled lower piece is 6.5 inches long. Based on the parts of the baking powder lid that are legible, "SAME PRICE / FOR OVER 30 YEARS" (and because KC Baking Powder has been on the market since 1890) this can dates to around 1920 (Ward et al.1977).

Firearms

In the American West, especially in rugged outback regions like the Big Bend, carrying firearms was the rule rather than the exception. Whether hunting for food, for protection from Indians, bandits, and outlaws, or for use against predators and snakes, carrying a firearm was customary if not necessary. This was true for civilians as well as the military during the first 50 years of historic occupation in the Big Bend. Although this pattern ended with the establishment of the national park (with the exception of park law enforcement and the U.S. Border Patrol), the ubiquity of artifactual remains indicative of firearm use attests to their major role in the region's history. A total of 90 artifacts were collected during the survey that are addressed in this section. These consist of 4 gun parts, 75 cartridge casings, 10 bullets, and 1 bullet jacket. The following discussion is based on this breakdown.

Figure 6-III.128 Handmade funnel.

Gun Parts

One magazine clip, two stripper clips, and one gun spring were collected during the survey. The magazine clip, from BIBE2153, is from a military issue Colt Model 1911 .45 caliber automatic pistol which was the standard Cavalry sidearm from 1911 until 1943 when the Cavalry was dismounted (Figure 6-III.129a). The gun remained the standard service issue pistol until 1985 (Steffen 1978:183). Although rusted, the clip is otherwise complete. Two stripper clips were collected from BIBE1910 (Figure 6-III.129b and c). These clips are made of brass and held several rounds of ammunition for easy loading. Both of these were for the 1903 Springfield .30-06 rifle which was the standard military issue rifle from 1906 until 1957 (Barnes 1997:289). One mainspring from a revolver was collected from BIBE1920 (Figure 6-III.129d). This is a curved metal band with a screw hole at one end and a cupped extension on the other. The entire spring is approximately 3.5 inches in length and around 0.38 inches wide. This mainspring is rusted but complete. Similar springs were used in a number of revolvers, but this one looks most similar to the Colt Model 1877 double action revolver (Chicoine 2012).

Ammunition

Metallic cartridge casings are among the most useful of historic diagnostic artifacts. Because they are made of non-ferrous metals (typically brass), cartridges preserve well. In addition, cartridges serve both as functional and, often, temporal diagnostics. Cartridges were also among the most abundant historic artifacts encountered during the project. Such abundance is not uncommon for rural historic sites in the American West, but occurs here in an exaggerated fashion due to a number of historical and geographical contingencies. The lawlessness that accompanied the frontier phase of

Figure 6-III.129 Gun parts: (a) Colt Model 1911 .45 caliber magazine clip; (b–c) .30-06 Stripper Clips; (d) Revolver Mainspring.

settlement, the Mexican Revolution (and the attendant militarization of the border), and the proximity of the Mexican border itself all played a role in the number of cartridges found in BBNP.

The lower Big Bend experienced an unusually substantial military presence—first with the Black Seminole Scouts stationed at Camp Neville Spring in the late 1880s, and later with the numerous Cavalry and National Guardsmen stationed along the border during the tumultuous years of the Mexican Revolution. Even after peace had been restored to the region, border issues such as illegal immigration and smuggling persisted (especially during prohibition) calling for a continued armed presence that, today, is represented by law enforcement park rangers and the U.S. Border Patrol.

The practice of headstamping cartridges dates back to 1877 when the Frankford Arsenal—the ammunition production center for the U.S. government—began stamping .45-70 cases with the production date and codes to distinguish rifle from carbine rounds. The latter were standard issue to cavalry regiments, but because the two loads appeared identical, once out of the box there was no way to distinguish them. Because the powder load of the rifle cartridges was significantly greater, to fire one in a carbine meant violent recoil and certain pain. This fact was not lost on the infantry who reportedly enjoyed playing the joke on the cavalry (Reuland 1993:18).

The majority of cartridges recorded during the survey bear headstamps that serve as useful diagnostic indicators. Military cartridges included the date of manufacture in addition to the ordnance plant that made them. Civilian cartridges include the manufacturer as well as the caliber and sometimes other identifying characteristics. Cartridges lacking headstamps can still be roughly dated according to their caliber, material type (copper versus brass), and primer type (internal versus external).

Considering the vast number of cartridges documented during the project, relatively few were collected. In most cases the headstamp code was sufficient to type the cartridge and this data was taken on every cartridge encountered during the survey (although only the isolates have been tabulated). However, cartridges that were unusual (odd calibers or odd markings) or that had been modified (emptied of powder, ripped open, or bent), or that were particularly old were collected. Because the project lacked a well-defined collection strategy, during its first several years a number of cartridges were collected that in later years would have been left behind. Consequently, the resulting assortment represents neither the full range of cartridges recorded during the survey nor a representative sample but rather a sample of some of the more common calibers and many of those that were less common.

Significantly, 50 percent of all calibers and 55 percent of all cases collected were military issue, testifying to a substantial military occupation. However, the presence of military cartridges alone does not necessarily indicate a military occupation—at least not definitively. The widespread distribution of .30-06 military cartridges in BBNP, in particular, suggests that civilians purchased and used surplus military ammunition. Consequently, to assign a military affiliation requires more than the presence of military cartridges alone.

A total of 75 cartridge casings were collected during the survey, representing 30 different calibers and 47 distinct headstamps. Of these, 42 were rifle cartridges, 14 were pistol cartridges, 17 were for either a rifle or pistol, and 2 were shotgun cartridges. In addition to the cartridges, 10 bullets and 1 bullet jacket were collected. The following discussion follows this breakdown. Note that headstamps here are indicated by reading top left-to-right then bottom left-to-right (rather than clockwise). Where codes exist in the three and nine o'clock positions, they are indicated last.

Rifle Cartridges

A total of 42 rifle cartridge casings representing 19 different calibers were collected during the survey. Of the 19 calibers, 9 were originally intended for military use—two of which were calibers used by the military of foreign countries (Mexico and Switzerland). While the Mauser (Mexican) cartridges might be expected considering the proximity to Mexico, the Swiss cartridge came as a surprise.

5.56 x 45 mm (.223 Remington)

One cartridge casing bearing the headstamp "T-W-7-2" was recovered as IF925 (Figure 6-III.130a). This military cartridge was a blank M200 cartridge casing manufactured by Twin City Army Ammunition Plant in Minneapolis, Minnesota in 1972. The 5.56 x 45 mm was adopted as the U.S. military's standard service ammunition for the M16 rifle in the Vietnam War. It was used by the M249 machine gun and all 5.56 mm rifles for simulated firing in training exercises and for saluting purposes. It continues to be used as the standard U.S. and NATO military round (Barnes 1997:19; Cooke 2005).

.25-35

One "WRA CO. .25-35 W.C.F." cartridge was recovered as IF249 (Figure 6-III.130b). This cartridge is from Winchester Repeating Arms Company in New Haven, Connecticut, the W.C.F. referring to "Winchester Center Fire." This headstamp was used from 1866 until around 1938 (Steinhauer 2002). The .25-35 was introduced by Winchester in 1895 for the Model 94 lever-action rifle as one of the first small-bore, smokeless powder, sporting cartridges developed in the United States. Despite its relative accuracy, the cartridge is largely obsolete. No American rifles have been made for this cartridge since World War II (Barnes 1997:33).

7 mm Mauser

Three 7 mm Mauser cartridge casings were collected during the survey. The 7 mm Mauser was a bolt-action

Figure 6-III.130 Rifle cartridge casings: (a) 5.56x45mm; (b) .25-35; (c–e) 7mm Mauser; (f) .30 Carbine; (g–i) .30-30; (j–k) .30-40 Krag; (l–s) .30-06; (t) .32-20; (u) .32-40 Remington; (v) .351 Winchester; (w) .38-40 Winchester; (x–z) .38-55; (aa) .38-56; (bb) .40-82 Winchester; (cc) .401; (dd) .41 Swiss; (ee–gg) .45-70 Benét primed; (hh–nn) .45-70 Externally primed; (oo) .50-45 Cadet; (pp) .50-70.

rifle developed in 1892 by Paul Mauser of the Mauser company (a German arms manufacturer operating from the 1870s to 1995). The rifle was adopted by the Mexican military in 1895 and was used by Federales during the Mexican Revolution. Although the cartridge is still manufactured, chambering was discontinued by American gun manufacturers about 1940 due to lack of popularity (Scarlata 2010; Barnes 1997:43).

Two of the Mauser cartridges were collected from BIBE2071, one bearing the headstamp "DM-K-18-97" (Figure 6-III.130c). This cartridge was manufactured by the *Deutsche Waffen und Munitionsfabriken* (DM or DWM), a German arms company founded in 1896. The "K" stands for Karlsruhe—the city in southwest Germany where it was manufactured. The numbers indicate the year of manufacture as 1897 (Steinhauer 2002). It is notable that the Mexican Government placed an order with DWM for 50,000 Mauser rifles and carbines chambered for the 7 mm in 1895, which probably included an order for ammunition. This could have been the origin of this cartridge (Scarlata 2010).

The second Mauser cartridge from BIBE2071 has the headstamp "FN-1909" which was made by the *Fabrique National d'Armes de Guerre* (FN) in Belgium in 1909 (Figure 6-III.130d). The third Mauser cartridge, bearing the headstamp "W.R.A. Co. 7-mm," was recovered from BIBE2030G (San Vicente) (Figure 6-III.130e). This cartridge was manufactured by the Winchester Repeating Arms Company of New Haven, Connecticut (Steinhauer 2002). All three cartridges were found within 3 km of each other, and all in historic sites along the Rio Grande.

.30 Carbine

One cartridge casing bearing the headstamp "P-C-4" was recovered from BIBE1942 (Figure 6-III.130f). This is a military round made in 1944 by Peters Cartridge Company, Kings Mill, Ohio. The .30 carbine was developed for the M1 Carbine semi-automatic introduced in the 1940s. Peters operated from 1887 to 1934 when it became part of Remington-UMC, although the Peters headstamp continued to be used to distinguish between factories (Barnes 1997:51; Steinhauer 2002).

.30-30

Three .30-30 cartridges were collected and a great many more were observed over the course of the survey. This caliber was by far the most frequently encountered (making up 20 percent of all isolated cartridge casings documented). This is likely because for most of the twentieth century, the .30-30 was the most popular small-bore sporting cartridge in North America, especially in rural northern Mexico where the *treinta-treinta* was sometimes the only high-powered cartridge known. The .30-30 was introduced by Winchester in 1895 for the Winchester Model 1894 lever action rifle—the first U.S. small bore sporting rifle cartridge designed for smokeless powder. As originally produced, it was known as ".30 WCF" standing for ".30 Winchester Center Fire." Rival companies UMC and Marlin dubbed their version of the cartridge ".30-30" which gained broader usage (Barnes 1997:52).

One of the cartridges recovered, from BIBE1118, is a "UMC Co. .30-30" made by the Union Metallic Company of Bridgeport, Connecticut which used this headstamp from 1867 to 1911 (Figure 6-III.130g). Another cartridge, a live round from BIBE1910, is a "REM-UMC .30-30" made by Remington Arms-Union Metallic Company in Bridgeport, Connecticut following their merger in 1911 which used this headstamp until 1960 (Figure 6-III.130h). The last .30-30 cartridge, another live round collected from BIBE1318, is a "U.S.C. Co. 30-30" (Figure 6-III.130i). This cartridge was made by the United States Cartridge Company in Lowell, Massachusetts which used this headstamp until 1938 (Steinhauer 2002).

.30-40 Krag

Also known as the "30 U.S. Army," the .30-40 Krag was adopted in 1892 for military use in the U.S. Krag Jorgensen rifle—the first U.S. small-bore military cartridge. Used during the Spanish-American War, it also saw service in training rifles during World War I. They remained in military use until 1903 when they were replaced by the .30-03 cartridge, predecessor to the .30-06 (Logan 1959:116; Barnes 1997:54). One "W.R.A. Co. .30 U.S.G." cartridge was recovered from BIBE1910 (Figure 6-III.130j). This cartridge was made by the Winchester Repeating Arms Company of New Haven, Connecticut which used this headstamp until around 1954. The "U.S.G." stands for U.S. government. Another, bearing the headstamp, "REM-UMC 30 USA" was recovered from BIBE1920 (Figure 6-III.130k). Made by Remington Arms – Union Metallic Company in Bridgeport, Connecticut, this headstamp was used from 1911 to 1960 (Steinhauer 2002).

.30-06

Eight .30-06 cartridge casings were collected during the survey, the vast majority of which (n=7) are military rounds. One of these, from BIBE2064, bears the headstamp "WCC-41" indicating it was made by the Western Cartridge Company of East Alton, Illinois in 1941 (Figure 6-III.130l). Although Western and Winchester were combined in 1932 to form Winchester Western, cartridges made under military contract continued to use the earlier WCC headstamp. The second military cartridge, from BIBE2138, has the headstamp "RA-H-18" indicating it was made by Remington Arms Company at their munitions plant in Hoboken, New Jersey in 1918 which produced military cartridges under contract from 1914 to 1918 (Figure 6-III.130m). Another, collected as IF734, has the headstamp "SL-43" indicating it was made by the U.S. Cartridge Company at the St. Louis Ordnance Plant which produced military cartridges from 1941 to 1945 (Figure 6-III.130n). The last four military .30-06 cartridges were made by the Frankford Arsenal, Philadelphia, Pennsylvania, which was the premier U.S. Army ammunition plant that manufactured ammunition from 1864 to 1977. Two of these cartridges were recovered from BIBE859G, one made in 1912 and one in 1914 (Figure 6-III.130o and p). The other two were recovered from BIBE1910 and were made in 1910 and 1913 (Figure 6-III.130q and r). The last .30-06 cartridge was a civilian round from BIBE1205 with the headstamp "Super Speed .30G 1906" (Figure 6-III.130s). This cartridge was made by Winchester-Western of East Alton, Illinois, which used the "Super Speed" headstamp from 1933 to 1978 (Steinhauer 2002).

The .30-06 was introduced in 1906 to replace the .30-03 with a lighter, more streamlined bullet. Adopted for the Model 1903 Springfield service bolt-action rifle, this remained the U.S. Army's primary rifle cartridge for nearly 50 years. Rifles were chambered for civilian use starting in 1908 with the Winchester Model 1895 lever action rifle. Later civilian rifles chambered for the caliber include the Remington bolt-action Model 30 introduced in 1921, and the Winchester Model 54 introduced in 1925. The .30-06 is considered the most flexible all around big game cartridge in North America (Barnes 1997:57).

.32-20

One "Peters .32-20" cartridge casing was collected from BIBE338 (Figure 6-III.130t). This caliber was originally introduced by Winchester in 1882 for the Model 73 lever-action rifle, its first intended for small-game and varmints. Virtually all American gun manufacturers subsequently chambered rifles for this caliber (Barnes 1997:64). Peters Cartridge Company from Kings Mill, Ohio was in business from 1887 to 1934 when it became part of Remington-UMC although the headstamp continued to be used to distinguish between factories (Steinhauer 2002).

.32-40 Remington

One "REM-UMC .32-40" cartridge with a nickel plated primer was collected from BIBE775 (Figure 6-III.130u). The top of the casing has been sheared, creating an irregular mouth. This caliber was introduced in 1871–72 for use with the Remington single-shot rolling block sporting rifle No. 1. It was both a hunting and target round of limited popularity and is obsolete today (Barnes 1997:108). The cartridge was made by Remington Arms-Union Metallic Company in Bridgeport, Connecticut. This headstamp was introduced following the merger in 1911, and was used until 1960 (Steinhauer 2002).

.351 Winchester Self Loading

One "W.R.A. Co. .351 S.L." cartridge was collected from BIBE1920 (Figure 6-III.130v). This cartridge was made by the Winchester Repeating Arms Company of New Haven, Connecticut, which used this headstamp until around 1938 (Steinhauer 2002). Winchester introduced the .351 caliber for its Model 1907 self-loading (semi-automatic) rifle which was produced until 1958. This was a popular rifle with law enforcement, especially during the 1930s, and was used in the Western U.S. in aerial gunning of varmints (Barnes 1997:113).

.38-40 Winchester

One "W.R.A. Co. .38 W.C.F." cartridge was recovered from BIBE1206 (Figure 6-III.130w). This cartridge was developed by Winchester Repeating Arms Company of New Haven, Connecticut for their Model 1873 lever action rifle. Although nominally a .38, it is actually a .44-40 case necked down to .40 caliber. Shortly after it came out Colt chambered revolvers for it. The cartridge was fairly popular until around 1920 when sales declined. It was discontinued in 1937 (Barnes 1997:80).

.38-55

Three .38-55 caliber cartridge casings were recovered during the survey. Originally designed as a target cartridge, the .38-55 was introduced in 1884 for the Ballard Perfection No. 4. It was later used in the Marlin Model 93, Winchester 94, and the Remington-Lee among others. Although later reintroduced, by 1940 the cartridge was largely obsolete (Barnes 1997:79). One "U.M.C. .38-55 S-H" cartridge was recovered from BIBE2030A (Figure 6-III.130x). This cartridge, made by the Union Metallic Company of Bridgeport, Connecticut, was made for rifles such as the Winchester model 1894. The "S H" stands for "Solid Head" which indicated a solid forged case rather than a folded-head case which had a tendency to blow out at the high-stress fold (Jones n.d.). The U.M.C. headstamp was used from 1867 to 1911 when they merged with Remington. Two "W.R.A. Co. .38-55" cartridges were also recovered, one from BIBE1325 and one from BIBE1910 (Figure 6-III.130y and z). These were manufactured by the Winchester Repeating Arms Company of New Haven, Connecticut which used this headstamp until around 1954 (Steinhauer 2002).

.38-56

One "W.R.A. CO. .38-56 W.C.F." cartridge was recovered from BIBE1920 (Figure 6-III.130aa). It was manufactured by the Winchester Repeating Arms Company of New Haven, Connecticut. This particular headstamp has a capital "O" in "CO." indicating this cartridge was made before the 1890s (Steinhauer 2002). The .38-56 was introduced in 1887 for the Model 1886 Winchester repeater but also used in the single-shot version and the 1895 Marlin. It was discontinued around 1936 and today is obsolete (Barnes 1997:118).

.40-82 Winchester

One "W.R.A. Co. .40-82 W.C.F." was recovered as IF671 (Figure 6-III.130bb). This cartridge was manufactured by the Winchester Repeating Arms Company of New Haven, Connecticut. The .40-82 caliber was introduced in 1885 for the Winchester single-shot as well as for the Model 1886 lever-action repeater. Although the caliber gained a favorable reputation for use on elk and other large game, it was discontinued in 1935. Based on font characteristics of the headstamp, this cartridge probably dates between 1900 and 1920 (Steinhauer 2002; Barnes 1997:125).

.401

One "WRA Co. .401 SL" cartridge was recovered from BIBE2146 (Figure 6-III.130cc). This "self-loading" (semi-automatic) cartridge was introduced in 1910 for use in the Winchester Model 10 rifle produced until 1936 for American large game hunting. It is obsolete today (Barnes 1997:125). The cartridge was made by the Winchester Repeating Arms Company of New Haven, Connecticut which used this headstamp until around 1954 (Steinhauer 2002).

.41 Swiss (10.4 x 38R mm Swiss Vetterli)

One rare .41 Swiss rimfire cartridge casing was recovered from BIBE2367 (Figure 6-III.130dd). This was the military cartridge adopted by the Swiss in 1869 for use in the Vetterli turnbolt rifle. The cartridge and rifle were both discontinued in 1889 although U.S. companies continued to manufacture the .41 Swiss cartridge until 1942. The headstamp is a cross centered in the middle of the base of the cartridge indicating it was made by a Swiss ammunition manufacturer (as per their flag and coat of arms). The base also bears the mark of the double firing pin of the Vetterli rifle (Barnes 1997:300).

.45-70

Ten .45-70 cartridge casings were collected during the survey, three of which are internally (Benét) primed and seven that are externally primed. Of the three that are internally primed, one is a live round lacking a headstamp collected as IF176 (Figure 6-III.130ee). The second cartridge, collected from BIBE2545, also lacks a headstamp and the top of the casing has been sheared off (Figure 6-III.130ff). Both of these cartridges were made prior to 1877 when the Arsenal began headstamping cartridges (Reuland 1993:18). The third internally primed cartridge bears the headstamp "C-F-1-80" indicating it was a carbine load made by the Frankford Arsenal in January of 1880 (Figure 6-III.130gg).

Of the externally primed cartridges, one collected from BIBE1271 lacks a headstamp (Figure 6-III.130hh). The cartridge case itself split open in two places along the long axis of the case body, probably when it was fired. All the remaining six cartridges contain headstamps indicating they were carbine loads manufactured by the Frankford Arsenal. The first, collected from BIBE1217, has a production date of March 1886 (Figure 6-III.130ii). The second, collected from BIBE44, is a live round made in September 1883 (Figure 6-III.130jj). Two externally primed cartridges were collected from BIBE415, one made in November of 1884 and one in March of 1886 (Figure 6-III.130kk and ll). The last two, collected as IF898 and IF784 bear date stamps of January 1885 and April 1886, respectively (Figure 6-III.130mm and nn).

The Frankford Arsenal, Philadelphia, Pennsylvania, was the premier U.S. Army ammunition plant that manufactured cartridges from 1864 to 1977 (Steinhauer 2002). The .45-70 was adopted by the U.S. military in 1873 for use with the single-shot "Trapdoor" Springfield rifle. The caliber was replaced by the .30-40 Krag in 1892. This caliber remained popular as a sporting cartridge, however, and surplus ammunition was readily available for many years (it was listed in Sears Catalogs at least through 1920). American companies dropped the caliber in the early 1930s (Barnes 1997:86). It is notable that all of these cartridges were made for carbines rather than rifles, suggesting they were likely related to the Cavalry occupation at Camp Neville Spring.

.50-45 Cadet

A rare .50-45 government cartridge was collected from BIBE2030I (Figure 6-III.130oo). This unstamped cartridge retains its unfired primer although the casing is torn and smashed. This may have resulted from an accident or in an effort to retrieve the gunpowder. Also known as a "Cadet cartridge" or the ".50 carbine," this caliber was originally intended to be used in the 1867 Navy Cadet rifle by Remington. However, it apparently was also marketed for the Sharps and Remington carbines—which would explain its presence in BBNP (rather than the East Coast) (Hildebrand 2010). This rare cartridge was the carbine equivalent to the standard military issue .50-70 Government black powder round adopted in 1866 for the Springfield Model 1866 Trapdoor rifle. It probably had an equally short life. The .50-70 was replaced by the .45-70 in 1873 (Logan 1959:148).

.50-70

One "U.M.C. .50-70 S-H" cartridge casing was collected from 2030K (Figure 6-III.130pp). This caliber, also known as the "50 Government," was the standard U.S. military rifle cartridge from 1866 to 1873 and the first centerfire cartridge in general use by the military. Designed for use with the Springfield Model 1866 Trapdoor rifle, it was also chambered in the Remington single-shot rifle and a variety of sporting rifles. It was a popular cartridge through the 1880s, said to be very effective on buffalo and other large game. Although the original .50-70 cartridge was internally primed, this U.M.C. cartridge has an external primer (Barnes 1997:309). The cartridge was manufactured by the Union Metallic Company of Bridgeport, Connecticut which produced this headstamp until their merger with Remington in 1911 (Steinhauer 2002). The "S" and "H" on the left- and right-hand side of the cartridge base, respectively, stand for "solid head" which indicates a solid-forged case rather than a folded-head case which had a tendency to blowout at the high-stress fold (Jones n.d.). This particular cartridge is unusual in that the primer appears to have exploded outward, leaving a hole where the firing pin struck. The top half of the case has been battered and crimped and is heavily corroded.

Pistol Cartridges

A total of 14 cartridge casings representing 6 different calibers for use with pistols were collected during the survey. Significantly, all but one (the .41 Long Colt) were originally intended for military use. Due to their small size and portability, handguns offer distinct advantages for certain hunting applications as well as self-defense. The former tend to be larger, heavier, and with a longer barrel for increased accuracy. The latter tend to be smaller and lighter, with the focus on stopping power and the ability to be concealed.

.38 Special

One "Peters .38 S.&W. SP'L" cartridge was collected from BIBE338 (Figure 6-III.131a). The .38 Special was developed by Smith and Wesson and introduced with their Military and Police Model revolver in 1902. It is considered one of the "best balanced, all-round handgun cartridges ever designed" (Barnes 1997:254). Peters Cartridge Company operated from 1887 to 1934 when it became part of Remington-UMC. The headstamp continued to be used, however, to distinguish between factories (Steinhauer 2002).

.38 Long Colt

One .38 Long Colt Cartridge was collected from BIBE2030E bearing the headstamp "F-A-9-06" (Figure 6-III.131b). This is a military cartridge manufactured by Frankford Arsenal, Philadelphia, Pennsylvania in September of 1906. This round was introduced by Colt in 1875 and was adopted by the U.S. Army in 1892 for the Colt New Army M1892 double-action revolver. This handgun remained the standard army issue until 1911 when it was replaced with the Colt New Service (Barnes 1997:253).

.41 Long Colt

Two .41 Long Colt cartridge cases were collected, one from BIBE1920 and one as IF732 (Figure 6-III.131c and d). Both bear the headstamp "U.M.C. 41 L.C." indicating their manufacture by the Union Metallic Company in Bridgeport, Connecticut. The .41 Long Colt cartridge was introduced in 1877 for use with the Colt double action Lightning Model revolver. It was later used in the New Army, New Navy, Army Special, Single-action Army, and the Bisley although no revolvers have been chambered for it since the early 1930s. It has since become obsolete (Barnes 1997:259). Because U.M.C. and Remington merged in 1911 (thereafter using the REM-UMC headstamp), this cartridge would have been produced between 1877 and 1911 (Steinhauer 2002).

Figure 6-III.131 Pistol cartridge casings: (a) .38 Special; (b) .38 Long Colt; (c–d) .41 Long Colt; (e–h) .45 ACP; (i–j) .45 Schofield Benét primed; (k) .45 Shofield externally primed; (l–n) .45 Colt.

.45 ACP

Four .45 ACP cartridge casings were collected. Two of these were made by the Frankford Arsenal in Philadelphia, Pennsylvania—one from BIBE859A made in 1915 (Figure 6-III.131e) and one recovered as IF236, made in 1935 (Figure 6-III.131f). The third cartridge, from BIBE1912, has the headstamp "E-C-S-43" indicating it was manufactured in 1943 by the Evansville Chrysler Sunbeam Plant (Evansville, Indiana) that operated from 1942 to 1944, primarily to make the .45 ACP (Figure 6-III.131g). The fourth cartridge, from BIBE859E, has the headstamp "U.S.C. Co.-17" indicating it was made in 1917 by the United States Cartridge Co., in Lowell, MA (Figure 6-III.131h) (Steinhauer 2002).

The .45 ACP was developed by John Browning in 1905 and was adopted for use with the Colt-Browning automatic pistol by the U.S. armed forces in 1911, serving as the standard-issue side arm until 1985. It was also adopted by Argentina, Mexico, and Norway. It is the most powerful military handgun cartridge in history and has proven its substantial stopping power in combat all over the world. It was replaced as the official U.S. military handgun by the 9 mm Parabellum in 1985 but is still used by the marines and police agencies in the U.S. (Barnes 1997:269).

.45 Schofield

Three .45 caliber Schofield cartridge casings were collected—all recovered from BIBE593 (Neville Spring). Two of these are internally (Benét) primed and lack headstamps (Figure 6-III.131i and j). However, both are .45 Schofield cartridges that would have been made by the Frankford Arsenal. The third cartridge is externally primed and has the headstamp "F-5-86" indicating it was made by Frankford Arsenal in May of 1886 (Figure 6-III.131k) (Steinhauer 2002).

The .45 Schofield cartridge was introduced in 1875 for the Smith and Wesson Schofield revolver adopted by the U.S. Army and used until 1892 when it was replaced by the .38 Colt Army and Navy Model. Based on context and manufacture, they were almost certainly fired by scouts from Camp Neville Spring, a U.S. military subpost occupied between 1885 and 1891 (Barnes 1997:270).

.45 Colt

Three unstamped, externally primed .45 Colt cartridges were collected from BIBE415, BIBE1204, and BIBE2146 (Figure 6-III.131l and n). The .45 Colt was introduced in 1873 by Colt's Manufacturing Company of Hartford, Connecticut as one of the cartridges for their famous "peacemaker" single-action revolver, which was adopted by the U.S. Army in 1875 and used until 1892. The .45 Colt is one of the classic cartridges that attended the settlement of the American West and is still a popular caliber with more stopping power than almost any other (Barnes 1997:271; Logan 1959:139).

Rifle and Pistol Cartridges

Some calibers were manufactured for use in either a rifle or a pistol, which offered a distinct advantage when carrying both and was an especially favored trait in the early days of the American West. A total of 17 cartridges representing three such calibers were collected during the survey.

.22 Long Rifle

Five .22 Long Rifle rimfire cartridge cases were recovered during the survey. Two of the cartridges, both from BIBE1942, bear the impressed "H" headstamp used by Winchester Repeating Arms Co. of New Haven, Connecticutt, which Winchester used for all rimfire cartridges to honor B. Tyler Henry (of the famous Henry Rifle) (Figure 6-III.132a and b). Winchester first produced the .22 Long Rifle cartridge in 1890 (Huegel 2012). One of these cartridges failed to fire and remains complete although its base bears the firing pin mark and the bullet has been crimped, possibly in an unsuccessful effort to remove it (Figure 6-III.132a). Another cartridge base has as many as eight firing pin marks from at least two different guns and the entire base of the shell is deformed.

Three of the cartridges, all from BIBE1910, bear the impressed "U" headstamp used by Remington for their "Hi-Speed" brand from 1931 to the 1980s (Merchant 2009) (Figure 6-III.132c and e). One of these cartridges bears two firing pin marks (Figure 6-III.132e). This cartridge was introduced by the J. Stevens Arms and Tool Company in 1887 and it has become one of the most popular cartridges in the world (Suydam 1960:54).

.44 Henry

Two .44 caliber Henry long-case rimfire cartridge cases were recovered, one from BIBE415 and one from BIBE593. The cartridge from BIBE415 has a headstamp of a raised H within an indented circle and a bevel along the edge of the rim (Figure 6-III.132g). This cartridge was introduced in 1862 and was called the .44 Henry flat because of its flat nosed bullet. It was the first to bear the letter H headstamp (McDowell 1984:35-36). The cartridge from BIBE593 consists of a stamped H within a larger stamped circle (Figure 6-III.132f). Interestingly, the latter cartridge exhibits six different firing pin marks from two different guns. Four attempts with one gun failed to fire the cartridge. It was inserted into another gun, utilizing a double firing pin, and fired effectively. Because rimfire ammunition had a tendency to misfire, Henry repeaters and 1866 Winchesters utilized such double firing pins, striking the cartridge rim on opposite sides (Scott and Fox 1987:70).

The New Haven Arms Company began making cartridges in 1861 with the characteristic "H" stamp in honor of B. Tyler Henry who invented the famous Henry Repeating Rifle—the first effective lever action repeating rifle. These rifles were able to fire 16 large caliber metallic cartridges without reloading

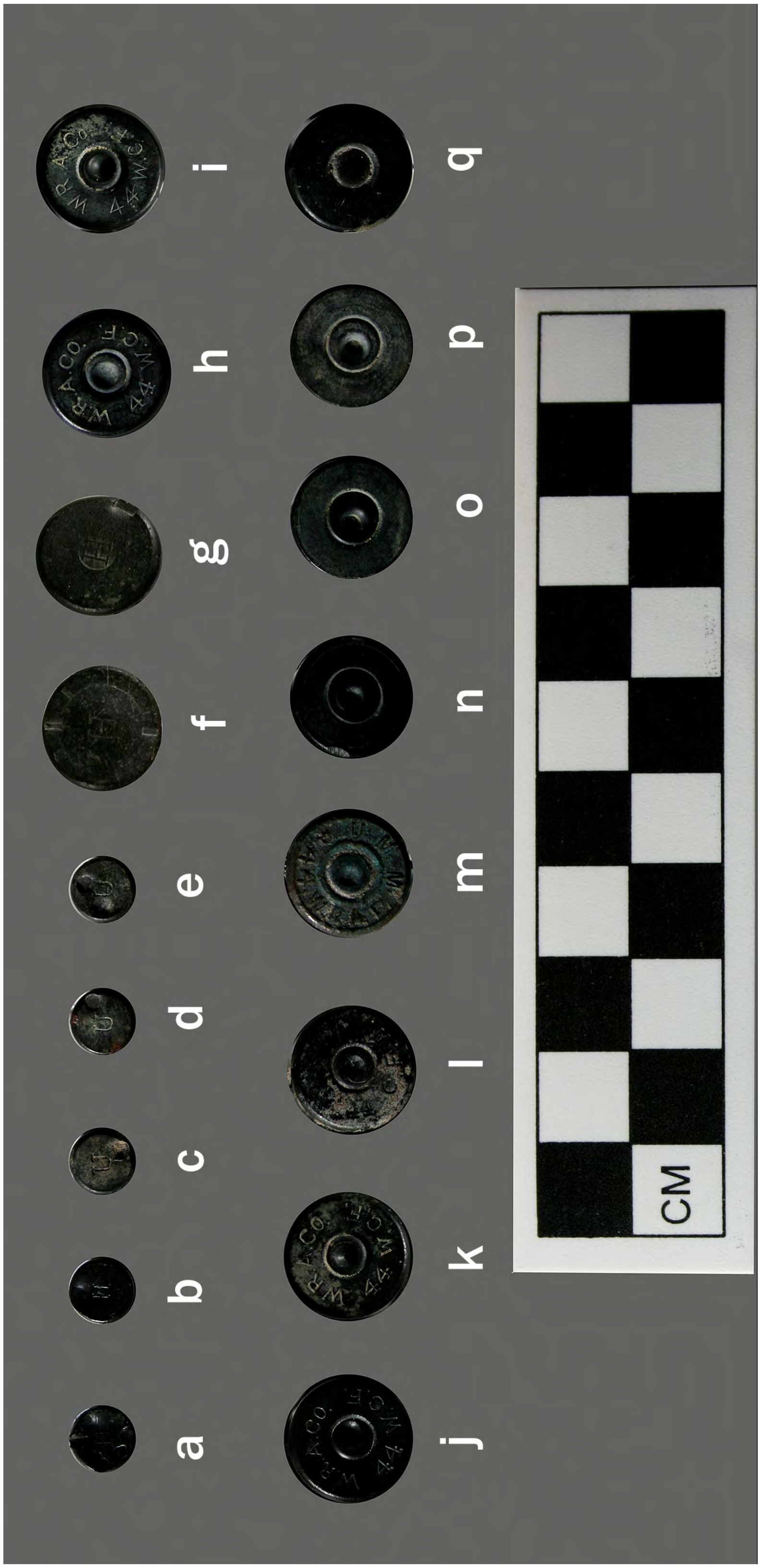


Figure 6-III.132 Rifle and pistol cartridge casings: (a–e) .22 Long Rifle; (f–g) .44 Henry; (h–q) .44-40 Winchester.

and, although they were never an official military issue, many soldiers purchased them for use in the Civil War. An improved version, addressing flaws in the original Henry, was introduced in 1866—the Model 1866 Winchester. Both weapons were popular during the 1870s, especially with Native Americans. Pistols were also developed that could fire the .44 rimfire, including the .44 rimfire Colt pistol and the .44 rimfire Remington revolver. Although the heyday of this cartridge was the 1870s, this ammunition continued to be manufactured into the 1930s (Scott and Fox 1987:70–73).

.44-40 Winchester

A total of 10 .44-40 cartridge casings were collected during the survey. Four of these are "W.R.A. Co. .44 W.C.F" casings manufactured by the Winchester Repeating Arms Company of New Haven, Connecticut (Figure 6-III.132h–q). Three of these were collected from BIBE1118 and one from BIBE1204. The fifth .44-40 cartridge, bearing the headstamp ".44 C.F.W.," was recovered from BIBE1920 (Figure 6-III.132l). Although lacking a manufacturer's mark, this cartridge was probably made by the Union Metallic Company of Bridgeport, Connecticut which later produced the headstamp "U.M.C. .44 C.F.W." to avoid advertising for Winchester (since "W.C.F." stood for "Winchester Center Fire.") Union Metallic Company merged with Remington in 1911 after which the headstamp was changed to "REM-UMC." The sixth .44-40 cartridge, from BIBE1942, bears the headstamp "UMM 44 WRA" with "P" and "L" at nine o'clock and three o'clock respectively (Figure 6-III.132m). The letters are raised within a shallow depressed area surrounding the primer. No information could be found on this particular cartridge although the headstamp indicates it was made for the Winchester .44-40 rifle.

The last four .44-40 caliber cartridges are unstamped (Figure 6-III.132n–q)—two recovered from sites and two as IF246 and IF202. The jacket of IF246 had been ripped open, possibly as a result of an accident or to retrieve the gunpowder inside. The third unstamped .44-40 was recovered from BIBE1910. The fourth is a live round collected from BIBE1176 (Figure 6-III.132q).

The .44-40 was the original cartridge for the famous Winchester Model 1873 lever-action repeating rifle. Soon after, Colt chambered revolvers in this caliber and most other gun manufacturers followed suit. Considered one of the all-time great American cartridges, it was the first effective cartridge that could be used in either a rifle or a pistol. Another classic cartridge in the settling of the American West, it served both for hunting as well as personal protection (Barnes 1997:84).

Shotgun Cartridges

Two shotgun cartridge casings were collected during the survey, one of which was manufactured for military use. Shotguns, or fowling pieces as they were originally called, were among the earliest firearms to be used for hunting. Originally, all guns were smooth-bored (like the shotgun) and it was not uncommon to load shot in flintlock muskets for small game animals. The first breech-loading shotguns were introduced in the late 1840s (Barnes 1997:395).

20-Gauge

One all-brass shotgun shell was collected as IF870. This shell bears the headstamp "F-10-86-No.20" (Figure 6-III.133a). This 20-gauge shotgun shell was manufactured by the Frankford Arsenal in October of 1886 for use in their Springfield Trapdoor Forager 20-gauge shotguns that were produced between 1880 and 1885. These shotguns were issued to companies—mostly in the West—for hunting purposes to supplement rations. Some of these cartridges were shipped loaded, but most were shipped with only a primer—leaving the

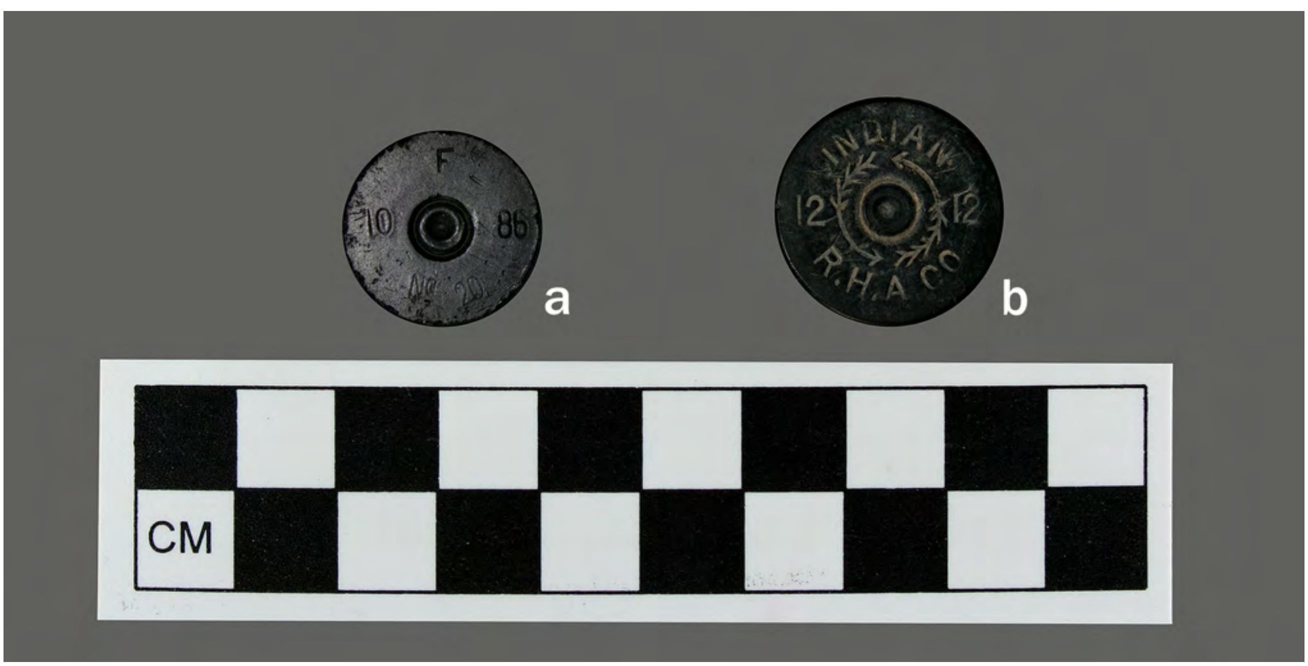


Figure 6-III.133 Shotgun cartridge casings: (a) .20 Gauge; (b) 12 Gauge.

reloading to the user (Reuland 1993:25; Flayderman 2007:585). This cartridge was likely shot by one of the Seminole Scouts on hunting detail from Camp Neville Spring. For reasons unknown, this particular specimen was crimped in a 4-way crimp that extends from the mouth of the case to about one inch below it.

12-Gauge

One 12-gauge shotgun shell base was collected from BIBE2130 bearing the headstamp "Indian-R.H.A. Co" (Figure 6-III.133b). This was a paper shotshell (as opposed to an all-brass shell) manufactured by the Robin Hood Ammunition Company of Swanton, Vermont—a small company established in 1898 that sold to Remington in 1915 although shells continued to be produced under the Robin Hood name until 1919 (Farrar n.d.). Evolved from smoothbore muskets, the first breech-loading shotguns appeared in the late 1840s. In 1866 a rebated rim reloadable steel 12-gauge shell was patented by Mr. Thomas L. Sturtevant. Since then, the 12-gauge has become the most popular, versatile, and most varied shotshell ever made (Barnes 1997:395, 403).

Bullets and Jackets

In addition to the cartridge casings, 10 bullets and 1 bullet jacket were collected during the survey. Of the 10 bullets, 4 were unfired and complete—probably intended for reloading spent cartridges. Two sharp-pointed full-metal jacketed bullets are .30-06 cartridges for use with the Army M1903 Springfield rifle, both recovered from BIBE1942 (Figure 6-III.134a and b). Although unfired, both are deformed—bent, crushed, and partially stripped of their brass jacket. These bullets

Figure 6-III.134 Bullets and jackets: (a-c) .30-06; (d) .30; (e-f) .44; (g-h) .45; (i) flattened bullet .30?; (j) .45-70; (k) brass jacket.

may have been damaged during reloading activities. Another unfired bullet from BIBE1910 is a complete full-metal jacketed pointed bullet with a single knurled cannelure (ring) likely also for a .30-06 cartridge (Figure 6-III.134c). Another unfired .30 caliber bullet from BIBE1920 is a corroded round-nosed lead bullet with a knurled cannelure (Figure 6-III.134d). In addition, two fired but intact flat-nosed, lead .44 caliber bullets with two knurled cannelures were collected from BIBE1594 and 1843 (Figure 6-III.134e and f). The last two bullets are also both fired but intact round-nosed full-metal jacketed .45 caliber bullets collected from BIBE1910 (Figure 6-III.134g and h) (Dillon n.d.; Steinhauer 2002).

The last three collected bullets are deformed from having been fired. A flattened lead bullet of unknown caliber (but resembling a .30 caliber) was collected from BIBE859B (Figure 6-III.134i). The second fired bullet, collected from BIBE2526, is a lead bullet that has 3 cannelures and appears most like those used in standard military .45-70 rounds (Figure 6-III.134j). The last fired bullet—from BIBE593—is a fragment, consisting only of the ripped brass jacket from the base of a jacketed solid-base bullet of unknown caliber (Figure 6-III.134k) (Dillon n.d.).

Commerce

The Commerce category is represented solely by 10 coins and 1 lead seal which is partly indicative of the remoteness of the area, and the distance to major commercial centers. However, it is also indicative of the fact that the survey did not sample major known commercial centers in the Big Bend, such as Johnson's Farm or Castolon.

Coins

A total of 10 coins were collected during the survey. Of these, 5 were government-issued currency and 5 were company-issued tokens. Of the currency, 2 are U.S. coins, 2 are Mexican coins, and 1 is from the former People's Republic of Yugoslavia. The remaining five coins are merchandise tokens issued by the Mex-Tex Wax Company.

Of the two U.S. minted coins, one is a Liberty Head 1904 nickel collected from BIBE859I (Figure 6-III.135a). It was designed by chief engraver Charles Barber and was issued from 1883 to 1913. The front of the coin portrays "lady liberty" wearing a coronet and wreath, while the reverse side has a large V surrounded by a wreath. This nickel is composed of 75 percent copper and 25 percent nickel (Krouse and Mishler 1988:1523). The other U.S. coin, from BIBE2031, is a 1993 penny suspected of being counterfeit (Figure 6-III.135b). The penny has a slight bend, convex on the obverse side, is slightly larger than a regular penny, and the center of its edge is slightly recessed. Other than the absence of a mintmark, there are no other distinguishing features of this penny.

Of the two Mexican coins, one is an 1893 *centavo* collected from BIBE1942 (Figure 6-III.135c). On the front are the words "*Republica Mexicana*" and on the reverse side are the words "*Un Centavo 1893 M*." This coin was minted in Mexico City, the only mint which struck centavos between 1892 and 1896 (Professional Coin Grading Service 2010). The other Mexico coin, collected from BIBE2596, is an 1892 10 *centavos* (Figure 6-III.135d). On the front are the words "*Republica Mexicana 1892*" and on the back "*MoM 902.7 10 centavos*." This silver 10-cent piece is a very common coin that was minted in Mexico City between 1869 and 1905 (Professional Coin Grading Service 2010).

One rare, all-aluminum 1953 Yugoslavian coin was recovered from BIBE2734 (Figure 6-III.135e). This 50-Para coin was minted during the Federal People's Republic of Yugoslavia which only existed from 1946 to 1963. On the front is a flame inside a wreath around which are the words "*Federativna Narodna Republika Jugoslavija.*" On the reverse side are seven stars, the words "*50 IIapa*" with a "19" on the left hand side and "53" on the right (World Coins Dealer website n.d.).

Figure 6-III.135 Coins: (a) Liberty Head 1904 nickel, (b) 1993 possible counterfeit penny; (c) 1893 Centavo; (d) 1892 Diez Centavos; (e) 1953 Yugoslavian 50-Para; (f) Intact Mex-Tex Wax Co. token; (g-h) Flattened Mex-Tex Wax Co. token; (i-j) Flattened and folded Mex-Tex Wax Co. token.

The five remaining coins are aluminum tokens produced by the Mex-Tex Wax Company, all collected from BIBE1942. Of the five, only one is completely intact (Figure 6-III.135f). This specimen has a diameter of 21.18 mm, a thickness 1.18 mm and a weight of 0.96 g. On the obverse side is stamped "MEX-TEX WAX CO." on the top and "SIERRA CHINO, TEXAS" on the bottom. The reverse side is stamped "GOOD FOR 10 IN MERCHANDISE." The other four tokens have been severely deformed. Two of them have been flattened (as if placed on railroad tracks or beaten with a hammer) (Figure 6-III.135g and h). The others have been slightly smashed and folded (Figure 6-III.135i and j). Although little of the writing remains legible, one of them appears to have a "9" stamped on it suggesting that different denominations were made. These tokens were issued to Mex-Tex Wax Company employees for use at either the company store, or a local store—likely either at Castolon or Boquillas.

The Mex-Tex Wax Company was established around January of 1922 in Cerro Chino Texas (near the landform of same name), some 12 km (7.5 miles) east of Castolon, where they operated until 1924 when production began to decline. The operation was moved downriver in 1924, likely to the village site of Pantera where these tokens were collected. A relatively small company, the workforce consisted of around 24 or more families, all of Hispanic origin, under an Anglo boss. The company continued operations for an unknown period of time at this (and possibly other) locations probably using Glenn Springs for their post office and shipping needs (Keller 2012).

Lead Seal

One lead seal was collected from BIBE1942 (Figure 6-III.136). The seal is shaped like a small disk 0.68 inches in maximum diameter and 0.2 inches thick. Two parallel holes run through the disk's long axis through which wire was passed. A remnant of a piece of wire remains inside one end of one of these holes. One face of the disk has a remnant impress of one or more letters. Although illegible, it may be a conjoined "H" and "P." The other side of the disk shows a central round disk 0.21 inches in diameter, flush with the face. This is likely a rivet connected to the other face, suggesting they were assembled as two pieces. The edges and obverse side bearing the remnant stamp have a golden brown patina whereas the reverse side is the natural gray color of lead.

Seals such as this were used to seal textiles as well as parcels and bales of goods, most commonly in Europe between the thirteenth and nineteenth centuries as a means of identification, to comply with regulations, and as an indication of quality control. Such seals are most frequently encountered at Spanish and French Colonial sites, but also occur at Civil War era sites in the eastern United States. In the present context, this seal may well date to the Spanish Colonial period (Tedesco 2002; McMahan 2010).

Entertainment

The only entertainment related artifacts collected during the project were parts of two harmonicas. Although other instruments—and other forms of entertainment—were certainly a part of the local history, because of their portability and ease of use, harmonicas are emblematic of the Western outdoor experience and are, thus, appropriately represented in the collected artifact assemblage.

Harmonicas

Two harmonica fragments were recovered during the survey. A harmonica cover plate fragment was collected at BIBE2030G (Figure 6-III.137a). A portion of the maker's mark is visible, bearing the letters "edral" (perhaps "cathedral") and additional letters (perhaps "organ") separated by a design. "Germany" is stamped just below. No information could be found on this harmonica. A single reed plate to a 10-hole diatonic harmonica (plays in only one key) was collected from BIBE1942 (Figure 6-III.137b). The plate itself is made

Figure 6-III.136 Lead seal.

Figure 6-III.137 Harmonica parts: (a) Harmonica cover plate fragment; (b) Harmonica reed plate.

of aluminum and has 10 slots covered by brass reeds, most of which are broken. It lacks any further identifying characteristics.

Miscellaneous Artifacts

This final section on historic artifacts contains those items whose function or identity could not be determined. A total of 22 artifacts are included in this category, consisting of 9 items whose function is unknown and 13 items whose identity is unknown.

Unknown Function

The following nine artifacts could be roughly identified, but their function remains elusive. This category contains a variety of miscellaneous items, consisting of a piece of hand-stamped tin, a button or rivet, a brass wing nut, a decorative thumbscrew, a nameplate, an aluminum tab, and three unidentified threaded caps.

Hand-Stamped Tin

One strip of hand-stamped tin was collected from BIBE1709 (Figure 6-III.138a). The strip is 4.84 inches long and 0.92 inches wide. One of the long edges is a fold where the tin was folded back upon itself. The long edge of this small back strip appears to have a clean machine-cut edge and a long crease set just inside the edge. The other long side, and one of the short sides, have been sheared to create fairly clean edges. The other short end, however, has a jagged, irregular break. The strip has a series of stamped dots—two sets of large ones arranged in round floral patterns and smaller ones creating a V shape between and on either side of the floral pattern. The strip is lightly rusted and

Figure 6-III.138 Artifacts with unknown function: (a) stamped tin; (b) Brass button or rivet; (c) Brass wingnut; (d) Decorative thumbscrew; (e) "Drummond" Nameplate; (f) Aluminum tab; (g–h) Unidentified threaded caps; (i) Tube top.

is fragmentary. The original function of this piece of decoratively stamped tin is unknown.

Button or Rivet

One brass button or rivet was collected from Historic Scatter 7 (Figure 6-III.138b). It measures to a 30 L. (0.75 inches diameter) and consists of two disks connected by a central spindle and between which is a thin metal plate. The base is flat around the edge and is domed in the middle. A blob of solder overlays the dome. The top is slightly convex and has a central disk within an outer disk which has two small holes opposite each other along the outer edge. Between the holes is stamped "PATENTED JANUARY 7, 189?," the last letter illegible. Although its actual function could not be determined, this appears most like a rivet, perhaps to secure cloth to some apparatus.

Brass Wingnut

One wingnut was collected from BIBE1920 (Figure 6-III.138c). The wingnut is made of brass, has a cylindrical shaft that is hollow with internal threads, and two rounded "wings" extending out of each side. It is 0.4 inches tall and 0.78 inches wide from tip to tip of the wings. This nut would have allowed for quickly attaching or separating two components although its specific function remains unknown.

Decorative Thumbscrew

One decorative thumbscrew was collected from BIBE1920 (Figure 6-III.138d). Made of brass, it is 0.73 inches long and 0.25 inches in maximum diameter. The top portion is decorative with chamfered edges and a rounded ball-shape on top. The threaded portion extends out 0.17 inches beyond the top portion. This artifact was clearly decorative rather than functional, although the original object to which this was attached is unknown.

Name Plate

One small metal nameplate was collected from BIBE1910 (Figure 6-III.138e). The artifact is about one inch long by 0.25 inches wide with two small metal tabs at either end. On its face is stamped "DRUMMOND." This is the name of several towns in the United States and at least one company—an Alabama mining company. However, no definite source for this particular nameplate could be found.

Aluminum Tab

One small aluminum tab was collected from BIBE2312 (Figure 6-III.138f). The tab is one inch long by 0.5 inches wide. The top half is oval-shaped and on it is stamped "1087 / PAT. JAN / 8-07." The lower half is square in shape and has small hole in the center and rounded "teeth" along the lower edge. Although fashioned from a single piece of aluminum, a bead of solder runs across the middle of the tab. No information could be found on this tab.

Unidentified Threaded Caps

Two unidentified threaded caps were collected during the survey (Figure 6-III.138g). The first cap, collected from BIBE1978, is made of brass and coated with a silver paint. Although dented at the top, it is complete. The cap is roughly mushroom-shaped with a bulbous top that tapers to a smaller threaded section. The cap measures one inch tall by one inch in maximum diameter. The threaded portion is approximately 0.75 inches in diameter. The origin of the cap is unknown although its somewhat decorative appearance suggests it might have been for a lotion or other health / grooming product.

The second cap, from BIBE859D, is made of brass (Figure 6-III.138h). It is partially crushed but measures approximately 0.38 inches tall by 1 inch in diameter. The grip at the top of the threaded portion consists of a series of angled parallel grooves. The top of the cap has a raised area around which is stamped "PAT'D MARCH ?0.58" and "EXT'D MARCH 30.72" both separated by a maltese cross. The kind of product used with this cap is unknown.

Tube Top

An aluminum top to a squeeze tube was collected from BIBE1942 (Figure 6-III.138i). The top is 0.75 inches in diameter and has a screw top spout which extends downward through the top for 0.75 inches at which point it is sheared off. On the underside of the top is stamped "WIRZ / INC. / CHESTER / PA / PAT / APL'D / FOR." This was made by A.H. Wirz, Inc., founded in 1836, which was the country's first manufacturer of collapsible tubes. The company moved from Philadelphia to Chester in 1914 (Stauter 1958). Although probably used for some type of ointment, the product this cap was used for remains unknown.

Unknown Identity

A total of thirteen artifacts were collected that could not be confidently identified. These consist of a domed cap, a glass half-sphere, a possible pendulum, a "crown pin," an eyelet swivel, a metal plate, a modified brass tube, a porcelain cone, a decorative piece of cast metal, a possible awl, a possible shoe heel fragment, and two hand-forged artifacts.

Domed Cap

One, from BIBE1920, is a small, round, domed cap that appears very similar to the top of a thumb tack (Figure 6-III.139a). It is made of brass, is 0.33 inches in diameter and is 0.09 inches wide. Inside the center of the bottom (concave part) of the cap is a small central hollow raised area (cylindrical). If it was solid, this would be interpreted as a tack, but being hollow in the center suggests this was an attachment point to

Figure 6-III.139 Artifacts of unknown identity: (a) Brass domed cap; (b) Glass half sphere; (c) Probable pendulum; (d) "Crown pin;" (e) Eyelet swivel; (f) Metal plate; (g) Modified brass tube; (h) Porcelain cone; (i) Decorative cast metal; (j) Possible awl.

clothing (perhaps a button) or as a decorative element to a number of household appliances.

Glass Half Sphere

A third unidentified artifact, collected from BIBE2030J, is a half sphere made of opaque black glass (Figure 6-III.139b). It is 0.66 inches in diameter and 0.49 inches thick. Although curved inward at its base, tapering slightly, it once extended further but is fractured. A tiny hole in the center suggests it was formed around something, perhaps a piece of wire. This may have been a button whose shank has broken. If so, due to its weight, it would have been used on a heavy coat.

Probable Pendulum

One probable clock pendulum was collected from BIBE1920 (Figure 6-III.139c). This small disk-shaped object is made of brass and measures 0.44 inches in diameter and is 0.21 inches thick. A small segment (0.2 inches long) of ferrous wire extends out of one end. Although lacking any maker's marks or other identifying features, this is likely a pendulum (swinging weight) to a small wall or table clock.

Crown Pin

One nickel-plated object was collected from BIBE1625 (Figure 6-III.139d). This artifact has a decorative cast "crown" at the top, below which extends a spindle 0.79

inches long and 0.13 inches in diameter that is rounded at its far end. The crown is 0.48 inches in maximum diameter and the entire object is 0.79 inches long. The identity and function of this object is unknown although it may have been part of a piece of jewelry.

Eyelet Swivel

One chrome plated eyelet swivel was collected from BIBE1725 (Figure 6-III.139e). This object is 0.94 inches long and 0.25 inches in diameter. The eyelet hole, which extends through the top part of the artifact, is 0.12 inches in diameter. The inside of the swivel is hollow, apparently where it fitted over another part. The precise identity and function of this artifact is unknown although, based on context (U.S. Geological Survey Triangulation Station), this may have come from a piece of surveying equipment, such as a transit, and may have been the attachment point for the plumb bob.

Metal Plate

A fourth unidentified artifact is a flat cuprous metal plate collected from BIBE1920 (Figure 6-III.139f). It is complete, roughly triangular in shape, and has one hole near the "apex," three holes along the "base," and three slots in between. This appears most like a chassis for some kind of switch that pivoted in the first hole, the other holes and slots serving as stops—such that the switch had three positions. This likely came from an automobile, but could also have come from any number of electrical appliances, such as a radio.

Modified Brass Tube

One small modified brass tube was collected from BIBE2030L (Figure 6-III.139g). The tube has been sheared on one end leaving an irregular edge, smashed flat (based on the molar-like marks, perhaps bitten flat), and the other side has been cut into a series of tiny "teeth." It measures 1.58 inches long and 0.68 inches wide. This appears very much like a modified cartridge casing (perhaps a .45-70) except that it bears a stamped line around its circumference near its middle that appears original. Because this is unlike any known cartridge, it may have come from another object, possibly a brass lipstick tube. Its function is a complete mystery. There is no use-wear on the tiny teeth to indicate it might have served as an expedient abrader / flesher / scratcher. This may have been intended as an ornament, similar to a tinkler, made by a Historic Indian or Mexican-Indian. However, there is no evidence to support either hypothesis.

Porcelain Cone

A fifth unidentified artifact was collected from BIBE2153 (Figure 6-III.139h). It is a hollow, cone-shaped piece of porcelain whose base is set inside a metal cup. The base of the metal cup has a narrow slot in its middle that extends from near the edge to past the center. The artifact is 1.14 inches tall and 0.64 inches in maximum diameter at the base of the metal cup. This artifact appears to be complete. Because this site featured an old car chassis, this may have been part of this vehicle but its identity is uncertain.

Decorative Cast Metal

Another unidentified artifact was collected from BIBE1942 (Figure 6-III.139i). It is a decorative piece of cast metal, probably pewter, that resembles an ornamental cartouche. It is 0.7 inches in maximum diameter and is approximately 0.08 inches thick. It has a domed central circular "button" from which radiate eight "spokes"—some of which terminate with another button. One part, now separated from the main piece, is composed of two domed buttons between which are two crossed lines with a third button at their intersection. The artifact, which is crudely made and bears no distinguishing marks, may have been part of a piece of jewelry.

Possible Awl

One narrow, pointed piece of rusted metal was collected from BIBE1942 (Figure 6-III.139j). Appearing similar to a small knife blade, it measures 2.7 inches in total length and is 0.33 inches in maximum width. One end is squared off and narrow, with a notch, and appears to have been where it was hafted. The other end gradually narrows to a sharp point. The narrow edges of the object, however, are blunt rather than sharp. The combination of a sharp point, blunt edges, and evidence that it was hafted suggests this might have been a leather awl although this interpretation remains speculative.

Figure 6-III.140 Possible shoe heel fragment.

Possible Shoe Heel Fragment

One horseshoe-shaped rusted metal plate with square holes was collected from BIBE1716 (Figure 6-III.140). Although badly rusted and broken, it measures 3.09 inches in length by 3.46 inches in width. This artifact appears, at first glance, like a badly rusted horseshoe, but the four holes visible on one side and the two on the other are far larger (at 0.22 inches x 0.31 inches in size) than a horse or muleshoe would be. It is also far wider (1.31 inches maximum) and thinner (0.15 inches) than horseshoes. The function of this artifact is uncertain, but was probably part of a reinforced shoe or boot heel.

Hand-Forged Artifacts

Two hand-forged artifacts were collected that could not be identified. The first, from BIBE2030A, is a piece of rusted iron in a Y-shape (Figure 6-III.141a). It appears to have been fashioned out of a single piece of round barstock that was split in half for part of its length to form the upper part of the Y which recurves slightly outward before terminating. The base of the Y comes to a sharp point suggesting it was meant to be driven into a piece of wood. This artifact is 4.75 inches in maximum length and 2.5 inches in maximum width. Although the function of this artifact is unknown, it appears to be a rest, or support, of some kind and resembles a crudely made musket rest. If so, that could place this artifact squarely within the Spanish Colonial period. Although unlikely, considering the proximity of the Presidio San Vicente, it is not impossible.

The second hand-forged artifact, collected as IF332 consists of a thick metal bar bent into a C-shape (Figure 6-III.141b). The bar is about 1.7 inches in width, 6 inches in length, and is .54 inches in maximum thickness. A round metal rod, about 0.65 inches in maximum diameter was welded to the inside middle of the C and extended out from it perpendicular to its long axis. This rod broke very close to the metal bar. This artifact is rusted and heavily battered, especially along its outside edge. The function of this artifact is unknown, although it could be a wagon wheel wrench. The weight of the C-shaped metal bar was clearly too much for the relatively small diameter rod that was attached to it, a shortcoming in the design.

Figure 6-III.141 Handforged artifacts: (a) Handforged "Y;" (b) Handforged "C."

Chronology

Historic sites can be dated by both archival and archeological sources. Secondary sources provide broad contexts for historic sites whereas primary sources, often in the form of county records and oral histories, provide much more detailed information that can fill in the gaps. In terms of material culture, an array of historic artifacts can serve as useful temporal diagnostics, either as a general gauge (to the decade) or—in some cases—a specific one (to the year). Depending on the nature of the site, cartridge casings and manufactured items with patent dates can sometimes supply the latter whereas other temporal diagnostics can serve as general gauges of a site's age such as hole-in-cap cans, cut nails, solarized glass, hand-blown bottles, and locally made ceramics—all of which are indicators of relatively early sites in the region.

Based on artifact assemblages, historic components encountered during the project ranged in age from the Spanish Colonial period to modern times. Several sites along the Rio Grande (BIBE859, BIBE2030, BIBE2085, and BIBE1942) generally contained the earliest artifacts. One exception is BIBE246, near the park's northwest corner, which contained Spanish majolica dating to roughly 1650–1830. Historic sites approaching the modern period, like those relating to early park visitation (ca. 1944–1950) were also documented. However, most datable material tended to cluster between 1880 and 1940, with the majority dating between 1910 and 1940, when activity in the region was most pronounced.

A small number of radiocarbon samples submitted for analysis dated to either the protohistoric or historic period. Out of a total of 13 samples, one (from BIBE1859) was an aboriginal hearth that dated to the protohistoric period (ca. A.D. 1590), and five were from thermal features on multi-component sites

(BIBE1332, BIBE1910 [3 dates], and BIBE1942). Significantly, the median dates from all five analyses clustered between A.D. 1800 and 1810, demonstrating a Euro-American or (more likely) Mexican-American occupation earlier than is typically proposed in published histories of the region. These findings corroborate similar dates derived from relative dating of artifacts recovered during the project. For details on the context and description of these radiometric samples, see Appendix 8.

Cultural Affiliation

Cultural affiliation was usually difficult to assess at historic sites because people generally had access to the same goods in the region and there is considerable consistency in artifact assemblages between sites. However, because there was often a significant disparity in economic standing between Anglo and Hispanic settlers, site content was often a good clue as to the ethnicity of its occupants. Thus, some sites—based on a combination of their features and artifact assemblages—were more suggestive of Mexican-American occupation whereas others were more indicative of Anglo occupation.

For example, sites containing *jacales*, dugouts, and adobe construction and whose artifact assemblage include a significant number of items from Mexico, or items frequently used in Mexican cuisine (such as chili powder) are suggestive of Mexican-American occupation. On the other hand, houses of frame construction, or that were of substantial rock construction, and that include items from mail order catalogs or that likely originated in the eastern U.S. are more suggestive of Euro-American occupation. But in a great many cases, these differences were not readily apparent, and often Mexican-Americans and Euro-Americans adopted very similar lifestyles that are indistinguishable in the archeological record.

Impacts to Historic Sites

It is important to note that a great many historic sites in BBNP have been severely impacted, both by natural and "artificial" means, since the park was established in the 1940s. Although erosion is to blame for most of the natural damage, the NPS itself is to blame for most of the artificial ones. In fact, the intentional destruction of domestic homesites, outbuildings, fences, and corrals, as well as other historic features was essentially part of an official NPS policy in BBNP's first decade. As a result, many of these sites have suffered insults far beyond the ravages of erosion, vandalism, unauthorized collecting, and other impacts that have taken a toll on many sites across the park (Alex 2007).

Because BBNP was established to protect and celebrate its natural wonders, one focus of its early development was to remove the "Mexican hovels," ostensibly as a matter of safety for tourists, but also, programmatically, to take the park back to its "natural state." Consequently, between 1944 and 1960, dozens of structures were dismantled, bulldozed, or otherwise destroyed by NPS employees, resulting in an incalculable loss to the archeological record (Figure 6-III.142) (Alex 2007).

Although the Historic Sites Act of 1935 might have been invoked to protect these structures, the old vernacular *jacales* and adobes in the park were not considered to be "of national significance" and were consequently excluded from consideration. The landmark National Historic Preservation Act of 1966, which would have protected these historic sites, came too late. By that time, the damage had already been done.

Consequently, when recording the village of San Vicente, as well as several other historic sites, among the features recorded were bulldozer push piles and blade scars from heavy machinery, mute testimony to this dark chapter in the park's history. In many cases, only a small fraction of the original site remained intact, resulting in a heavily skewed archeological signature. In light of this failure of stewardship, it is ironic that today the NPS is the agency charged with administering the National Register—the nation's most comprehensive database of sites and districts of national historical significance.

Summary and Conclusions

This chapter detailed the historic findings of the BBNP project, providing an overview of sites, features, and artifacts with Euro-American and Mexican-American affiliation recorded during the survey. Some 26 percent (n=405) of the 1,566 sites recorded during the project contained historic components although only 31 percent (n=127) of those sites were predominantly so. This body of "predominantly historic" sites formed the basis of the historic findings chapter.

Although the spatial distribution of historic sites was patterned, much of this is explained by the greater abundance of water resources in the southern half of the park as well as the location of the community of San Vicente relative to the total area surveyed. Aside from these factors, however, historic site distribution is largely a function of historical contingencies such as the randomness of the cadastral surveys and state land laws as well as the location of targeted resources such as mercury and candelilla plants.

The 127 historic sites examined were divided into 23 different site types although more than half of the sites were confined to just three groups: campsites, homesteads, and ranching sites. A total of 768 historic features were documented during the project, representing 27 different feature types in six categories: structures, ranching, farming, mining, candelilla wax processing, and miscellaneous.

Historic artifacts, 895 in all, were placed in 19 functional categories in 5 different major groups: domestic, personal, structural, activities, and miscellaneous. Of these, the domestic group was by far the largest although this was primarily a function of a targeted collection of historic ceramics that comprised more than 74 percent of the domestic assemblage.

Figure 6-III.142 NPS employee razing the Chata Sada house at Boquillas in the 1950s.

The temporal affiliation of the historic components encountered during the project ranged from the Spanish Colonial period to modern times, the earliest of which were found along the Rio Grande. However, most components tended to cluster between 1880 and 1940, with the majority dating between 1910 and 1940. Cultural affiliation could sometimes be inferred by material assemblages but most of the time these determinations were not readily apparent and were not systematically tallied. Instead, artifact assemblages between sites tended to be fairly uniform, reflecting the limited variety of goods available in the region historically.

Prior to the present project, relatively little work had been conducted on historic sites in BBNP. Of the 522 park sites on record that contain historic components, those documented during the current project represent a full 78 percent of that total. The project also attained an unprecedented level of detail in recording historic features and artifacts, and collections were made on a scale far greater than before. In so doing, the historic data collected during the BBNP project reveal a much lengthier, more nuanced, and more complex picture of the historical record than any regional history has yet brought to light.

6-IV

Isolates

Isolates are simply features or artifacts located outside of archeological sites and that are otherwise "isolated," lacking association with other archeological materials. The following section addresses all isolates documented during the BBNP project. Isolated features are addressed first, followed by isolated artifacts, lithic scatters, and historic scatters.

Features

Isolated features documented during the survey consist of cairns, rock groupings, and other rock anomalies as well as several features placed in a miscellaneous category. Although one of the project guidelines was that all archeological features must be made into sites, the following features types were not. One reason for this is their abundance and ubiquity, another is because they were typically independent of other features or artifact types that would have warranted additional consideration. In most cases these features fit nicely into one of the established isolated feature categories. The two isolated features that did not were placed within a miscellaneous category.

Cairns

An isolated cairn (IC) is any stacked rock feature that is non–thermal and non–structural, located outside of a site (Figure 6-IV.1). Cairns are often of unknown function unless clearly related to a trail (trail marker) or associated with a U.S. Geological Survey (USGS) benchmark or other topographic or cadastral surveys. Depending on the setting, the relative age of cairns could usually be inferred by their intactness. Documentation included the location, cairn dimensions, number of rocks, number of courses, rock type, size range of rocks, degree of definition, and possibly associated features or artifacts.

A total of 257 isolated cairns were documented during the project. The vast majority of these cairns could not be assigned temporal or functional affiliation although there were exceptions. A number of cairns were known or suspected to be USGS topographic survey cairns. In some cases, the location corresponded to benchmarks shown on maps and, in other cases, contained an actual USGS brass benchmark. When cairns were associated with wooden lath or metal stakes bearing numerical data, these were interpreted as being either from the cadastral survey or, more frequently, marking vegetation or soil survey plots as part of the ongoing scientific research conducted in BBNP (Figure 6-IV.2). In addition, trail markers associated with NPS trails were typically easy to distinguish from other cairns.

Although cairns typically lacked clues as to their affiliation, in many cases this could be inferred based on the characteristics of the cairns themselves, such as degree of intactness, depth of embeddedness, mineral

Figure 6-IV.1 Small, well-defined cairn consisting of three courses. Photo by C. Covington.

Figure 6-IV.2 Cairn with central marker lath on top of a cuesta, probably survey related. Photo by C. Covington.

staining, geographical location, or general appearance. For example, well-constructed, robust cairns on stable surfaces that are partially embedded but are only moderately or poorly intact might be suspected of being prehistoric. Conversely, a small cairn located on an unstable surface, and whose constituent rocks retained calcium carbonate on their upper cortex, could be interpreted as modern.

Cairns have been constructed throughout time and for a multitude of reasons although they most often appear to have served simply as location markers. They are known to have been used to mark burials, the location of lithic caches (such as the Lizard Hill Cache), water sources, trails, campsites, and as monuments to commemorate events. Cairns can also be arranged to form larger figures, whether abstract or representational, in which case they are usually part of petroforms, including medicine wheels and abstract figures. In historic times, cairns have been used as trail markers, to serve as horizontal or vertical control points for topographic or cadastral land surveys, to locate mining claims, as section corners, as datums for mapping archeological sites, or to mark the location of buried goods. In modern times, recreationists sometimes create cairns around "geocaches," a kind of GPS assisted treasure hunt. Consequently, cairns abound and are nearly ubiquitous across the landscape.

Despite their near ubiquity, of those documented as isolates during the project, their general distribution was well patterned. Table 6-IV.1 and Figure 6-IV.3 show their distribution by landform, based on the Natural Resources Conservation Service (NRCS) soil survey data published in 2011. Although cairns are shown to occur in a variety of different settings (a total of 15 different landform types), over half of all isolated cairn density (ICs per hectare [ha]) is found in only two landform types. Scarps and uplands are shown to account for a full 34 percent of cairn density and sandstone scarps to account for another 18 percent. These areas as characterized by sparsely vegetated low hills and cuestas with residuum derived from tuff in the former and from soft sandstone in the latter. Abounding in rock and with many low peaks and ridges, these environments are conducive to cairn construction.

Table 6-IV.2 shows summary data for the isolated cairns documented during the project, organized by cairn size (maximum diameter), indicated graphically

Table 6-IV.1 Isolated Cairns by Landform.*

Landform	HA Surveyed	% of Total	# Cairns	% of Total	IC Density	% of Total
Scarps and Uplands	124	0.49%	13	5.06%	0.1052	33.96%
Sandstone Scarps	474	1.90%	26	10.12%	0.0548	17.70%
Fan Terraces	39	0.16%	1	0.39%	0.0254	8.20%
Igneous Hill Slopes	634	2.54%	13	5.06%	0.0205	6.61%
Igneous Hills and Mountains	1,634	6.54%	28	10.89%	0.0171	5.53%
Arroyo Floodplains	422	1.69%	6	2.33%	0.0142	4.58%
Badlands	2,253	9.01%	30	11.67%	0.0133	4.30%
Arroyo Terraces	608	2.43%	8	3.11%	0.0132	4.25%
Sandstone Erosional Remnants	3,213	12.85%	36	14.01%	0.0112	3.62%
Pediments	815	3.26%	8	3.11%	0.0098	3.17%
Fan Remnants	7,139	28.56%	70	27.24%	0.0098	3.16%
Flagstone Hills	970	3.88%	9	3.50%	0.0093	3.00%
Gravelly Fan Remnants	1,521	6.08%	6	2.33%	0.0039	1.27%
Limestone Hills	1,529	6.12%	2	0.78%	0.0013	0.42%
Alluvial Flats	1,358	5.43%	1	0.39%	0.0007	0.24%
Total	**22,734**	**90.95%**	**257**	**100.00%**	**0.3099**	**100.00%**

*Note that landforms that were surveyed but did not contain ICs are excluded (n=6). The landform breakdown follows that of the NRCS 2011 BBNP soil survey.

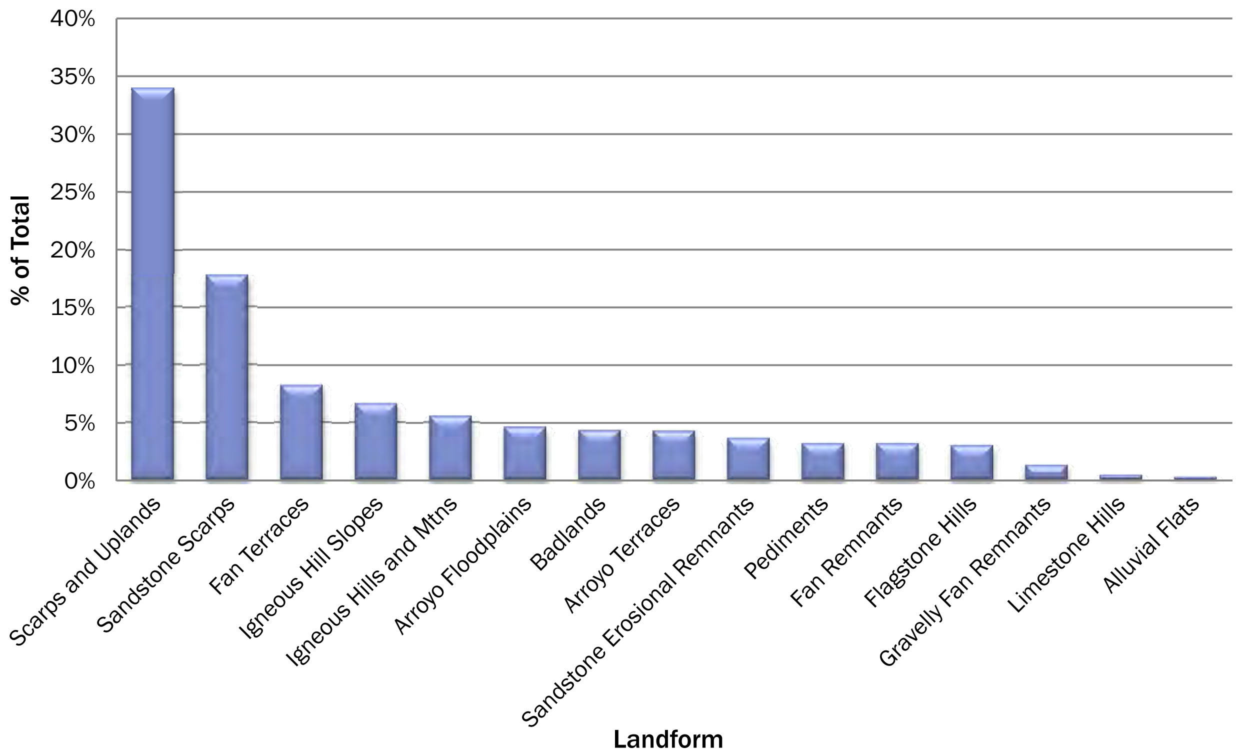


Figure 6-IV.3 Isolated cairn density by landform.

Table 6-IV.2 Isolated Cairns by Diameter, in cm.

Maximum Diameter	# Cairns	% of Total
10–20	22	8.56%
21–30	51	19.84%
31–40	77	29.96%
41–50	48	18.68%
51–60	23	8.95%
>60	15	5.84%
Unknown	21	8.17%
Total	257	100.00%

in Figure 6-IV.4. The distribution follows a normal curve such that most cairns fall within the middle values with 30 percent measuring between 31 and 40 cm in maximum diameter. About 20 percent of cairns are shown to be slightly smaller (21–30 cm) and another 20 percent to be slightly larger (41–50 cm). Taken together, these three size grades comprise almost 70 percent of all cairns, indicating that the vast majority of cairns documented during the project measure between 21 and 50 cm in maximum diameter.

Table 6-IV.3 and Figure 6-IV.5 show cairns arranged by height. Because this data was not routinely taken during the early stages of the project, only about 60 percent of all cairns are represented in this dataset (n=150). The figures indicate that over a quarter of all cairns for which this data was reported fall between 26 and 30 cm in height but that the remainder are distributed among the remaining height ranges in near equal proportions. The exceptions are the shortest range, which is to be expected, and the 41 to 45 cm range, amounting to only 2 percent of the total—a figure that is attributed to chance. Thus, the data indicates that although the reported cairns range from 5 to 90 cm in height, almost 90 percent are between 10 and 50 cm in height, with most clustered in the middle height range.

Table 6-IV.4 and Figure 6-IV.6 organize cairns according to the number of rocks contained. The data indicates that the highest percentage (33 percent) of cairns contain between 6 and 10 rocks, and that the majority (over 60 percent) contain between 2 and 10 rocks. Progressively fewer cairns contain more than 11

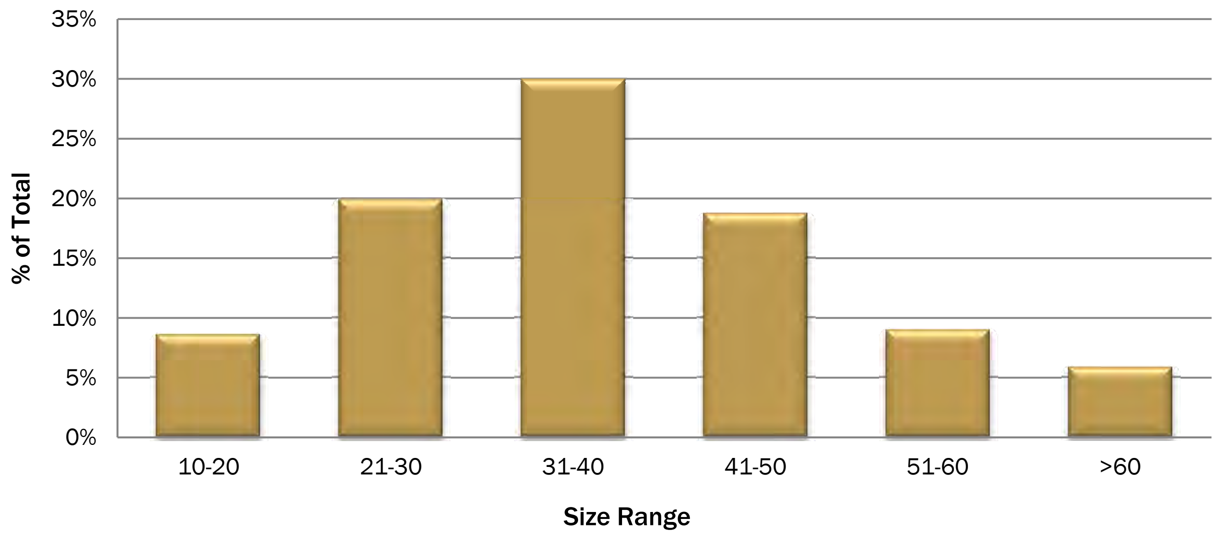


Figure 6-IV.4 Isolated cairns by diameter.

rocks, and less than 10 percent contain more than 40. Although cairns containing well over a hundred rocks were documented, these were quite rare and indicate that most cairns are rather expediently constructed.

Table 6-IV.5 and Figure 6-IV.7 show the cairns ordered by the maximum rock size used in their construction. The data shows that most rocks are between 36 to 40 cm in maximum diameter and that nearly 60 percent of all cairns contained rocks smaller than 40 cm. However, nearly 33 percent of cairns contained

Table 6-IV.3 Isolated Cairns by Height, in cm.

Height	# ICS	% of Total
5–10	2	1.33%
11–15	17	11.33%
16–20	19	12.67%
21–25	12	8.00%
26–30	38	25.33%
31–35	14	9.33%
36–40	15	10.00%
41–45	3	2.00%
46–50	16	10.67%
>50	14	9.33%
Total	150	100.00%

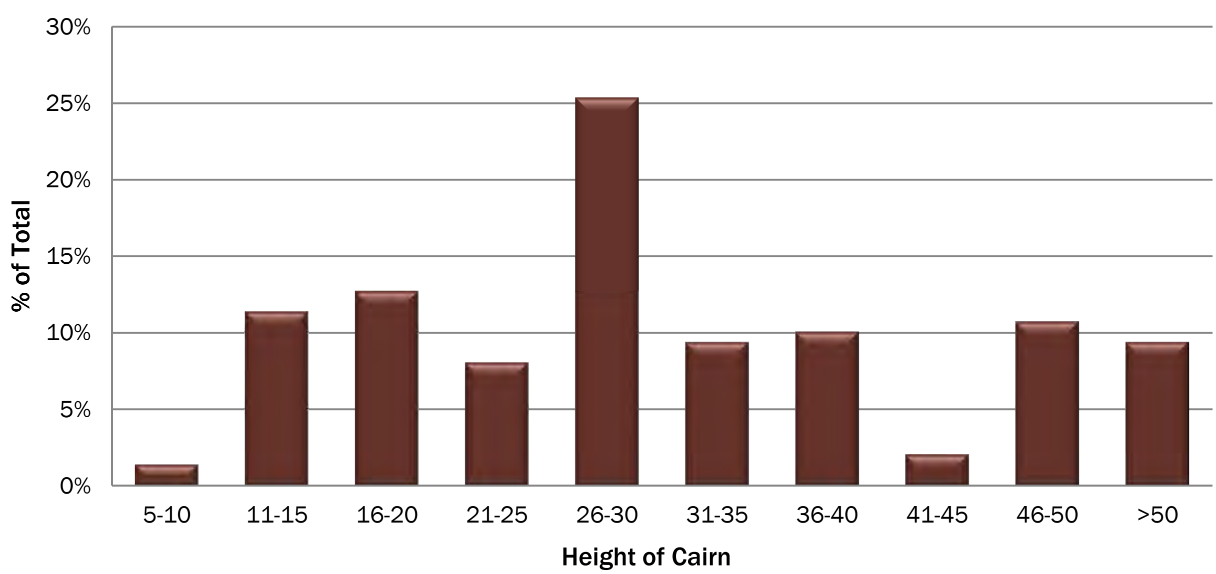


Figure 6-IV.5 Isolated cairns by height.

Table 6-IV.4 Isolated Cairns by Rock Count.

# Rocks	# ICS	% of Total
2–5	71	27.63%
6–10	85	33.07%
11–15	18	7.00%
16–20	18	7.00%
21–25	11	4.28%
26–30	15	5.84%
31–35	4	1.56%
36–40	8	3.11%
41–45	2	0.78%
46–50	6	2.33%
>50	12	4.67%
NA	7	2.72%
Total	257	100.00%

Table 6-IV.5 Isolated Cairns by Rock Size.

Max Diam	# ICS	% Of Total
6–10	3	1.17%
11–15	11	4.28%
16–20	9	3.50%
21–25	23	8.95%
26–30	28	10.89%
31–35	31	12.06%
36–40	45	17.51%
41–45	24	9.34%
46–50	24	9.34%
>50	36	14.01%
NA	23	8.95%
Total	257	100.00%

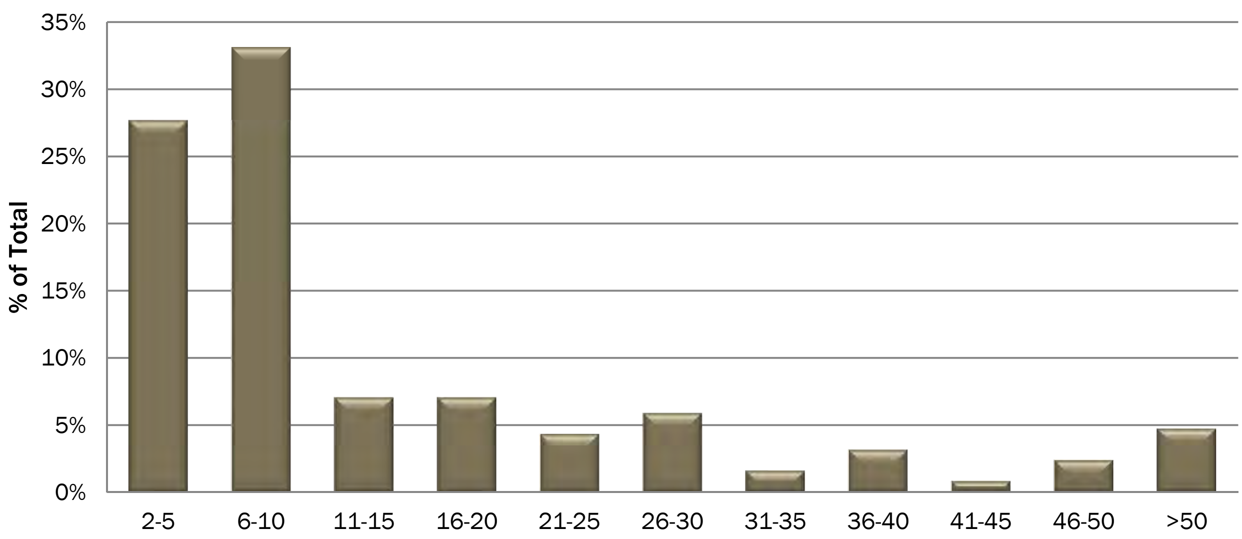


Figure 6-IV.6 Isolated cairns by rock count.

rocks larger than 40 cm, including 14 percent that contained rocks larger than 50 cm in maximum diameter. This breakdown shows that in general cairn construction favored cobble-sized rocks, usually between 26 and 40 cm in maximum diameter. Of course, this only refers to the maximum sized rocks used in cairn construction, not all the rocks. Combined with the above data, a cairn representative of those documented during the project would be about 35 cm in maximum diameter, about 28 cm in height, and would be composed of 6 to 10 rocks that measure between 26 and 40 cm in maximum diameter.

Rock Groupings

A "rock grouping" (RG) is an arbitrary name for a unique feature type that was discovered during the project and that began to be encountered frequently in some parts of the park. Rock groupings are non–stacked, non–thermal features typically consisting of 3–6 rocks, of roughly uniform size (ca. 20–40 cm maximum diameter) in a loose grouping (Figure 6-IV.8). Although sometimes the rocks are touching one another, more typically they are spaced apart by 10–20 cm or so. These features almost always occur outside of sites and are of unknown function. Beginning in the fall of

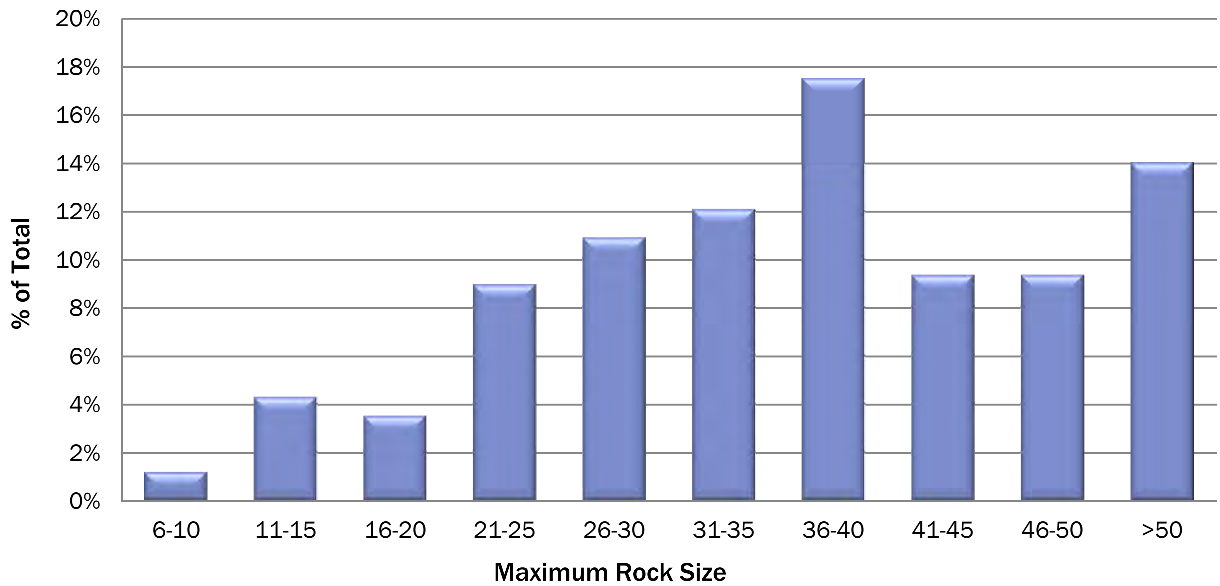


Figure 6-IV.7 Isolated cairns by rock size.

Figure 6-IV.8 Rock grouping consisting of three rocks. Photo by C. Covington.

2005, following their discovery, specific data were taken on dozens of these features (dimension, rock size, rock type, and possible associations were documented along with the location) before the sheer volume of them (and the degree of similarity) made this impracticable. Subsequently, RGs were simply noted by location.

As shown in Table 6-IV.6 and graphically in Figure 6-IV.9, the 2,612 rock groupings documented during the project are strongly spatially patterned, almost equal to that of cairns. Although nearly half of all documented RGs occur in fan remnants, when area surveyed is taken into account, the actual density of

Table 6-IV.6 Rock Groupings by Landform.*

Landform	HA Surveyed	% of Total	# RGs	% of Total	RG Density	% of Total
Pediments	815	3.26%	413	15.81%	0.5067	34.58%
Sandstone Scarps	474	1.90%	88	3.37%	0.1856	12.67%
Fan Remnants	7,139	28.56%	1,207	46.21%	0.1691	11.54%
Arroyo Terraces	608	2.43%	81	3.10%	0.1332	9.09%
Badlands	2,253	9.01%	267	10.22%	0.1185	8.09%
Sandstone Erosional Remnants	3,213	12.85%	253	9.69%	0.0787	5.37%
Gravelly Fan Remnants	1,521	6.08%	114	4.36%	0.0750	5.11%
Igneous Hills and Mountains	1,634	6.54%	122	4.67%	0.0747	5.09%
Scarps And Uplands	124	0.49%	6	0.23%	0.0486	3.31%
Igneous Hill Slopes	634	2.54%	22	0.84%	0.0347	2.37%
Flagstone Hills	970	3.88%	24	0.92%	0.0248	1.69%
Alluvial Flats	1,358	5.43%	12	0.46%	0.0088	0.60%
Arroyo Floodplains	422	1.69%	3	0.11%	0.0071	0.48%
Total	21,165	84.67%	2,612	100.00%	1.4654	100.00%

*Note that landforms that were surveyed but did not contain RGs are excluded (n=8). The landform breakdown follows that of the NRCS 2011 BBNP soil survey.

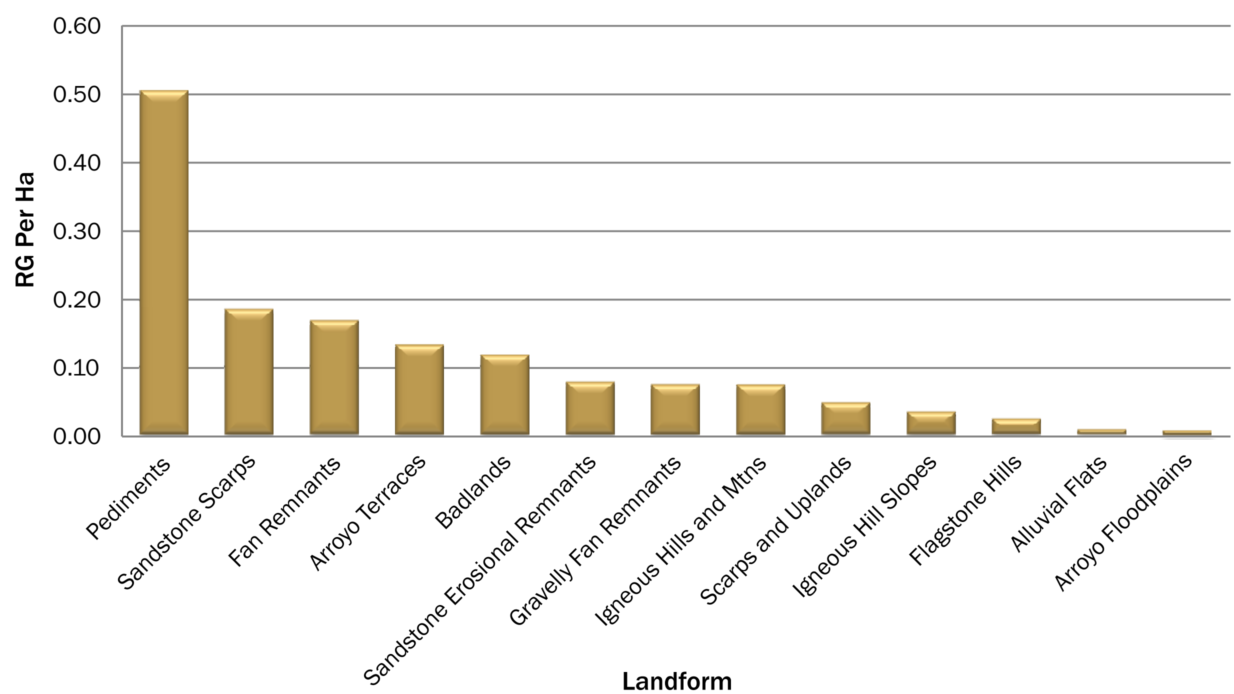


Figure 6-IV.9 Rock grouping density (RG per ha) by landform.

RGs is shown to be greatest in pediments, followed by sandstone scarps and fan remnants. Together, these three landforms account for nearly 60 percent of the total RG density. Their abundance declines significantly with other landforms such that the bottom five landform types account for less than 9 percent of all RG density.

The patterned distribution of RGs was quickly evident in the field. They were noted to occur on flat, elevated landforms—often along their crests or margins—and almost never in isolation (Figure 6-IV.10). In fact, they often occur in loosely linear or sub-linear arrangements, with the individual features averaging about 58 m apart. These distribution characteristics can be seen in Figure 6-IV.11 where RGs are shown to occur in linear arrangements along the middle and edges of a relatively flat landform bounded by intermittent drainages. This patterning was typical where such landforms were present.

Although more than 2,500 RGs were documented during the project, they were never found in good association with any other feature or artifact type that would provide an indication of their temporal or functional affiliation. However, based on the complete absence of historic materials and distance from historic habitation sites, they are believed to be prehistoric in age. It was also observed that in the typically flat, open settings in which they occur, these RGs tend to attract small animals for the meager protection they provide. Rabbit droppings and forms (scraped out depressions), in particular, were frequently noted to occur within these features. This aspect of rabbit behavior led to the hypothesis that these features may have functioned as a type of prehistoric rabbit trap. If the rocks served as an attractant, the rabbits could potentially be snared or caught. If so, then the linear nature of their patterning suggests the idea of a "prehistoric trap line." However, this explanation remains purely speculative and additional research will be needed to test this hypothesis.

Figure 6-IV.10 One of a series of rock groupings on a gravel pediment. Photo by D. Keller.

Other Rock Anomalies

Two additional isolated feature categories, subsumed here under "other rock anomalies," consist of rock clusters and rock alignments—two feature types that are nearly always of unknown function or affiliation. In cases where rock anomalies were recognized as intentional arrangements (petroforms, medicine wheels, or effigies), or they were in association with other features or artifacts, these were recorded as sites rather than as isolates, and greater detail went into their documentation.

Rock Clusters

The term "rock cluster" (RC) served as a catch–all category for all non–stacked, non–thermal rock features of unknown function (Figure 6-IV.12). This category

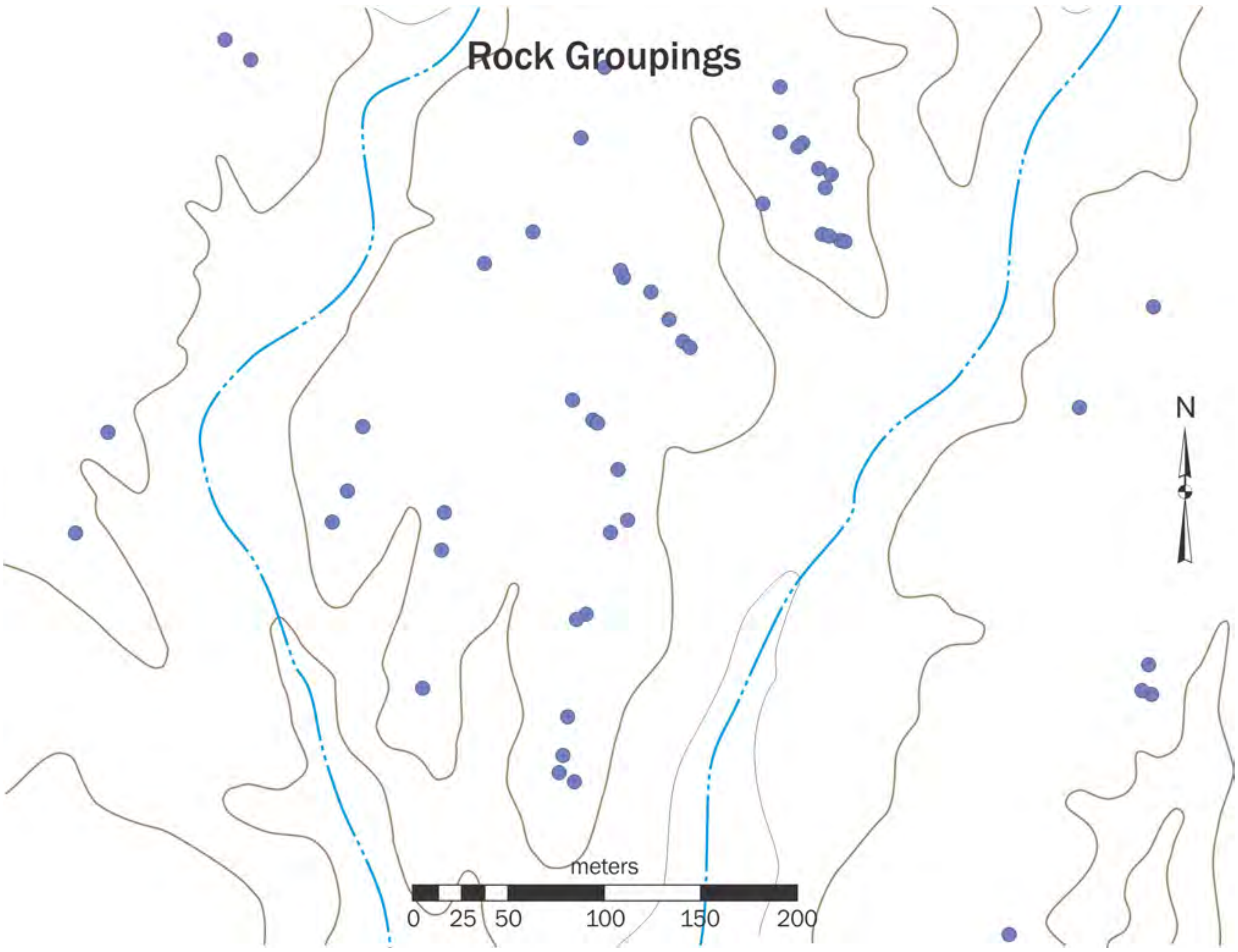


Figure 6-IV.11 An example of the spatial patterning of rock groupings. Note the linear nature of their distribution and the preference for the edges of relatively level landforms.

was meant to address all rock features that clearly were not hearths or cairns, were not architectural, and did not fit the definition of a rock grouping, but were clustered enough to suggest they were cultural. These feature types occurred both within as well as outside sites—both prehistoric and historic—and almost certainly represent a vast suite of expedient feature types. Documentation included the feature dimensions, number of rocks, size range of rocks, and associated features or artifacts in addition to location.

A total of 1,074 RCs were recorded during the project. As suggested by their broad definition, these features represent a great deal of morphological variability. As such, they also represent a wide range of different feature types—both prehistoric and historic—that have become disarticulated beyond recognition. Some may be eroded rock hearths that were never "fired," disarticulated cairns, bracing for fenceposts, miniature petroforms, children's play areas, or simply decorative features. The possibilities seem limitless. In only rare cases have function been discernable. One of these was at the village site of San Vicente where, through oral history, we were able to identify one set of RCs as bee hive lid weights, and another as a child's play corral. But in the vast majority of instances, such associations remain obscure.

Figure 6-IV.12 Large rock cluster composed of unmodified limestone cobbles. Photo by B. Dailey.

Because RCs lack specificity in morphology and thus represent such a wide range of feature remnants, it is not surprising that their distribution departs significantly from that of the well-defined RGs. As shown in Table 6-IV.7, RCs were found most often in sandstone scarps, followed by pediments, scarps and uplands, and fan remnants which, taken together, account for almost half of their total density. The five landform types with the lowest RC density—loamy alluvial flats, arroyo terraces, alluvial flats, arroyo floodplains, and limestone hills—account for less than 7 percent of the total. The remaining RCs were spread out among the other seven landform types where these features were found.

The same data are shown graphically in Figure 6-IV.13, which is presented beside the RG data for comparison. The distinctions between the distributions of the two feature types is most evident with respect to pediments and arroyo terraces where RGs occur in far greater numbers. A distinction is also expressed in those landform types where RCs occur in greater numbers, such as sandstone scarps and scarps and uplands as well as by the broader distribution of RCs compared to RGs. Despite the fact that far fewer RCs were recorded during the project, (amounting to only 40 percent of all RGs recorded), they occur in a wider range of landform types and are more evenly distributed among those types than RGs. Overall, RCs have a broader and more uniform distribution, although—as might be expected—they occur less frequently in landform types where rocks are not as abundant, such as floodplains.

Table 6-IV.7 Rock Clusters by Landform.

Landform	HA Surveyed	% Of Total	# RCs	% of Total	RC Density	% of Total
Sandstone Scarps	474	1.90%	55	5.12%	0.1160	16.88%
Pediments	815	3.26%	76	7.08%	0.0932	13.57%
Scarps and Uplands	124	0.49%	8	0.74%	0.0648	9.42%
Fan Remnants	7,139	28.56%	446	41.53%	0.0625	9.09%
Igneous Hills and Mountains	1,634	6.54%	101	9.40%	0.0618	8.99%
Badlands	2,253	9.01%	137	12.76%	0.0608	8.85%
Fan Terraces	39	0.16%	2	0.19%	0.0508	7.39%
Sandstone Erosional Remnants	3,213	12.85%	124	11.55%	0.0386	5.62%
Igneous Hill Slopes	634	2.54%	22	2.05%	0.0347	5.05%
Flagstone Hills	970	3.88%	32	2.98%	0.0330	4.80%
Gravelly Fan Remnants	1,521	6.08%	37	3.45%	0.0243	3.54%
Loamy Alluvial Flats	259	1.04%	3	0.28%	0.0116	1.69%
Arroyo Terraces	608	2.43%	7	0.65%	0.0115	1.67%
Alluvial Flats	1,358	5.43%	14	1.30%	0.0103	1.50%
Arroyo Floodplains	422	1.69%	4	0.37%	0.0095	1.38%
Limestone Hills	1,529	6.12%	6	0.56%	0.0039	0.57%
Total	21,463	85.87%	1,074	100.00%	0.6873	100.00%

*Note that landforms that were surveyed but did not contain RCs are excluded (n=5). The landform breakdown follows that of the NRCS 2011 BBNP soil survey.

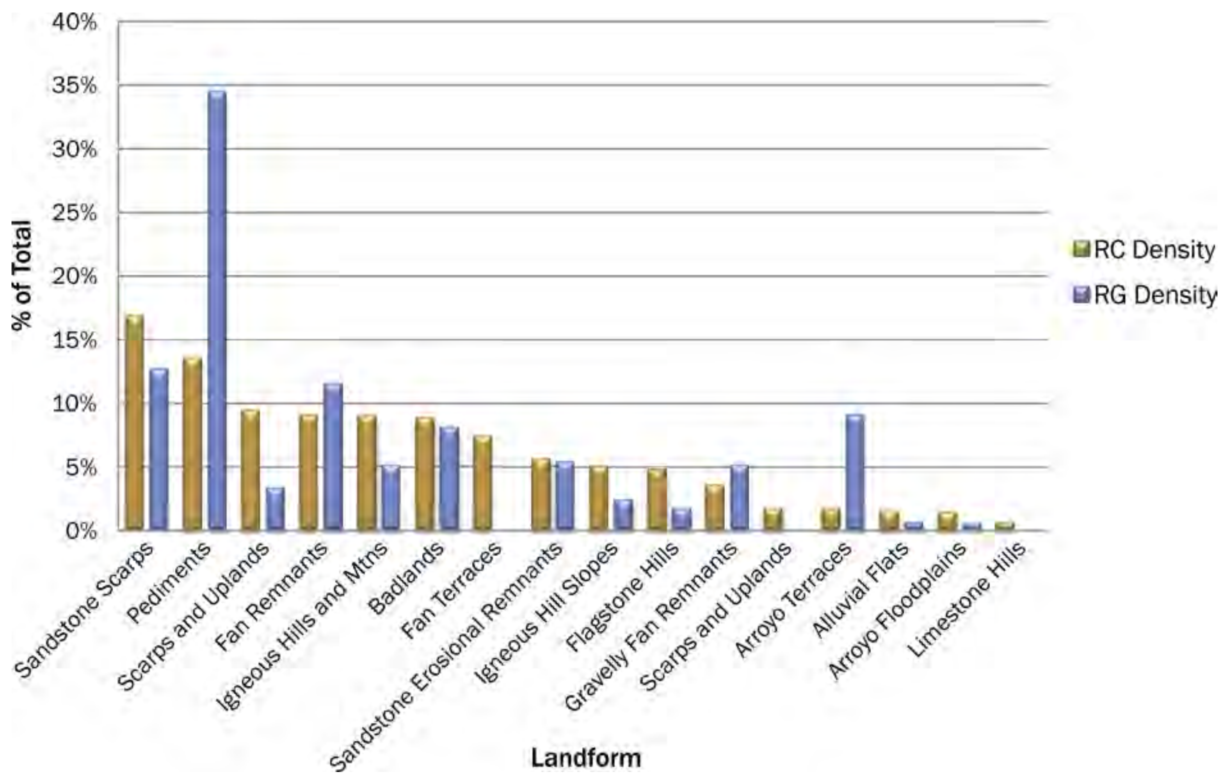


Figure 6-IV.13 Rock cluster (RC) and rock grouping (RG) density (RC and RG per ha) by landform, arranged from highest to lowest RC density, shown as percent of total density.

Rock Alignments

The other feature type subsumed under rock anomalies is that of rock alignments. A rock alignment (RA) is a horizontal, linear—or roughly linear—arrangement of rocks upon the ground surface, typically of unknown function or affiliation (Figures 6-IV.14 and 6-IV.15). Like rock clusters, rock alignments embraced a broad range of forms and could be prehistoric or historic, but could not be architectural. These features were likewise found both within and outside of sites. Documentation included the location, alignment dimensions, number of rocks, size range of rocks, and associated features or artifacts. Because rock alignments are of unknown function and because they were extremely variable in form, the results of their documentation were not systematically tallied.

A total of 74 isolated rock alignments were documented during the survey. Although this feature type is nearly as generic as rock clusters, with the only difference being the requisite linearity, its distribution was far more patterned than its non-linear counterpart. As shown in Table 6-IV.8, RAs were found to occur in only 10 out of 21 landform types surveyed. Thirty percent of RA density occurred on pediments, with fan remnants and igneous hills and mountains accounting for another 28 percent. Together, these three landform types contain well over half of all RA density.

Figure 6-IV.16 graphically represents the data, showing the much higher density on pediments relative to

Figure 6-IV.14 Rock alignment of tabular and blocky sandstone cobbles. Photo by L. Weingarten.

Figure 6-IV.15 Rock alignment of igneous cobbles. Photo by L. Weingarten.

other landform types, with fan remnants and igneous mountains and hills both distant seconds. However, much of this patterning resulted from a far greater density in RAs in survey Block L (n=29), amounting to nearly 40 percent of all RAs documented during the project. This is likely indicative of sampling bias, but it may also suggest that these are less generic feature types than previously thought and that their distribution may be related less to landform than to specific parts of the park. Indeed, only 8 RAs were recorded in the entire north half of the park; the remaining 66 were in its southern half. By quadrants, the southwest quadrant dominates, containing 60 percent of all RAs (n=44). It is also significant that one effigy and at least two additional possible effigies were also documented in Block L. Thus, RAs may have served a similar function, or been created by the same people. Regardless, their clustering in this particular area warrants further investigation.

Select Pebble Concentrations

One of the more curious discoveries made during the project were several examples of what came to be called "select pebble concentrations." As the name suggests, these features are simply discrete concentrations of specially selected pebble-size rocks (4–64 mm) (Figure 6-IV.17). The selected rocks are typically colorful or otherwise pleasing to the eye—such as crystals, chalcedony, cherts, agates, or silicified wood—although in one instance the rocks were simply smooth rounded pebbles. In most cases the select rocks were contained within a ring of larger cobbles (Figure 6-IV.18).

Table 6-IV.8 Rock Alignments by Landform.*

Landform	HA Surveyed	% of Total	# RAs	% of Total	RA Density	% of Total
Pediments	815	3.26%	9	12.16%	0.0110	29.90%
Fan Remnants	7,139	28.56%	38	51.35%	0.0053	14.42%
Igneous Hills and Mountains	1,634	6.54%	8	10.81%	0.0049	13.26%
Flagstone Hills	970	3.88%	4	5.41%	0.0041	11.17%
Arroyo Terraces	608	2.43%	2	2.70%	0.0033	8.91%
Badlands	2,253	9.01%	6	8.11%	0.0027	7.21%
Sandstone Scarps	474	1.90%	1	1.35%	0.0021	5.71%
Igneous Hill Slopes	634	2.54%	1	1.35%	0.0016	4.27%
Sandstone Erosional Remnants	3,213	12.85%	4	5.41%	0.0012	3.37%
Gravelly Fan Remnants	1,521	6.08%	1	1.35%	0.0007	1.78%
Totals	**19,261**	**77.06%**	**74**	**100.00%**	**0.0369**	**100.00%**

*Note that landforms that were surveyed but did not contain RCs are excluded (n=11). The landform breakdown follows that of the NRCS 2011 BBNP soil survey.

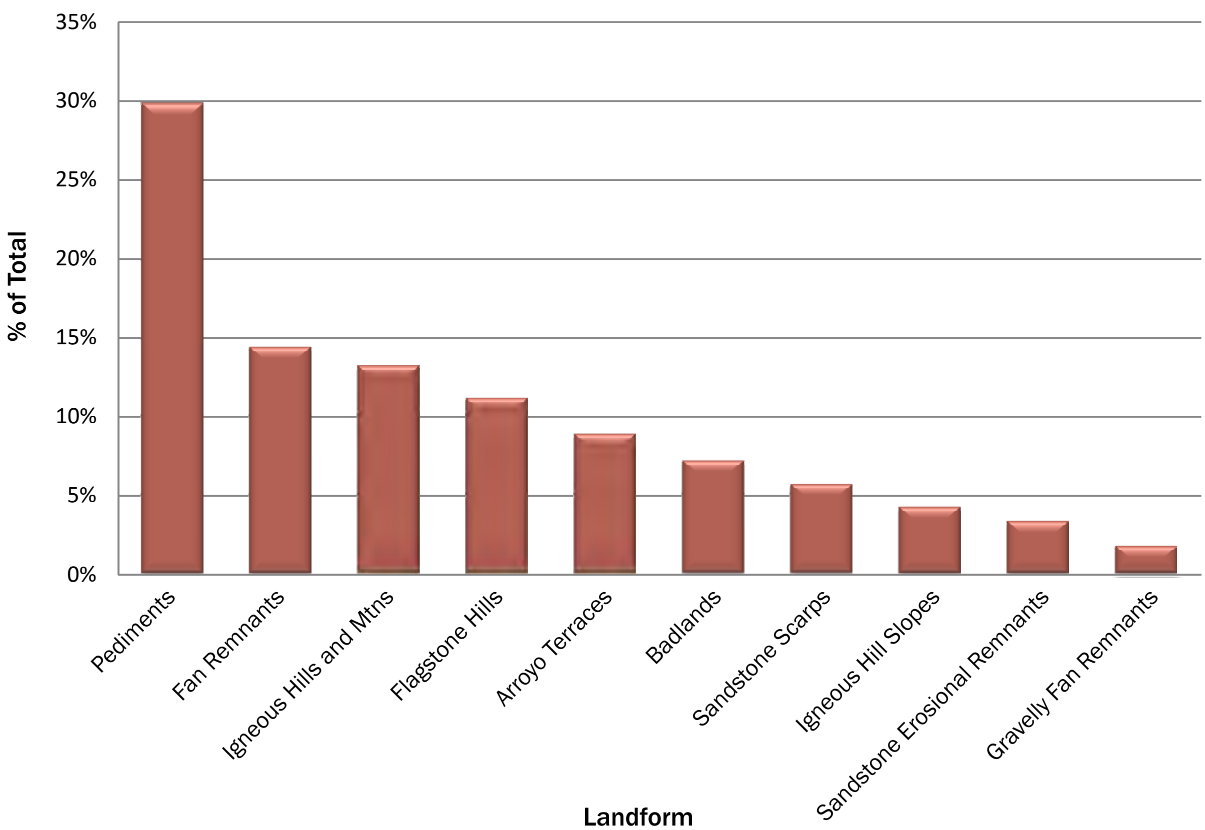


Figure 6-IV.16 Rock alignment density (RA per ha) by landform, arranged from highest to lowest density, shown as percent of total density.

Six select pebble concentrations were recorded during the project, one on a historic site (BIBE1707) and the remainder as isolates, all of which occurred within 3 km of each other and within 2 km of the Rio Grande. A couple of them, due to their degree of intactness and proximity to a park road, could be

Figure 6-IV.17 Select concentration of various streamworn pebbles. Photo by L. Weingarten.

Figure 6-IV.18 Select concentration of calcite crystals contained by several angular igneous cobbles. Photo by C. Covington.

modern and were initially assumed to represent child's play or "New Age" spiritualism. However, based on their geographically constricted distribution, proximity to one another, general context, preservation, and the fact that one pebble concentration was located within a historic campsite, these features are believed to be historic (pre-park). Beyond visual appeal, their function is unknown. It is possible they had a ritual function, and may have been constructed by a *curandera* or healer. Alternatively, they could be special markers of some sort. It is also possible that each feature had a unique affiliation and function. It seems most likely, however, that these features were constructed by children as the end product of playing, or for purely aesthetic reasons.

Miscellaneous Features

In addition to the isolated feature categories discussed above, two miscellaneous features were documented that did not fit within any of the standard categories nor, for various reasons, did they qualify to be recorded as a site. These features consist of a cobble platform and a modern effigy. These two miscellaneous isolated features were originally recorded as isolated finds. Because that category is reserved for artifacts, they are reported here instead.

The first miscellaneous isolated feature (IF 478) is a single–tiered "cobble platform" consisting of around 150 rhyolite cobbles. Because there is no evidence of thermal alteration nor any associated features or artifacts, this feature is of unknown function. The second (IF 90) is an anthropomorphic figure, or effigy, fashioned out of red tabular stones. Because this was interpreted to be modern, it did not qualify to be recorded as an archeological site. However, because it was undeniably cultural, neither could it be ignored. Within only 50 years it could be considered significant (by federal guidelines). Additionally, ignoring such modern features completely can cause considerable confusion for future archeologists.

Artifacts

Artifacts that were documented outside of historic sites were placed in one of several categories depending on context, content, and abundance. These categories consist of isolated finds, lithic scatters, and historic scatters. Each of these is addressed below.

Isolated Finds

Formal tools that were found outside of sites were documented as "isolated finds," defined as 1 to 5 formal tools or other cultural item (historic or prehistoric), typically within a 20 m diameter area. In cases where more than five formal tools were encountered within a relatively small area, they were recorded as sites. Documentation included the tool type, material type, and associated artifacts along with the location. The complete data table on isolated finds documented during the project can be found in Appendix 2.

A total of 858 isolated finds were recorded during the project, consisting of 265 prehistoric isolates, comprising 31 percent of the total, and 593 historic isolates, comprising 69 percent of the total (Table 6-IV.9). In most cases, each isolated find consisted of only a single object although 52 isolates contained two or more. These objects were usually of the same type (multiple bifaces or cartridge casings, for example), although in a few cases different artifact types were found together (tin can and glass sherd, for example).

Table 6-IV.9 Isolated Finds Documented During the Project.

Period	Count	% of Total
Prehistoric	265	30.89%
Historic	593	69.11%
Total	858	100.00%

Table 6-IV.10 Prehistoric Isolated Finds Documented During the Project.

Object	Count	% of Total
Biface	67	21.61%
Dart Point	62	20.00%
Flake	48	15.48%
Mano	25	8.06%
Metate	23	7.42%
Scraper	23	7.42%
Arrow Point	13	4.19%
Core	12	3.87%
Spokeshave	12	3.87%
Hammerstone	8	2.58%
Uniface	6	1.94%
Shell	3	0.97%
Ornament	3	0.97%
Chopper	2	0.65%
Preform	1	0.32%
Shaft Abrader	1	0.32%
Drill Fragment	1	0.32%
Total	310	100.00%

Prehistoric Isolated Finds

The 265 prehistoric isolated finds consist of 310 individual artifacts in 17 different categories (Table 6-IV.10). In order of abundance, these consist of bifaces, dart points, flakes, manos, metates, scrapers, arrow points, cores, spokeshaves, hammerstones, unifaces, shell, ornaments, choppers, a preform, a shaft abrader, and a drill fragment. It is notable that the top three categories comprise over half of all prehistoric isolated finds. Nearly a quarter (n=75) of all prehistoric isolates are diagnostic projectile points and point fragments, 61 of which were collected (those not collected were too fragmentary for identification). Although flakes make up over 15 percent of prehistoric isolates documented during the project, most of these were either trimmed, utilized, or both. Unmodified debitage was not typically recorded as it occurs nearly ubiquitously as "background noise" across the park. When it was recorded, it was usually in exceptional circumstances where artifacts of any kind were scarce.

Eighty-two of the 268 prehistoric isolated finds were collected, or 30 percent of the total. Of these 82 collected specimens, 61 are diagnostic projectiles, 39 of which are identified to individual subperiods. The remaining 22 projectiles, however, could only be identified as Archaic in age. Of those that could be identified to subperiod, 15 percent are Early Archaic, 31 percent are Middle Archaic, 23 percent are Late Archaic, and 31 percent are Late Prehistoric (Table 6–IV.11).

Table 6-IV.11 Projectiles Collected as Isolates.*

Time Period	Count	% Of Total
Early Archaic	6	15.38%
Middle Archaic	12	30.77%
Late Archaic	9	23.08%
Late Prehistoric	12	30.77%
Total	39	100.00%

*Note that this does not include the 22 unspecified.

These figures stand in stark contrast to those of all projectiles collected during the project, as shown in Table 6–IV.12 and graphically in Figure 6–IV.19. For one, no Paleoindian projectiles were collected as isolates (although this is not surprising since they only represent two percent of the entire project collection). Instead, there was a higher percentage of Early Archaic and Middle Archaic projectiles collected and a lower percentage of Late Archaic and Late Prehistoric projectiles collected compared with the project-wide totals. Thus, rather than revealing a pattern of steadily increasing projectiles through time as seen in project–wide data, we see percentages that suggest a more fluctuating pattern.

However, as with the project-wide projectile point distribution, the ratios of projectiles collected as isolates are skewed as a result of the absence of the 22 Archaic unspecified in the tally. Because these unidentified points were fragmentary they were only noted as being dart points, which then gives more weight to arrow points. As was done in Chapter 7, these unspecified

Table 6-IV.12 Projectiles Collected as Isolates Compared to the Project-Wide Projectile Distribution.*

Time Period	Isolates	% of Total	Project	% of Total
Early Archaic	6	15.38%	73	7.20%
Middle Archaic	12	30.77%	225	22.19%
Late Archaic	9	23.08%	320	31.56%
Late Prehistoric	12	30.77%	376	37.08%
Total	39	100.00%	994	98.03%

*Note that this does not include the 22 unspecified of the isolates or the 222 unspecified for the project-wide figures. The % of total for the project–wide data is less than 100% because Paleoindian points are not included here.

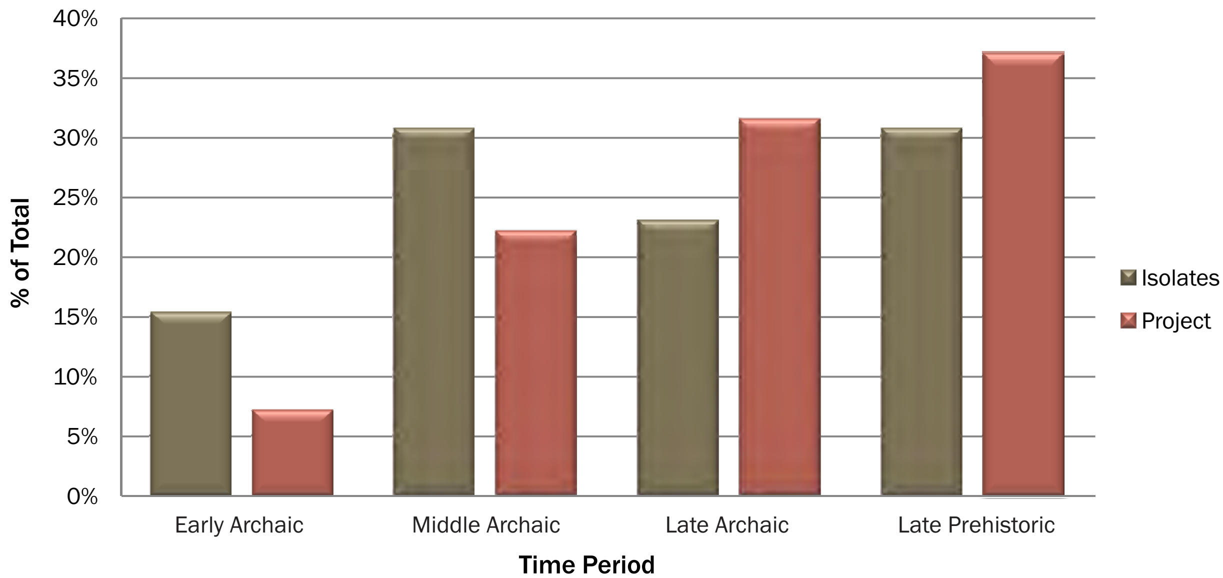


Figure 6-IV.19 Projectiles collected as isolates compared to the project–wide projectile distribution. Note that this does not include the 22 unspecified of isolates or the 222 unspecified for the project-wide figures.

projectiles can be added to their most likely category—the Late Archaic. In so doing, and in comparing these numbers to the project–wide distribution with the 222 Archaic unspecified provisionally added, a different pattern is revealed (Table 6-IV.13, Figure 6-IV.20).

The figures, as percentages of total, are much closer between the isolates and project–wide collection with the Archaic unspecified included (the sum of divergence between the two in the first instance is 32 percent compared with 23 percent in the latter). Although these projections must remain tentative, they may represent prehistoric behavior more accurately. If so, then a very interesting pattern is revealed. As shown before, proportionately more early projectiles were collected as isolates than in the project-wide collection although the difference is not great. More striking is the significantly greater number of Late Archaic projectiles and the significantly lower number of Late Prehistoric projectiles that were collected as isolates. What this may reflect is greater mobility in the earlier periods, much greater mobility in the Late Archaic, and much lower mobility in the Late Prehistoric. Indeed, these findings generally corroborate those from Chapter 7, especially with respect to mobility during the Late Archaic.

Table 6-IV.13 Projectiles Collected as Isolates Compared to the Project-Wide Projectile Distribution.*

Time Period	Isolates	% of Total	Project	% of Total
Early Archaic	6	9.84%	92	7.44%
Middle Archaic	12	19.67%	229	18.53%
Late Archaic	31	50.82%	519	41.99%
Late Prehistoric	12	19.67%	376	30.42%
Total	61	100.00%	1,216	98%

*Shown with the 22 unspecified added to the isolates and the 222 unspecified added to the project-wide totals.

Historic Isolated Finds

The 593 historic isolated finds represent an overwhelming majority, nearly 70 percent, of all isolates documented during the project. Part of this imbalance is the result of typically higher visibility of historic artifacts, but also because all historic items—regardless of significance—were documented whereas prehistoric artifacts considered insignificant or exceedingly common were not. As mentioned above, debitage was not routinely documented unless it was distinct from lithic “background noise” or unless it

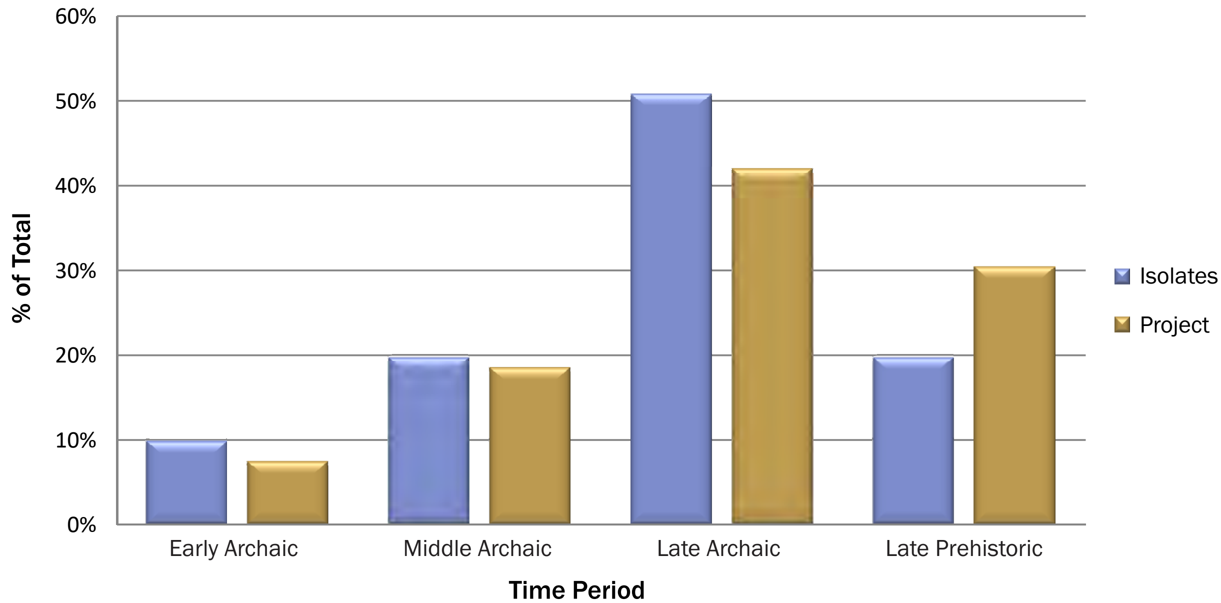


Figure 6–IV.20 Projectiles collected as isolates compared to the project–wide projectile distribution with the Archaic unspecified provisionally added to each.

occurred as a discrete lithic scatter, in which case it was documented in the lithic scatter category. Thus, the higher percentage of historic items is largely a reflection of documentation bias rather than greater abundance.

As shown in Table 6-IV.14 and graphically in Figure 6-IV.21, a total of 617 historic artifacts were documented in 22 major categories during the project. In order of abundance, these consist of tin cans, horseshoes, cartridge casings, tobacco tins, bottles, unknown metal, glass, miscellaneous, containers, milled lumber, ceramics, car parts, pipe, hardware, barbed wire, chains, wire, camping items, tools, cable, coins, and knives. Significantly, over a third of all documented items were tin cans. When combined with horseshoes and cartridge casings, these three categories comprised over 60 percent of all historic isolated finds.

Five percent of the historic isolates were identified as unknown metal objects. These were typically fragmentary metal items, often sheet metal, whose function could not be determined. The miscellaneous category, representing 4 percent of all historic isolates, consists of objects that could be identified, but that did not occur in great enough abundance to be considered a category. Among these were items such as a harmonica reed plate, a fork, a tea cup, and a brass button. The container category included all types of containers larger than food-type tin cans, from buckets to barrels to lard pails, and so is not specific to any one container type. The camping category consists

Table 6-IV.14 Historic Isolated Finds by Category.

Object	Count	% of Total
Tin Can	204	33.06%
Horseshoe	91	14.75%
Cartridge Casing	79	12.80%
Tobacco Tin	38	6.16%
Bottle	32	5.19%
Metal-Unknown	28	4.54%
Glass	25	4.05%
Miscellaneous	25	4.05%
Container	15	2.43%
Milled Lumber	14	2.27%
Ceramic	13	2.11%
Car Part	13	2.11%
Pipe	7	1.13%
Hardware	6	0.97%
Barbed Wire	5	0.81%
Chain	5	0.81%
Wire	5	0.81%
Camping	3	0.49%
Tool	3	0.49%
Cable	2	0.32%
Coin	2	0.32%
Knife	2	0.32%
Totals	617	100.00%

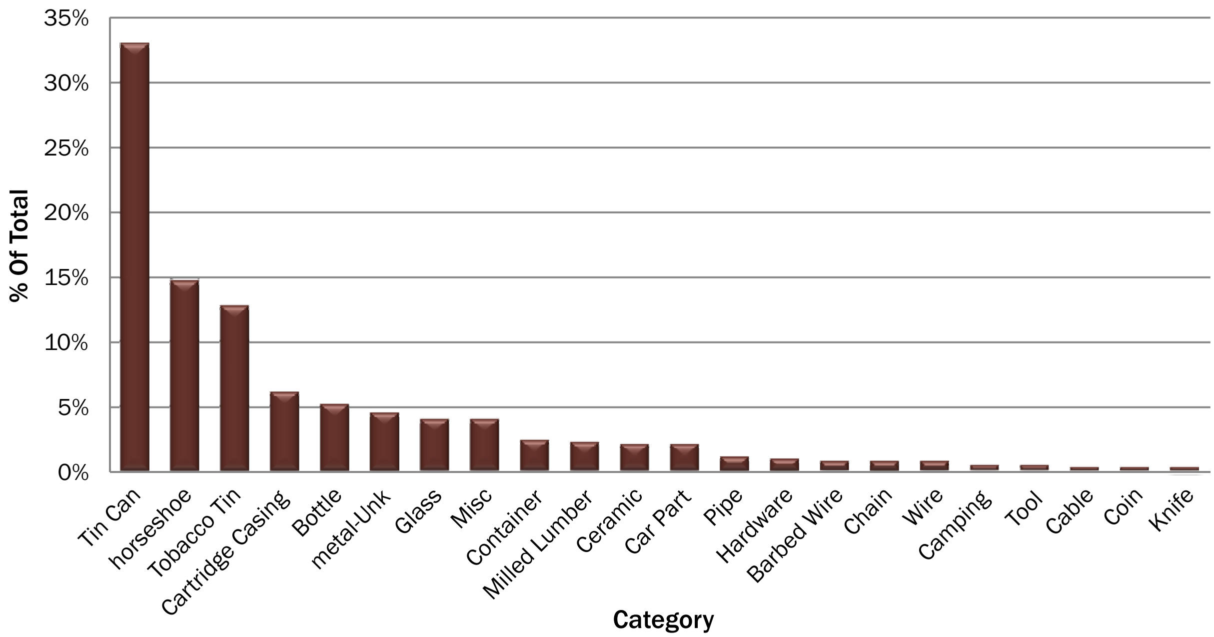


Figure 6-IV.21 Historic isolated finds by category as percent of total.

of two canteens and a tent stake. The remaining categories are self–explanatory.

A total of 32 historic artifacts were collected out of the 593 historic isolated finds. These consist of 12 cartridge casings, 5 bottles, 4 metal objects, 3 horseshoes, and one each of a canteen, salt shaker, brass button, ceramic sherd, coin, container, tool, and tobacco tin. Details on these items can be found in the historic artifact analysis in Chapter 6.

Of all the historic isolate categories, cartridge casings are by far the most useful functional and temporal diagnostic. A total of 79 were documented, including the 12 that were collected. Of these, 76 could be identified to caliber and are shown in Table 6-IV.15 by count and percent of total, arranged in order of abundance. Figure 6-IV.22 graphically represents this same data as percent of total.

At more than 20 percent of the total, the majority of cartridge casings documented as isolates were .30-30 caliber, the most common and ubiquitous civilian caliber in the region. This is followed in abundance by the .30-06, representing the military occupation of the region during the Mexican Revolution. Third in abundance is the .44 caliber, the first effective cartridge that could be used in either a rifle or a pistol. This flexibility, in addition to its knockdown power, contributed to its popularity. Fourth in abundance is the .45-70, representing the early military occupation of the region in the late 1870s and 1880s. The .30-40 Krag, seventh on the list, replaced the .45-70 as stan-

Table 6-IV.15 Cartridge Casings Documented as Historic Isolates.

Caliber	Count	% of Total
.30-30	16	21.05%
.30-06	10	13.16%
.44	9	11.84%
.45-70	8	10.53%
.45	7	9.21%
.25-35	3	3.95%
.30-40 KRAG	3	3.95%
.45 ACP	3	3.95%
.250-3000	2	2.63%
.38 L	2	2.63%
.22	1	1.32%
.35	1	1.32%
.243	1	1.32%
10 GA	1	1.32%
12 GA	1	1.32%
16 GA	1	1.32%
20 GA	1	1.32%
.303 SAV	1	1.32%
.38 SPL	1	1.32%
.40-82	1	1.32%
.41 LC	1	1.32%
.45-60	1	1.32%
5.56 x 45 mm	1	1.32%
Total	76	100.00%

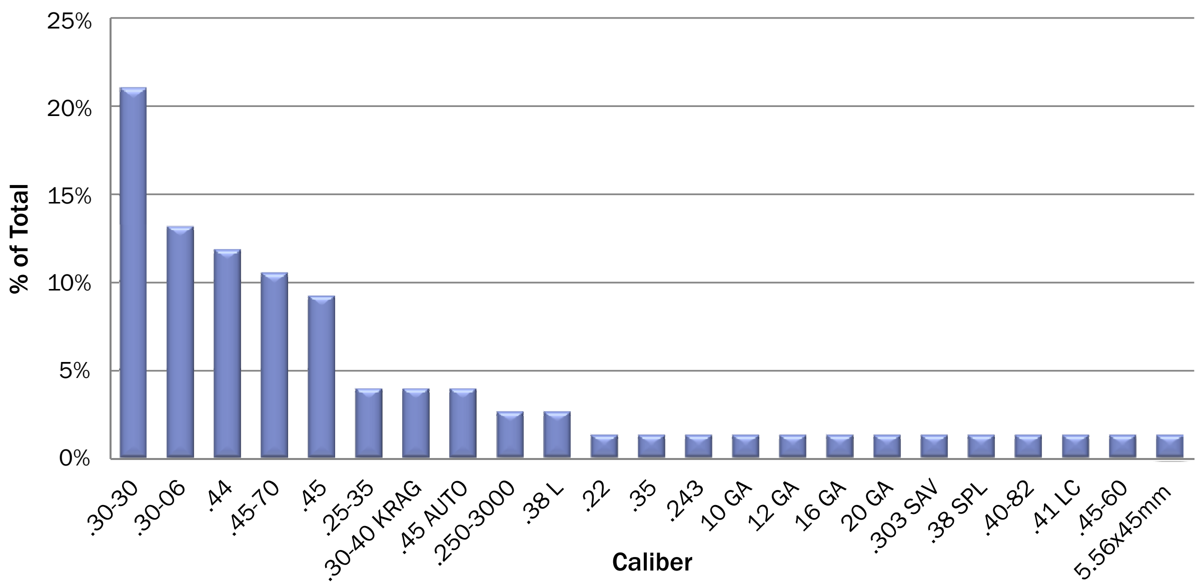


Figure 6-IV.22 Cartridge casings documented as historic isolates by caliber, represented as percent of total.

dard military issue in 1892 until it was replaced by the Model 1903 Springfield .30-06. The remaining calibers are all primarily civilian except the .45 ACP (standard military issue from 1911 to 1985), the .38 Long Colt (standard military issue from 1892 to 1911), and the 5.56 x 45 mm (standard service ammunition for the M16 rifle during the Vietnam War).

Lithic Scatters

A lithic scatter (LS) is defined as an area containing a small and discrete concentration of debitage within a defined area, usually with no formal tools (Figure 6–IV.23). This category was intended for scatters that were spatially discrete, often indicating a single reduction episode. Ideally, there were fewer than 20 pieces of debitage within a 20 m diameter area although this was often not the case. In fact, 53 percent of all lithic scatters recorded during the survey contained more than 20 pieces of debitage and 22 percent of scatters were larger than 20 m so the guidelines for this class of archeological finding were not strictly adhered to. However, in cases where lithic scatters far exceeded the defined parameters, or a number of formal tools were present, they were often recorded as sites. Documentation typically included the dimension of the scatter, number of pieces of debitage, the material types, the flake types (reduction stage), and associated artifacts along with the location. The complete data table on lithic scatters documented during the project can be found in Appendix 3.

A total of 237 lithic scatters were recorded during the project. As shown in Table 6-IV.16, nearly 45 percent of these lithic scatters occurred in a 5 m diameter area or less with the remaining 55 percent occurring over a larger area. However, less than 4 percent of recorded LSs occurred in an area larger than 50 m in diameter. In about 7 percent of cases, scatter dimensions were not noted.

Table 6-IV.16 Lithic Scatters by Size of Scatter (in meters).

Diameter of Area	# LS's	% of Total
0-5	106	44.73%
6-10	24	10.13%
11-15	19	8.02%
16-20	20	8.44%
21-30	24	10.13%
31-40	11	4.64%
41-50	7	2.95%
>50	9	3.80%
ND	17	7.17%
Total	237	100.00%

Figure 6-IV.23 Lithic scatter consisting of several flakes and chunks of brown agate. Photo by B. Dailey.

Table 6-IV.17 indicates the number of lithic scatters, arranged by debitage count. The majority of scatters (over 50 percent) are shown to contain between 6 and 30 pieces of debitage. Nearly 38 percent of all scatters contained more than 31 pieces of debitage. The greatest number within a single size grade was 55 scatters (or 23 percent of the total) that contained between 11 and 20 pieces of debitage. Very few scatters, less than 6 percent of the total, contained less than 5 pieces of debitage. In about 6 percent of cases, the debitage count was not noted.

In Table 6-IV.18, lithic scatters are tallied by material type. Because some LSs contained more than one material type, the total count of material types exceeds the number of scatters recorded (n=237). The most common lithic type documented was hornfels, representing nearly half of the total. This is followed by chert at 20 percent and agate at 16 percent. Together these 3 types comprised over 84 percent of all lithic types documented. Silicified wood comprised another 8 percent and chalcedony another 4 percent.

Table 6-IV.17 Lithic Scatters by Debitage Count.

# of Pieces	# LS's	% of Total
1-5	13	5.49%
6-10	29	12.24%
11-20	55	23.21%
21-30	37	15.61%
31-40	21	8.86%
41-50	16	6.75%
>50	52	21.94%
ND	14	5.91%
Total	237	100.00%

Table 6-IV.18 Lithic Scatters by Material Type.

Material	# LSs	% of Total
Agate	51	15.94%
Chert	64	20.00%
Chalcedony	12	3.75%
Hornfels	156	48.75%
Mudstone	5	1.56%
Novaculite	1	0.31%
Quartzite	3	0.94%
Rhyolite	2	0.63%
Silicified Wood	26	8.13%
Total	320	100.00%

Mudstone, quartzite, novaculite, and rhyolite were the least commonly encountered material types, together representing less than 4 percent of all material types documented. However, the abundance of one material type over another was largely conditioned by the area surveyed. Several, like Block E, contained or were located near lithic quarries (hornfels) so that the material type reflected that proximity.

As shown in Table 6-IV.19, a total of 186 lithic scatters contained other artifact types. As might be expected, aside from debitage, cores were the most common associated artifact, noted in more than half of documented scatters. Surprisingly, however, hammerstones were noted in less than 4 percent of scatters. The most abundant tools found were bifaces, represented at more than 11 percent of all lithic scatters. These typically consisted of crude, thick, bifacially worked debitage that had been discarded during reduction (in many cases, this appeared to be the result of the biface being too thick to be further reduced). Another 5 percent of scatters contained scrapers and 3 percent contained spokeshaves. Perhaps more by coincidence than association, another 3 percent of LSs contained a projectile point. (Because lithic scatters represent early stage lithic reduction, to find finished points within them is not expected.) The only other tool forms encountered, manos, metates, and anvils, occurred less than 1 percent each.

Table 6-IV.19 Lithic Scatters by Associated Artifact Type.*

Other Artifacts	# LSs	% of Total
Anvils	2	0.84%
Bifaces	27	11.39%
Cores	122	51.48%
Hammerstones	8	3.38%
Manos	2	0.84%
Metates	1	0.42%
Projectile Points	6	2.53%
Scrapers	12	5.06%
Spokeshaves	6	2.53%
Total	186	78.48%

*Note that the percent of total references the total number of scatters recorded (n=237), rather than just those scatters containing other tools.

Historic Scatters

A historic scatter (HS) is a concentration of historic artifacts (typically less than 10) outside of a site, usually within a 20 m diameter or smaller area (Figure 6-IV.24). This category was developed to address small concentrations of historic artifacts in areas lacking features or other cultural materials. Because these are common in the park, this category proved a useful way of capturing this data without conducting a full site recording. Documentation included the scatter dimension, number and type of materials present, and associated sites or features along with the scatter's location. The complete table of historic scatters documented during the project can be found in Appendix 4.

A total of 32 historic scatters were documented during the project. Table 6-IV.20 shows the spatial extent of historic scatters by count and percent of total. The majority of scatters, representing 28 percent of the total, were contained within an area between 6 and 10 m in diameter. The overwhelming majority, nearly 80 percent of all historic scatters, were within a 20-m diameter or less area. About 12 percent occurred in an area greater than 25 m in diameter and 9 percent of historic scatters lacked this data.

Figure 6-IV.24 Historic scatter consisting of woodstove fragments, a threaded bolt, wire, and riveted metal. Photo by D. Keller.

The number of items contained within historic scatters is shown in Table 6-IV.21. When broken out by count, the highest number of scatters in any one category fall within the first, 0 to 5 items. A full 72 percent of the scatters contained less than 10 items and all but 3 percent of HSs contained 25 items or less.

Table 6-IV.20 Historic Scatters by Size of Scatter (in meters).

Diameter Area	# HSs	% of Total
0–5	8	25.00%
6–10	9	28.13%
11–15	5	15.63%
16–20	3	9.38%
21–25	0	0.00%
>25	4	12.50%
Unknown	3	9.38%
Total	32	100.00%

When examined by scatter content, as shown in Table 6-IV.22 and graphically in Figure 6-IV.25, tin cans again dominate the assemblage, appearing in 47 percent of all historic scatters. Glass came in second, represented in 22 percent of scatters. Cartridge casings and ceramics were equally represented at 19 percent of scatters. This was followed by wire, metal objects, tobacco tins, milled lumber, horseshoes, car parts, fencing materials, nails,

Table 6-IV.21 Historic Scatters by Number of Items.

# Items	# Hss	% of Total
0–5	13	40.63%
6–10	10	31.25%
11–15	4	12.50%
16–20	1	3.13%
21–25	3	9.38%
>25	1	3.13%
Total	32	100.00%

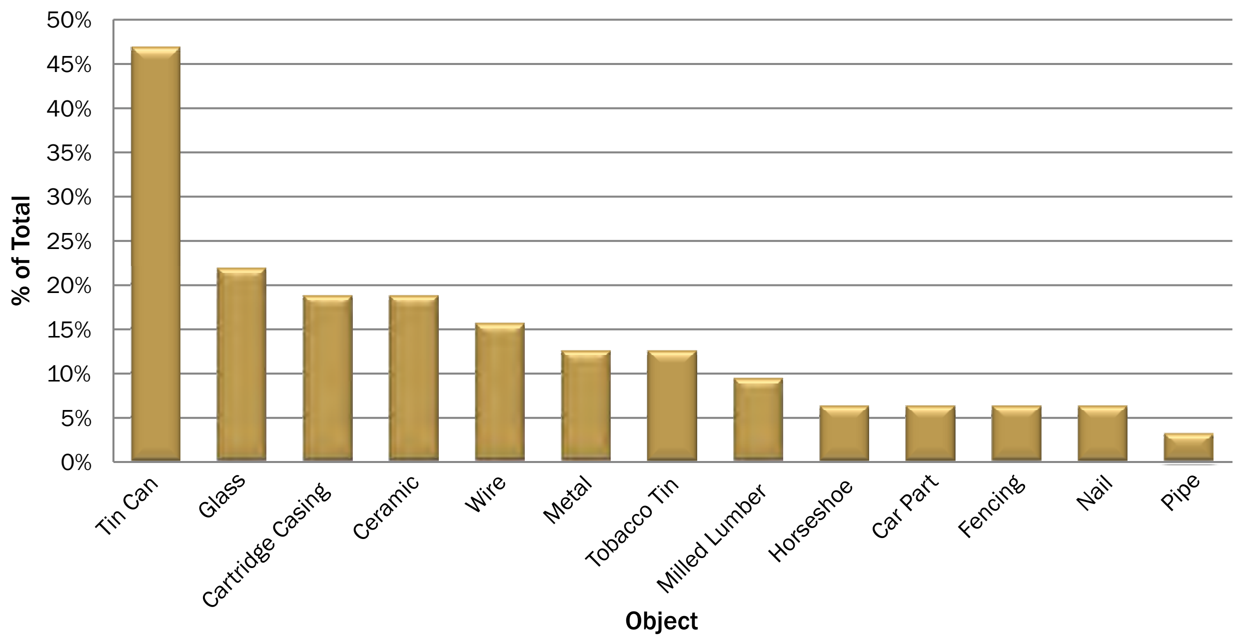


Figure 6-IV.25 Historic scatter contents, arranged in order of frequency.

Table 6-IV.22 Historic Scatters by Content.*

Object	# HSs	% of Total
Tin Can	15	46.88%
Glass	7	21.88%
Cartridge Casing	6	18.75%
Ceramic	6	18.75%
Wire	5	15.63%
Metal	4	12.50%
Tobacco Tin	4	12.50%
Milled Lumber	3	9.38%
Horseshoe	2	6.25%
Car Part	2	6.25%
Fencing	2	6.25%
Nail	2	6.25%
Pipe	1	3.13%
Total	**59**	**184.38%**

*Because most HSs contained items from more than one category, the totals exceed the number of HSs recorded. Note that % of total refers to the total number of HSs

and pipe. Additional items that occurred singly include stove pipe, stripper clips, brick and concrete fragments, a maintainer blade, woodstove fragments and a threaded metal cap.

Summary and Conclusions

This section discussed the features and artifacts that were documented outside of sites during the project. These "isolated finds" constitute material culture that is typically isolated from additional contextual information. The features included under this heading were either those that typically occurred outside of sites (such as rock groupings and cairns) or that lacked adequate context to be able to assign temporal or functional affiliation that would allow it to be recorded as a site. Four isolated feature categories were discussed: cairns, rock groupings, other rock features, and miscellaneous.

A total of 257 isolated cairns were documented during the project. Their distribution was well patterned, with over half of all isolated cairn density found in only two landform types: scarps and uplands, accounting for 34 percent, and sandstone scarps, accounting for 18 percent. Based on collected metric data, an "average" cairn documented during the project would be about

35 cm in diameter, about 28 cm in height, and would be composed of 6 to 10 rocks that measure between 26 and 40 cm in maximum diameter.

Rock groupings, a category representing a specific isolated feature type, were also documented during the project. A total of 2,612 were recorded, revealing spatial patterning that was nearly as strong as that of cairns, with the greatest density found on pediments, followed by sandstone scarps and fan remnants which, together, account for nearly 60 percent of all rock grouping density.

Within the "other rock features" category were three feature types: rock clusters, rock alignments, and select pebble concentrations. A total of 1,074 rock clusters were documented during the project, which—based on their broad definition—embrace a wide range of morphological variability and are found in wider range of landform types than rock groupings. The 74 rock alignments documented, however, were far more patterned than clusters, occurring primarily in three landform types: pediments, fan remnants, and igneous hills and mountains that, together, account for over half of all rock alignment density. In addition, six select pebble concentrations were documented, one on a historic site, and the remainder as isolates. This unusual feature type is presumed to be historic, and was found to occur only in a relatively confined area. In fact, all six occur within 2 km of the Rio Grande, and within 3 km of each other.

Finally, two miscellaneous features were documented that did not fit in any other category, both of which were originally recorded as isolated finds. These features consist of a cobble platform and a modern effigy. Although the temporal context of the cobble platform remains unknown, the modern effigy most likely represents activities of recent park visitors.

Artifacts documented as isolates were placed in one of three categories: isolated finds, lithic scatters, and historic scatters. A total of 861 isolated finds were documented, 31 percent of which were prehistoric and 69 percent of which were historic. The 268 prehistoric isolated finds consisted of 315 individual artifacts in 15 different categories. Eighty–two of these were collected, 61 of which were diagnostic projectiles. While only 39 of these projectiles could be identified to subperiod, by projecting the remaining 22 into their most likely category reveals a striking pattern, with a significantly higher number of Archaic (especially Late Archaic) projectiles relative to Late Prehistoric projectiles, findings that corroborate those from Chapter 7.

A total of 617 historic artifacts in 22 different categories were documented in the 593 historic isolated finds from the project. Most of these were tin cans, followed by horseshoes and cartridge casings, which together amount to over 60 percent of all historic isolated finds. Of the 79 cartridge casings documented, 76 could be identified to caliber. Most of these were .30-30 caliber, followed by .30-06, and .44 caliber. Together, these comprise nearly half of all calibers documented.

Lithic scatters, intended to address discrete lithic concentrations, were also documented during the project, 237 of which were recorded. More than half of these occur in a 10 m diameter area or less although a few were greater than 50 m in diameter. Most scatters contained between 6 and 30 pieces of debitage that were most often hornfels, followed by chert, and agate, which, together, comprise over 84 percent of documented scatters.

Finally, a total of 32 historic scatters were also recorded during the project, intended to address historic artifact concentrations that lacked features and did not otherwise qualify to be a site. Most of these scatters contained less than 10 items. As with historic isolates, the majority of artifacts were tin cans, which were found in nearly half of all historic scatters. This was followed in abundance by glass, cartridge casings, and ceramics.

As a category, isolates are able to convey information that sites cannot. One of these is as a proxy for mobility, especially with respect to prehistoric isolates. But isolates also capture phenomena, such as that represented by rock groupings and cairns, which may not be found within sites. In addition, isolates serve as a window into numerous single events through time that, taken together, can offer a more complete picture of past human behavior.

7

Analysis of Survey Results

This chapter presents the results of analyses of prehistoric sites and material culture documented during the project—primarily through examining temporal and spatial site data in an effort to illuminate relationships between them. This investigation of the project data are performed through a combination of basic descriptive statistics and exploratory data analysis that allows patterns and associations to be revealed and evaluated. The goal is to highlight variability in prehistoric human behavior over time and space in Big Bend National Park (BBNP) as well as to identify geomorphic or taphonomic processes that have shaped the archeological record.

The first section, **Site Data and Analytical Methods**, explains how project site data was organized and how the analyses were performed. The second section, **Challenges of the Data Set**, discusses the challenges and limitations of survey-level data, both in general terms as well as ones specific to the present survey project. The purpose is to qualify observations and to serve as a cautionary note in interpreting results from the analytical exercises.

The third section, **Temporal and Spatial Analysis**, examines a number of key characteristics of archeological *sites*, including temporal affiliation, site size, environmental distribution, and site richness. The range of variability within each category is addressed first (such as the range of site sizes or environmental distribution of sites), followed by an examination of potential associations between various site attributes. The analyses attempt to illustrate, for example, whether a relationship exists between time periods and site locations. Where relationships are evident, preliminary interpretations are offered as hypotheses.

The fourth section, **Analysis of Archeological Content**, examines three of the most common feature classes (hearths, middens, and stone enclosures) in light of their relative frequency, possible temporal affiliations, environmental contexts, and potential associations. This focus on variability within site content allows several overarching questions to be addressed such as:

- Were certain technologies confined to or favored during specific times during prehistory?
- Were certain technologies utilized more often in specific environments?
- In what ways are these features indicative of site function?
- How did technologies change over time?

Site Data and Analytical Methods

The following analyses were confined to sites recorded during the project, which comprise over half of the 2,878 sites documented in BBNP as of this writing. Project data was managed in two primary formats. Site content (i.e., the presence, type, and number of features and artifacts) was entered into a Microsoft Excel "Master Spreadsheet" directly from site forms. All spatial data was downloaded and managed in ArcGIS developed by the Environmental Systems Research Institute (ESRI).

Due to technological limitations, spatial data for project sites recorded before 2005 was limited to site centroids that were keyed to physical site datums. Site boundaries were later digitized from hand-drawn field maps. Following 2005, however, much greater resolution was afforded by recording spatial and morphological data of individual features and artifacts within sites through increased use of handheld Global Positioning System (GPS) units and data collectors (Thales Mobile Mappers). As a result, there are several instances where 2005–2010 data are used as a higher-resolution data subset.

Environmental stratification of the national park was achieved through a number of different Geographic Information Systems (GIS) layers on file at BBNP, including vegetation maps, geological maps, and—at the highest resolution—environmental zonation and soil maps. Temporal information was generated primarily through analyses of 1,236 projectile points collected during the project. In cases where points could be typed (see Chapter 6), the data was added to the project's master spreadsheet.

The combination of site attribute data, temporal data, and GIS data resulted in a relatively comprehensive *project data set*, maintained in both Microsoft Excel spreadsheets and various GIS layers. In many cases spreadsheets were joined to the spatial data and then exported. Queries of the data set were performed in Excel using filters and pivot tables as well as GIS intersects and selections based on locations and attributes. In this fashion, tables, charts, graphs, and maps were generated to illustrate relationships between environmental and cultural variables.

Challenges of the Data Set

Limitations of Survey-Level Data

Survey-level data (as opposed to excavation data) has both strengths and weaknesses. One of its greatest strengths is allowing data to be gathered relatively quickly from a large area, helping us to understand the range and spatial distribution of archeological materials that can be found in an area. Survey also tends to generate greater quantities of formal tools, including temporal diagnostics that indicate the time periods in which an area was occupied, and allows comparisons of styles, craftsmanship, and material types. This type of data allows archeologists to gain a broad overview of past cultures and their archeological expressions. From this we are able to generate testable hypotheses and contextualize future archeological studies.

Among survey data's greatest weaknesses are the near absence of vertical spatial integrity (stratigraphic context) and much lower confidence in horizontal spatial integrity. Information is gleaned from observations made primarily on the ground surface and only rarely (in cases where erosional cuts create exposures or by shovel testing) on materials buried beneath the surface. Likewise, the portion of the archeological record that has eroded or otherwise been removed is rarely evident. Also, because of imperfect human detection abilities and variable ground visibility, an archeological survey can never truly provide 100 percent coverage. Rugged terrain, dense vegetation, and weather extremes also have a significant impact on what is observed. Consequently, surveys can only truly *sample* a study area. Unlike excavations, they are limited in their ability to capture fine-grained aspects of material culture.

Another problem with survey-level data, especially in erosional environments such as the Big Bend, is what is known as the **palimpsest effect** (the combined material assemblages of multiple occupations that result from erosion or the absence of deposition; Foley 1981). Although some sites recorded during the project appeared to represent only a single time period (in cases where temporal diagnostics from only one broad time period were documented), far more frequently the temporal range of diagnostics within sites represents palimpsests.

Palimpsests, while problematic, also have value because they indicate settings with high redundancy of use—locations that, for whatever reason, drew people repeatedly over time. Palimpsest sites become informative when we examine their distributions and ask what environmental conditions are most conducive to redundant use rather than single occupations. However, parsing out separate components or occupations within a site can be a major challenge. Rarely can one be 100 percent confident that any one artifact is behaviorally associated with another artifact or feature, despite their physical proximity.

Herein reside two terminological distinctions: *behavioral association* implies that artifacts or features were utilized during the same occupation, or that they were utilized by the same cultural group; *spatial association,* on the other hand, indicates that archeological materials are located either close to one another or are simply part of the same site; they *may* or *may not* be behaviorally related. In this latter instance, behavioral association can rarely be confirmed; the material could be from temporally disparate events and different cultural/technological traditions.

Prehistoric behavior itself can significantly confuse a site's interpretation. For example, artifact curation (collecting and retaining an artifact, or moving it from its primary context) occurred prehistorically just as it does today. If a Paleoindian or Early Archaic dart point is found on a predominantly Late Prehistoric site, it is often impossible to know whether it is still in its primary context. Similarly, personal preference may have influenced tool manufacturing styles and feature construction nearly as much as temporally driven technological conventions, which could confuse interpretations. Thus, prehistoric people sometimes served to obscure the archeological record as much as illuminate it.

Because of the nature of surficial documentation, it is also often difficult to discern whether patterns and distributions of cultural materials are the result of past human behavior or natural taphonomic processes such as erosion and differential preservation. This is a key problem, with regard to both resource management as well as anthropological interpretation.

Finally, another challenge of survey data involves the seemingly inescapable element of **subjectivity** of the archeological observer—how "calls are made in the field." Even with definitions and protocols clearly spelled out at the beginning of each season (as was the case with this project), different archeologists inevitably perceive the archeological record in slightly different ways, whether it is making a judgment about what kinds of taphonomic processes are at work at a site, or whether burned rock on the surface constitutes a *concentration* or a *scatter*. This challenge is magnified as a project progresses over time, and especially when personnel changes occur. In the present analysis, this problem was minimized by selectively utilizing subsets of data representing periods of time when project personnel had consistent leadership and guidance in the field.

Limitations of the Project Data

Perhaps the greatest challenge specific to the present project resulted from the scale of the undertaking. In addition to the sheer size of the project in terms of its spatial coverage, persistent logistical challenges and a temporary funding hiatus caused the fieldwork to span more than 12 years. As discussed in Chapter 5 (Project Design), over the course of the project, changes were made to the project goals, methodology, personnel, and the technology employed. Some of these changes created challenges in comparing data between the two major "phases" of the project, primarily because of differences in the way data was recorded (such as greater reliance on GPS units). Despite this, reasonable consistency was maintained throughout the project, mainly because key leadership positions remained fairly constant (Robert J. Mallouf, William A. Cloud, Thomas C. Alex, and David W. Keller).

Another problem inherent in the project data are the fact that many (if not most) of the archeological sites within the park have been significantly altered, in some cases losing precious temporal or functional data. Because the Big Bend is a mostly erosional environment, sites are typically located on the ground surface rather than being buried. As a result of this, sites are left at risk to both natural and human-caused impacts. Erosion and animal traffic tend to disarticulate features and move materials out of primary context although, except in extreme cases, these impacts do not typically result in the complete loss of artifacts.

Alternatively, the high visibility of archeological sites has made them prime targets for casual collecting over the past century. In fact, "artifact hunting" was a regional pastime for many early residents of the Big Bend, and continues even today in the form of unauthorized collecting by park visitors. It is especially problematic that projectile points are the most commonly targeted item, which also happen to be among the most temporally significant artifact types found on sites. When such collection occurs on large multiple component sites, there is often enough artifact redundancy that some temporal or functional data remains. With simple, single-component sites, however, the loss of a single projectile may completely remove the site's temporal affiliation, significantly reducing the site's research potential.

Because of these shortcomings—both those inherent in survey-level data as well as those specific to this project—this investigation is limited in the types of analyses that can be performed and the veracity of results. Nevertheless, there are instances where the nature of site content raises the level of confidence that the material may represent or be dominated by one time period, primarily when temporally diagnostic artifacts come from only a single time period, or where archeological materials are fairly sparse (perhaps suggesting a single event). In these cases, we stand to learn a great deal.

The hope is that the sheer size of the project data set will allow true prehistoric trends to emerge through the noise of imperfect data; that, although muted, patterns of past behavior may still shine through. Indeed, the vast amount of information generated over the course of the 12-year project is unprecedented—providing the most robust baseline data regarding prehistoric human behavior in the history of BBNP, if not the region. Although the many correlations between temporal and spatial data explored below are preliminary, they lay the groundwork for future investigations and more refined research strategies.

Temporal and Spatial Analysis

In this section, the temporal and spatial distribution of prehistoric sites is examined in an effort to discern patterns and seek correlations between them. The key elements examined here consist of the project sites' temporal affiliations, size, environmental contexts, and richness.

Temporal Distribution

As introduced in Chapter 6, prehistoric temporal data were derived primarily from projectile points collected during the course of the project (in addition to limited C14 analyses), most of which are indicative of specific archeological time periods. Taken as a whole, they crosscut the different survey blocks, environmental zones, and categories of archeological sites (i.e., sizes, types, and content). As such, they provide the most substantial—and robust—data subset produced during the project. When arrayed against other archeological data, temporal data can illuminate changing population densities, temporal shifts in land use and subsistence patterns, and shifts in the use of specific feature and artifact types.

A total of 1,236 projectile points and point fragments from 284 sites and 65 isolated finds (a total of 349 localities) were collected during the survey. Of those, 1,014 could be confidently typed, placing them into chronological categories. Of the remaining 222 untyped projectiles, 116 retain some stem morphology, 1 is a preform, and the remaining 105 are fragments. Table 7.1 shows the breakdown of the 1,014 projectiles that could be typed. Note that since sites representing multiple time periods are included in the "total number of sites," this total reflects a greater number of sites with projectiles than actually occur (since some sites are counted more than once).

Temporal data can be presented in a number of different ways, four of which are offered here (Table 7.1). The most basic simply presents the total number of *projectiles* recovered from each time period, a figure that is independent of space. A second method indicates the number of *sites* with projectiles from each time period. A third method combines these two figures to show the number of *projectiles per site* from each time period. A fourth method takes time into account and presents the number of projectiles recovered per time period divided by the length of that time period, known as the projectile "*deposition rate*" (Figure 6, Rhode 1990). Since this method takes time into account, it is a more accurate indicator of prehistoric population density.[1] Each measure of temporal data are displayed graphically in Figures 7.1 through 7.4. As with the table, these four charts exclude the 222 "unspecified Archaic" specimens.

Figure 7.1 Number of diagnostic projectile points recovered during the project, by time period with trendline.shows the relative abundance of all temporally diagnostic projectiles recovered during the project. Note that a linear trendline is included in this and subsequent graphs in order to indicate the general trend, or tendency, of the data over time. In so doing, it also highlights which of the data deviates from this general trend, and to what degree. The chart indicates that the number of points increases significantly with each successive time period, but increases most sharply between the Early Archaic and Middle Archaic (from 7 percent of total to 22 percent of the total number of projectiles—a jump of 15 percentage points). Following the Middle Archaic, the number of points continues to increase, but at a slower rate—by an additional 9 percent in the Late Archaic and an additional 6 percent in the Late Prehistoric. As a proxy measure of prehistoric population, then, the raw projectile point distribution indicates that population levels increased

Table 7.1 Projectile Points per Site by Time Period.

Time Period	Period Length	# of Projectiles	% of Project Total	# of Sites With Projectiles	% of Project Total	# of Projectiles Per Site	Projectile Deposition Rate Per Year
Pa	5,000	20	1.97%	13	3.21%	1.54	0.0040
EA	4,000	73	7.20%	40	9.88%	1.83	0.0183
MA	1,500	225	22.19%	89	21.98%	2.53	0.1500
LA	1,700	320	31.56%	145	35.80%	2.21	0.1882
LP	850	376	37.08%	118	29.14%	3.19	0.4424
Total	13,050	1,014	100.00%	405	100.00%	2.50	0.0777

Note: This excludes the 222 Archaic specimens that could not be definitively placed within the Archaic subperiods.
Pa=Paleoindian, EA=Early Archaic, MA=Middle Archaic, LA=Late Archaic, and LP=Late Prehistoric.

1. It is important to note that projectile deposition rate could also be influenced by factors other than population density, such as an increase in hunting or cultural-behavioral factors that might have caused an increase in projectile point loss / deposition.

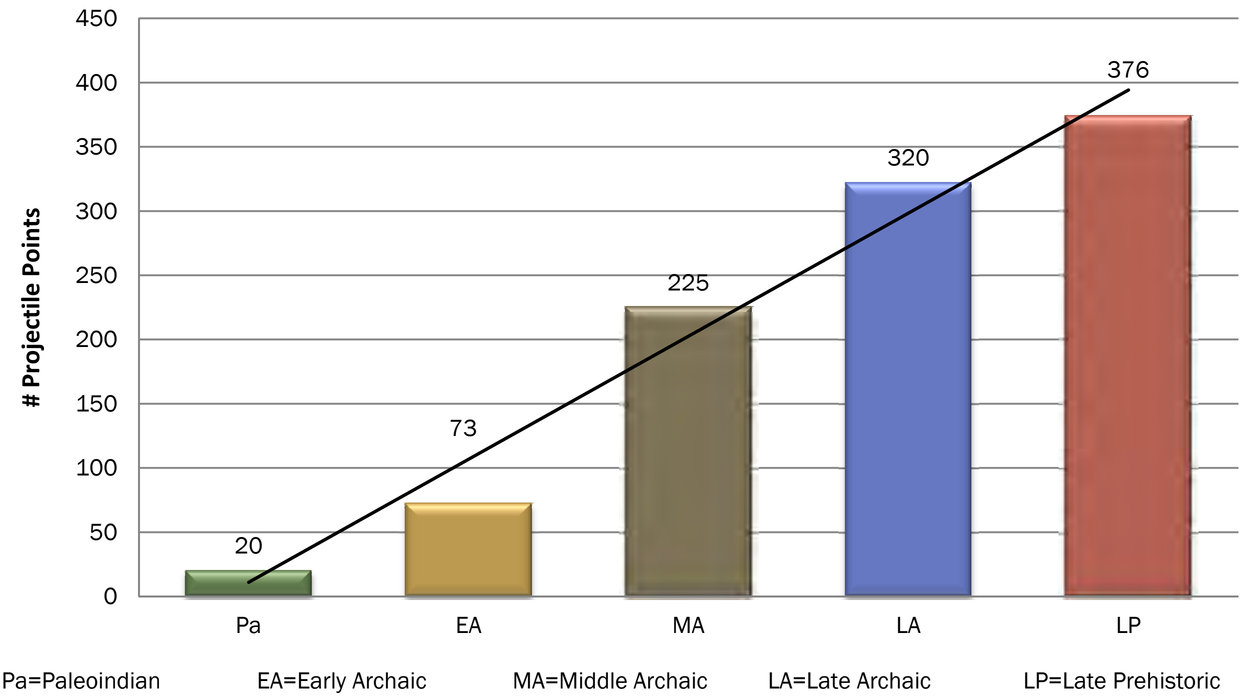


Figure 7.1 Number of diagnostic projectile points recovered during the project, by time period with trendline.

steadily throughout prehistory, with a particularly steep rise during the Middle Archaic.

Figure 7.2 shows the number of *sites* recorded during the project that contained temporally diagnostic projectiles.[2] The resulting graph closely mirrors the projectile point frequency across all time periods except for a greater relative increase in sites during the Late Archaic and a significant *decline* during the Late Prehistoric. Again, there is a slight increase (6.67 percent) in the number of Early Archaic sites with projectiles compared to the Paleoindian period, and a much larger increase in both the Middle Archaic (12.10 percent) and Late Archaic (13.83 percent) followed by a decrease in the Late Prehistoric (-6.67 percent). Overall, these data indicate a general increase in the number of sites with projectiles through time, with the *rate of increase* greater between the Middle Archaic and Late Archaic than between any other time periods, and an unprecedented *decrease* in the number of sites with projectiles in the Late Prehistoric. With respect to projectile point data, then, this decline departs from other noted trends.

When both the number of projectiles and the number of sites with projectiles are considered, providing the number of points per site, the resulting graph shows that the general trend through time is a greater number of projectiles per site (Figure 7.3 Number of diagnostic projectile points per site, by time period with trendline.) The singular deviation from this trend occurred during the Late Archaic, at which time fewer projectiles were recovered per site relative to the Middle Archaic, causing the Late Archaic to fall notably below the trendline. Because of this, the greatest increase occurred between the Late Archaic and Late Prehistoric (8.68 percent). Had the Late Archaic remained consistent with the trend, the greatest increase

2. The number of sites where temporally diagnostic projectiles were recovered indicates sites where projectiles from a specific time period were recovered. Since many sites contained projectiles from more than one time period, these sites are counted more than once. Thus, the total number of sites containing projectiles from a specific time period (n=405) is greater than the total number of sites where temporally diagnostic projectiles from all time periods were recovered (n=284).

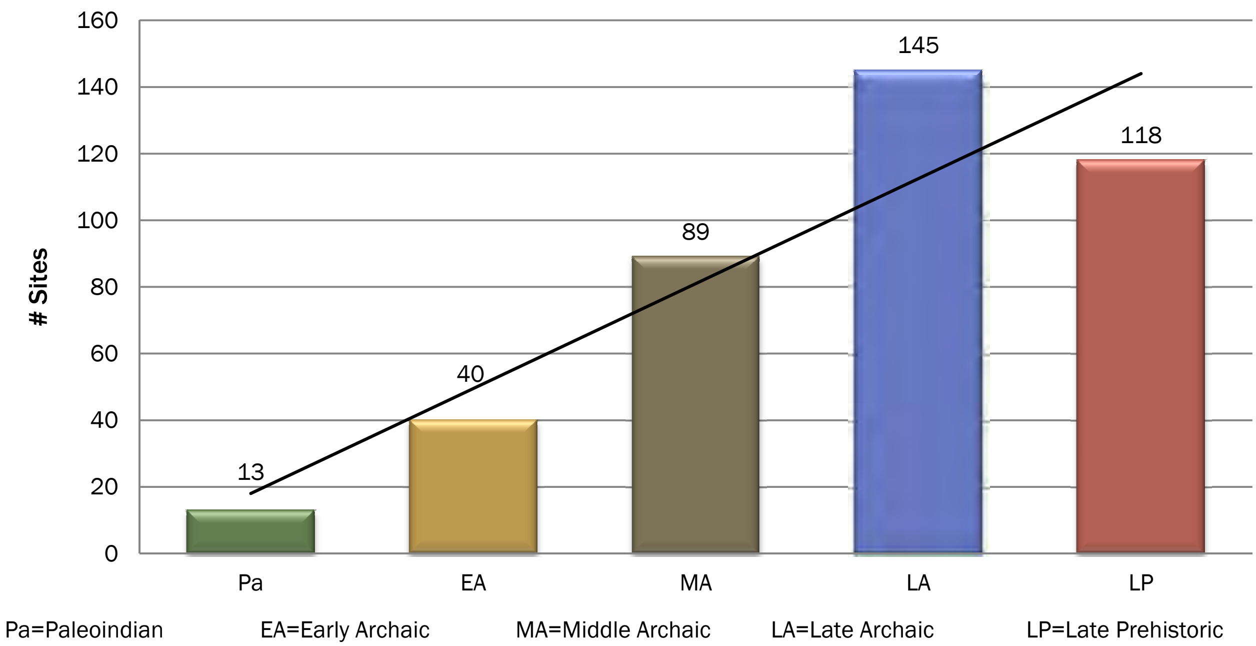


Figure 7.2 Number of sites where temporally diagnostic projectiles were recovered, by time period, with trendline.

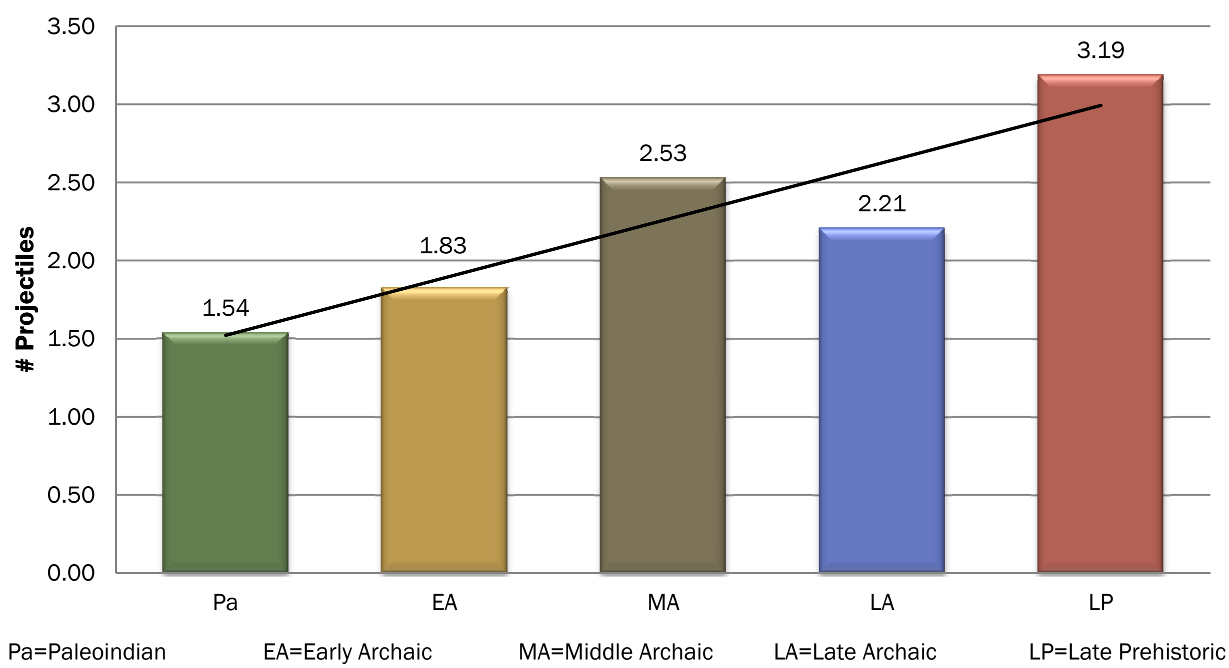


Figure 7.3 Number of diagnostic projectile points per site, by time period with trendline.

would have occurred between the Early Archaic and the Middle Archaic (6.23 percent). A higher number of projectiles per site could suggest a higher projectile deposition rate within sites and/or longer occupations, which, in turn, may also suggest an increasing reliance on hunting (in the case of the former) and/or decreasing mobility (in the case of the latter). The Late Archaic exception, then, suggests that during this period there was a lower projectile deposition rate within sites and/or shorter occupations (and possibly less reliance on hunting and/or greater mobility) relative to the general trend through time.

Figure 7.4 Projectile point deposition rates, or the theoretical number of points deposited per year by time period with trendline.shows the deposition rate of projectiles across the different time periods. Here the length of each time period is taken into account to arrive at the number of points lost or "deposited" per year. This is accomplished simply by dividing the number of points per time period by the length of that time period (number of years). Because the length of each time period differs substantially, the resulting graphs offer a more refined measure of population levels. Here, the graph shows the same general increase through time, but significantly accentuates the dramatic increase that occurred during the Middle Archaic (16.41 percent) and Late Prehistoric (31.65 percent) relative to the other time periods. The graph also shows the deposition rate during the Late Archaic falls below the general trendline, suggesting a break in the upward trajectory.

It is significant that the above graphs do not include the 222 dart points that could not be definitively typed. This is problematic because it necessarily skews the data towards the Late Prehistoric at the expense of the Archaic periods. All arrow points—including fragmentary ones—can be attributed to the Late Prehistoric since they were limited to that period. However, fragmentary or anomalous dart points cannot always be attributed to one of the Archaic subperiods. This is the case with the 222 dart points that could not be typed. Fortunately, 116 of these specimens retain some stem morphology, 105 of which could be tentatively placed into a time period. Despite the uncertainty, it is instructive to include them provisionally, if only to contrast with the trends noted above. Thus, Figure 7.5 Projectile point deposition rates with 105 of the unspecified projectiles placed in their probable Archaic time periods with

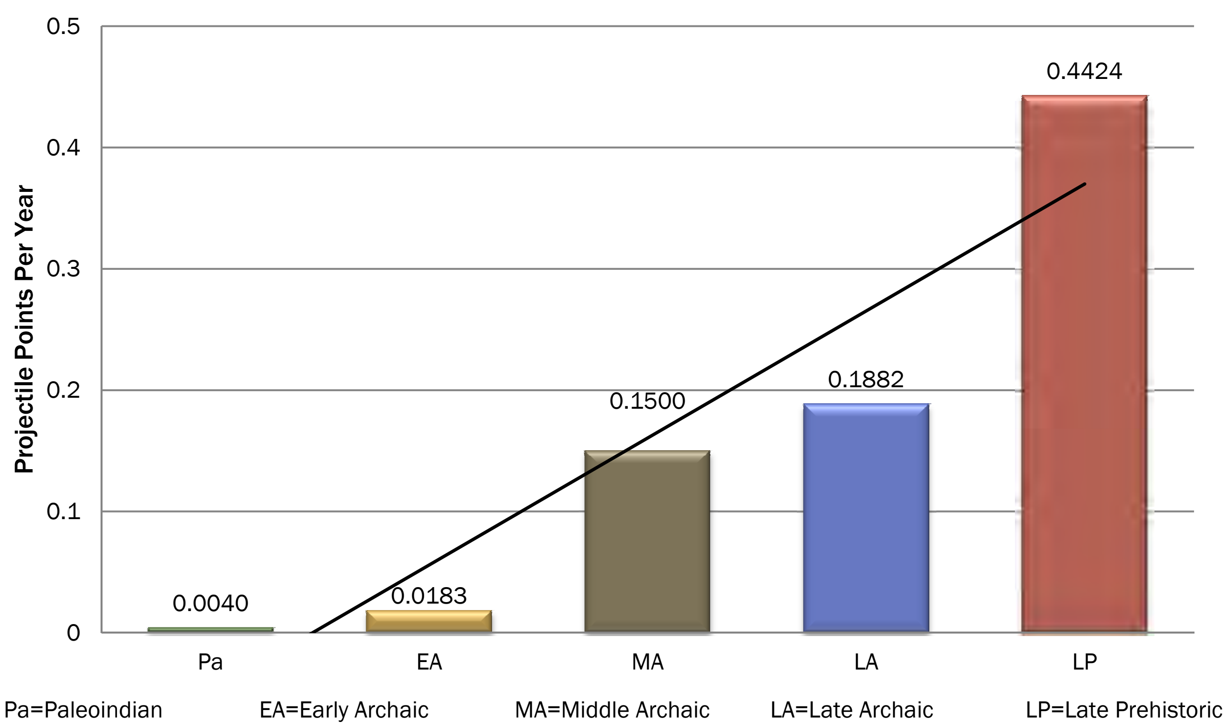


Figure 7.4 Projectile point deposition rates, or the theoretical number of points deposited per year by time period with trendline.

trendline. shows the same projectile point deposition rate, but includes the 105 projectile points placed in their most probable time period (adds 9 points to the Early Archaic, 2 points to the Middle Archaic, and 94 points to the Late Archaic). In so doing, the deposition rate of the Archaic periods, especially the Late Archaic, increases more in keeping with the general trend (as indicated by the trendline) through time, suggesting this to be a more accurate representation.

However, Figure 7.5 still leaves out the 117 dart point fragments that remained after the 105 were tentatively typed which still skews the data by reducing the number of dart points relative to arrow points. However, these fragments can also be provisionally (and imperfectly) included by "projecting" them into their most likely time periods. This was achieved by figuring the percent of total (ratios) of the 105 tentatively typed points for each Archaic time period and multiplying that ratio by the number of remaining untyped points (117). Thus, the 9 provisionally typed specimens for the Early Archaic amount to 8.57 percent of the total 105 specimens. Multiplying this by 117 (.0857 x 117) equals 10—the number of points out of the 117 we *might* expect to fall within the Early Archaic. This projection also places 2 additional points in the Middle Archaic and 105 additional points in the Late Archaic. The resulting graph is shown in Figure 7.6.

As shown by the revised graphs in Figures 7.5 and 7.6, the increase in deposition during the Middle Archaic relative to the Early Archaic remains significant. However, the rate in the Late Archaic in both latter examples rises substantially, bringing it in accord with the general trend through time (as indicated by the trendline). In Figure 7.6, the Late Archaic replaces the Late Prehistoric in having the greatest increase between time periods (from a 4.67 percent increase without the 222 unspecified to a 16.46 percent increase with them projected).

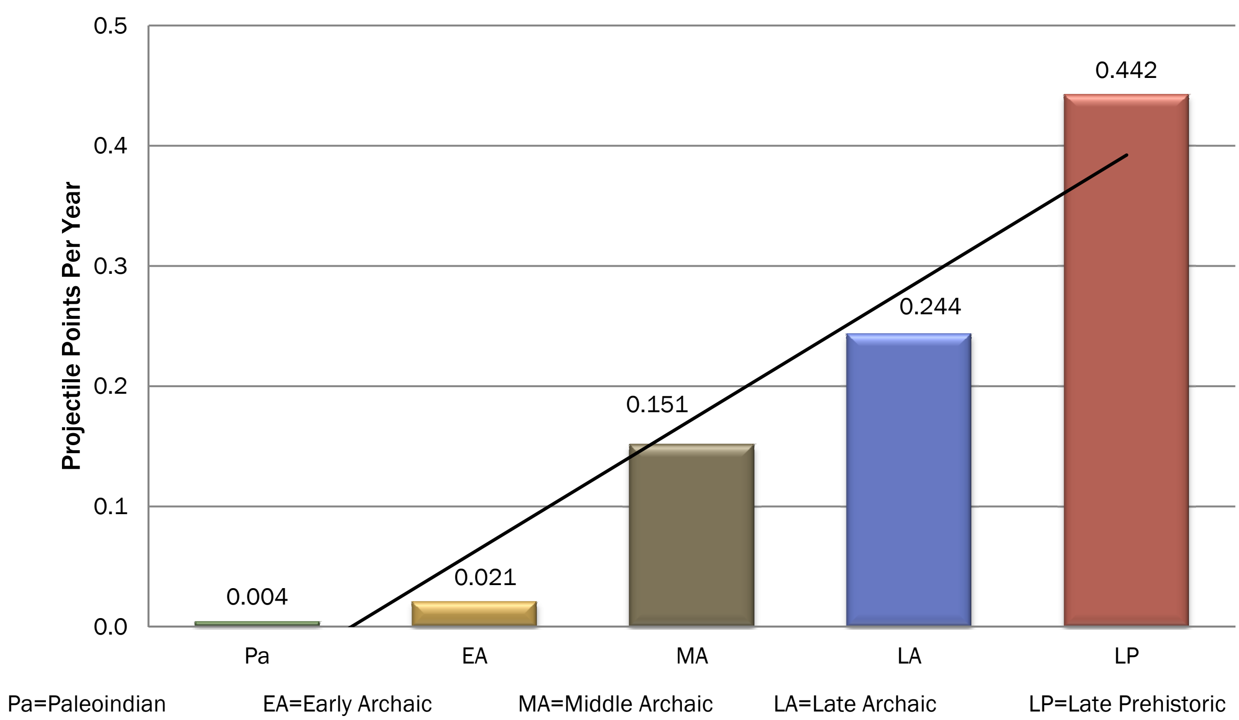


Figure 7.5 Projectile point deposition rates with 105 of the unspecified projectiles placed in their probable Archaic time periods with trendline.

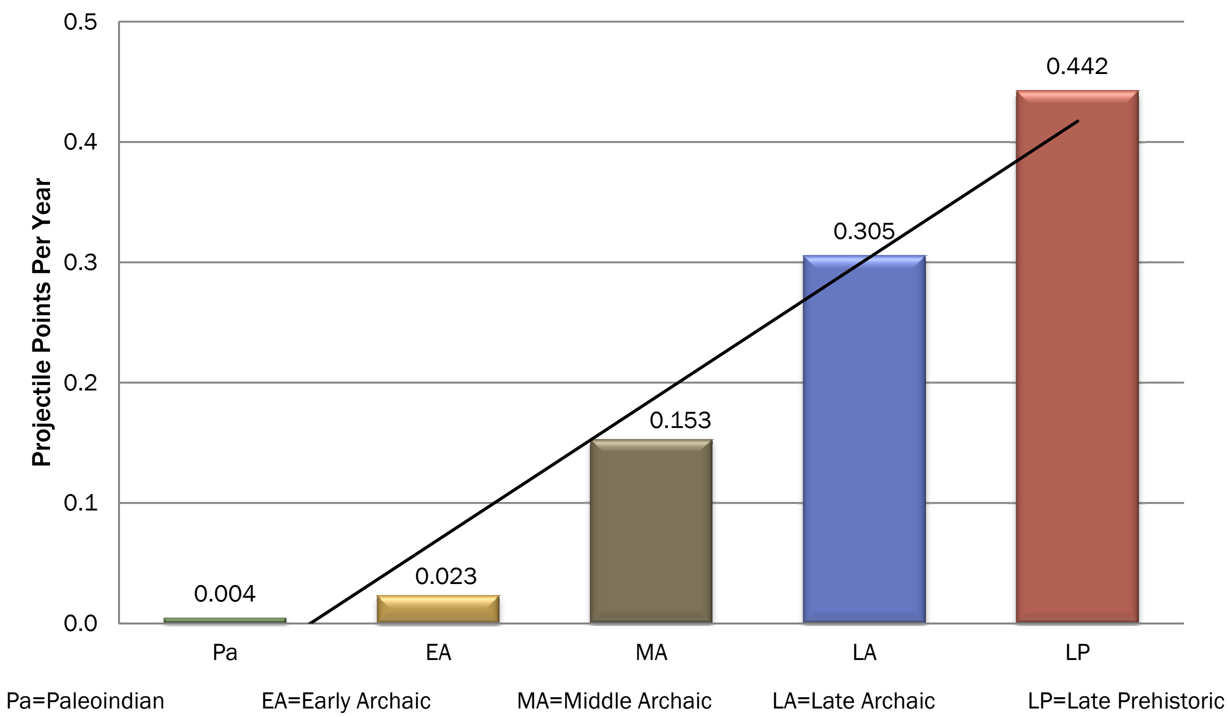


Figure 7.6 Projectile point deposition rates with 105 of the 222 unspecified projectiles provisionally typed and *the remaining 117 unspecified projectiles provisionally "projected" into their most likely time period with trendline.*

These revised figures dramatically change the total projectile point count for the Late Archaic (to 414 and 519 respective to the two revisions) as well as the number of sites with points during that period (to 163 and 222, respectively). Although the revisions are far-reaching, they do not materially change the Late Archaic trend with respect to the other periods with the exception that the Late Archaic replaces the Late Prehistoric in total number of projectiles. Otherwise, the Late Archaic remains the time period with the highest number of sites with projectiles and the lowest in number of points per site. Although the difference between the original breakdown and the projected breakdowns is stark, the latter are probably a better reflection of the true prehistoric record. However, because this is a projection, it remains little more than an educated guess. What is important to remember is that the original breakdown, omitting the 222 unspecified archaic, cannot be taken at face value and must always be qualified.

Although the use of temporal diagnostics is one of the better proxy measures for prehistoric population, it is not without its flaws. For example, the exercise assumes that the rate of projectile point deposition should be the same for each individual during each time period at each location. A great deal of potential variability (differential behavior, technological conservatism, availability of lithic resources, the role that hunting played in the diet, prehistoric artifact curation, as well as post-depositional processes, etc.) cannot be accounted for. However, we can expect that these factors would have had a greater or lesser influence on projectile deposition rates at any one point in time. Attempting to account for, or to measure, these variables is beyond the scope of the present report, but should be considered in future studies.

The projectile point temporal distribution is used in subsequent sections as a baseline for comparing temporal distributions within specific spatial parameters.

According to the null hypothesis, if conditions in prehistory were equal (such that environmental factors did not affect people's decisions and geomorphic and taphonomic processes worked the same in all the diverse setting across the park), then we should expect that the occurrence of diagnostic projectiles between sites, survey blocks, or environmental zones would mirror the project-wide distribution. As demonstrated below, this is not the case, which indicates that environmental, geomorphic, and taphonomic factors are significant in temporal distributions.

Site Size

Site size, measured in square meters, was introduced in Chapter 6, and a classification system was devised according to size ranges or grades for all sites recorded during the project (see Table 6-II.5). The current analysis was performed to examine variability in site size—how site size and the range of site sizes may have changed over time, and to determine whether variability in site size may be related to behavior, natural processes, or project sampling constraints.

As with several of the following analyses, a data subset was utilized in analyzing site size. In an effort to exclude multi-component sites, only sites with diagnostic artifacts representing a single archeological time period were selected. The data set was further refined by excluding an additional 19 sites based on a variety of confounding factors including site patterning that suggested palimpsest effects, other known components (such as historic), special use sites, and sites that were also lithic procurement areas that expanded the site boundaries far beyond the camp itself.

Although the remaining 124 sites still cannot be considered "single-component" sites in an absolute sense, they do appear to be the sites most limited in time depth. Table 7.2 presents these select sites by size grade. Of those sites selected for analysis, more than half are 5,000 m^2 or less, with the remaining sites exceeding 5,000 m^2 (including 16 percent between 5,000 and 10,000 m^2, 10 percent between 10,000 and 15,000 m^2, 6 percent between 15,000 and 20,000, and lower percentages in the higher size grades). The average size of all sites from the sample is 10,495 m^2 although the median is only 4,668 m^{2,} indicating the data are skewed significantly to the right (meaning the data are "bunched up" towards the left and thins out towards

Table 7.2 Size Grades of Sites Selected for Analysis.

Grade	Size Range M^2	# of Sites
1	0–100	1
2	101–1,000	18
3	1,001–5,000	45
4	5,001–20,000	40
5	20,001–100,000	20
6	100,001–2,000,000	0

Table 7.3 Number of Sites with Projectile Points from Only One Time Period.

Time Period	# of Sites	Range (M^2)	Mean (M^2)	Median (M^2)	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Paleoindian	4	10,881	5,361	3,619			2 (50%)	2 (50%)	
Early Archaic	4	4,497	2,411	2,488	1 (25%)	1 (25%)	2 (50%)		
Middle Archaic	19	73,608	14,850	8,170		3 (16%)	5 (26%)	5 (26%)	6 (32%)
Late Archaic	51	51,417	6,607	4,186		8 (16%)	21 (41%)	20 (39%)	2 (4%)
Late Prehistoric	46	63,569	14,156	6,046		6 (13%)	15 (33%)	13 (28%)	12 (26%)

Note: Site Area in Square Meters; see Table 6-II.5 in Chapter 6 defining size grades).

the right). In this case, this translates into a far greater number of small sites represented (less than 5,000 m^2) compared to large sites, which is a characteristic inherent in the data set of prehistoric sites in BBNP.

Table 7.3 presents site size by time period showing the number of sites, size range, mean and median site size, and size grade. The data shows that even *within* individual archeological time periods, site size is highly variable with the greatest range in the Late Prehistoric (63,569 m^2) and Middle Archaic (73,608 m^2) and the lowest in the Early Archaic (4,497 m^2) and Paleoindian periods (10,881 m^2). However, because larger sample sizes are more likely to reflect actual prehistoric behavior, the small sample sizes representing the Paleoindian and Early Archaic periods are consequently suspect and must be interpreted with caution.

Figure 7.7 graphically displays both measures of central tendency for site size *between* time periods which, unlike other analyses—such as those for the diagnostic projectiles—is remarkably non-linear. Instead, site size through time exhibits considerable diversity—with an average low of 2,411 m^2 in the Early Archaic to an average high of 14,850 m^2 in the Middle Archaic. The data indicates that in both the Paleoindian and Early Archaic periods sites were relatively small, notably so for the Early Archaic. Again, however, the sample size for both periods is quite small and is unlikely to accurately reflect true prehistoric patterning.

Beginning with the Middle Archaic, however, sample size increases significantly, suggesting more accurate results. The majority of Middle Archaic sites (58 percent) are shown to fall in the higher two size grades (larger than 5,000 m^2), with nearly 32 percent of sites larger than 20,000 m^2. Not only did this time period produce the largest site of those sampled, it also produced the highest percentage (32 percent) of large (grade 5) sites. Conversely, it has among the fewest (16 percent) of sites in the two smallest grades. The Middle Archaic also has the second greatest divergence between the mean and median (6,680 m^2), indicating a large range of site sizes within the sample.

The Late Archaic demonstrates a radical departure from that of the Middle Archaic, with the average site size a mere 6,607 m^2, less than half that of the time periods before and after. Broken out by size grade, the vast majority (80 percent) of Late Archaic sites fall

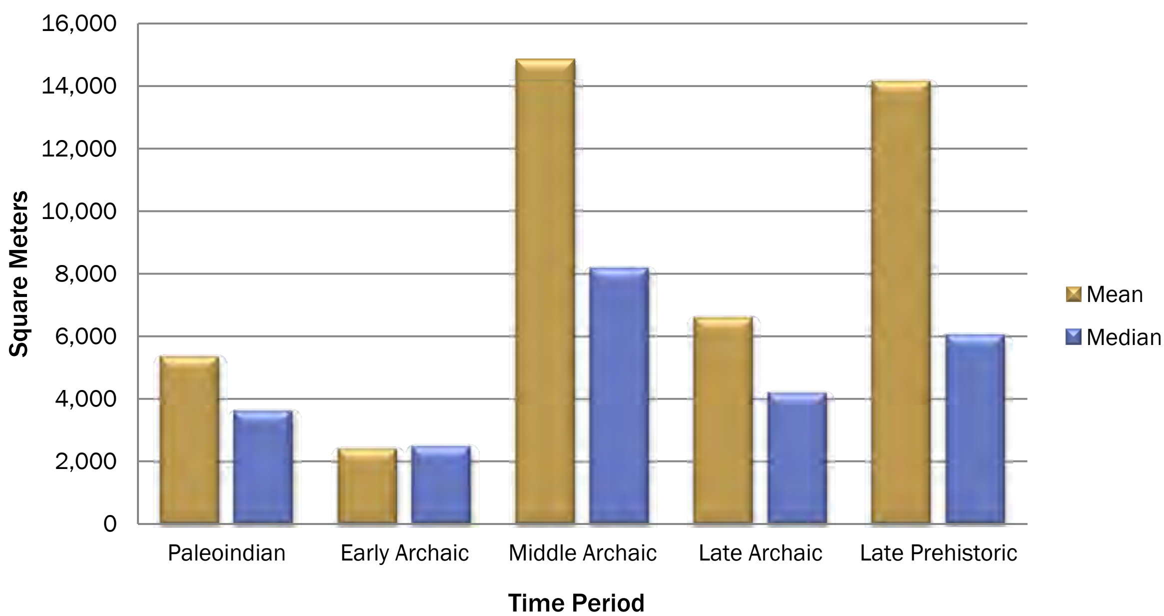


Figure 7.7 Mean and median site size by time period for select sites.

within grades 3 and 4, with only 4 percent of sites in grade 5. Significantly, of the three later time periods, the Late Archaic displays much greater homogeneity with respect to site size, with a full 96 percent of sites clustered around the three middle size grades. This is also reflected in the relatively small difference between mean and median site size (2,421 m^2), indicating a limited range of site sizes within the sample.

Sites dating to the Late Prehistoric period are shown to be significantly larger than those of the Late Archaic, but do not reach the size attained during the Middle Archaic. In examining size grades, however, the breakdown is quite similar to that of the Middle Archaic, with a high percentage (54 percent) of sites falling in the two highest size grades and very few (13 percent) sites in the two smallest grades. The largest difference in site size between the two periods is in the middle size grade (grade 3) where a higher percentage (33 percent) of Late Prehistoric sites fall. Of all time periods, the Late Prehistoric exhibits the greatest divergence between the median and mean values (8,110 m^2), indicating the highest variation in site size.

If the trend during prehistory was one of gradually increasing population density, as is suggested by the projectile point data, one might expect that site size would increase proportionately through time. However, the analysis results indicate this is not the case, suggesting that population level and group size are not necessarily correlated. By far the most anomalous finding of the present analysis is the dramatic spike in site size during the Middle Archaic. One hypothesis to explain this observation (which accords generally with the theorized Middle Archaic population spike), is that these groups were larger and more sedentary than earlier and later time periods. There is also evidence to suggest aggregations of people—probably seasonally—along the Rio Grande during the Middle Archaic. In fact, although the survey blocks along the Rio Grande comprised only 18 percent of the total surveyed area, 40 percent of all Middle Archaic projectiles were recovered along the river (twice the expected value). And of the 6 sites that contained more than 10 Middle Archaic projectiles, 4 of them were also along the Rio Grande.

Although most evidence indicates population levels were higher during the Late Archaic than previous periods, the present analysis suggests the operable *group size* may have declined. So while there may have been more people overall, the results indicate they may have been split into many smaller groups rather than fewer large ones. If smaller group size was selected for by limiting environmental factors, such as resource patchiness, we might expect that residential mobility would be high and subsistence more opportunistic. If that was the case, we might also expect sites to be smaller, more homogenous, and potentially less visible in the archeological record.

Site size is assumed here to relate most directly to group size. However, the substantial range of site sizes even within individual time periods may more accurately reflect site function (with group size as a corollary) such that some sites in the larger size grades may represent "base camps," and smaller sites may represent "field camps" and processing locales. Accordingly, time periods that exhibit a wider *range* of site sizes (such as the Middle Archaic and Late Prehistoric) may reflect differences between residential and logistical site patterning. If subsistence tasks became more specialized over time and were based out of seasonal base camps, then we might expect a greater difference between large sites (bases) and small sites (field camps/logistical locals), thus wider ranges in site sizes. Similarly, an abundance of logistical camps—or a decline in the use of base camps—during any one period would significantly reduce the range in site sizes.

There were likely complex reasons for fluctuations in group size or the size signature of sites between time periods. But in terms of ultimate (primary) causes, some of the more plausible include changes in the environment and/or changes in the availability of resources, an influx of new people from other regions, or an increase in intra regional or inter regional interaction. One or more of these could affect a change in group size and/or subsistence strategy, and we would expect those changes to be reflected in the archeological footprint.

In spite of the robust results, caution must be exercised due to the uncertainty in drawing a truly representative sample for any one time period. As mentioned above, survey-level data always leaves questions with regard to the number of components a site actually contains. And even the process of limiting the analysis to sites representing only one time period can skew the results in favor of certain types of sites. For example, logistical sites are probably over-represented in the data since they typically contain fewer projectiles. Base camps, on the other hand, are almost always multiple-component due to the fact that they tend to be sited in attractive locales and would have been used throughout time. Consequently, these types of sites are almost certainly under-represented in the present analysis.

Site Distribution

Although variables other than the environment affected the decisions of prehistoric peoples (such as territorial boundaries, culture, and personal choice), the importance of environment in influencing human behavior cannot be understated. In fact, this is probably one of the most significant contributions that the present project is able to make to regional archeological inquiry. Because of the expansiveness of the survey and the number of different environmental zones that were sampled, this project is in a unique position to illuminate the interplay between culture and environment through time. Ultimately, evaluating the relationship between environment and culture highlights other influences as well. This section examines site distribution and site density by physiographic and environmental zones for all prehistoric sites recorded during the project.[3]

By Mountain and Basin

The coarsest environmental stratification of the park is that of the mountain versus the lowland basin settings (Table 7.4). Of the 24,996 ha (61,766 acres [ac]) surveyed, 4,415 ha (10,910 ac) (18 percent) were in the mountain zone, and the remaining 20,581 ha (50,856 ac) surveyed area (82 percent) were in the basin zone. However, site density was not uniform between zones. Although 18 percent of the surveyed area was in the mountain zone, only 13 percent of the sites were located there. This corresponds roughly to 23 ha (57 ac) per site in the mountain zone versus 16 ha (40 ac) per site in the basin zone. While this may reflect the true archeological patterning, it is undoubtedly influenced at least in part by lower visibility in the mountain zone due to denser vegetation, leaf litter, and a depositional environment. By contrast, the basin zone is sparsely vegetated and is predominantly erosional, which allows for much better site visibility.

Despite its small sample size, the mountain data indicate that site density is also significantly different between the limestone and igneous mountains, the primary subdivision within this zone. The differences in patterning are likely related to the relatively abundant rockshelters in the limestone mountains due to the predominance of this more erodable bedrock. In fact, Block C—which was primarily in the limestone mountains—contained 42 percent of all rockshelter

Table 7.4 Site Density (Hectares per Site) by Mountain and Basin Zone.

Zone	# Sites	% of Total	Ha Surveyed	% of Total	Ha Per Site
Mountain	191	12.97 %	4,415	17.66 %	23.12
Basin	1,282	87.03 %	20,581	82.34 %	16.05
Total	1,473	100.00 %	24,996	100.00 %	16.97

3. It is important to note two adjustments made to the data sets used in the present section. First, 57 of the 1,473 total prehistoric sites are excluded because they occur in zones with less than 500 ha (1,236 ac) surveyed, considered here to be an insufficient sample size (the crosscut physiographic zone was excluded as well since it is comprised of two of these under-sampled environmental zones). Also, site area was adjusted downward significantly, by a total of 320 ha (791 ac), in removing three excessively large lithic procurement / quarry sites whose size would otherwise dramatically skew results.

sites although it represented only 8 percent of the surveyed area.

By Physiographic Zone

Physiographic zones (PZ) were developed during the analysis phase of the project, serving as an alternative to the gross mountain/basin breakdown, which did not seem to capture important aspects of variability in the study area, and to the Environmental Zone (EZ) breakdown which was, in many cases, too detailed. Physiographic zones were formulated from the aggregation of EZ categories, for which there are quantifiable data (attributed GIS shapefile polygons derived from detailed Natural Resources Conservation Service [NRCS] soil maps). This simplified schema consists of three major categories for the larger basin zone—upland, piedmont, and lowlands—which together represent a series of landforms ranging from high, steep, upland mountains to the long piedmont slope extending outward from the mountains to the lowland, eroded alluvial settings. Figure 7.8 below depicts where EZ categories fit within the scheme. Following a brief description of each of these three zones, the distribution of prehistoric sites between these zones is explored.

The **upland zone** (distinct from the higher elevation landforms, such as the Chisos Mountains) is generally steep with limited localized sedimentation. It includes

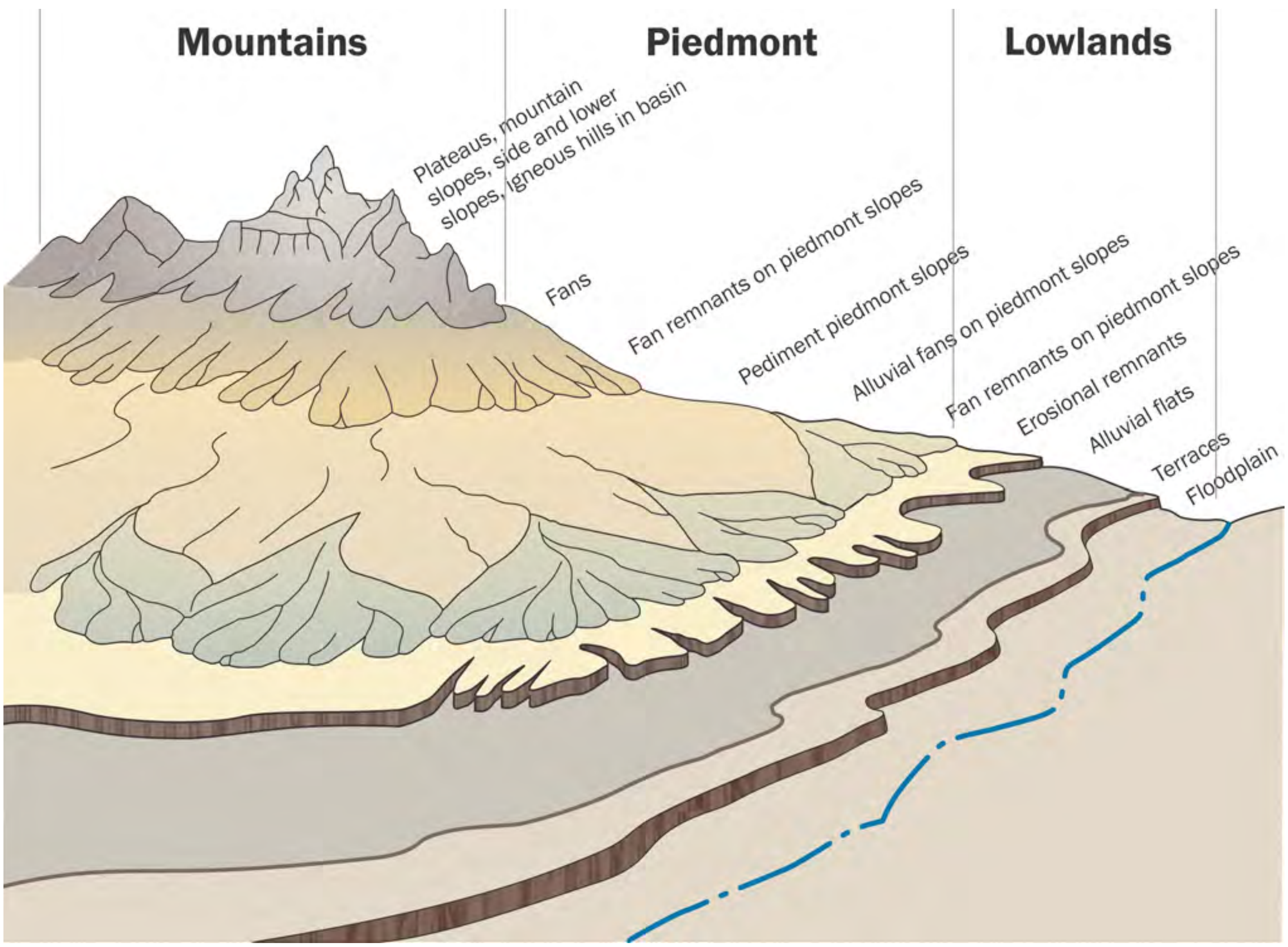


Figure 7.8 Physiographic zones showing constituent EZ elements. Illustration by L. Wetterauer from drawing by S. Cason.

both igneous and limestone geologic settings, and is comprised of a conglomeration of *plateaus*, *mountain slopes*, *side and lower slopes*, and *igneous hills in basin* from the EZ classification. This category also captures minor mountain landforms and major foothills (steep landforms not included in the piedmont zone). However, like the *mountain setting*, site density can be substantial in the uplands, though discovery is often complicated by steep terrain and difficult access.

The **piedmont zone** is dominated by alluvial fans and pediment surfaces that are outwash deposits from the higher upland settings. These surfaces—generally coarse and rocky sediments—are frequently irregular and punctuated by bedrock projections or foothills. The piedmont is a conglomeration of *fan remnants on piedmont slopes*, *piedmont slopes*, *alluvial fans on piedmont slopes*, and *fan remnants* from the EZ classification. It is noteworthy that *fan remnants* are situated mostly (but not exclusively) within the limestone setting of the Dead Horse Mountains along the park's eastern edge and Mariscal Mountain near its southern boundary. Alternatively, *fan remnants on piedmont slopes*, *piedmont slopes*, and *alluvial fans on piedmont* slopes are situated in settings dominated by igneous mountains, though they also overlap lesser, localized exposures of limestone as well.

The **lowland zone** typically consists of finer-grained sediments and abundant alluvial deposits, many of which have been highly eroded and incised by gullies and arroyos. This zone encompasses *erosional remnants*, *alluvial flats*, *erodable clay from mudstone*, and *terraces* from the EZ classification. The lowland zone is the stage for two major geomorphological processes: massive deposition and high-energy erosion. The two processes together create both opportune and challenging settings for archeologists because sites are being both buried by ongoing sedimentation as well as exposed by recent erosion—the latter accelerated by historic and modern human impacts to soil stability.

Two additional PZ classifications were also devised, that of **crosscut** and **insufficient**. Crosscut consists of *scarps* and *arroyos*, EZ categories that crosscut upland, piedmont, and lowland settings. Insufficient refers to EZ categories where the current project surveyed less than 500 hectares (1,236 ac). EZ categories that were insufficiently surveyed include *hillslopes, alluvial fans, limestone hills in basin, low hills from tuff, steep mid slopes, floodplains,* and *moist meadows*. Because of the imprecise nature of the crosscut category and the small sample sizes of the insufficient category, these classifications are excluded from analysis and reduce the total surveyed area to 23,062 ha (56,987 ac).

The distribution of prehistoric sites between the three physiographic zones is presented in Table 7.5 below, including hectares surveyed, number of prehistoric sites, site hectares, percentages of total, and two measures of site density.

The upland zone is shown to comprise roughly 20 percent of the surveyed area across the three physiographic zones, with piedmont about 47 percent, and lowland roughly 33 percent. Here and in subsequent sections, the percentage of total area surveyed in each zone serves as an **expected value** for the number of sites and site area in each zone (also expressed as percentages of total). This expected value is based on the

Table 7.5 Prehistoric Site Data by Physiographic Zone.

Phys. Zone	Hectares Surveyed	% of Total	Preh Sites	% of Total	Site Hectares	% of Total	Sites Per Ha	Site Ha Per Ha
Upland	4,591	19.91%	197	13.91%	65	4.82%	0.0429	0.0141
Piedmont	10,800	46.74%	726	51.27%	696	51.91%	0.0673	0.0646
Lowland	7,691	33.35%	493	34.82%	580	43.27%	0.0641	0.0755
Total	23,062	100.00%	1,416	100.00%	1,341	100.00%	0.0614	0.0582

Note: 57 prehistoric sites located in EZ categories that had insufficient coverage are excluded here.

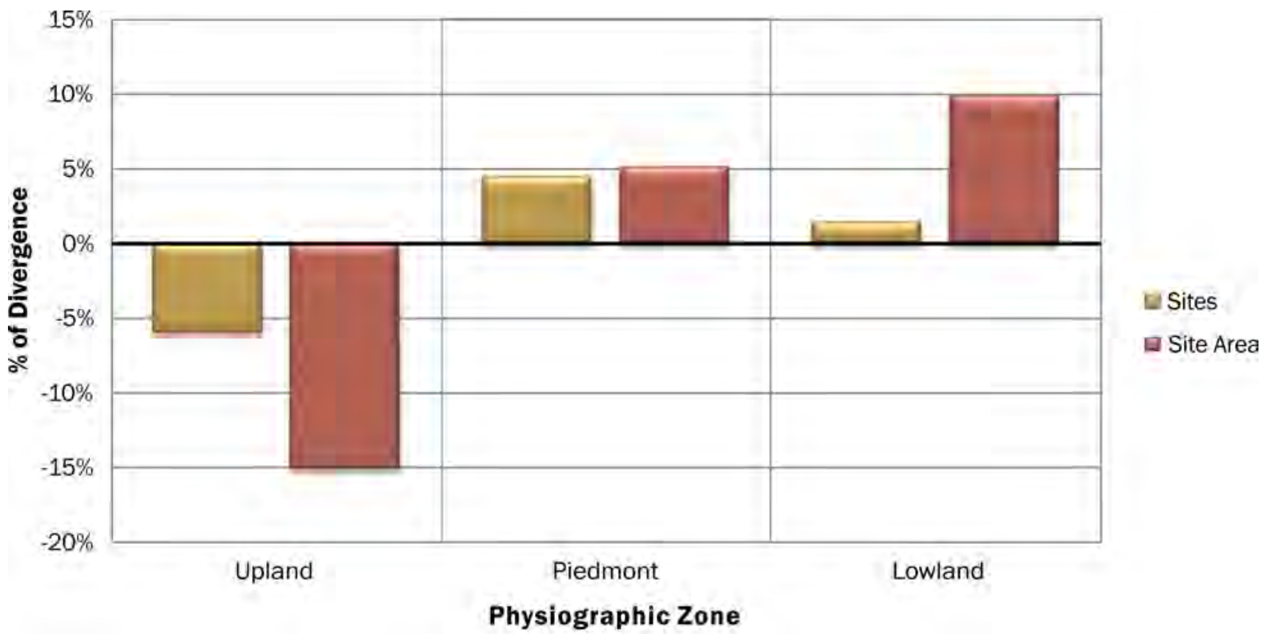


Figure 7.9 Divergence of prehistoric site distribution from area surveyed by physiographic zone.

assumption that site density is the same across the entire study area (such that site occurrence should be proportionate to the area surveyed). Thus, if 20 percent of the upland zone was surveyed, we should expect to find 20 percent of sites in that zone. When these values depart, it reflects a higher or lower site density in that zone than would be expected, which suggests that zone had a greater or lesser environmental influence on prehistoric behavior (in this case, site location).

Figure 7.9 shows the divergence of prehistoric site occurrence (observed value) from area surveyed (expected value), both by site count and by site area, for each physiographic zone. These were derived simply by subtracting the observed value (for example, the percent of the total number of sites in the uplands [13.91]) from the expected value (percent of the total area surveyed in the uplands [19.91]) to arrive at the measure of divergence (-6). Note that the X-axis (representing the expected values) crosses the Y-axis at 0 percent in the middle of the graph instead of the bottom of the graph as is common. In this way observed values that are greater than or less than expected value are shown as bars extending upward or downward, respectively. The graph indicates that sites in the upland zone occur *much less frequently* and site area is *significantly smaller* than expected (-15.09 percent).[4] Sites in the piedmont zone, on the other hand, occur *somewhat more often* than expected with site area larger than expected. Sites in the lowland zone occur only *slightly more frequently* than expected but are *significantly larger* than expected (9.92 percent). Overall, then, this comparison with expected values shows that prehistoric sites tend to occur *more frequently* in the piedmont and lowland zones and *less frequently* in the upland zone than expected. Similarly, site area is *larger* in the piedmont zone, *significantly larger* in the lowland zone, and *dramatically smaller* in the upland zone than expected.

Sites per hectare, as shown in Table 7.5, is a measure of **site density** expressed as a single value derived from

4. Nomenclature used here is not meant to suggest statistical significance. Because this remains an exercise, primarily, of basic descriptive statistics, actual significance testing is beyond the scope of this report. Thus, the words “dramatically,” “significantly,” “somewhat,” “slightly,” and “at or near” are used only loosely to indicate quantitative values, and such values shift from analysis to analysis depending on the range of values in any given exercise. Generally, however, values that depart by more than 5% from expected values are considered here to be “significant.”

dividing the number of sites by the number of hectares surveyed in any one zone (sites per hectare surveyed). This figure addresses the total number of sites in any one zone but is independent of the *size* of those sites. A second measure addresses the total area contained within sites in any one zone but is independent of the *number* of sites (site hectares per hectare surveyed). Both figures are instructive. Where site density is high by number of sites, but low in spatial extent of sites, it indicates a high number of small sites in a given area. Where site density is low by number of sites but high in spatial extent of sites, it indicates a small number of very large sites.

Both measures of density are shown graphically in Figure 7.10 that displays the project-wide—or average—distribution (derived from values in the "Total" row). Here, the average site density *by site* is shown to be .0614 sites per ha surveyed and the average site density *by area* is shown to be .0582 ha per ha surveyed. Thus, site density by number of sites is slightly higher than site density by area for all prehistoric sites recorded during the survey (aside from those sites excluded from analysis). These two measures of average site density as well as the relationship between these two values, then, (a difference of only .0032) becomes the expected values of site density within individual environmental zones.

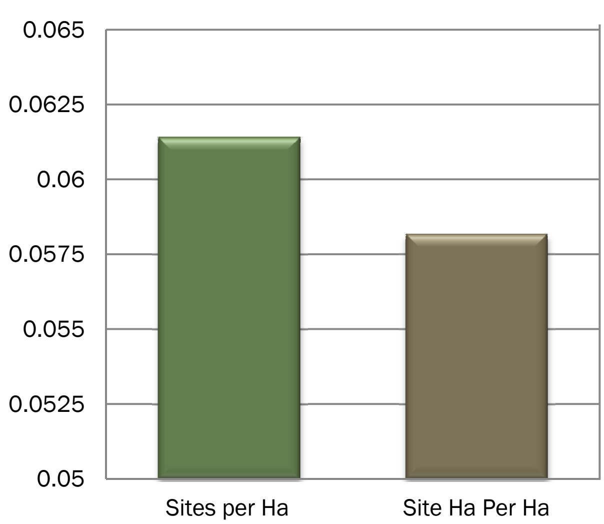


Figure 7.10 Project-wide site density by site and area.

Both measures of site density are again shown in Figure 7.11 but are broken out by physiographic zone. Here the data indicates that density by *site* is greatest in the piedmont zone followed by the lowland and upland zones, whereas density by *area* is greatest in the lowland zone, followed by the piedmont and upland zones. In terms of divergence between the two values, they are actually closer together in the piedmont zone (difference of .0028) than expected (.0032). In the upland zone, however, density by area lags far beneath density by site, by a difference of .0288 (departing from the expected value by .0256). The relationship between the two measures of density are reversed in the lowland zone such that density by area eclipses density by site by .0114, but still departs from the expected value less than in the upland zone (.0146). Thus, although *more* sites are shown to occur in the piedmont zone than in any other zone (per unit of area), sites tend to be *largest* in the lowland zone. Conversely, there are not only significantly fewer sites in the upland zone, but the sites that do exist tend to be much smaller than average.

In this relatively coarse-grained spatial analysis, then, the data indicate a preference prehistorically for the piedmont zone, followed by the lowland and upland zones. The total site area within each zone shows a different trend, with the lowland containing the most site area, followed by piedmont and upland zones. These findings conform well to what might be expected based on observable differences in physiography and the amount of habitable space. Thus, because of the more rugged and sloping terrain in the upland zone where habitable space is at a far greater premium, we might expect sites to be smaller, reflecting geographical constraints. Conversely—because of the more expansive pediments and flats in the piedmont and lowland zones—we would expect sites to be larger, reflecting the absence of such constraints. Following this line of logic, we might also expect greater redundancy of use in the upland zone sites (more multiple component sites) and lower redundancy of use in the lowland zone (more single component sites). However, to further illuminate these patterns, and to address the issue of

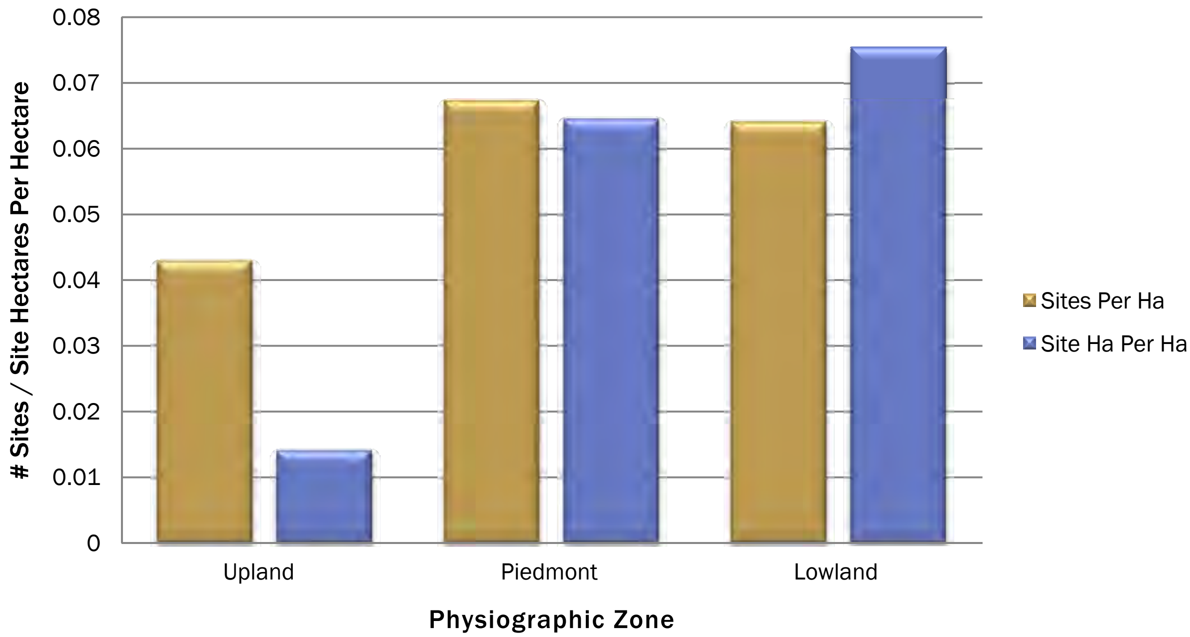


Figure 7.11 Site density by site and area per physiographic zone.

redundancy of use, will require a more refined analysis and possibly a sampling design that incorporates excavation data.

By Environmental Zone (EZ)

A more detailed environmental zonation scheme was developed for the predictive model, replacing the coarser breakdown that was employed during the first phase of the project (see Appendix 15 for a discussion of this change). The park was divided into different zones based largely on geomorphological characteristics keyed to United States Department of Agriculture (USDA) "Ecological Site Descriptions." These site descriptions themselves were derived from high-resolution soil data produced by the NRCS in 2009. A total of 25 zones were delineated across the park, 23 of which received at least some survey coverage. Although soil data, rather than environmental zonation, was ultimately used for the predictive model, the zones served as the basis for the following spatial analyses.

Table 7.6 provides an overview of the total number of hectares surveyed, the number of sites, site area, and both measures of site density for each environmental zone for which there was adequate coverage. Because 11 of the 23 environmental zones each had less than 500 hectares surveyed (considered here to be an insufficient sample size), they—and the 57 sites they contained—are excluded from the analysis. The remaining data subset, comprising 12 zones and 1,416 sites, represents 92 percent of the area surveyed and 96 percent of prehistoric sites.

The table is sorted in descending order by area surveyed in each zone with pediments / piedmont slopes (representing 20 percent of area surveyed) at the top of the list and terraces (representing 3 percent of area surveyed) at the bottom. Among the 12 sufficiently represented environmental zones, the 4 top zones comprise 58 percent of the total survey area but contain over 68 percent of all sites and 63 percent of total site area.

Figure 7.12 shows the divergence of prehistoric site presence (observed value) from area surveyed (expected value), both by site count and by site area, for each environmental zone. Site occurrence in most zones is shown to be near expected values with divergence less than 2

Table 7.6 Prehistoric Site Data by Environmental Zone.

Environmental Zone	Hectares Surveyed	% of Total	Preh Sites	% of Total	Site Hectares	% of Total	Sites Per Ha	Site Ha Per Ha
Pediments/Piedmont Slopes	4,542.69	19.70%	399	28.18%	305.96	22.81%	0.0878	0.0674
Fan Remnants on Piedmont Slopes	3,411.26	14.79%	182	12.85%	185.40	13.82%	0.0534	0.0544
Erosion Remnants	3,212.76	13.93%	236	16.67%	228.51	17.04%	0.0735	0.0711
Erodable Clay from Mudstone	2,253.08	9.77%	145	10.24%	129.20	9.63%	0.0644	0.0573
Alluvial Flats	1,616.97	7.01%	77	5.44%	188.30	14.04%	0.0476	0.1165
Mountain Slopes	1,545.21	6.70%	63	4.45%	33.78	2.52%	0.0408	0.0219
Fan Remnants	1,520.95	6.60%	117	8.26%	180.90	13.49%	0.0769	0.1189
Alluvial Fans on Piedmont Slopes	1,305.00	5.66%	28	1.98%	23.92	1.78%	0.0215	0.0183
Side & Lower Slopes	1,258.27	5.46%	52	3.67%	3.62	0.27%	0.0413	0.0029
Plateaus	1,055.94	4.58%	53	3.74%	17.01	1.27%	0.0502	0.0161
Igneous Hills in Basin	731.71	3.17%	29	2.05%	10.22	0.76%	0.0396	0.0140
Terraces	608.14	2.64%	35	2.47%	34.28	2.56%	0.0576	0.0564
Total	23,061.96	100.00%	1,416	100.00%	1,341.11	100.00%	0.0614	0.0582

Note: 57 prehistoric sites located in EZ categories that had insufficient coverage are excluded here.

percent in all but 4 of the zones. Interestingly, sites occur more often than expected in only 4 zones with sites in pediments / piedmont slopes occurring 8.48 percent more often than expected and sites in erosion remnants and fan remnants occurring slightly more than expected (2.74 percent and 1.67 percent, respectively). Site occurrence in the remaining 8 zones is less than expected although only mountain slopes (-2.25 percent) and alluvial fans on piedmont slopes (-3.68 percent) depart by more than 2 percentage points.

There is much greater overall divergence in *site area* per zone, with four zones departing from expected values by more than four percentage points. Similar to the site count, site area was greater than the expected value in only 4 zones: pediments / piedmont slopes (3.12 percent), erosion remnants (3.11 percent), alluvial flats (7.03 percent) and fan remnants (6.89 percent). It is especially notable that site occurrence in alluvial flats was 1.57 percent *below* the expected value whereas site area in the same zone was 7.03 percent *above* the expected value, indicating that although there were fewer sites than expected in this zone, they tended to be very large. Site area in the remaining 8 zones was less than expected, with 5 zones departing by more than 2 percentage points: mountain slopes (-4.18 percent), alluvial fans on piedmont slopes (-3.88 percent), side and lower slopes (-5.19 percent), plateaus (-3.31 percent), and igneous hills in basin (-2.41 percent).

In comparing the two measures of site occurrence with relation to expected values, the data shows that site area significantly exceeds site count in alluvial flats and fan remnants, whereas site count significantly exceeds site area in pediments / piedmont slopes. Conversely, site area is much smaller than expected relative to site count in mountain slopes, side and lower slopes, and plateaus. In addition to illuminating prehistoric site location preferences, this exercise also demonstrates that percentage of area surveyed is a much better predictor of the number of sites than site area. This suggests that environmental conditions play a larger role in site *size* than they do in site *presence*.

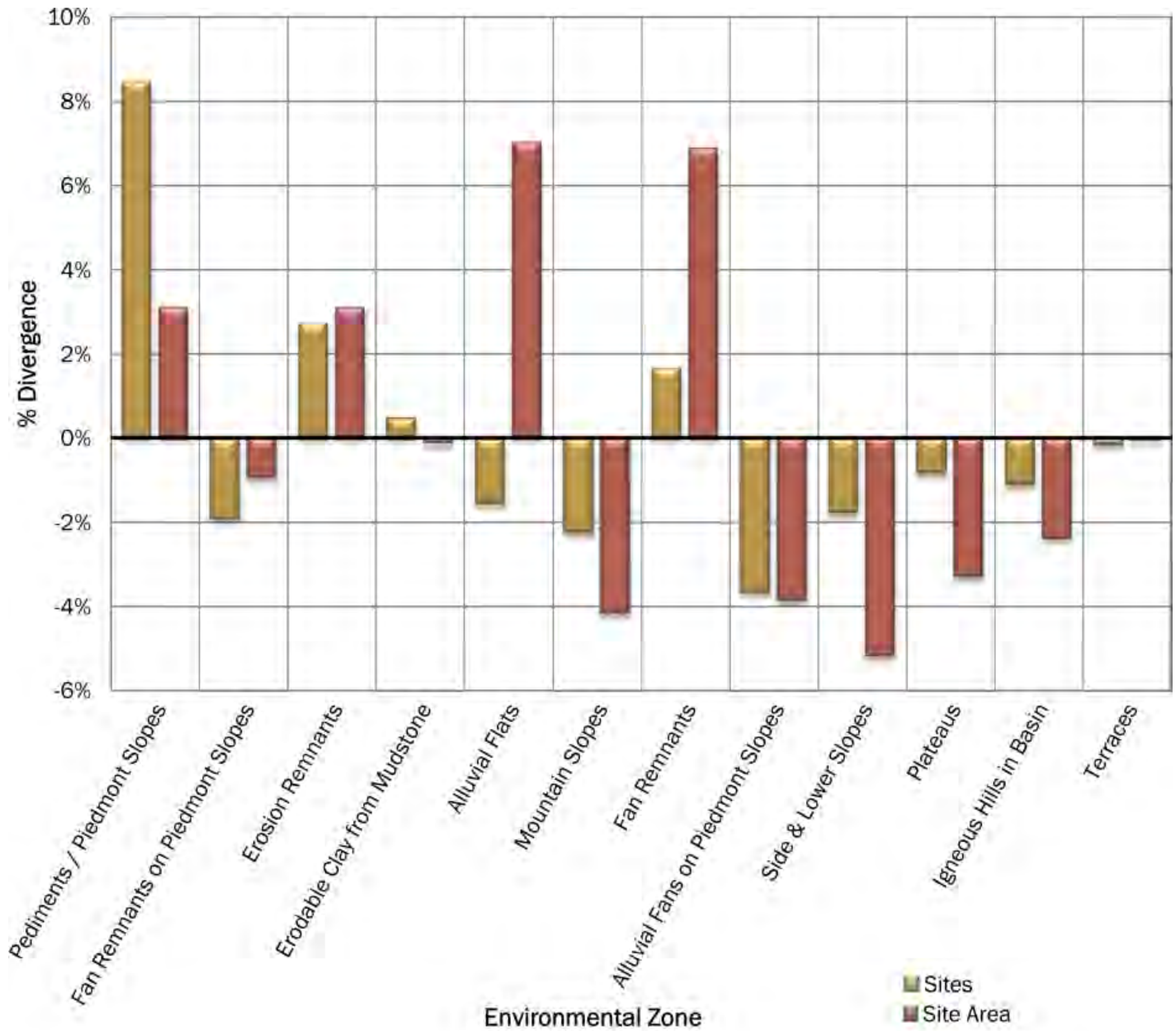


Figure 7.12 Divergence of number of prehistoric sites from area surveyed and prehistoric site area from area surveyed, by environmental zone.

The significant range in site density across EZs is graphically demonstrated in Figure 7.13, which displays both measures of site density and is arranged in descending order of density by *site*. Site density by site is shown to be greatest in pediments / piedmont slopes, fan remnants, and erosion remnants, with site density well above average (.0614). On the other hand, density is well below average in plateaus, alluvial flats, side and lower slopes, mountain slopes, igneous hills in basin, and alluvial fans on piedmont slopes. In examining site density by area, sites are shown to be much larger than average (.0582) in fan remnants, alluvial flats, erosion remnants, and pediments / piedmont slopes. By contrast, sites are shown to be much smaller than average in mountain slopes, alluvial fans on piedmont slopes, plateaus, igneous hills in basin, and side and lower slopes.

Across most EZs, the two measures of site density remain fairly close, and are even closer than expected (project average divergence=.00325) in alluvial fans on piedmont slopes (.0031), erosion remnants (.0023), terraces (.0012) and fan remnants on piedmont slopes (.001), indicating that the relationship between site count and site size are fairly consistent.

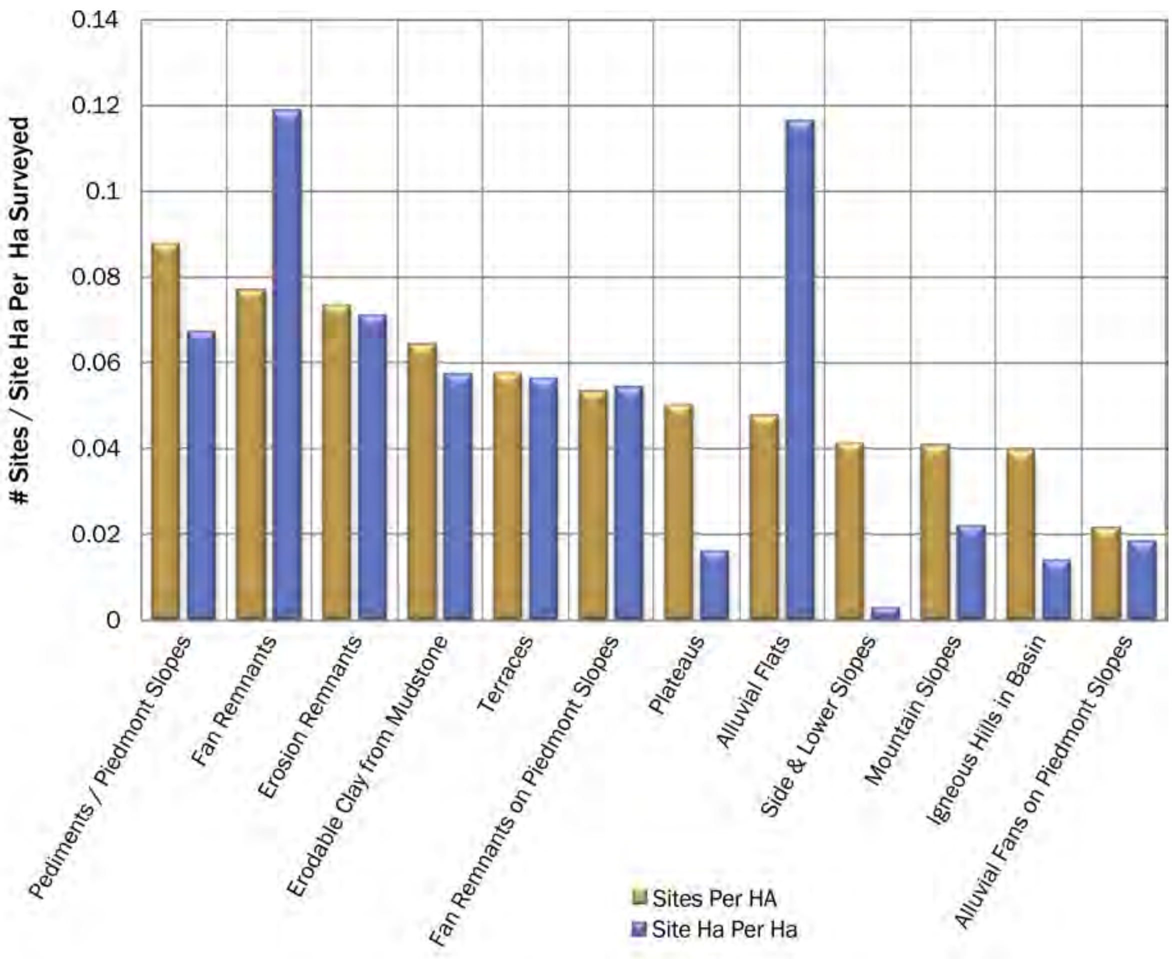


Figure 7.13 Site density by site and area, by environmental zone.

However, the two measures diverge dramatically—and are reversed from the project-wide relationship—in alluvial flats (.0688) and fan remnants (.0420). Significant differences are also evident in side and lower slopes (.0385), plateaus (.0341), igneous hills in basin (.0257), pediments / piedmont slopes (.0205) and mountain slopes (.0189). Thus, the two measures of site density diverge notably in about half of the EZs.

At either extreme, sites on alluvial flats are shown to be much *larger* than expected, whereas sites on side and lower slopes are shown to be much *smaller* than expected relative to the number of sites in each zone. Put another way, alluvial flats have only 5.44 percent of all sites but contain 14.04 percent of total site area. Conversely, side and lower slopes have 3.67 percent of all sites but contain only .27 percent of total site area.

Again, these findings conform well to what might be expected based on physiographic differences between zones. Thus, the relatively flat nature of pediments / piedmont slopes creates an abundance of easily habitable space, and might be expected to have been favored prehistorically. Similarly, the expansiveness of habitable space in alluvial flats and fan remnants would have allowed for very large sites to exist. Conversely, the limited habitable space in side and lower slopes and plateaus would have restricted the size of sites in those zones.

Site Distribution by Time Period

This section examines the relationship between site distribution and temporal affiliation. Sites used in this analysis contained one or more diagnostic projectile points from a specific time period. Because some sites contained projectiles from more than one time period, sites could be counted more than once. A total of 405 prehistoric sites recorded during the project were "temporally affiliated" based on projectile point data. However, because environmental zones that had less than 500 ha surveyed are excluded, sites within those zones are also excluded from the present analysis (n=16). The remaining 389 sites form this data subset.

A total of 13 Paleoindian sites, 40 Early Archaic sites, 85 Middle Archaic sites, 139 Late Archaic sites, and 112 Late Prehistoric sites make up the body of temporally affiliated sites used in the present analysis. Because of the very low sample size of the two earliest periods, especially the Paleoindian period, results from these periods should be viewed with caution.

This section is divided into two main subsections: the first examines site distribution by the coarser-grained *physiographic zones,* the second examines site distribution by the finer-grained *environmental zones*. In each subsection, the *overall distribution* of temporally affiliated sites is examined first, followed by site *distribution by individual time period.* The analysis compares site distribution between zones and time periods as well as to expected values (area surveyed, the general prehistoric site distribution and, where appropriate, the general temporal distribution). This is followed by an examination of site density of temporally affiliated sites.

By Physiographic Zone

Table 7.7 presents summary site information by physiographic zone and time period. Zones are presented in order of decreasing elevation. Hectares surveyed in each zone and the total number of prehistoric sites—along with the percent of total for each—are included for comparative purposes. The 389 temporally affiliated sites are presented by time period and by zone, with total site count and percent of totals by zone. It is important to note that the general distribution of prehistoric sites has been adjusted by removing the temporally affiliated sites to provide a "cleaner" comparison.

General Distribution of Temporally Affiliated Sites

Table 7.7 reveals that 15 percent of temporally affiliated sites recorded during the project occurred in the upland zone, 49 percent in the piedmont zone, and 37 percent in the lowland zone. Taken together, these figures depart from expected values (as percentages of total area surveyed) by a total of ten percentage points. Five percent fewer temporally affiliated sites are located in the upland zone, whereas 1.84 percent more sites are found in the piedmont zone and 3.15 percent more sites in the lowland zone than expected. The distribution

Table 7.7 Temporally Affiliated Sites by Physiographic Zone and Time Period.

Phys. Zone	Ha Surveyed	% of Total	Adj Preh Sites	% of Total	Pa	EA	MA	LA	LP	Total	% of Total
Upland	4,591.12	19.91%	139	13.53%	1	6	15	24	12	58	14.91%
Piedmont	10,779.88	46.74%	537	52.29%	7	23	43	62	54	189	48.59%
Lowland	7,690.95	33.35%	351	34.18%	5	11	27	53	46	142	36.50%
Totals	**23,061.95**	**100.00%**	**1,027**	**100.00%**	**13**	**40**	**85**	**139**	**112**	**389**	**100.00%**

Note: Shaded figures are the expected values.

Pa=Paleoindian, EA=Early Archaic, MA=Middle Archaic, LA=Late Archaic, and LP=Late Prehistoric.

more closely mirrors the general prehistoric site distribution (% of total adjusted prehistoric sites column) by a total of 7.4 percent with 1.38 percent more temporally affiliated sites in the upland zone, 3.7 percent fewer sites in the piedmont zone, and 2.33 percent more sites in the lowland zone than in the general distribution. In both the upland and piedmont zones, the percentage of temporally affiliated sites is closer than the total prehistoric site distribution to expected values (percentage of area surveyed). However, in the lowland zone the percentage of temporally affiliated sites departs further from the percentage of area surveyed than the total prehistoric site distribution.

By measures of site density, temporally affiliated sites diverge from those of the total prehistoric site distribution across each of the three physiographic zones. The much lower sample size of the temporally affiliated sites makes for lower site density in all zones, as would be expected. But the difference in density between zones is marked. Rather than having the greatest site density in the piedmont zone, followed by the lowland and upland zones—as in the general site distribution—site density for all temporally affiliated sites is shown to be greatest in the lowland zone (.019), closely followed by the piedmont (.018), and upland zones (.013). In other words, per unit of land, there are slightly more sites in the lowland zone that contain diagnostic projectiles although the piedmont zone contains more sites overall. Comparing site density between the two data sets as percentages of total reveals the greatest divergence between the temporally affiliated sites and all prehistoric sites to be in the piedmont zone (-3.57 percent) followed by the upland (1.9 percent) and lowland zones (1.67 percent). While the significance of these figures is difficult to discern, they may signify the varying effects of post-depositional processes upon artifacts between different zones (including, possibly, unauthorized collecting) more than any definitive measure of prehistoric behavior.

Distribution by Time Period of Temporally Affiliated Sites

This section examines the distribution of sites between physiographic zones by individual time period, first by comparing percentages of total and then by site density. Table 7.8 shows temporally affiliated sites by

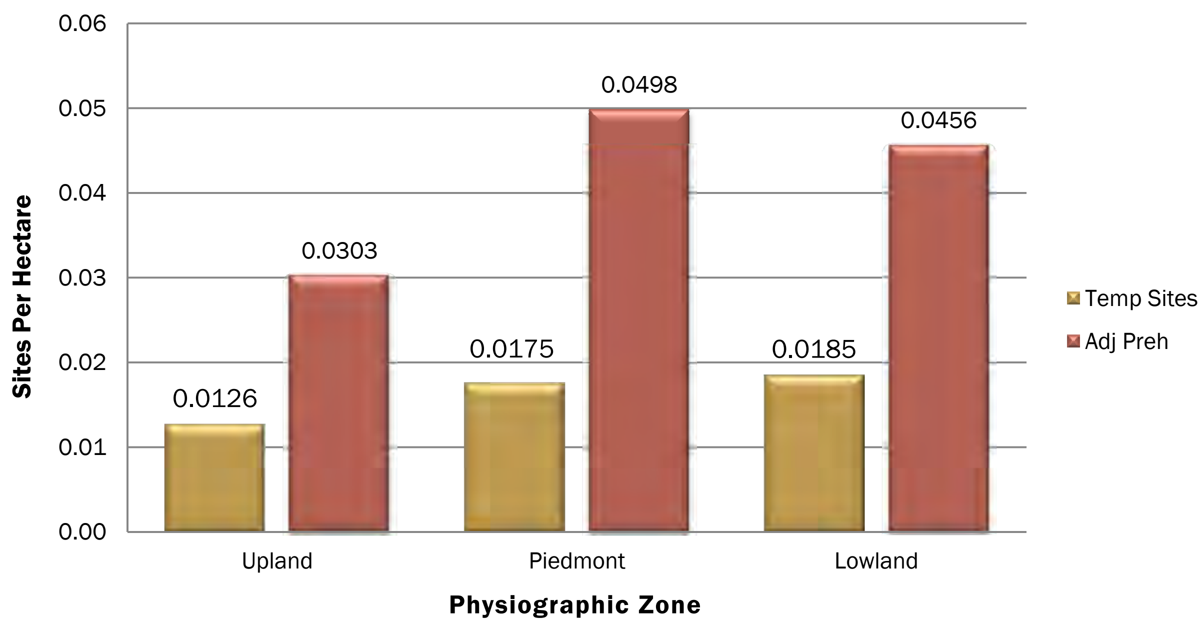


Figure 7.14 Site density by physiographic zone for temporally affiliated sites and the general distribution of prehistoric sites (adjusted prehistoric).

Table 7.8 Temporally Affiliated Sites by Physiographic Zone and Time Period as Percent of Total.

Phys. Zone	Ha	Adj Preh Sites	Pa	EA	MA	LA	LP
Upland	19.91%	13.53%	7.69%	15.00%	17.65%	17.27%	10.71%
Piedmont	46.74%	52.29%	53.85%	57.50%	50.59%	44.60%	48.21%
Lowland	33.35%	34.18%	38.46%	27.50%	31.76%	38.13%	41.07%
Totals	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Pa=Paleoindian, EA=Early Archaic, MA=Middle Archaic, LA=Late Archaic, and LP=Late Prehistoric.

physiographic zone and time period as percentages of total *by time period*. This allows comparisons between time periods, but does not take into account area surveyed, and is thus more a reflection of the project data set than actual site density (which factors out area surveyed). Thus, we find 7.69 percent of Paleoindian sites recorded occurred in the upland zone, 53.85 percent in the piedmont zone, and 38.46 percent in the lowland zone, with similar values shown for all time periods. Hectares surveyed and adjusted prehistoric sites are also shown as percentages of total for direct comparison.

Figure 7.15 graphically displays the divergence of the distribution of temporally affiliated sites from expected values (area surveyed) by physiographic zone. This graph indicates that temporally affiliated sites from all time periods occur less frequently than expected in the upland zone, with Paleoindian and Late Prehistoric sites occurring much less frequently than expected. In fact, overall divergence is greatest in this zone, the sum of which amounts to more than 30 percentage points. In the piedmont zone, Paleoindian and Middle Archaic sites are shown to occur more often than expected, Early Archaic sites are shown to occur much more often than expected, with the remaining time periods close to expected values. In the lowland zone, Paleoindian and Late Archaic sites are shown to occur more often than expected and Late Prehistoric sites much more than expected, whereas Early

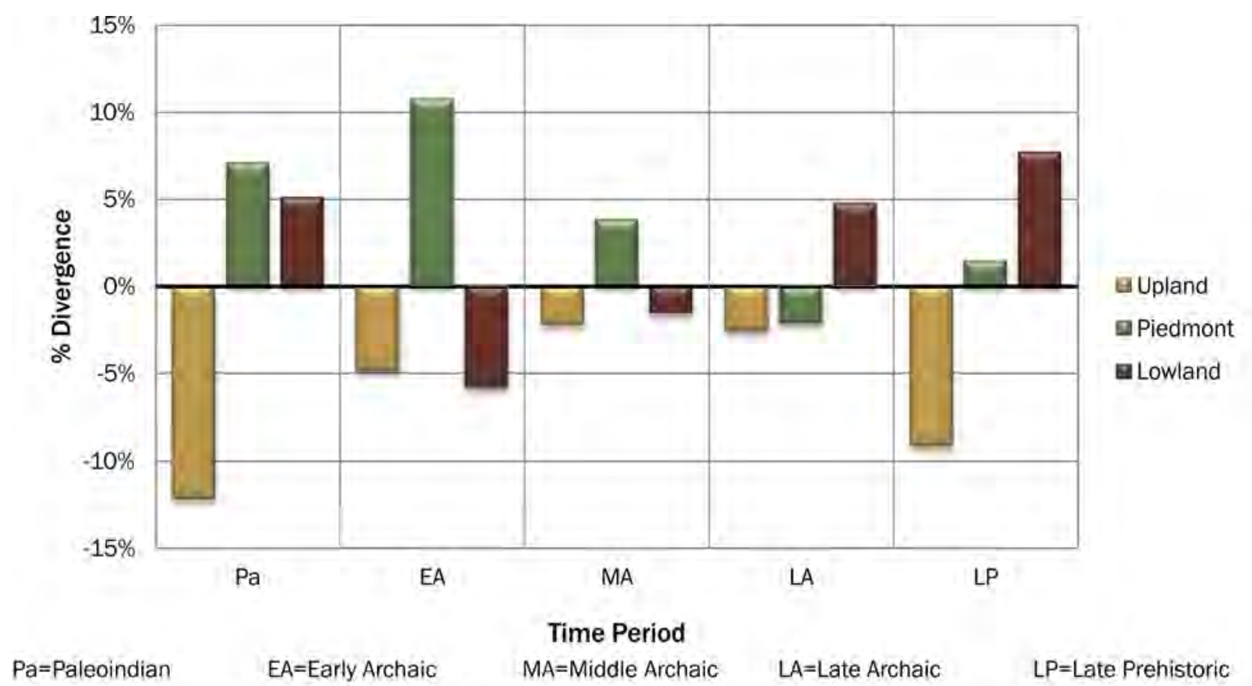


Figure 7.15 Divergence of temporally affiliated site distribution from area surveyed by physiographic zone.

Archaic and Middle Archaic sites occur less often than expected.

In examining trends through time compared to expected values, then, it appears that the uplands assumed greater importance throughout the Archaic period, and assumed significantly less importance during the Late Prehistoric. The piedmont zone is shown to assume greater importance during the Paleoindian through Early Archaic times, and less importance through the Late Archaic, rising slightly in importance during the Late Prehistoric. The lowland zone is closest to expected values overall and also shows the most linear trajectory through time (Paleoindian period excepted), with more sites occurring with each successive time period, assuming the greatest significance during the Late Prehistoric period.

Figure 7.16 displays *site density* by physiographic zone and time period. The data are presented as number of sites per hectare surveyed and includes the average density in each zone for comparative purposes. As discussed previously, the data indicates that the overall temporally affiliated site density is greatest in the lowland zone, followed by the piedmont, and upland zones. Here, the graph reveals that the significantly higher site density for Late Archaic and Late Prehistoric sites in the lowlands appears to have shifted the balance of all temporal sites to this zone. Interestingly, all three zones are dominated by Late Archaic sites. Middle Archaic sites are second highest in density in the upland zone whereas in both the piedmont and lowland zones, Late Prehistoric sites are second highest in density. Site density of Paleoindian and Early Archaic sites is significantly lower than the other time periods, but the data shows a clear preference for the lowland zone in the former period and a preference for the piedmont zone in the latter.

Figure 7.17 displays site density as percentages of total by time period, as if the same number of sites were recorded for each period (and is perhaps the most representative of true prehistoric patterning among the graphs). It reveals some striking differences in density between periods. The upland zone is shown to contain

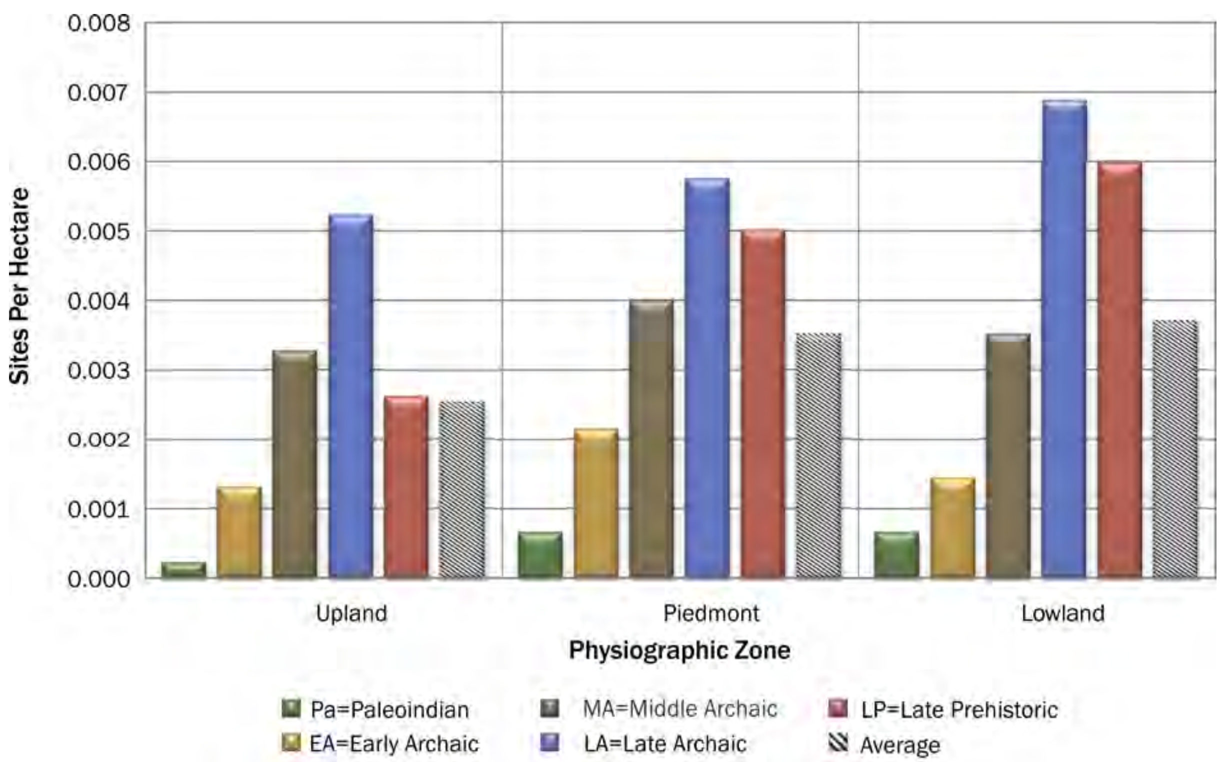


Figure 7.16 Site density by physiographic zone and time period.

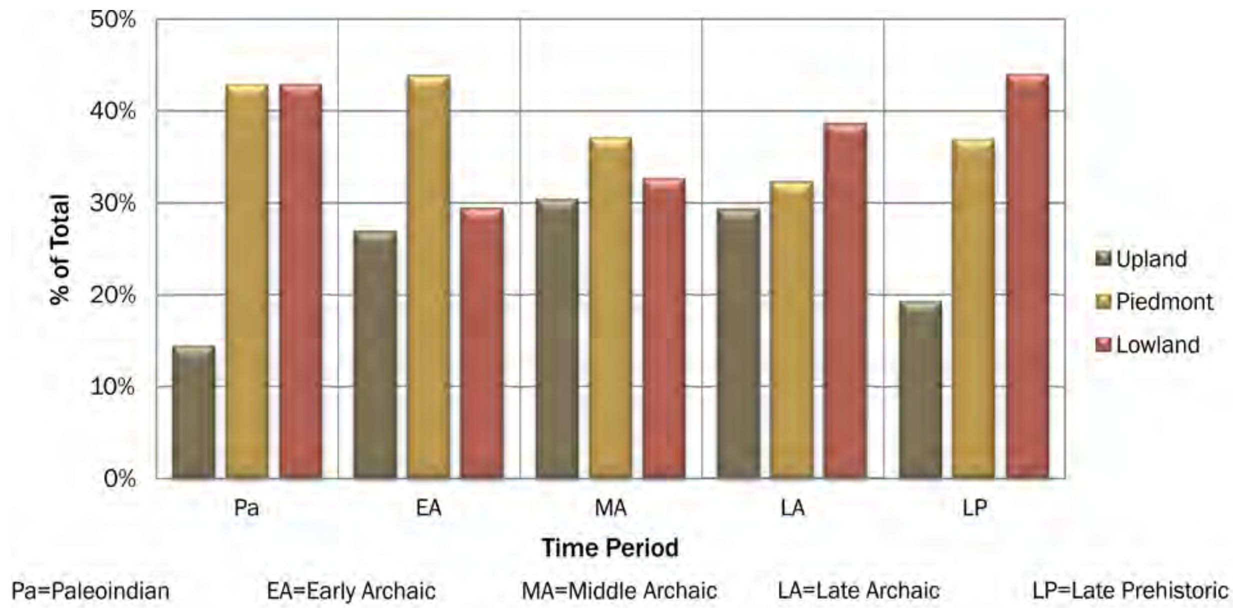


Figure 7.17 Site density by physiographic zone as percent of total, by time period.

the lowest site density for all time periods but assumed the greatest relative importance during the Middle Archaic, followed by the Late Archaic and Early Archaic periods. The piedmont zone, on the other hand, contains the highest site density for both the Early and Middle Archaic periods whereas the lowland zone has the greatest density for the Paleoindian, Late Archaic, and Late Prehistoric periods.

Thus, the trend through time indicates that the uplands assumed increasing importance during the Archaic period—with a peak during the Middle Archaic—before declining during the Late Prehistoric period. The piedmont zone—although containing the highest density during two of the time periods—generally decreased in importance through the Archaic period before rising again during the Late Prehistoric period. The lowland zone is shown to have been most important during Paleoindian times before declining to its lowest density for any time period during the Early Archaic then gradually assuming increasing importance throughout the remainder of the prehistoric period.

Taken together, the data suggests that following the Paleoindian period, prehistoric people from earlier periods utilized higher landforms—whether upland or piedmont—more often than people in later periods. Conversely, the lowland zone appears to have assumed increasing importance throughout the prehistoric period. The trajectory likely reflects known climatic trends during this period, notably the Holocene climatic optimum that occurred between 9,000 and 5,000 years ago, roughly contemporaneous with the Early Archaic period. The more xeric conditions of this period may have forced an upslope movement of food resources that triggered a cultural shift towards higher landforms—as more mesic-adapted plant and animal species moved upslope in response to hotter and dryer conditions, so did the people. The subsequent Middle Archaic period, indicating a preference for piedmont followed by lowlands, may have reflected increasingly more mesic conditions. As the climate continued to ameliorate in the Late Archaic and Late Prehistoric, there may have been relatively less emphasis on upland settings as a broader spectrum of resources became available in the piedmont and lowland zones.

5. Sum of divergence, as used here and throughout this chapter, is a crude metric that simply tallies divergence from expected values across all categories, regardless of whether that divergence is positive (greater than expected) or negative (less than expected). Thus, negative figures are treated as positive ones in order to arrive at the sum.

Table 7.9 Sites by Environmental Zone and Time Period.

Phys. Zone	Environmental Zone	Hectares Surveyed	% of Total	Adj. Preh. Sites	% of Total	Pa	EA	MA	LA	LP	Totals	% of Total
Piedmont	Pediments/Piedmont Slopes	4,542.69	19.70%	319	31.06%	2	8	15	22	33	80	20.57%
Piedmont	Fan Remnants on Piedmont Slopes	3,411.25	14.79%	128	12.46%	4	7	14	17	12	54	13.88%
Lowland	Erosion Remnants	3,212.76	13.93%	186	18.11%	2	2	6	18	22	50	12.85%
Lowland	Erodable Clay from Mudstone	2,253.08	9.77%	96	9.35%	3	6	12	18	10	49	12.60%
Lowland	Alluvial Flats	1,616.97	7.01%	43	4.19%		3	7	13	11	34	8.74%
Upland	Mountain Slopes	1,545.21	6.70%	27	2.63%		4	10	13	9	36	9.25%
Piedmont	Fan Remnants	1,520.94	6.60%	77	7.50%	1	7	10	16	6	40	10.28%
Piedmont	Alluvial Fans on Piedmont Slopes	1,305.00	5.66%	13	1.27%		1	4	7	3	15	3.86%
Upland	Side & Lower Slopes	1,258.27	5.46%	47	4.58%				5		5	1.29%
Upland	Plateaus	1,055.93	4.58%	41	3.99%	1	1	4	4	2	12	3.08%
Upland	Igneous Hills in Basin	731.71	3.17%	24	2.34%		1	1	2	1	5	1.29%
Lowland	Terraces	608.14	2.64%	26	2.53%			2	4	3	9	2.31%
Totals		23,061.95	100.00%	1,027	100.00%	13	40	85	139	112	389	100.00%

Site counts represent the number of sites containing one or more projectile points from the indicated time period. Zones with less than 500 hectares surveyed omitted. The table is sorted by environmental zone in descending order of area surveyed. Shaded figures are the expected values.

By Environmental Zone

Table 7.9 presents summary site information by environmental zone and time period. Note that 11 out of 23 of the environmental zones are excluded due to limited survey in those zones (less than 500 hectares) and that 16 temporally affiliated sites (3.95 percent of total) and 41 unaffiliated sites (3.83 percent of total) located in those zones are likewise excluded. The remaining 389 sites used in this analysis occur in just 12 environmental zones. Aside from the Paleoindian period, all time periods are represented in all zones except for terraces, which lack Early Archaic sites, and side and lower slopes which contain *only* Late Archaic sites. Again, the general distribution of prehistoric sites has been adjusted by removing the temporally affiliated sites to provide a more accurate comparison.

Figure 7.18 graphically displays the data in Table 7.9, showing temporally affiliated sites by time period and EZ and the area surveyed in each zone. Bars represent the number of sites as percentages of the total number of temporally affiliated sites (n=389; percentage figures not shown in table). The area surveyed in each zone is represented as percentages of the total number of hectares surveyed. Because the graph reflects the proportion of sites relative to the sum, all bars representing temporally affiliated sites are comparable. However, because the bars do not take the area surveyed in each zone into account, they are not indicators of site density.

General Distribution of Temporally Affiliated Sites

Figure 7.19 below shows the divergence of all temporally affiliated sites from expected values (area surveyed). It reveals that the distribution of temporally affiliated sites is closer to expected values (sum of divergence=23 percent) than the general prehistoric distribution (sum of divergence=27 percent) as shown in Figure 7.11.[5] In only four zones does the distribution diverge more than two percentage points: erodable clay from mudstone (2.83 percent), mountain slopes (2.55

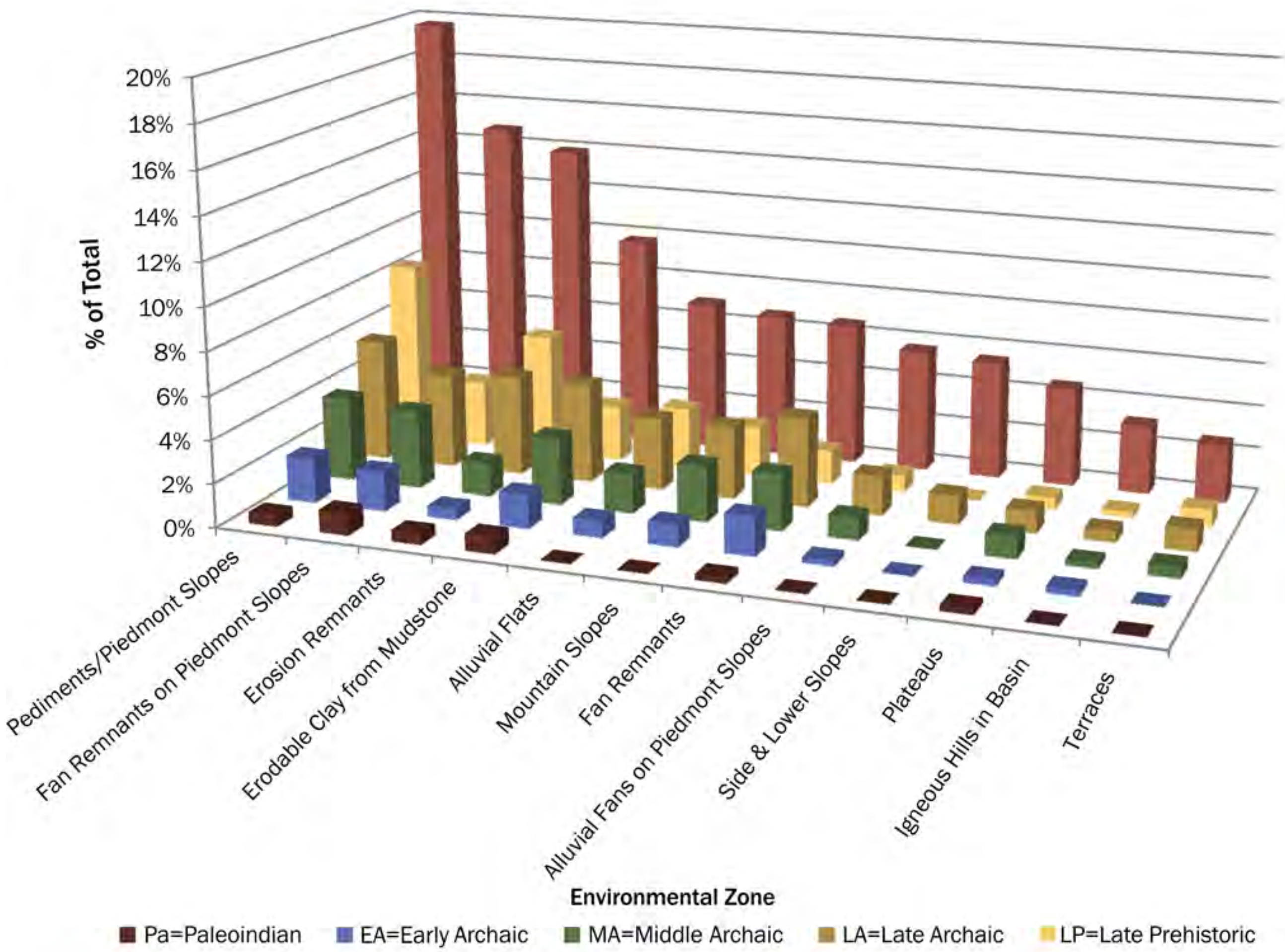


Figure 7.18 Percentage of sites containing temporal diagnostics by time period and environmental zone as well as total area surveyed. Sites are represented as percentages of the total number of temporally affiliated sites (n=389). Environmental zones are presented in descending order of area surveyed.

percent), fan remnants (3.69 percent), and side and lower slopes (-4.17 percent). Divergence is less than 1 percent in three of the zones: pediments/piedmont slopes (.87 percent), fan remnants of piedmont slopes (-.91 percent), and terraces (-.32 percent).

Figure 7.20 shows the divergence of all temporally affiliated sites from the general prehistoric distribution (the percent of total of adjusted prehistoric sites column in Table 7.9). The graph indicates that the distribution of all temporally affiliated sites departs significantly from the general site distribution (by a total of 42 percent), and is closer to expected values in the three zones where the most survey occurred (pediments/piedmont slopes, fan remnants on piedmont slopes, and erosion remnants).

This discrepancy is most pronounced with respect to pediments/piedmont slopes where there is a 10.5 percentage point difference from the general distribution, with the temporally affiliated sites significantly closer to the expected value (percent of total area surveyed). However, in 8 out of the 11 remaining EZs, temporally affiliated sites depart further from expected values than the general distribution.

Thus, compared to the general site distribution, far fewer sites containing temporal diagnostics occur on

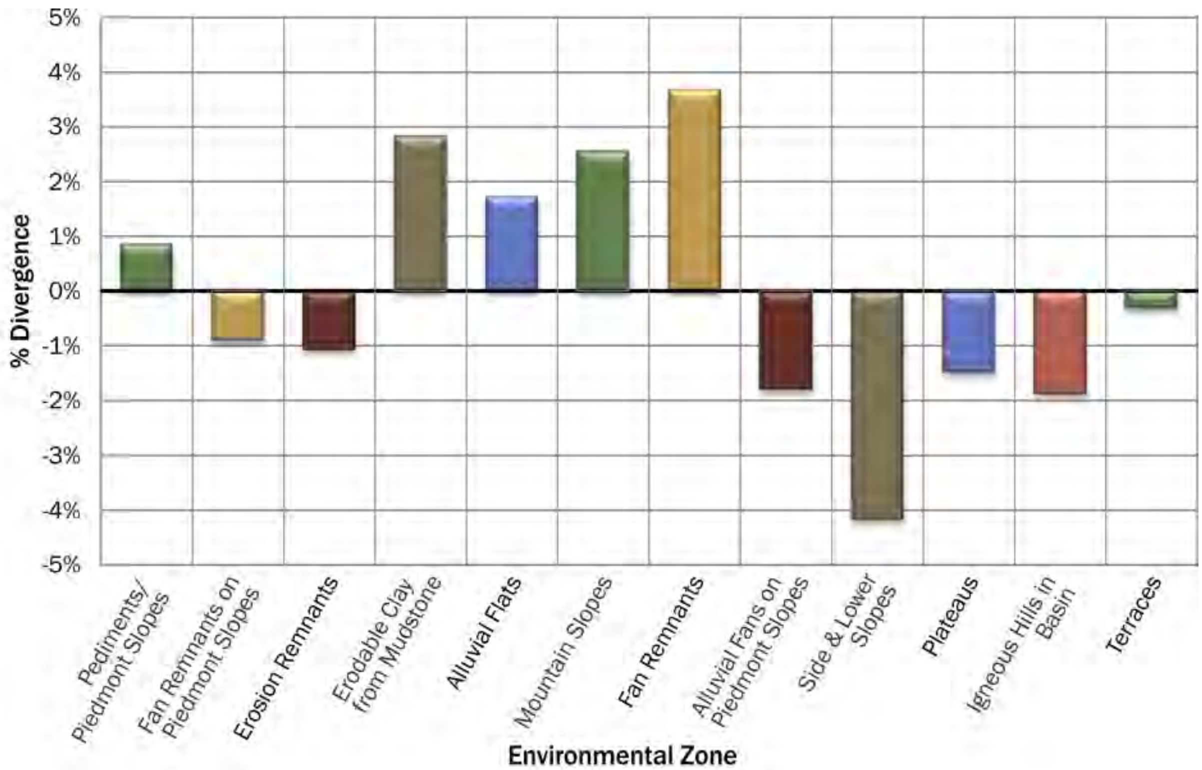


Figure 7.19 Divergence of all temporally affiliated sites from area surveyed (expected values) by environmental zone.

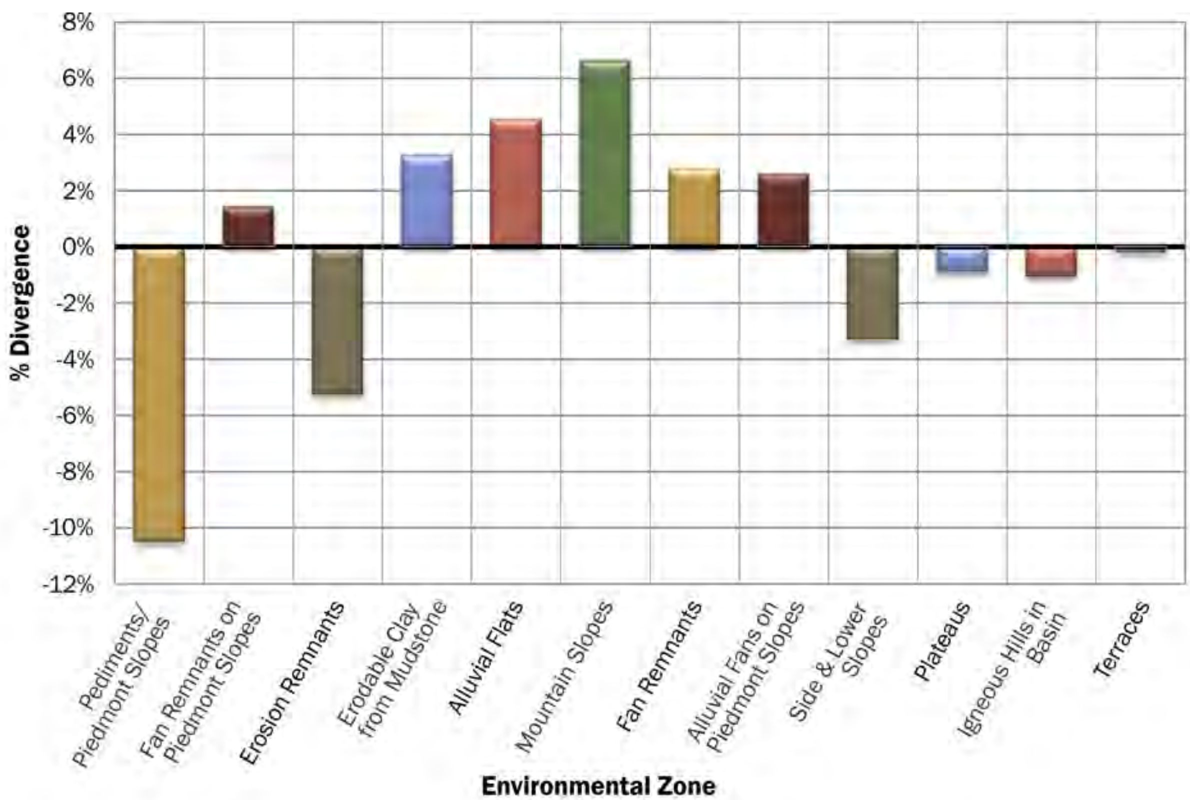


Figure 7.20 Divergence of all temporally affiliated sites from general prehistoric site distribution by environmental zone.

pediments/piedmont slopes than in other zones, and somewhat fewer temporally affiliated sites occur in erosion remnants and side and lower slopes. Conversely, a significantly *higher* number of temporally affiliated sites occur in mountain slopes and a somewhat higher number in erodable clay from mudstone, alluvial flats, fan remnants, and alluvial fans on piedmont slopes.

Such departures—especially those from the general site distribution—are instructive. Zones containing denser concentrations of temporally affiliated sites than the general distribution may suggest more complex sites occur in that particular zone (assuming that more points are dropped at complex sites than simple ones). Conversely, where temporally affiliated sites are less dense than the general distribution, this may suggest fewer complex sites and more potentially single- component sites.

Figure 7.21 displays the **site density** of all temporally affiliated sites by environmental zone. The graph reveals that the highest site density of all temporal sites is in fan remnants, followed by mountain slopes, erodable clay from mudstone, and alluvial flats which, taken together, account for almost half of the total site density. By contrast, the four zones with the lowest site density amount to less than 18 percent of the total. The four middle zones—all with near the same site density—account for the remaining 34 percent.

There are significant differences between temporally affiliated sites and that of the general site distribution with relation to site density, graphically displayed in Figure 7.22. Mirroring the divergence from the general site distribution and expected values, most notable is the much *greater* frequency of temporally affiliated sites on mountain slopes than the general distribution by a factor of 8.5 percentage points—moving from ninth place in the general distribution to second place in the temporal distribution. Temporal sites also occur with much greater frequency in alluvial flats than the general distribution, possibly a result of larger base camps in that zone. On the other hand, temporal sites are found far *less* frequently on side and lower slopes, pediments/piedmont slopes, and erosion remnants than the general distribution (-6 percent, -5.8 percent, and -4.3 percent,

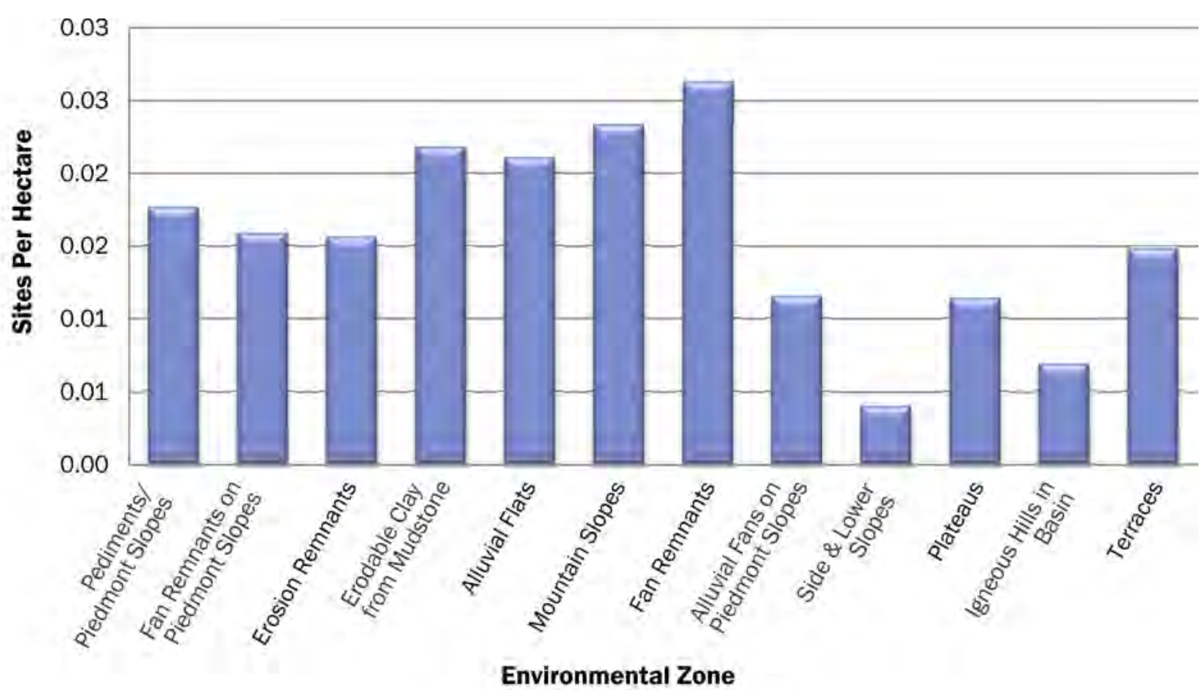


Figure 7.21 Site density of temporally affiliated sites by environmental zone.

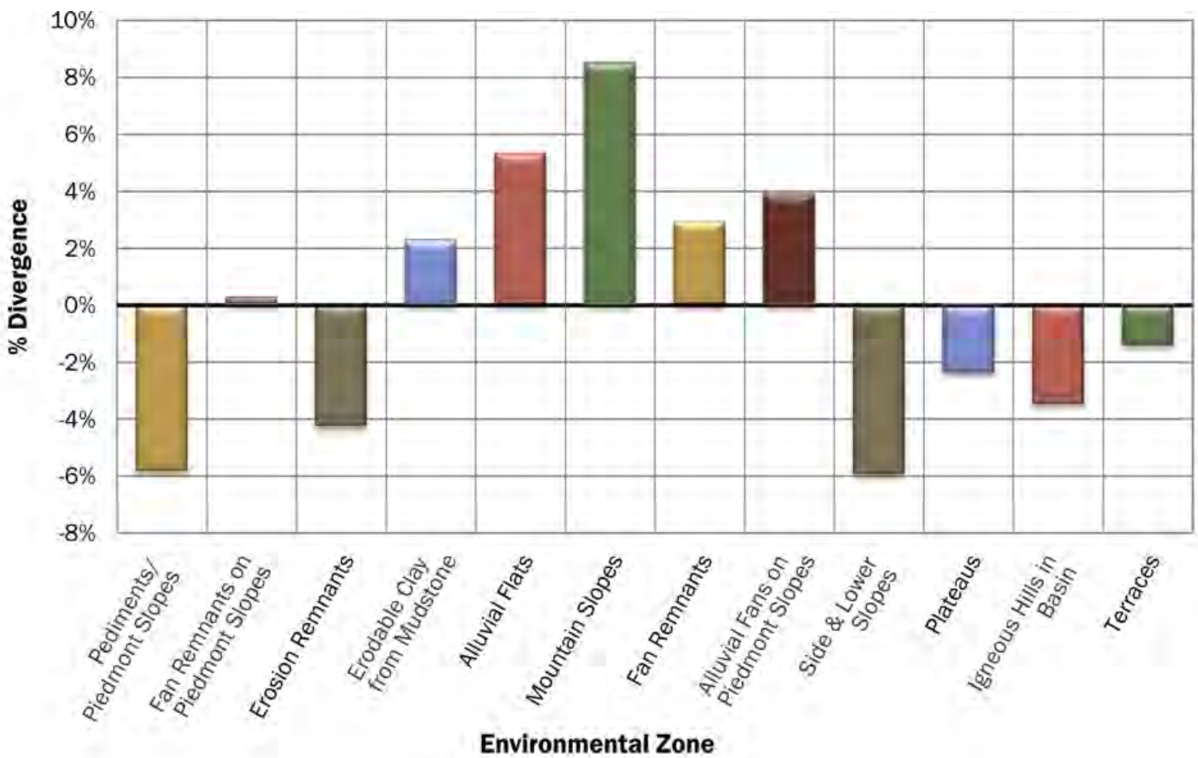


Figure 7.22 Divergence of density of temporally affiliated sites from that of all prehistoric sites (general site density) by environmental zone as percent of total.

respectively). Divergence is minor in fan remnants, erodable clay from mudstone, terraces, alluvial fans on piedmont slopes, plateaus, and igneous hills in basin and is negligible on fan remnants on piedmont slopes.

Distribution by Time Period of Temporally Affiliated Sites

When broken out by individual time periods, as shown in Figure 7.23, there are a number of notable departures from expected values, with the sum of total divergence of all time periods amounting to 217 percent. Paleoindian sites are shown to have the greatest overall divergence from expected values, a sum of 70 percent, and occur with dramatically *greater* frequency than expected in fan remnants on piedmont slopes and erodable clay from mudstone and significantly *lower* frequency than expected in alluvial flats, mountain slopes, alluvial fans on piedmont slopes, and side and lower slopes. However, as mentioned previously, the small sample size reduces the accuracy of results, a problem that increases as more categories are introduced (such as the 12 environmental zones). Consequently, these results must be viewed with caution.

The graph indicates that Early Archaic sites are second highest in total divergence, a sum of 46 percent. These sites are shown to occur with dramatically *greater* frequency than expected in fan remnants and significantly *greater* frequency than expected on erodable clay from mudstone than expected. Conversely, they are shown to occur with significantly *lower* frequency than expected in erosion remnants and side and lower slopes.

Middle Archaic sites rank fourth in total divergence from expected values, a sum of 35 percent. These sites occur significantly *more* frequently than expected in mountain slopes and fan remnants, somewhat more frequently in erodable clay from mudstone, and

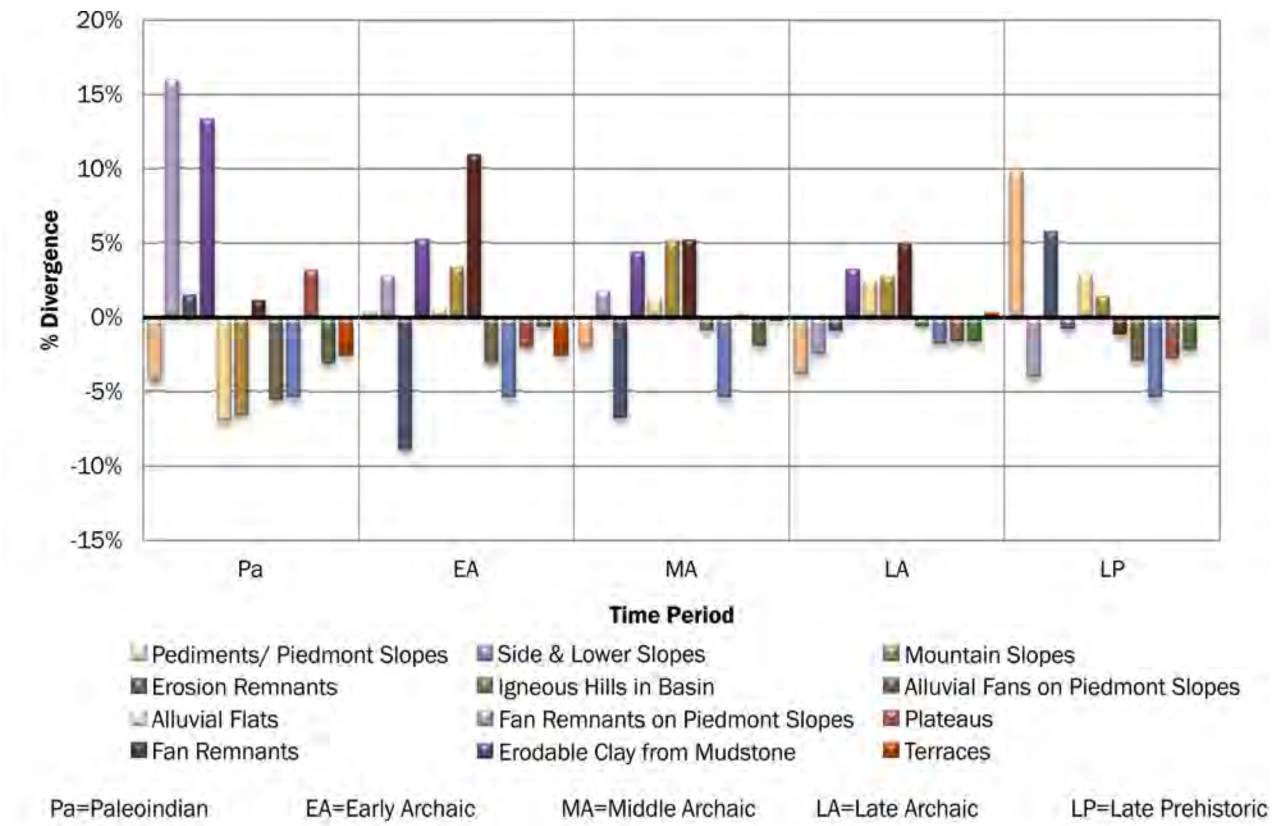


Figure 7.23 Divergence of the distribution of temporally affiliated sites from area surveyed by time period and environmental zone.

significantly *less* frequently in erosion remnants and side and lower slopes.

Late Archaic sites are lowest in total divergence from expected values, a sum of only 27 percent. These sites are shown to occur with somewhat *greater* frequency than expected in erodable clay from mudstone, alluvial flats, mountain slopes, and fan remnants. Conversely, they are shown to occur with somewhat *less* frequency than expected in pediments/piedmont slopes, and fan remnants on piedmont slopes. Generally, however, Late Archaic sites occur closest to expected values, indicating that they are distributed much more uniformly across the various environmental zones than are sites from other time periods.

Late Prehistoric sites rank third in total divergence from expected values, a sum of 39 percent. These sites are shown to occur with significantly *greater* frequency than expected in pediments/piedmont slopes and erosion remnants, significantly *less* frequently than expected in side and lower slopes, and somewhat *less* frequently than expected in fan remnants on piedmont slopes, alluvial fans on piedmont slopes, plateaus, and igneous hills in basin.

Figure 7.24 shows the divergence of temporally affiliated sites from the general prehistoric distribution by time period and environmental zone. The sum of the total divergence of all time periods amounts to 274 percent, which is about 25 percent greater than divergence from area surveyed.

The data indicates that the Paleoindian site distribution diverges from the general distribution by 72 percent, once again the highest of any time period.

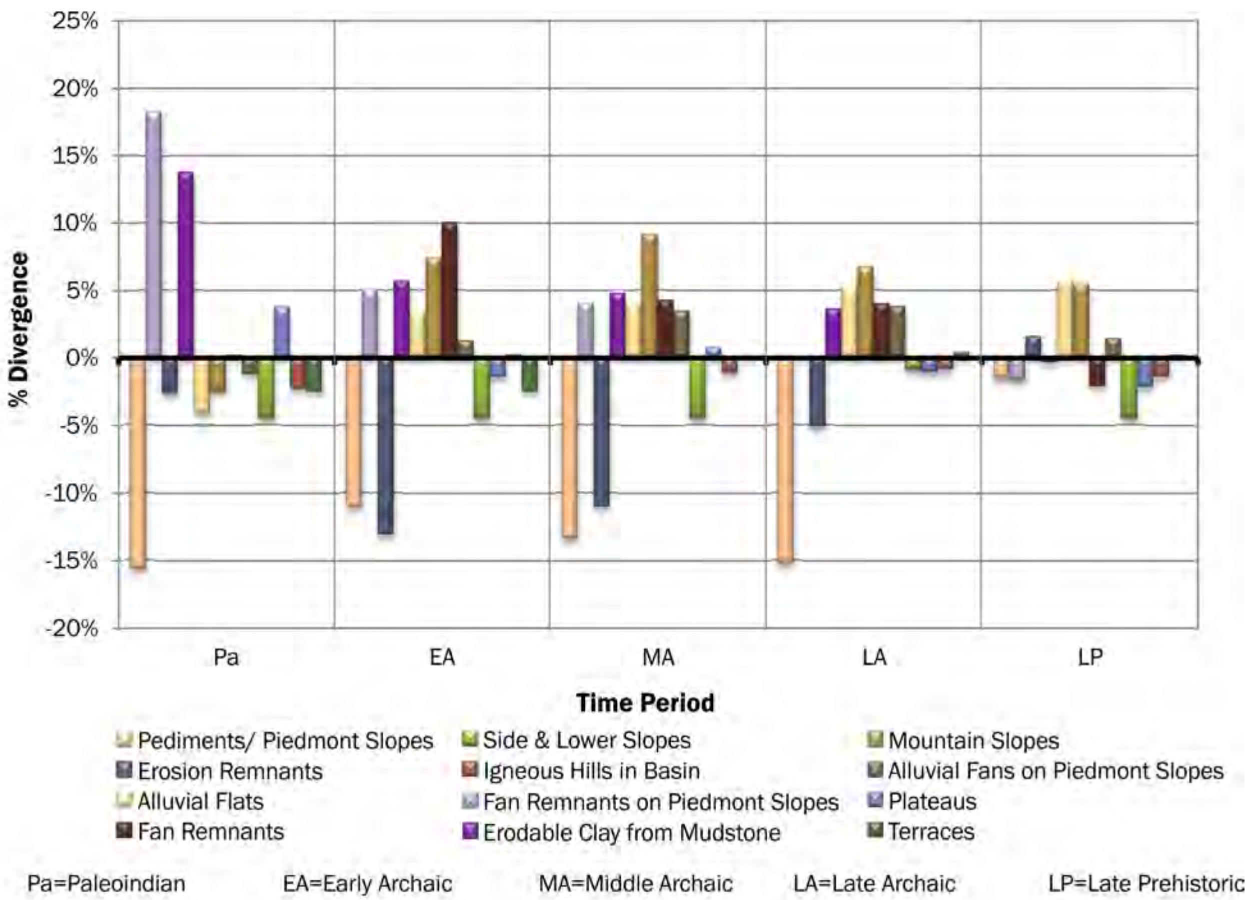


Figure 7.24 Divergence of the distribution of temporally affiliated sites from the general prehistoric distribution by time period and environmental zone.

These sites are shown to occur with dramatically *greater* frequency than expected on fan remnants on piedmont slopes and erodable clay from mudstone, and dramatically *less* frequently than expected on pediments/piedmont slopes than the general site distribution.

Early Archaic site distribution ranks second highest in divergence from the general distribution, a sum of 66 percent. These sites are shown to occur with significantly *greater* frequency than expected on fan remnants on piedmont slopes, erodable clay from mudstone, mountain slopes, and fan remnants. They occur with dramatically *less* frequency on pediments/piedmont slopes and erosion remnants.

Middle Archaic site distribution ranks third in divergence from the general distribution, a sum of 61 percent. These sites are shown to occur with significantly *greater* frequency than expected only on mountain slopes, whereas they are shown to occur with dramatically *less* frequency on pediments/piedmont slopes and erosion remnants.

Late Archaic site distribution ranks fourth in divergence from the general distribution, a sum of 47 percent. These sites are shown to occur with significantly *greater* frequency than expected on alluvial flats and mountain slopes, dramatically *less* frequently than expected on pediments/piedmont slopes, and significantly *less* than expected on erosion remnants.

Late Prehistoric sites are shown to diverge least from the general site distribution, a sum of only 28 percent. These sites are shown to occur with significantly *greater* frequency on alluvial flats and mountain slopes, and somewhat *less* frequently on side and lower slopes than expected, but otherwise accord quite closely with the general distribution.

That divergence decreases with each successive time period almost certainly reflects that more of the general prehistoric sites (temporally unaffiliated sites) belong to later periods than to earlier ones.

Figure 7.25 shows the site density of temporally affiliated sites by time period and environmental zone as the number of sites *per hectare surveyed* in each zone. Late Archaic sites are shown to dominate all zones with the exception of only three: pediments/piedmont slopes and erosion remnants, which are dominated by Late Prehistoric sites, and plateaus, which it shares in density with Middle Archaic sites. By contrast, Paleoindian sites are shown to have the lowest site density in all zones except erosion remnants and plateaus which it shares equally with Early Archaic sites.

Figure 7.26 shows the site density of temporally affiliated sites by time period and environmental zone, expressed as percentages of total by time period. Since it factors out the number of sites represented by each period, this allows better comparisons between time periods, placing all periods on equal footing. The data reveals that Paleoindian sites are most frequently located on erodable clay from mudstone, fan remnants on

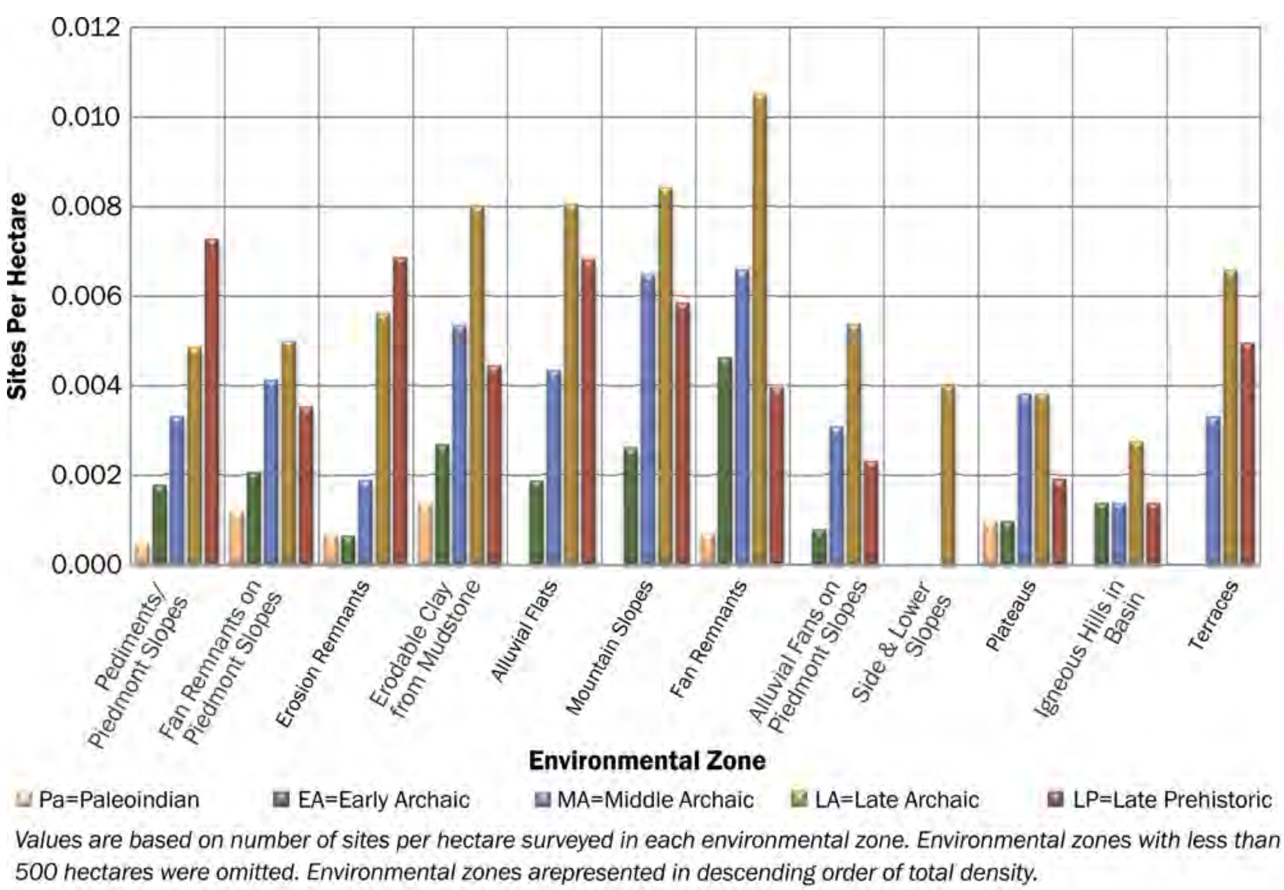


Figure 7.25 Site density of temporally affiliated sites by environmental zone.

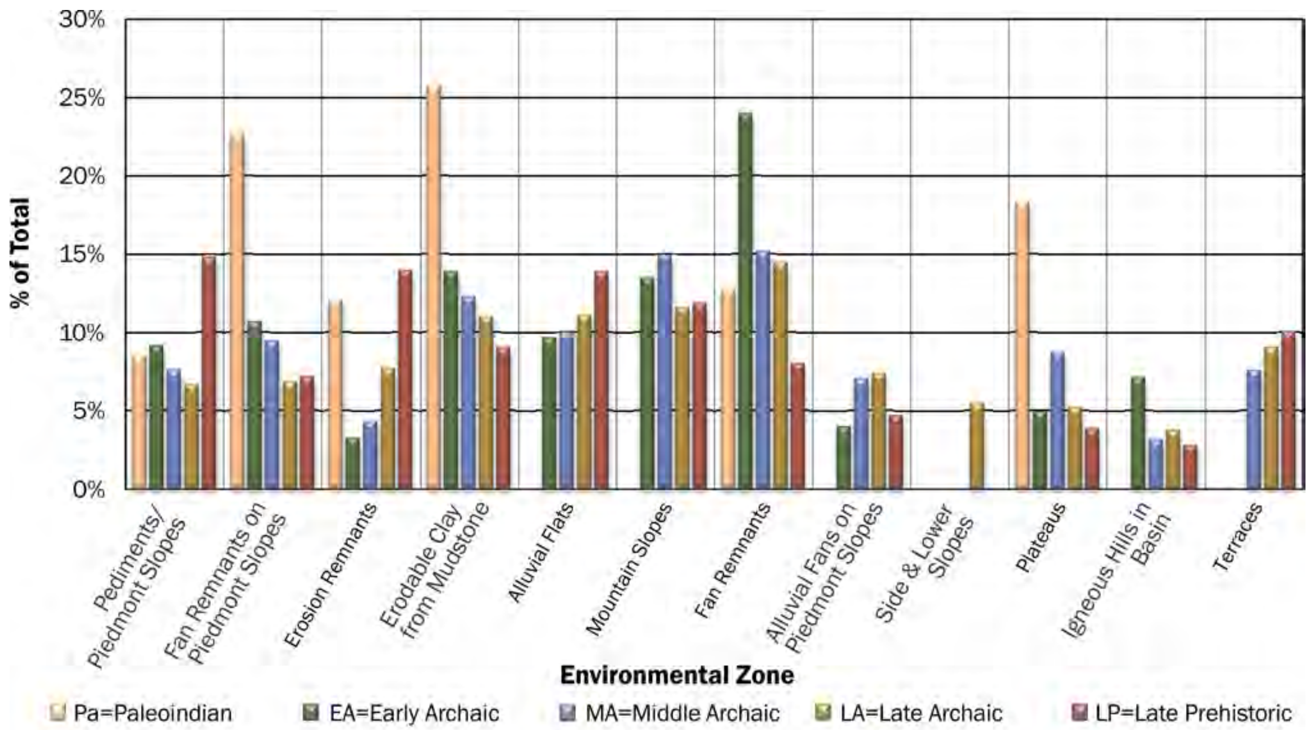


Figure 7.26 Site density by time period and environmental zone as percent of total by time period.

piedmont slopes, and plateaus, with fewer sites located on fan remnants, pediments/piedmont slopes, and erosion remnants.

Early Archaic sites are shown to occur most often on fan remnants, with fewer sites located on mountain slopes, erodable clay from mudstone, and fan remnants on piedmont slopes. Fewer than 10 percent of Early Archaic sites occur on each of alluvial flats, pediments/piedmont slopes, erosion remnants, alluvial fans on piedmont slopes, plateaus, and igneous hills in basin.

Middle Archaic sites are more uniformly distributed across zones, with most occurring on fan remnants, mountain slopes, and erodable clay from mudstone. Fewer than 10 percent of Middle Archaic sites occur on each of the remaining zones: alluvial flats, pediments/piedmont slopes, fan remnants on piedmont slopes, erosion remnants, terraces, alluvial fans on piedmont slopes, plateaus, and igneous hills in basin.

Late Archaic sites are distributed most uniformly of any time period, and occur in all zones where temporally affiliated sites were located. The highest preference is afforded fan remnants followed by mountain slopes, alluvial flats, and erodable clay from mudstone which are all nearly equal in site density. Late Archaic sites occur with only slightly less frequency on terraces, erosion remnants, alluvial fans on piedmont slopes, fan remnants on piedmont slopes, pediments/piedmont slopes, side and lower slopes, and plateaus. Less than 5 percent of Late Archaic sites occur on igneous hills in basin, the lowest density of any zone.

Late Prehistoric sites occur less uniformly than either Late or Middle Archaic sites, with the majority of sites occurring in just four zones: pediments/piedmont slopes, erosion remnants, alluvial flats, and mountain slopes. Late Prehistoric sites occur with less frequency on terraces, erodable clay from mudstone, fan remnants, and fan remnants on piedmont slopes. Less than 5 percent of Late Prehistoric sites occur in each of alluvial fans on piedmont slopes, plateaus, and igneous hills in basin.

Figure 7.27 shows the divergence of temporally affiliated site density from the general prehistoric density

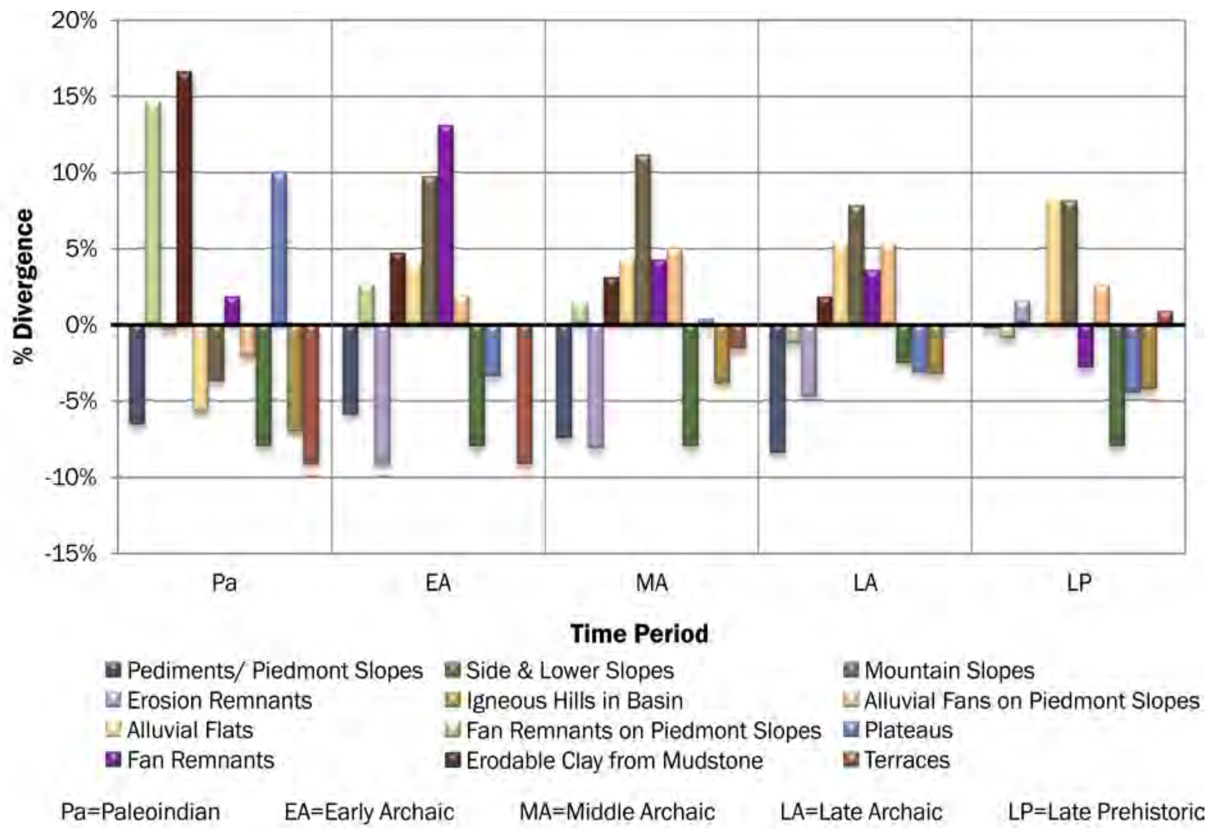


Figure 7.27 Divergence of temporally affiliated site density by time period and environmental zone from the general prehistoric distribution.

by time period and environmental zone. The exercise is similar to the one represented earlier in Figure 7.24, but in this case measures the *divergence in site density* (as percent of total by time period) so that area surveyed has been factored out. Interestingly, the results show a slightly higher total divergence by measures of density (306 percent) compared to the earlier exercise which did not account for area surveyed (274 percent).

Paleoindian sites are shown to diverge by a total of 86 percent from the general prehistoric distribution with the most dramatic departures being a far *greater* than expected density on erodable clay from mudstone and fan remnants on piedmont slopes. Paleoindian sites are also found *more* often than expected on plateaus and *less* than expected on terraces, side and lower slopes, igneous hills in basin, pediments/piedmont slopes, and alluvial flats.

Early Archaic sites diverge by a total of 72 percent, occurring with much *greater* frequency than expected on fan remnants and mountain slopes and far *less* frequently than expected on erosion remnants, terraces, side and lower slopes, and pediments/piedmont slopes. The remaining 6 zones show less than 5 percent divergence each.

Middle Archaic sites diverge by a total of 59 percent with a dramatically *higher* density than expected in mountain slopes and a significantly *lower* density than expected in erosion remnants, side and lower slopes, and pediments/piedmont slopes with the remaining 8 zones showing less than 5 percent divergence each.

Late Archaic sites diverge by a total of 47 percent with a significantly *higher* density than expected in mountain slopes, alluvial flats, and alluvial fans on piedmont slopes. Density is significantly *lower* than expected only on pediments/piedmont slopes with the remaining eight zones showing less than 5 percent divergence each.

Late Prehistoric sites diverge the least of any time period, by a total of 42 percent, with a significantly *higher* density than expected in alluvial flats and mountain slopes and a significantly *lower* density than expected in side and lower slopes. The remaining nine zones show less than 5 percent divergence each.

Summary of Site Distribution

This section explored the correlation between environmental zones and prehistoric sites, the bulk of which was devoted to temporally affiliated sites. Because of the great many variables involved and the number of analyses performed (and the potential for confusion), the results are summarized here.

Examination of the *general* prehistoric site distribution revealed a preference prehistorically for the piedmont zone, followed by the lowland and upland zones. However, despite the greater *number* of sites in the piedmont zone, sites tend to be *largest* in the lowland zone. Conversely, there are far fewer sites in the upland zone and the sites that do exist tend to be much smaller than average.

When broken out by the finer-grained environmental zones, site density is shown to be *greatest* in pediments/piedmont slopes, fan remnants on piedmont slopes, and erosion remnants. On the other hand, density is *lowest* in plateaus, alluvial flats, side and lower slopes, mountain slopes, igneous hills in basin, and alluvial fans on piedmont slopes.

By area, sites are shown to be much *larger* than average in fan remnants, alluvial flats, erosion remnants, and pediments/piedmont slopes. By contrast, sites are shown to be much *smaller* than average in mountain slopes, alluvial fans on piedmont slopes, plateaus, igneous hills in basin, and side and lower slopes.

These findings contrast significantly from the distribution of *temporally affiliated* sites which, by physiographic zone, are shown to have the highest density in the lowlands, followed by the piedmont and upland zones. The data shows that although there are more temporally *unaffiliated* prehistoric sites located in the piedmont zone, the lowland zone has the highest density of temporally *affiliated* sites, a phenomenon attributable primarily to the relatively high number of Late Archaic and Late Prehistoric sites that dominate that zone. These results likely reflect a higher percentage of "simple" sites in the general prehistoric distribution (that lack temporally diagnostic artifacts) compared to those of temporally affiliated sites, which often tend to be larger and more complex.

By measures of site density, the data suggests that the uplands assumed *increasing* importance during the Archaic period—with the highest site density during the Middle Archaic—before *declining* in importance during the Late Prehistoric period. The piedmont zone—although containing the highest density during two of the time periods—generally *decreased* in importance through the Late Archaic before *rising* again during the Late Prehistoric period. The lowland zone is shown to have been most important during the Paleoindian period before *declining* during the Early Archaic then gradually assuming increasing importance throughout the remainder of the prehistoric period.

In examining temporally affiliated sites by the finer-grained environmental zones, the data indicates that—compared to the general site distribution—far *fewer* sites containing temporal diagnostics occur on pediments/piedmont slopes than in other zones, and somewhat fewer temporally affiliated sites occur in erosion remnants and side and lower slopes. Conversely, a significantly *higher* number of temporally affiliated sites occur in mountain slopes and a somewhat higher number in erodable clay from mudstone, alluvial flats, fan remnants, and alluvial fans on piedmont slopes.

Despite the small sample size, the data indicates Paleoindian sites are *most frequently* located in erodable clay from mudstone, fan remnants on piedmont slopes, and plateaus, with *fewer* sites located on fan remnants, pediments/piedmont slopes, and erosion remnants. Their high presence in lowland areas may reflect milder climatic conditions during that time. However, their absence in alluvial flats and alluvial fans on piedmont slopes may be a result of sites from this time period being buried in these settings.

Temporally affiliated sites from all three subperiods of the Archaic occur most often on fan remnants followed by mountain slopes and erodable clay from mudstone (except during the Late Archaic, where alluvial flats hold third place, with erodable clay from mudstone ranking fourth). This distribution, then, reflects a clear Archaic preference for fans around limestone mountains, igneous mountains, and badlands.

Perhaps most conspicuous of these findings is that fan remnants are geographically constricted and wholly confined to the flanks of *limestone* mountains—primarily off the west slope and interior valleys of the Dead Horse Mountains and the southern flanks of the Santiago Mountains (with lesser areas around Mariscal Mountain and Mesa de Anguila). They are most commonly bounded by limestone mountains on the upslope side and alluvial flats on the downslope side. Considering this zone's very limited spatial extent, the preference for this area seems significant.

Mountain slopes, which essentially encompass all the major igneous mountains in the park, rank second highest in density. Because of the expansiveness of this zone, as well as the biodiversity it encompasses due to the range of elevation contained, this finding is not surprising. However, this zone is generally located a considerable distance from fan remnants, and only borders it to a significant extent around the McKinney Hills.

Of all time periods, Late Archaic sites are distributed most uniformly across environmental zones, and occur in all zones where temporally affiliated sites were located. The Late Archaic is also the only time period represented in side and lower slopes, which is a further reflection of the wide range of environmental zones utilized during this period.

Although Late Archaic site distribution reflects the preferences of the preceding two periods, a slightly higher preference is afforded alluvial flats over erodable clay from mudstone, essentially moving the latter zone from third place to fourth. This zone, characterized by flat open expanses of Quaternary-aged alluvium (and located most prominently in the northern portion of the park and the northern reaches of Tornillo Creek) is often found adjacent to, but slightly lower in elevation than, erodable clay from mudstone and may suggest increasing use of lower elevation areas.

Late Prehistoric sites are shown to occur less uniformly across zones than either Late or Middle Archaic sites, with the majority of sites occurring in just four zones: pediment/piedmont slopes, erosion remnants, alluvial flats, and mountain slopes. This largely concurs with the observation that Late Prehistoric occupation emphasized piedmont and lowland physiographic zones rather than upland settings, a departure from earlier Archaic settlement patterns. The data also indicates a dramatic shift *away* from fan remnants during the Late Prehistoric—moving it from first place to seventh.

The robust nature of this finding likely relates to specific resources found in the fan remnant settings that were targeted during the Archaic but—for whatever reason—not in the Late Prehistoric. That this zone is so geographically constricted and associated solely with limestone mountains seems to suggest that these targeted resources were strongly related to soil type, or some other environmental factor, affiliated with this zone.

While more data will be required to explain these findings, they suggest that environmental factors strongly influenced site location, and that these factors changed through time. While many forces may have been at work, it seems likely that much of the behavioral response reflected in the archeological record is in some measure related to changes in climate over time which would have forced commensurate changes in floral and faunal composition from one zone to another.

Despite the enticing nature of these findings, caution must be exercised in interpreting the data for a great many reasons, most of which were detailed at the beginning of this chapter. This is especially true in relation to the earlier time periods for which the sample sizes are quite low—particularly the Paleoindian period which is represented by only 13 sites. In addition, results become increasingly suspect when the departure from expected values is dramatic in comparison with the other time periods, as frequently occurred with both Paleoindian and Early Archaic sites.

Site Richness

One measure of archeological site content is site *richness*: the diversity of the artifact and feature assemblage within a site measured by the number of categories of archeological materials. For the BBNP data set, richness was calculated by simply tabulating the number of *categories* of archeological material, regardless of the abundance of items in (or the relative significance of) each class (Table 7.10).

Feature types that were tallied consist of hearth types (ring, pavement, and cobble-lined pavement), ring middens, and stone enclosures. Remaining feature types in the data set were excluded due to their inherent ambiguity, such as rock alignments, rock groupings, and sheet middens. Artifact types included in the richness tally consist of projectile points, bifaces, scrapers, hammerstones, cores, modified debitage, and groundstone (collectively including manos, metates, and mortar holes). Unmodified debitage was not included as a category. Each category was considered either present or absent, and assigned a value of 1 if present. The maximum possible value was 12 although the highest score achieved by any one site was 10. Sites with a richness value (RV) of 0 include those sites consisting only of debitage and scattered FCR or feature types that were not included in the richness calculation (such as a lithic scatter).

Table 7.10 Prehistoric Sites by Richness Value.

Richness Value	# of Sites	% of Total
RV0	136	9.23%
RV1	430	29.19%
RV2	316	21.45%
RV3	205	13.92%
RV4	158	10.73%
RV5	85	5.77%
RV6	58	3.94%
RV7	41	2.78%
RV8	23	1.56%
RV9	12	0.81%
RV10	9	0.61%
Grand Total	1,473	100.00%

Figure 7.28 shows the parkwide distribution of prehistoric sites by richness values. Excluding RV0, the distribution of RV frequencies follows an asymmetric curve (data skewed right) where the higher the richness value, the fewer the number of sites. Over 50 percent of prehistoric sites recorded during the project fall into RV1 and RV2. The number of sites is shown to decrease stepwise with each increase in richness value, with RV3 to RV10 comprising just over 40 percent of all sites and the three richest categories making up less than 3 percent of all sites.

Figure 7.29 depicts richness values across physiographic zones. The distribution by PZ generally mirrors the parkwide distribution, especially within the lowland and piedmont zones. The upland zone displays a departure from the norm with a relatively higher number of RV0, RV7, and RV8 sites and a relatively lower number of RV1 and RV6 sites. However, this is likely the result of the significantly smaller sample size in the uplands (n=198) versus those of the piedmont (n=729) and lowland (n=489) zones. The piedmont zone displays the highest proportion of RV0–RV4 sites, whereas the

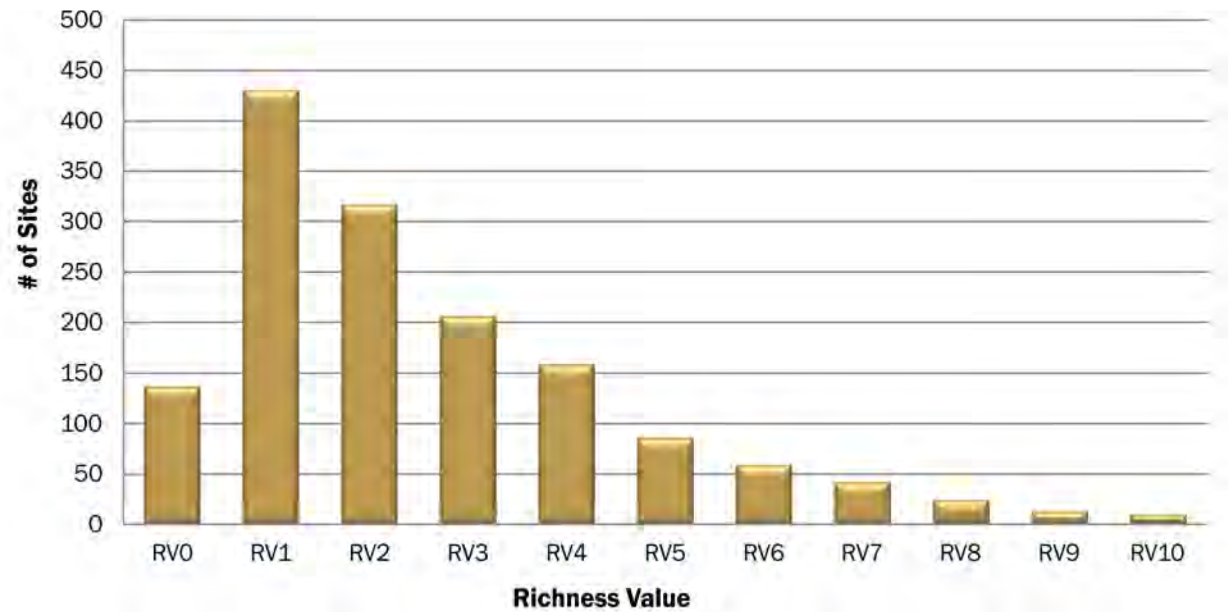


Figure 7.28 Distribution of prehistoric sites by richness value.

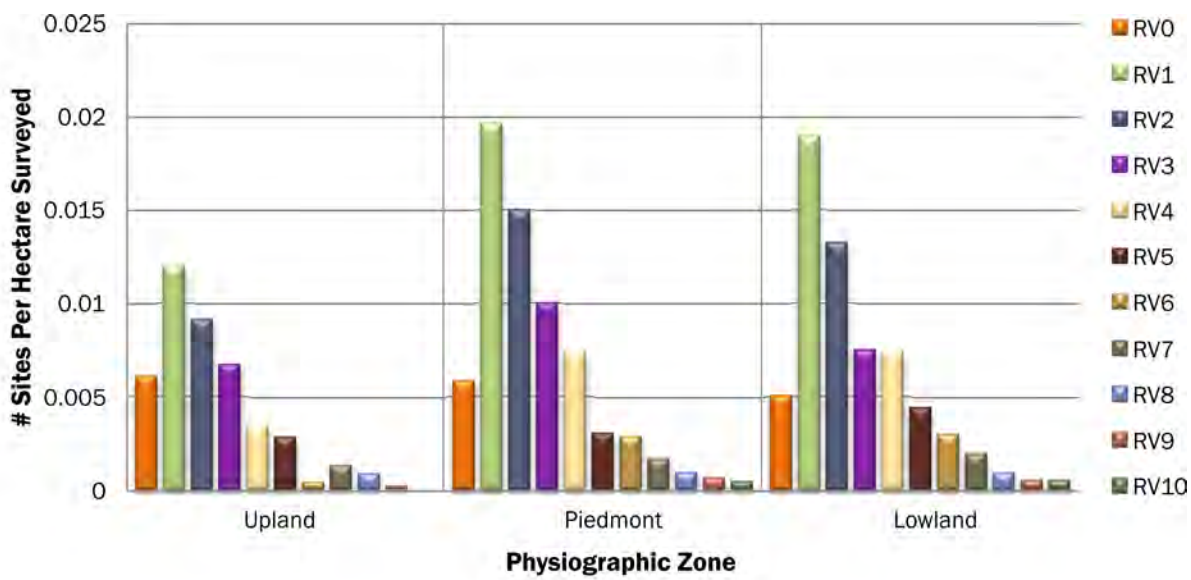


Figure7.29 Richness value of sites by physiographic zone. Bar values are number of sites per hectare surveyed. Crosscut and insufficient zones are omitted.

lowland zone has the highest proportion of RV5–RV10 sites, indicating that site complexity is somewhat greater in the lowlands. Figure 7.30 provides a closer look at the highest 5 richness values which further accentuates the discrepancies.

Table 7.11 shows the total number of sites in each richness category by environmental zone (here, the full 21 zones). Note that many of the environmental zones contain very few sites and only 9 zones contain more than 50 sites—considered here to be sufficient for comparison.

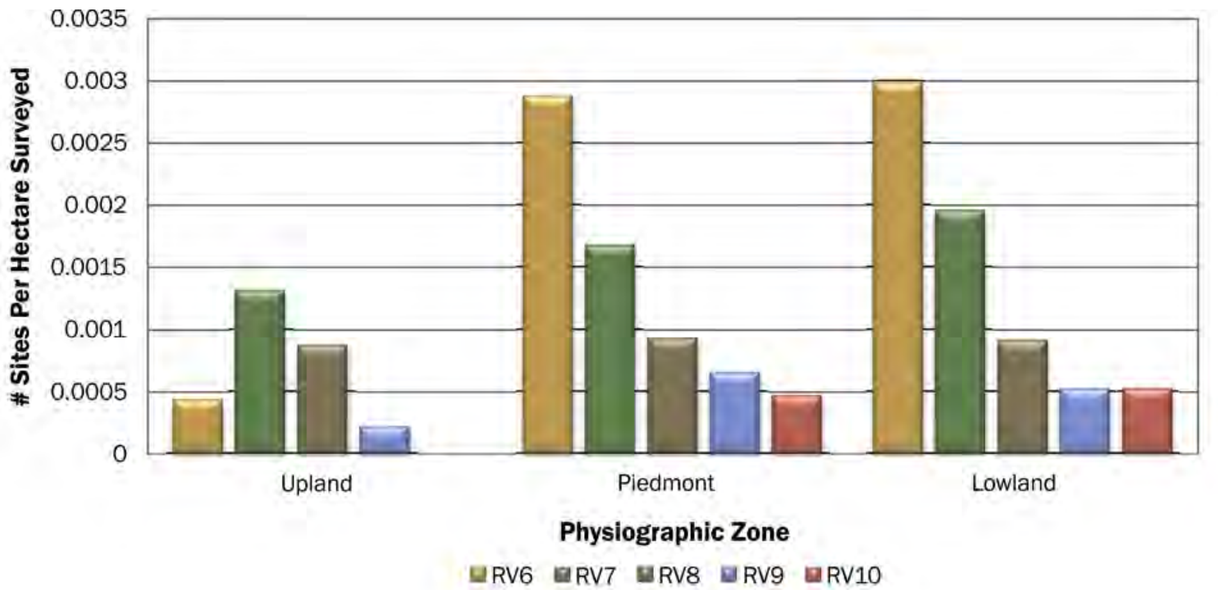


Figure 7.30 Highest richness values (RV 6–10) by physiographic zone. This chart is a subset of the previous figure to better illustrate the richer sites.

Table 7.11 Archeological Richness of Prehistoric Sites by Environmental Zone.

	Richness Values											
EZ	0	1	2	3	4	5	6	7	8	9	10	Total
Alluvial Fans		1				1						2
Alluvial Fans on Piedmont Slopes	6	7	2	5	4	2	1	1				28
Alluvial Flats	8	21	12	10	8	4	5	3	3	2	1	77
Arroyos		3	4	3	2	2		1				15
Erodable Clay from Mudstone	6	38	29	21	22	10	8	4		2	3	143
Erosion Remnants	22	73	57	24	22	15	9	8	4			234
Fan Remnants	10	39	19	22	13	4	4	2	3		1	117
Fan Remnants on Piedmont Slopes	15	44	44	29	21	9	11	5	3	2	1	184
Floodplains		1	1		1		1		1			5
Hillslopes	1	1					1		1			4
Igneous Hills in Basin	4	6	9	3	2	2	2		1			29
Limestone/Shale Hills in Basin	2		2		1							5
Low Hills from Tuff		4		2	1	1						8
Moist Meadows		1										1
Mountain Slopes	7	17	8	8	5	9		6	3	1		64
Pediments/Piedmont Slopes	32	122	97	52	42	18	15	10	4	5	3	400
Plateaus	6	17	14	9	6	1						53
Scarps	3	4	2	2		1		1				13
Side & Lower Slopes	11	15	11	11	3	1						52
Steep Mid-Slopes		2	1	1								4
Terraces	3	14	4	3	5	5	1					35
Grand Total	**136**	**430**	**316**	**205**	**158**	**85**	**58**	**41**	**23**	**12**	**9**	**1,473**

Figure 7.31 graphically displays the richness value of sites in environmental zones containing 50 or more sites; these are presented by site density (sites *per hectare surveyed*) to allow comparison between zones. In comparison with the projectwide distribution, the graph reveals considerable variability in site richness between the EZ categories. Notably, alluvial flats and mountain slopes appear to contain relatively fewer RV0–RV4 sites whereas erosion remnants, fan remnants and pediments/piedmont slopes contain relatively more. Conversely, sites in erodable clay from mudstone, mountain slopes, and pediments/piedmont slopes contain relatively more RV6–RV10 sites, indicating greater site complexity in these zones. These latter three zones each occur at different elevations, and within different physiographic areas, which reveals a more nuanced picture than is presented by the physiographic zones alone.

The starkest pattern is demonstrated in *plateaus* and *side and lower slopes,* which contain no sites above RV5. Almost all the sites in these zones tend to be less diverse in their variety of features and artifacts. It is instructive that both of these environmental zones occur within the limestone mountains, indicating that sites in these areas tend to be significantly less complex.

A more detailed view is shown in Figure 7.32 for sites with the *highest* richness values (RV5–RV10) which highlights the variability between zones of the more complex sites. Mountain slopes are shown to contain the highest density of RV5 and RV7 sites and shares the highest density of RV8 sites with fan remnants. Alluvial flats are shown to contain the most RV9 sites and erodable clay from mudstone to contain the most RV10 sites.

In sum, the site richness breakdown by physiographic zone reveals a slightly higher proportion of complex sites in the lowlands and a lower proportion of complex sites in the uplands, with the piedmont zone falling in between. When broken out by environmental zone, the most significant pattern relates to plateaus and side and lower slopes—both located

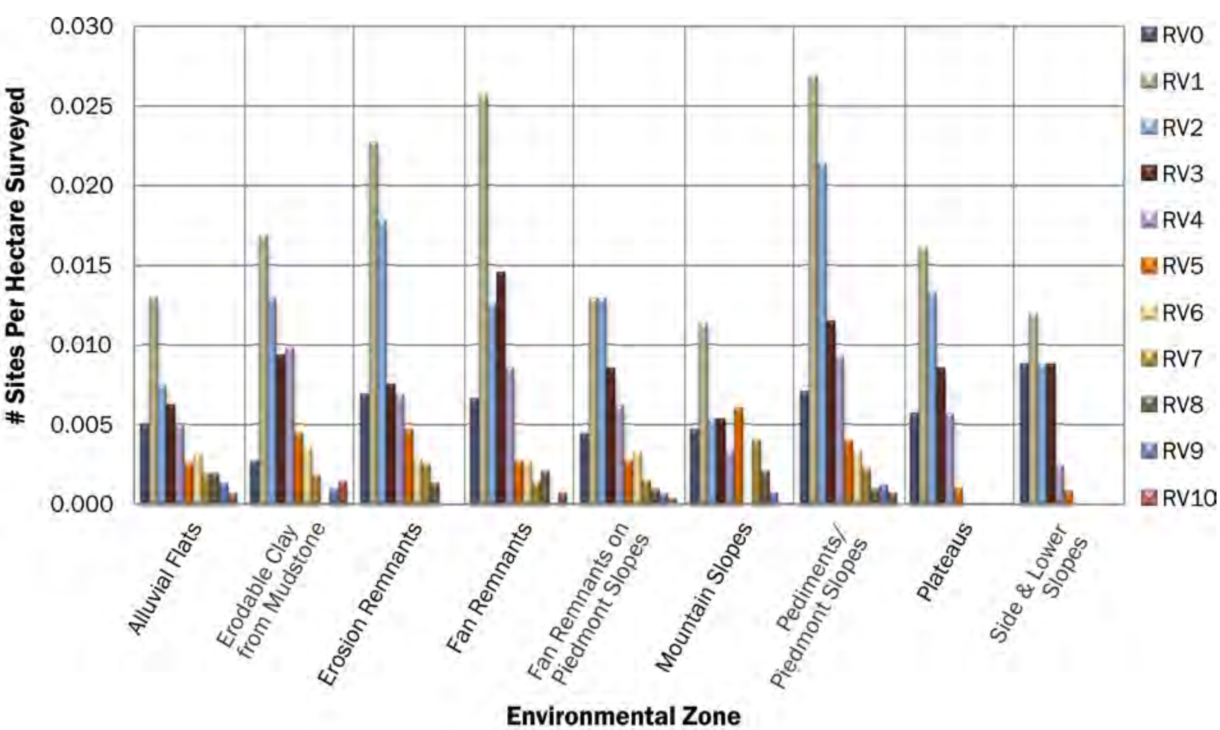


Figure 7.31 Site richness by environmental zone ***per hectare surveyed****. Zones containing less than 50 sites were omitted.*

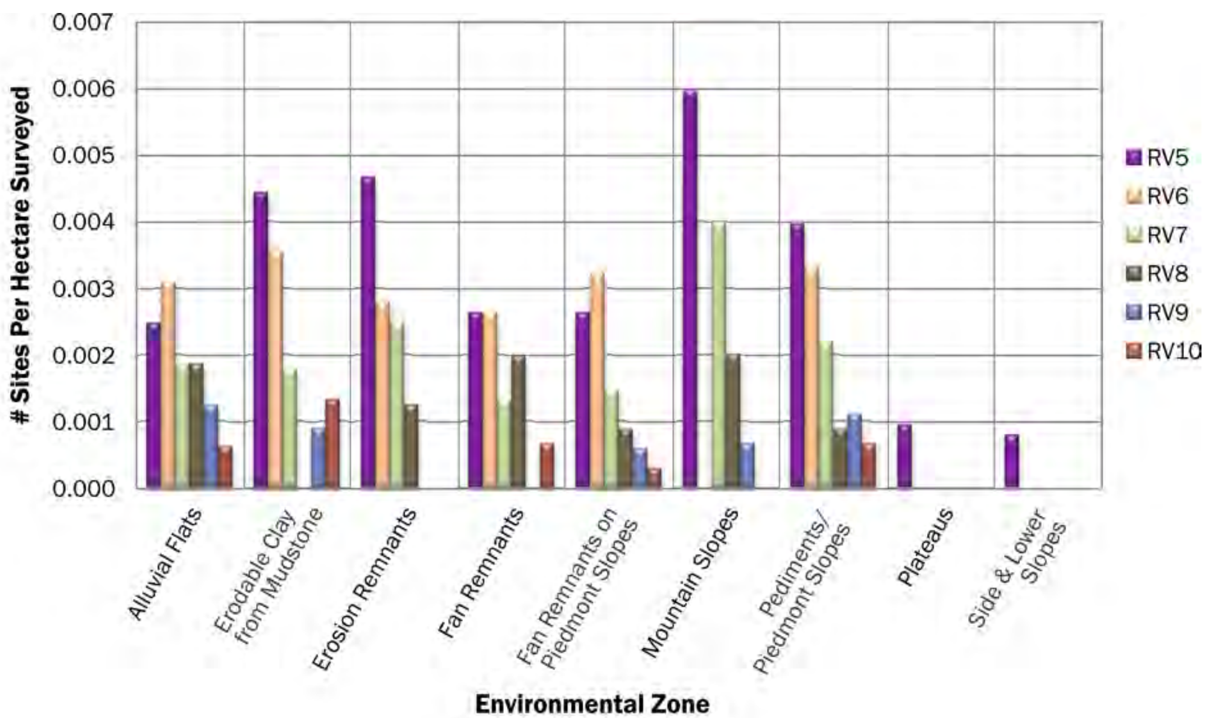


Figure 7.32 Highest richness values by environmental zone, RV6–RV10.

in the limestone mountains—where site complexity tends to be significantly lower. Other patterns are less certain. Sites located in erosion remnants and fan remnants tend to be *less* complex, whereas sites in erodable clay in mudstone and mountain slopes tend to be *more* complex. Both simple and complex sites are found in relative abundance on pediments—the environmental zone whose richness distribution most closely follows the general parkwide distribution.

High or low archeological richness can be conditioned by a number of factors, including post-occupation taphonomic processes as well as the behavior of prehistoric peoples. In cases where sites with high richness values are found in eroded settings (such as erodable clay from mudstone), these patterns might be explained as the result of multiple components exposed as a result of erosional processes. In this case, richness would be more a function of natural taphonomic processes than past human behavior. Human behavior *in tandem* with natural conditions may also influence site richness. For example, high site richness on landforms with long stable surfaces (such as pediments) may be a function of successive occupations on the same surface through time creating palimpsest archeological deposits.

In other cases, behavioral explanations are more likely. For example, high site richness may reflect occupations where diverse activities were carried out, such as sites that served as residential base camps (Binford 1980). Considering the EZ richness distributions, then, one might expect fewer base camps to have been situated on plateaus, side and lower slopes, and erosion remnants and, accordingly, we see few rich sites in these settings. Alternatively, in some cases low site richness may also be a function of poor visibility due to conditions such as dense vegetation. In other cases, substantial portions of archeological assemblages may be buried such that only a fraction of the total material culture is evident.

Future research could examine archeological richness by time period, focusing on sites with only a single time period represented by diagnostic projectile points.

Richness could also be examined by site type—perhaps by distinguishing between base camps and different types of logistical camps, such as those focused on food processing.

Analysis of Archeological Content

This section examines the relationships between major feature types and a selection of variables including time periods, environmental context, and artifact assemblages. Because numerical counts for artifacts other than projectiles were not tabulated in the master spreadsheet, they are not examined quantitatively in the subsequent analysis.

Hearth Analyses

The following section examines different hearth types recorded during the survey, including their presumed temporal affiliations, distribution, and associated material culture. Three major hearth types are examined: pavement, ring, and cobble-lined pavement. Although other hearth types occur (such as slab hearths, conjoined hearths, etc.) in BBNP, they are quite rare relative to these three. Due to a higher level of methodological consistency, the following analysis utilizes only the 2005–2010 data subset. It was also during this period that a previously unrecognized hearth type (cobble-lined pavement) was discovered and began to be tallied separately.

Table 7.12 shows the frequency and relative frequency of each hearth type in the 2005–2010 data subset.

Table 7.12 Counts of Major Hearth Types Documented from 2005 to 2010.

Type	Count	% of Total	# Sites	% of Total
Pavement	2,404	76.63%	706	68.81%
Ring	472	15.05%	206	20.08%
Cobble-lined Pavement	261	8.32%	114	11.11%
Total	3,137	100.00%	1,026	100.00%

The data reveals that pavement hearths are encountered with far greater frequency than any other type, comprising almost 77 percent of the total number of hearths recorded between 2005 and 2010. Ring hearths were encountered far less frequently, representing only about 15 percent of hearths. Cobble-lined pavement hearths were least frequently encountered, amounting to only 8 percent of the total number of hearths.

Figure 7.33 Graphically displays the data from Table 7.12. In comparing the number of hearths to the number of sites containing each hearth type, the lower relative percentage of *sites* containing pavement hearths, versus the higher percentages of sites containing ring and cobble-lined pavement hearths, likely reflects the fact that on sites containing only a single hearth, the hearths are most often pavement hearths rather than cobble-lined or ring hearths. In fact, of all single-hearth sites recorded between 2005 and 2010 in cases where the hearth type was identified (n=314), 76 percent were pavement hearths, 12 percent were ring hearths, and 12 percent were cobble-lined pavement hearths (note: single-hearth site data not shown).

Temporal Distribution

Examining the temporal distribution of hearths, the analysis is further limited to sites containing only a single hearth *type* that also contain one or more diagnostic projectiles.[6] The resulting data set is comprised of 643 sites, including 526 containing only pavement (PVT) style hearths, 73 sites containing only cobble-lined pavement (CLP) hearths, and 44 sites that contain only ring hearths (RING).

6. Analyses were also performed using more specific data subsets; for example, limiting the analysis to sites containing only one hearth of a single type AND a diagnostic projectile from a single time period. However, the resulting sample size (n=17) was too small for reliable results.

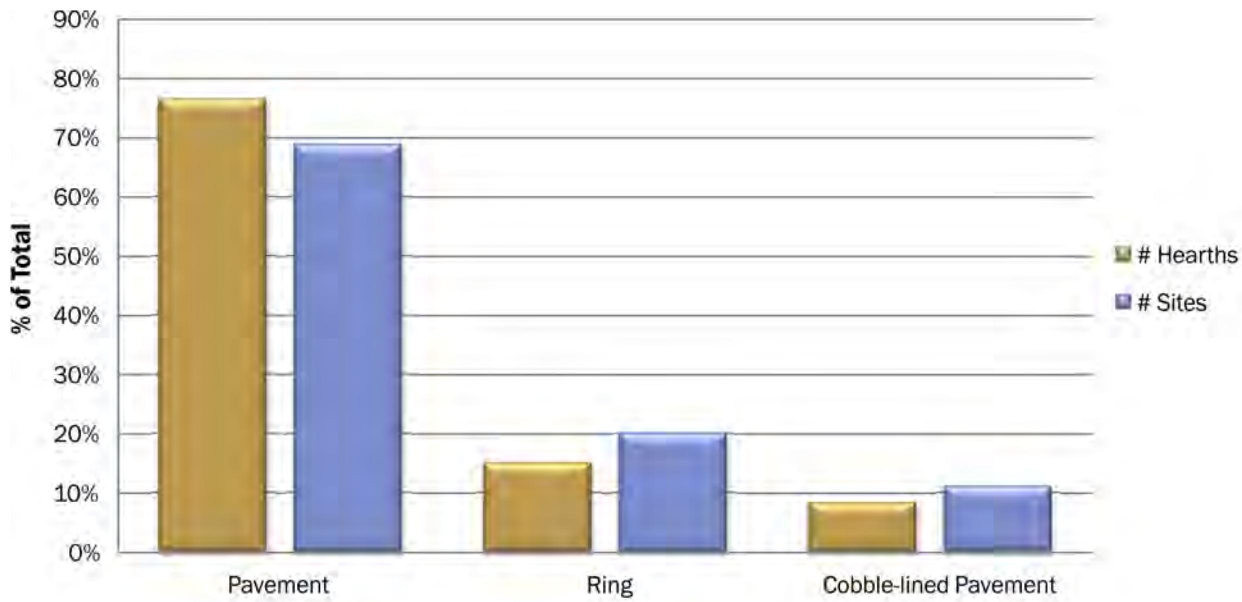


Figure7.33 Hearths by type showing the percentage of total for both the number of hearths and the number of sites containing each hearth type.

Table 7.13 Sites with One Hearth Type, Showing Number of Diagnostic Projectile Point(s).

					# of Projectiles					
Type	# Hearths	% of Total	# Sites	% of Total	Pa	EA	MA	LA	LP	Totals
Pavement	1,560	87.39%	526	81.80%	8	12	41	68	101	230
Cobble Lined	161	9.02%	73	11.35%	0	2	3	2	0	7
Ring	64	3.59%	44	6.84%	0	2	1	4	2	9
Totals	1,785	100.00%	643	100.00%	8	16	45	74	103	246

Pa=Paleoindian, EA=Early Archaic, MA=Middle Archaic, LA=Late Archaic, and LP=Late Prehistoric.

Table 7.13 shows sites containing only one hearth type and the number of diagnostic projectiles associated with these sites, arranged by hearth type and time period. The table reveals that 82 percent of sites contain only pavement hearths, 11 percent contain only cobble-lined hearths, and 7 percent contain only ring hearths. Compared to the broader 2005–2010 data, this subset contains a higher percentage of both pavement hearths and cobble-line pavement hearths, but a lower percentage of ring hearths. Thus, ring hearths are the least likely of the three types to occur as the sole hearth type on a site.

The table also reveals that sites with only pavement hearths contain far more diagnostic projectiles from every time period than sites containing other hearth types—amounting to 94 percent of the total. Projectiles on sites with cobble-lined pavement hearths comprise only 3 percent of the total, and contained no diagnostics from either the Paleoindian period or the Late Prehistoric. Projectiles on sites with ring style hearths amount to only 4 percent of the total but contained diagnostics from every period aside from the Paleoindian period.

Table 7.14 displays the same data as Table 7.13, but as percentages of total by hearth type. The data reveals that pavement style hearths are found with diagnostic projectiles with increasing association through time. Cobble-lined pavement hearths, on the other hand,

Table 7.14 Sites with One Hearth Type and Diagnostic Projectile Point(s).

Type	# Hearths	# Sites	Pa	EA	MA	LA	LP
Pavement	87.39%	81.80%	3.48%	5.22%	17.83%	29.57%	43.91%
Cobble Lined	9.02%	11.35%	0.00%	28.57%	42.86%	28.57%	0.00%
Ring	3.59%	6.84%	0.00%	22.22%	11.11%	44.44%	22.22%
Totals	100.00%	100.00%	3.25%	6.50%	18.29%	30.08%	41.87%

Note: Time periods shown as percentage of total by hearth type.
Pa=Paleoindian, EA=Early Archaic, MA=Middle Archaic, LA=Late Archaic, and LP=Late Prehistoric.

appear correlated solely with the Archaic subperiods, notably the Middle Archaic. Ring hearths appear to be associated with all time periods after the Paleoindian period, but most strongly with the Late Archaic.

Table 7.15 shows how time periods represented in sites with one hearth type diverge from the projectwide projectile point temporal distribution. Because unspecified Archaic specimens were not included in the hearth-type breakdown by time period analysis, the projectile temporal breakdown also excludes the 222 Archaic unspecified projectile points. The resulting projectile temporal distribution, as percentages of total, shows that 2 percent of typed projectiles were Paleoindian, 7 percent were Early Archaic, 22 percent were Middle Archaic, 32 percent were Late Archaic, and 37 percent were Late Prehistoric.

If each hearth type was used equally throughout prehistory, we would expect their temporal affiliation to approximate the projectwide temporal distribution. Thus, the projectwide temporal distribution becomes the expected value for each time period. Where these values differ suggests a stronger or weaker association with that time period.

Figure 7.34 graphically displays the divergence from expected values for each hearth type, by time period, represented as percentages of total. Pavement hearths are shown to diverge the least from the projectwide distribution, by no more than 7 percent for any one time period, with total divergence amounting to less than 17 percent. This suggests that pavement hearths were used throughout prehistory, but are shown to be most associated with the Late Prehistoric, and the least with the Middle Archaic.

Cobble-lined pavement hearths, by contrast, are shown to diverge the most—by a total of 85 percent across all time periods—which reflects that this hearth type is the least abundant type throughout time and suggests that it may have strong temporal associations. The graph reveals them to be most strongly associated (with more than 20 percent higher than expected value) with the Early Archaic and Middle Archaic periods, weakly with the Late Archaic, and with no association with either the Paleoindian or Late Prehistoric periods.

Ring hearths display the second highest divergence—by a total of 55 percent across all time periods. Divergence between time periods differs substantially,

Table 7.15 Divergence of Sites with One Hearth Type from The Projectwide Temporal Distribution.

Time Per.	Proj. Ratios	PVT	PVT Div	CLP	Clp Div	Ring	Ring Div
Paleoindian	2%	3.48%	1.48%	0.00%	-2.00%	0.00%	-2.00%
Early Archaic	7%	5.22%	-1.78%	28.57%	21.57%	22.22%	15.22%
Middle Archaic	22%	17.83%	-4.17%	42.86%	20.86%	11.11%	-10.89%
Late Archaic	32%	29.57%	-2.43%	28.57%	-3.43%	44.44%	12.44%
Late Prehistoric	37%	43.91%	6.91%	0.00%	-37.00%	22.22%	-14.78%

Note: Shown as percentages of total by time period.

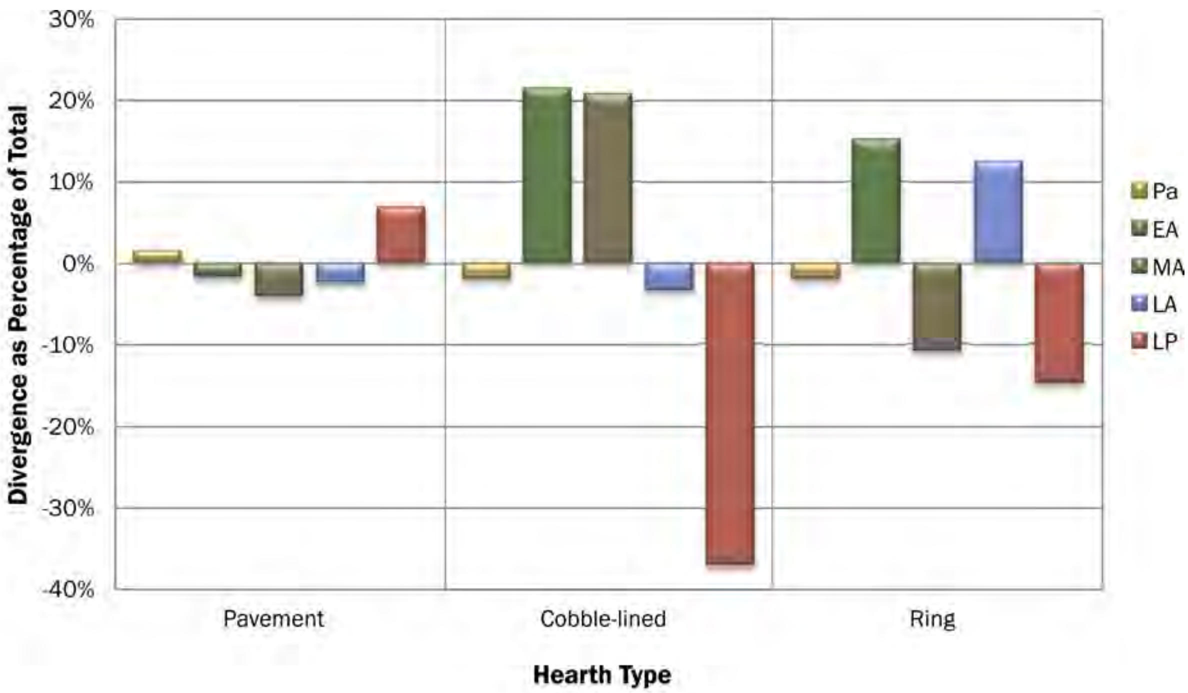


Figure7.34 Divergence from expected values for hearth types by time period, as percent of total.

with no discernible pattern. This style is shown to be most associated with the Early Archaic and Late Archaic, and less associated with the Paleoindian, Middle Archaic, and Late Prehistoric periods.

That pavement hearths are closest to expected values is likely the result of this hearth type being used throughout prehistory (and even into early historic times), but also reflects the substantially larger sample size (526 sites containing 1,560 pavement hearths compared to only 73 sites containing 161 cobble-lined pavement hearths and 44 sites containing 64 ring hearths). Conversely, the strong association indicated between cobble-lined pavement hearths and the Early and Middle Archaic and their weak or non-existent association with other time periods suggests that this hearth type may be temporally discrete.

Indeed, the two sites containing only cobble-lined pavement hearths and Early Archaic projectiles appear to have the strongest association by virtue of excellent context (proximity of the projectile to the hearth and degree to which hearth could be definitively typed). In the two sites containing cobble-lined hearths and Middle Archaic projectiles, the association is much less definite due to questionable context. Additional research is needed to better determine its temporal affiliation, and to support or refute the Early and/or Middle Archaic association. Of the three hearth types, however, cobble-lined hearths likely have the best chance at being either temporally and/or functionally diagnostic.

Of the three hearth types, the analysis results for ring hearths seems most suspect. While the strong association with the Early Archaic and Late Archaic periods and the weak association with the Middle Archaic and Late Prehistoric periods may represent true prehistoric patterns, the erratic nature of the findings and lack of any temporal trajectory places the results into question. Because, in some cases, cobble-lined hearths and ring style hearths are difficult to distinguish, some of the former could easily have been mistaken for the latter. This is a more likely scenario than the opposite. Although both feature types share the ring-like configuration, the presence of smaller FCR in the feature's interior distinguishes cobble-lined hearths from ring hearths (which themselves are often basin shaped in profile). In cases where deposition has occurred inside the feature, this characteristic could easily be obscured, leading recorders to misclassify some cobble-lined pavement hearths. If this happened with any regularity, and if cobble-lined pavement hearths are, indeed, associated primarily with the Early Archaic, then this may help explain these results. On the other hand, it is possible that ring-style hearths were used only episodically throughout prehistory, such that they were in common use in the Early Archaic but uncommon in the Middle Archaic. Excavation data will likely be required to shed further light on this question.

Environmental Distribution

Hearths were found in 17 out of 21 environmental zones surveyed during the project (Fig. 7.35). Only alluvial fans on piedmont slopes, steep mid-slopes, alluvial fans, and moist meadows contained no hearths. The frequency of hearths in the remaining zones do not mirror either the number of hectares surveyed in each zone or the number of sites found in each zone, suggesting that environmental factors are responsible either for prehistoric human preference or differential preservation of features.

Figure 7.35 shows hearth density by environmental zone for each hearth type. The data reveals that pavement hearths have the highest overall density, occur across more zones, and are distributed more evenly than any other hearth type (found in 16 out of 17 zones where hearths occur). Cobble-lined pavement hearths are found in the fewest zones of any hearth type (12 out of 17 zones) and are by far the most spatially patterned (meaning their distribution across the landscape is spatially distinctive). Ring hearths are

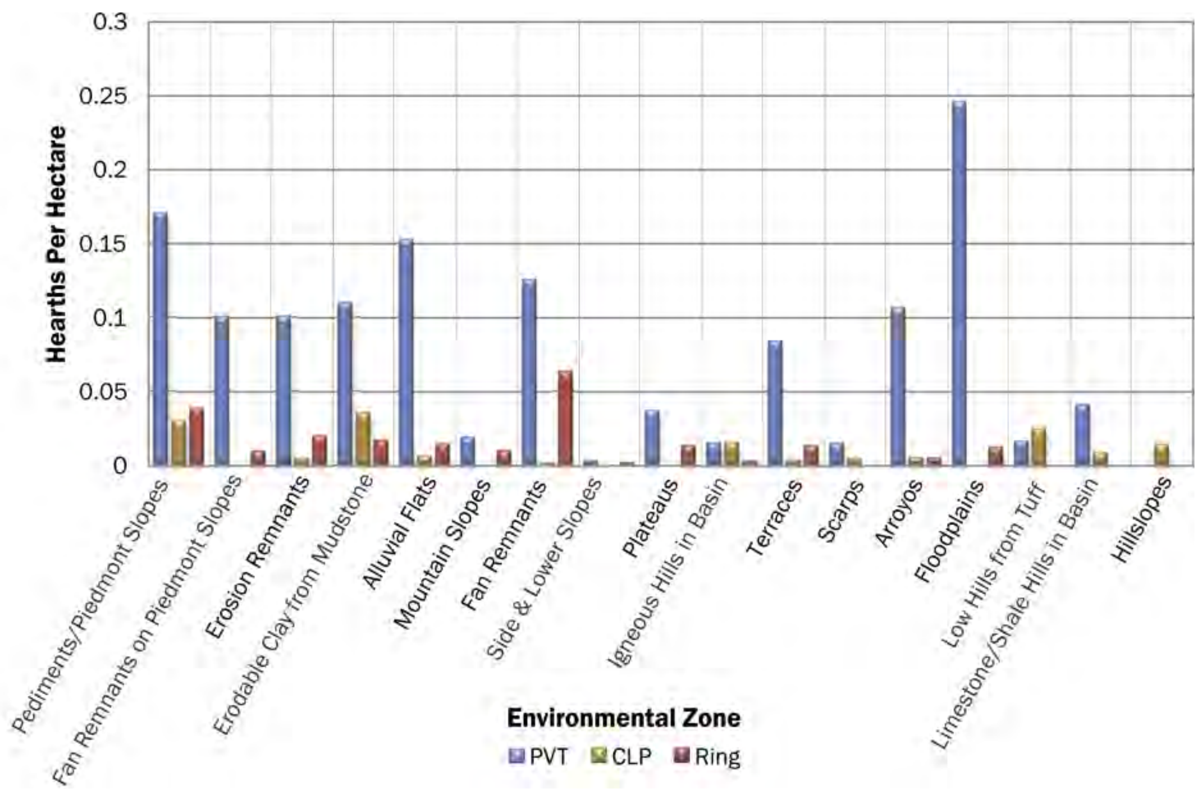


Figure 7.35 Number of hearths of each type per hectare surveyed per EZ, by EZ (2005–2010 sites). EZs are presented in descending order of area surveyed.

found in 13 out of 17 zones where hearths occur and are the second-most spatially patterned.

Figure 7.36 shows the site density of hearths by hearth type and environmental zone, expressed as percentages of total (of hearths per hectare) for each hearth type. This allows better comparisons between hearth types since it factors out the number of hearths in each class, placing all on equal footing. The data reveals, then, the relative significance of each environmental zone to each hearth type. Pavement hearths are shown to occur most frequently in floodplains, followed by pediments/piedmont slopes, alluvial flats, and fan remnants. They are found very infrequently in side and lower slopes, scarps, igneous hills in basin, low hills from tuff, and mountain slopes, and not at all on hillslopes.

Cobble-lined pavement hearths are shown to occur prominently in several "outlier" zones containing few, if any, other hearth types, particularly in hillslopes, low hills from tuff, and igneous hills in basin. These hearths are found most frequently in erodable clay from mudstone, pediments/piedmont slopes, low hills from tuff, and igneous hills in basin which, taken together, account for nearly 70 percent of all cobble-lined pavement hearth density. They occur least frequently in fan remnants, terraces, scarps, and erosion remnants. Ring hearths are found most frequently in fan remnants, pediments/piedmont slopes, erosion remnants, and erodable clay from mudstone. They are found least frequently in side and lower slopes, igneous hills in basin, arroyos, and remnants on piedmont slopes.

The significance of fan remnants to ring style hearths is shown to be the highest of any hearth-environmental zone correlation. This is followed by the strong correlation between cobble-lined pavement hearths and erodable clay from mudstone. Although all three hearth types occur prominently in pediments/piedmont slopes, the relative density of cobble-lined pavement hearths

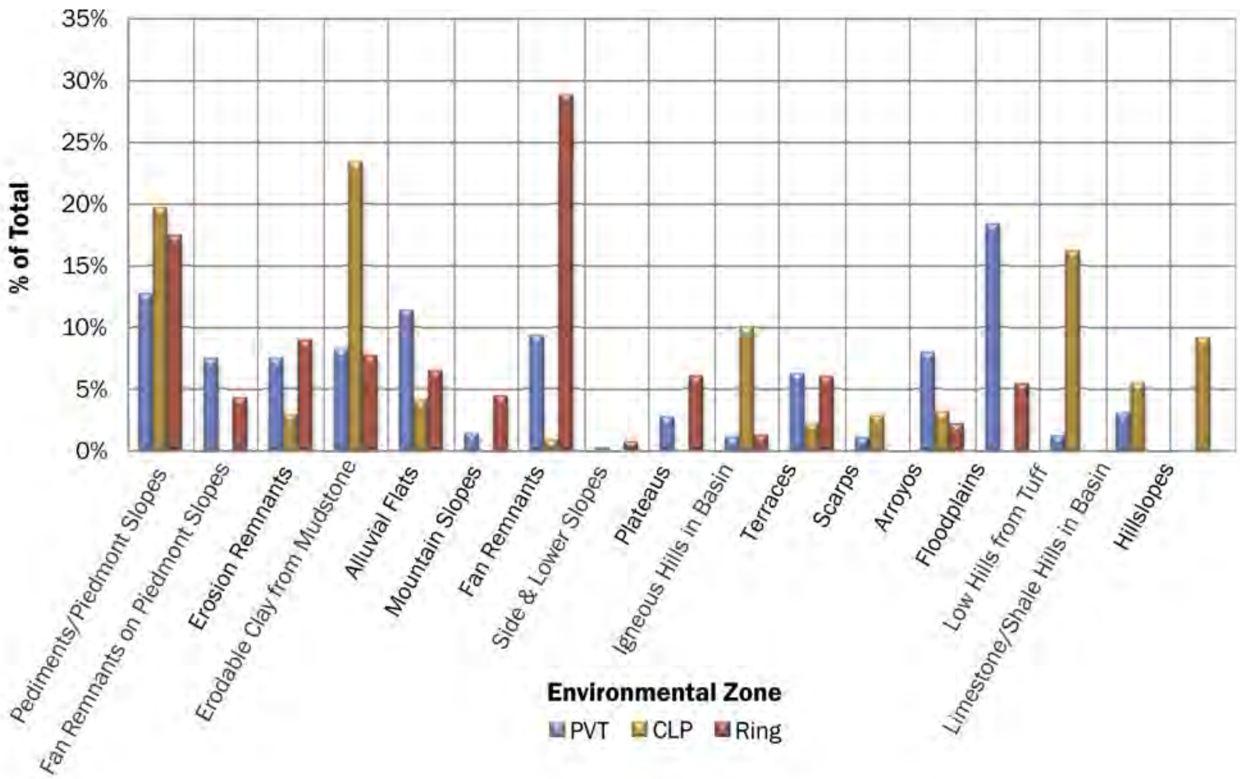


Figure 7.36 Hearth density as percent of total by hearth type and environmental zone (2005–2010 sites). EZs are presented in descending order of area surveyed.

is greatest, followed by ring hearths and pavement hearths.

The spatial patterning between hearth types is striking, particularly the fact that each hearth type "favors" a different environmental zone. Thus, pavement hearths occur most often in floodplains, cobble-lined pavement hearths in erodable clay from mudstone, and ring hearths in fan remnants. Similarly, floodplains—which has the highest density of pavement style hearths—is shown to contain no cobble-lined pavement hearths. Hillslopes, which contain the fifth highest density of cobble-lined pavement hearths, contain no pavement or ring hearths at all. It is equally noteworthy, however, that all three hearth types occur with the second greatest frequency on pediments/piedmont slopes.

Figure 7.37 shows the divergence between hearth density and area surveyed (expected values), expressed as percentages of the total. The most striking divergence, by far, is that of ring hearths in fan remnants—with more than 22 percent higher density than expected. This is followed by pavement hearths in floodplains—with almost 17 percent higher density than expected and cobble-lined pavement hearths in low hills from tuff—with almost 16 percent higher density than expected. By contrast, cobble-lined pavement hearths are shown to occur far less frequently than expected (-15 percent) in fan remnants on piedmont slopes and erosion remnants (-11 percent). Ring hearths are found to occur far less frequently than expected in fan remnants on piedmont slopes (-10 percent). Pavement hearths, however, fall below expected values by less than 8 percent in any one zone.

Interestingly, in terms of overall divergence from expected values, ring hearths diverge the least—by a total of 63 percent across all environmental zones. Pavement hearths diverge somewhat more, by a total of 74 percent across all zones. Cobble-lined pavement hearths,

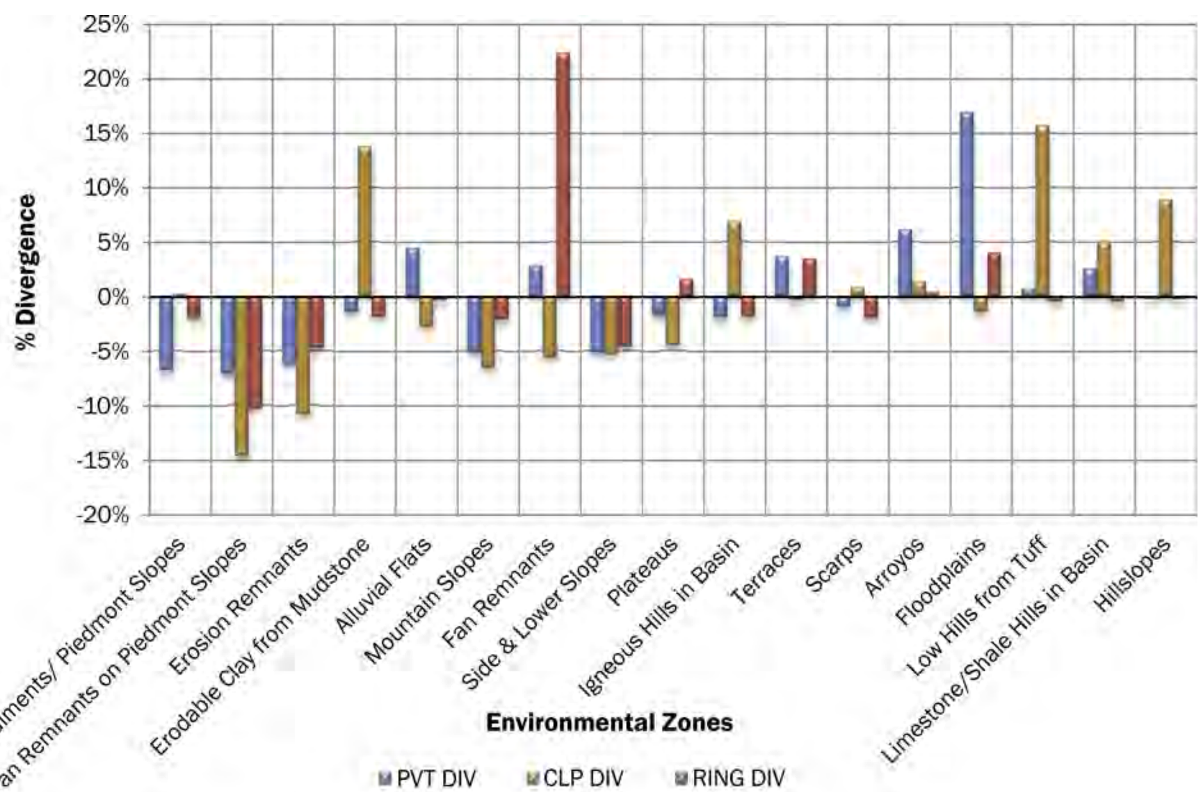


Figure 7.37 Divergence between hearth density and area surveyed (expected values) by hearth type and environmental zone as percentages of total. EZs are presented in descending order of area surveyed.

as noted previously, are the most spatially patterned of the three hearth types. Thus, their divergence from expected values is by far the highest of the three types—a total of 105 percent across all zones.

Associated Features and Artifacts

Hearths served as fundamental site appliances throughout prehistory, which results in their ubiquity in sites. Although hearths are typically the most prominent prehistoric feature on a site, they often occur with other feature and/or artifact types that can provide clues about the site's age or function. Table 7.16 shows the association of select features and artifact types, broken out by hearth type. Significantly, it also shows sites that have no formal tools.[7] It is important to remember that the term *association* here only indicates that one of the hearth types was found on the same site as other features or artifacts. Such *spatial co-occurrence*, however, does not necessarily imply a *behavioral association* except in cases where the spatial occurrence and context between the feature and artifact is exceptional, leaving little doubt that the two were utilized during the same event.

Table 7.16 and its associated graph (Figure 7.38) show that, of the three hearth types, pavement hearths are most likely to be associated with other feature types and formal tools, followed by ring hearths and cobble-line pavement hearths. Thus, the data suggests that pavement hearths are most likely to occur on complex sites containing more feature types and artifacts—

Table7.16 Number of Sites Containing Only the Specified Hearth Type and the Specified Association.

Associations	PVT	% of Total	CLP	% of Total	Ring	% of Total
Total Sites	526	100.00%	73	100.00%	44	100.00%
No Formal Tools	248	47.15%	42	57.53%	25	56.82%
Projectiles	69	13.12%	5	6.85%	6	13.64%
Bifaces	131	24.90%	11	15.07%	7	15.91%
Groundstone	138	26.24%	11	15.07%	5	11.36%
Scrapers	54	10.27%	4	5.48%	3	6.82%
Middens	46	8.75%	1	1.37%	2	4.55%
Stone Enclosure	28	5.32%	2	2.74%	4	9.09%

Note: Since these are not mutually exclusive categories, the sum of each column is greater than the total number of sites of any one hearth type.

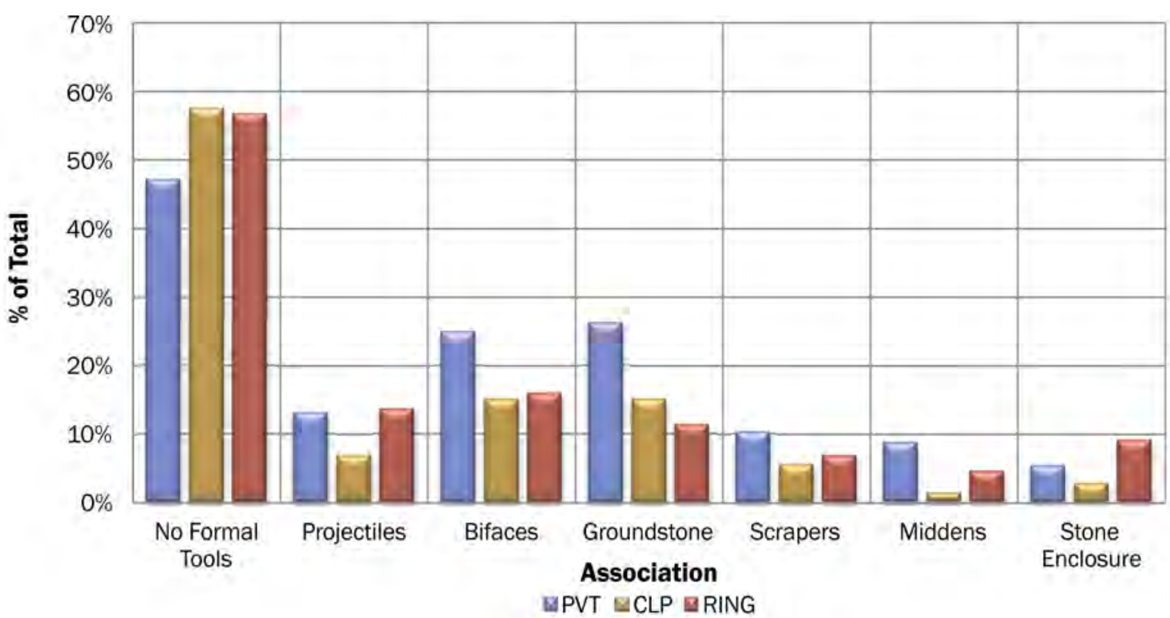


Figure 7.38 Associations by hearth type, shown as a percentage of the total number of sites per hearth type.

7. Formal tools here refers to any chipped- or ground-stone artifact, but do not include unmodified debitage, a category as ubiquitous as hearths.

such as basecamps where diverse activities were carried out. Conversely, the data suggests the other hearth types may be more likely to have been affiliated with logistical camps where specialized tasks were carried out. In light of this, the stronger relative association between ring hearths and projectiles and, especially, ring hearths and stone enclosures is intriguing. The stronger association of cobble-lined pavement hearths and groundstone relative to ring hearths is similarly revealing. However, the small sample size of cobble-lined pavement hearths and, especially, ring hearths, as well as the tentative associations, must temper any sweeping conclusions.

More research will be needed to shed light on such material culture associations. To further refine this approach, a site-by-site review to assess the precise spatial relationships between hearths, artifacts, and other feature types is needed, rather than simply tabulating their co-occurrence within the larger site area.

Summary of Hearth Analyses

This section examined the relationship between the three primary hearth types recorded during the latter half of the survey and their temporal, environmental, and artifactual relationships. Because these feature types are essentially diagnostic for identifying prehistoric sites, practically ubiquitous—and yet appear to be patterned in their distribution—considerable effort went into these analyses (especially compared to other feature types). Results showed that pavement style hearths are by far the most common hearth type, comprising almost 77 percent of the total number of hearths recorded between 2005 and 2010. This hearth type is affiliated with every time period, with increasing association through time, and tends to be found on sites with more feature types and artifacts than the other two hearth types.

Pavement hearths are shown to occur most often in floodplains, followed by pediments/piedmont slopes and alluvial flats. Taken together, these zones account for 43 percent of the total number of pavement hearths. Pavement hearth density in floodplains is nearly 17 percent higher than expected—more than double its divergence from expected value of any other environmental zone.

Cobble-lined pavement hearths are the least common of the three types, amounting to only 8 percent of all hearths recorded between 2005 and 2010. They appear to be associated strictly with the Archaic period and most strongly with the Early Archaic and Middle Archaic. Based on the specific context of diagnostic projectiles relative to this hearth type, however, the Early Archaic association seems strongest. This hearth type also occurs less frequently with formal tools or additional features, which may suggest these hearths are associated with logistical camps and specific resource processing.

Cobble-lined pavement hearths are shown to occur most frequently in erodable clay from mudstone, pediments/piedmont slopes, and low hills from tuff that, taken together, account for nearly 60 percent of the total cobble-lined pavement hearth density. Although this hearth type occurred at near expected value in pediments/piedmont slopes, it was found much more frequently than expected in low hills from tuff (16 percent above expected value) and erodable clay from mudstone (14 percent above expected value).

Ring hearths are the second highest in abundance of the three hearth types, accounting for 15 percent of all hearths recorded between 2005 and 2010. This hearth type appears to be associated with all time periods following the Paleoindian period, but is most strongly associated with the Late Archaic. However, temporal analysis suggests that ring hearths were episodically preferred, strong in the Early and Late Archaic, and weak in the Middle Archaic and Late Prehistoric. Like cobble-lined pavement hearths, ring hearths are less frequently associated with formal tools or additional features. However, of the three hearth types, it leads in association with projectiles and stone enclosures, an anomalous finding that may somehow articulate with its equally anomalous episodic popularity.

More research will be needed to determine if this represents true patterning.

Ring hearths are shown to occur with the greatest frequency in fan remnants, pediments/piedmont slopes, and erosion remnants. Combined, these zones account for over 55 percent of the total ring hearth density. Their presence in fan remnants is over 22 percent above the expected value, showing the strongest correlation between any one hearth type and an environmental zone. Aside from occurring far less frequently than expected in fan remnants on piedmont slopes (-10 percent), this hearth type diverges by no more than 5 percent across the remaining zones.

Overall, the hearth analysis demonstrates generally weak temporal patterning with respect to pavement hearths, moderate—but questionable—patterning with respect to ring hearths, and very strong temporal patterning with respect to cobble-lined hearths. The analysis also revealed that each of the three hearth types had strong spatial patterning, each distinct from the others, supporting the assumption that these are, indeed, distinct thermal feature types.

The spatial patterning of different hearth types certainly reflects prehistoric preferences, but it is also influenced by their age and the taphonomic processes they are subject to. For example, younger hearths, simply by virtue of their more recent vintage, will be better preserved on unstable surfaces than older hearths (while the latter may be present, they are likely to be too disarticulated to be typed).

Conversely, more stable surfaces, such as pediments, can allow hearths to remain well defined and intact for millennia. As a result, some zones favor hearth preservation over other zones, but the resulting spatial patterning reflects landform stability as much as prehistoric behavior. Further investigation, including abundant excavation data and an array of radiometric dates for each hearth type, will be needed to test some of the findings of the present analysis.

Midden Analyses

As introduced in Chapter 6, middens are simply an accumulation of debris resulting from cultural activities. A total of 222 middens of all kinds were recorded in 133 sites over the course of the entire project. These fall into two broad groups: ring middens and sheet middens. Although nomenclature during the project varied, these two groups encompass all the terms used. The term “ring midden,” used widely in the archeological literature, is the archeological expression of an earth oven, which is the actual prehistoric appliance. In cases where burned rock accumulation around an identifiable central void was substantial, they were referred to as “ring middens.” In cases where the morphological attributes were present but burned rock accumulation was lacking, these were often called “earth ovens.” Similarly, the terms “midden deposits,” “FCR middens,” and “sheet middens” were used interchangeably. Consequently, the term “ring midden” here also includes “earth ovens” and the term “sheet midden” includes “FCR middens” and “midden deposits.” By this criteria, a total of 127 ring middens (at 77 sites) and 95 sheet middens (at 84 sites) were recorded during the project.

Temporal Distribution

In this analysis, the data set was queried for sites containing middens and diagnostic projectile points from a single archeological time period to illuminate the relative strength or weakness of presumed temporal associations with these feature types. Table 7.17 shows all potentially single-component sites that contain either ring middens or sheet middens, arranged by time period. The data are presented both as number of sites as well as number of projectile points potentially associated with these features, and the percentage of the total those counts represent relative to each time period.

The data are represented graphically in Figures 7.39 and 7.40. Note that no middens were found on any potentially single-component Early Archaic sites. By number of sites, the data indicates temporal associations with ring middens to be just over 2 percent of Middle Archaic sites, a slightly lower percentage during the Late Archaic, and a substantially higher percentage, representing nearly 6 percent of sites, during the Late Prehistoric. Associations with sheet middens is more linear with an upward trajectory through time, represented by a low of 3 percent of sites in the Middle Archaic and rising to a high of 5 percent of sites in the Late Prehistoric.

The data indicates that Middle and Late Archaic sites tend to be more strongly associated with sheet middens compared to ring middens whereas this trend is reversed in the Late Prehistoric, showing a stronger association with ring middens than sheet middens. One likely explanation for this may be the greater antiquity of the first two time periods, such that sheet middens (formed by post-occupational processes) would have had more time to be subjected to the erosional forces that form them. Conversely, Late Prehistoric ring middens may be better preserved by virtue of their more recent age.

Whereas examining associations by number of sites indicates the strength of that association to any one time period, it does not indicate the relative strength of that association *within* the sites themselves. One potential proxy for this latter metric is the number of projectiles contained within these associated sites, as shown in Figure 7.40. The data are presented by the number of projectiles contained on potentially single-component sites with middens, arranged by time period (indicated as a percentage of the total number of projectiles attributed to that period that were collected during the survey).

Table 7.17 Sites with Diagnostics Representing only One Archeological Time Period that Contain Middens.

			Ring Middens				Sheet Middens			
Time Period	Total # Sites	Total # Projectiles	# Sites	# PTS	% Total Sites	% Total Proj.	# Sites	# PTS	% Total Sites	% Total Proj.
Middle Archaic	89	225	2	2	2.25%	0.89%	3	3	3.37%	1.33%
Late Archaic	145	320	3	5	2.07%	1.56%	6	8	4.14%	2.50%
Late Prehistoric	118	376	7	9	5.93%	2.39%	6	11	5.08%	2.93%

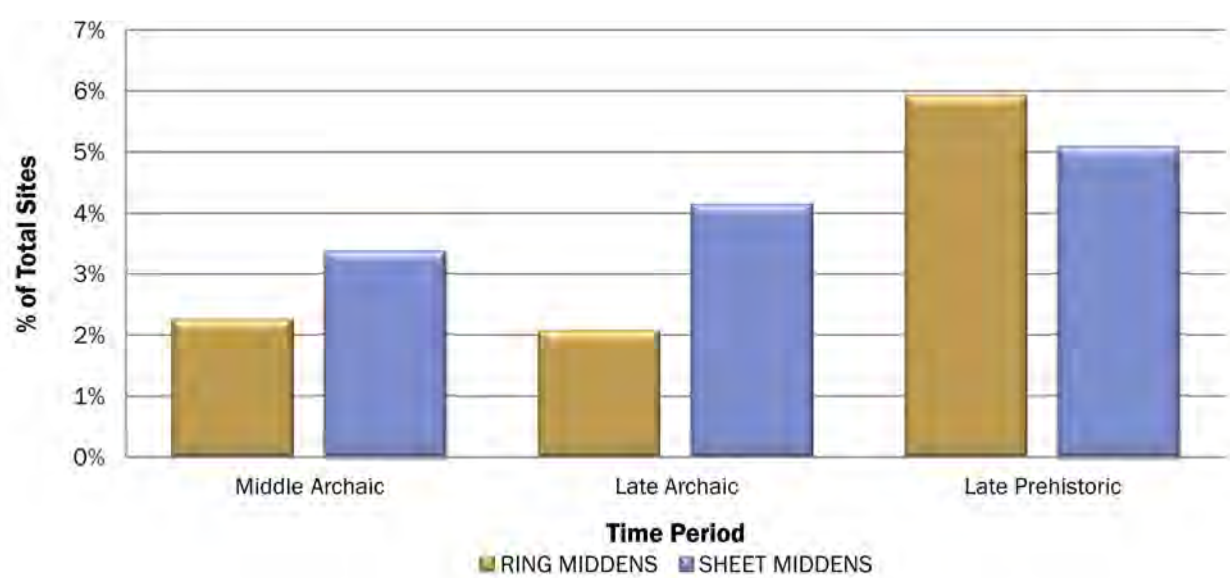


Figure 7.39 Percent of total of potentially single-component sites with middens per time period.

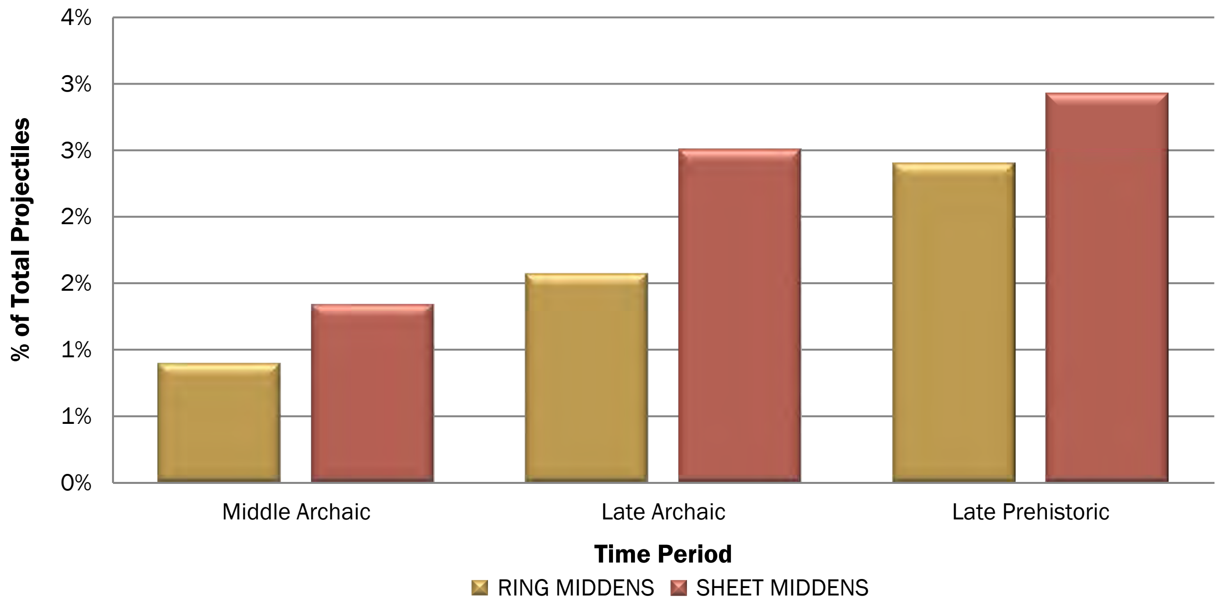


Figure 7.40 Percent of total projectiles from potentially single-component sites with middens per time period.

The resulting graph shows that the trend through time for both ring middens and sheet middens is a linear upward trajectory of increasing association from the Middle Archaic to the Late Prehistoric. It further shows that sheet middens are more strongly associated with each time period than ring middens (which, for the Late Prehistoric, is a departure from the analysis by number of *sites*).

Of the 95 sheet middens, none were discovered on sites with only Early Archaic projectile points. Considering that sheet middens may be the by-product of eroded earth ovens or conflated eroded hearths, this may suggest that these features were either not utilized or utilized as often in the Early Archaic as they were in later time periods. Similarly, there are no instances where ring middens were discovered on sites with only Early Archaic projectile points, again suggesting that earth oven technology may have been less common, or possibly even absent, during that period.

When the data set is queried for *all* potential temporal associations with middens, including multi- component sites, roughly 15 percent of sites containing Early Archaic projectiles are shown to also contain ring middens (more comparable to the 14 to 23 percent of sites represented by other time periods). While this much higher association could suggest that the large discrepancy is a result of sample size (due to proportionally fewer single-component Early Archaic sites), it is also likely that this higher association is attributable to later occupations.

Although preliminary, these findings suggest that the use of earth oven technology—and perhaps lengthier or more redundant site occupation resulting in sheet midden formation—increased during the Middle Archaic and rose substantially during the Late Prehistoric. The analysis by site also suggests that the use of earth ovens may have declined during the Late Archaic.

However, these findings should be viewed with caution considering the very small sample size (12 sites and 16 points associated with ring middens, and 15 sites and 22 points associated with sheet middens). This underscores the fact that ring middens—in particular—are relatively rare features in the Big Bend, at least compared to their ubiquity in the adjacent Lower Pecos region. Another note of caution involves interpreting the presence or absence of sheet middens. Because these features are caused as much by post-occupational processes as by the actual occupations, their interpretive utility is limited.

Environmental Distribution of Ring Middens

Ring midden distribution in BBNP is strongly patterned and largely confined to only three environmental zones—fan remnants on piedmont slopes, pediments/piedmont slopes, and erosion remnants—that together make up more than 65 percent of sites containing ring middens and 73 percent of all ring middens recorded during the project. Although ring middens were found in 13 out of 23 zones where survey occurred, 5 of those zones contained only a single ring midden site and the remaining 5 zones accounted for only 27 percent of the total number of ring midden sites.

Figure 7.41 shows the distribution of ring middens across the 13 environmental zones where they were found, by number of sites and number of ring middens as percentages of the total number of each. Fan remnants on piedmont slopes is shown to account for over a quarter of all sites and more than 30 percent of all ring middens documented during the project. Most of the remaining sites and ring middens occur in pediments/piedmont slopes and erosion remnants, accounting for almost 40 percent of the remaining sites and 43 percent of the remaining ring middens.

Figure 7.42 shows the divergence between the presence of ring midden sites and ring middens from expected values (area surveyed) by environmental zone. The graph indicates that ring midden-bearing sites occur over 12 percent more often than expected, and ring middens 17 percent more than expected, in fan remnants on piedmont slopes. On pediments/piedmont slopes, ring midden sites occur over 6 percent more of-

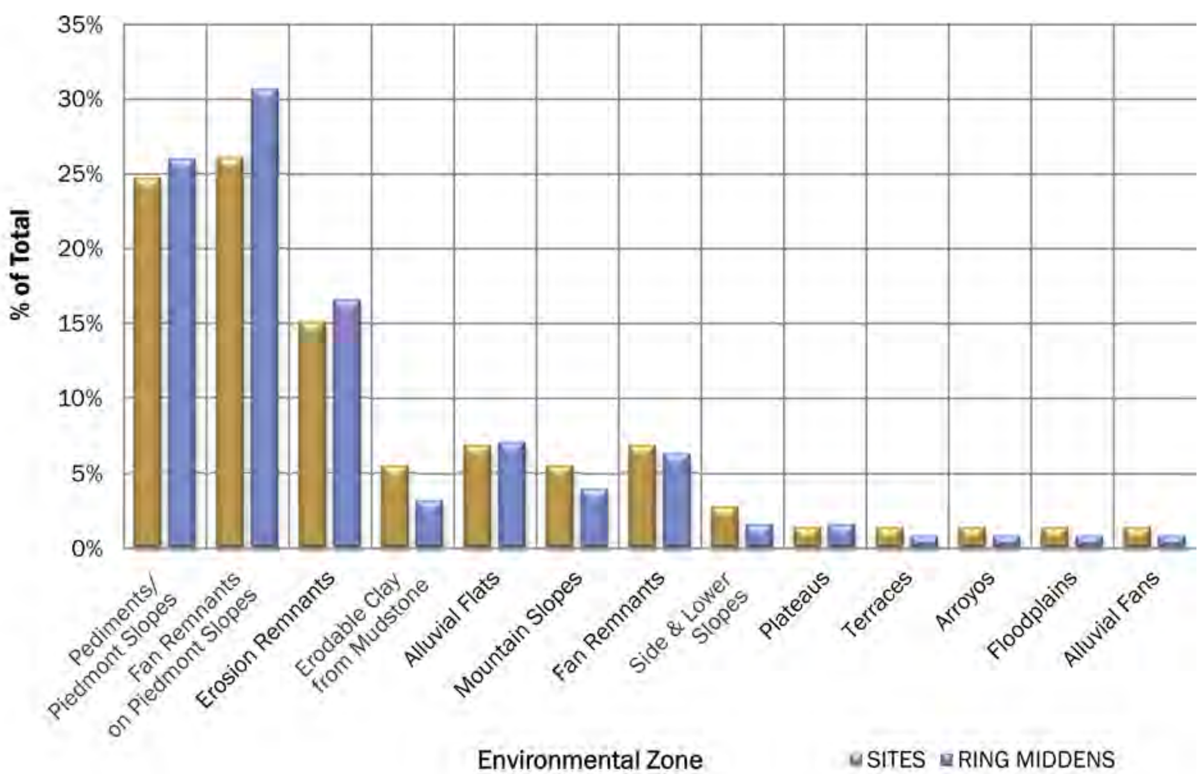


Figure 7.41 Ring midden sites and ring middens, by environmental zone, shown as percentages of total.

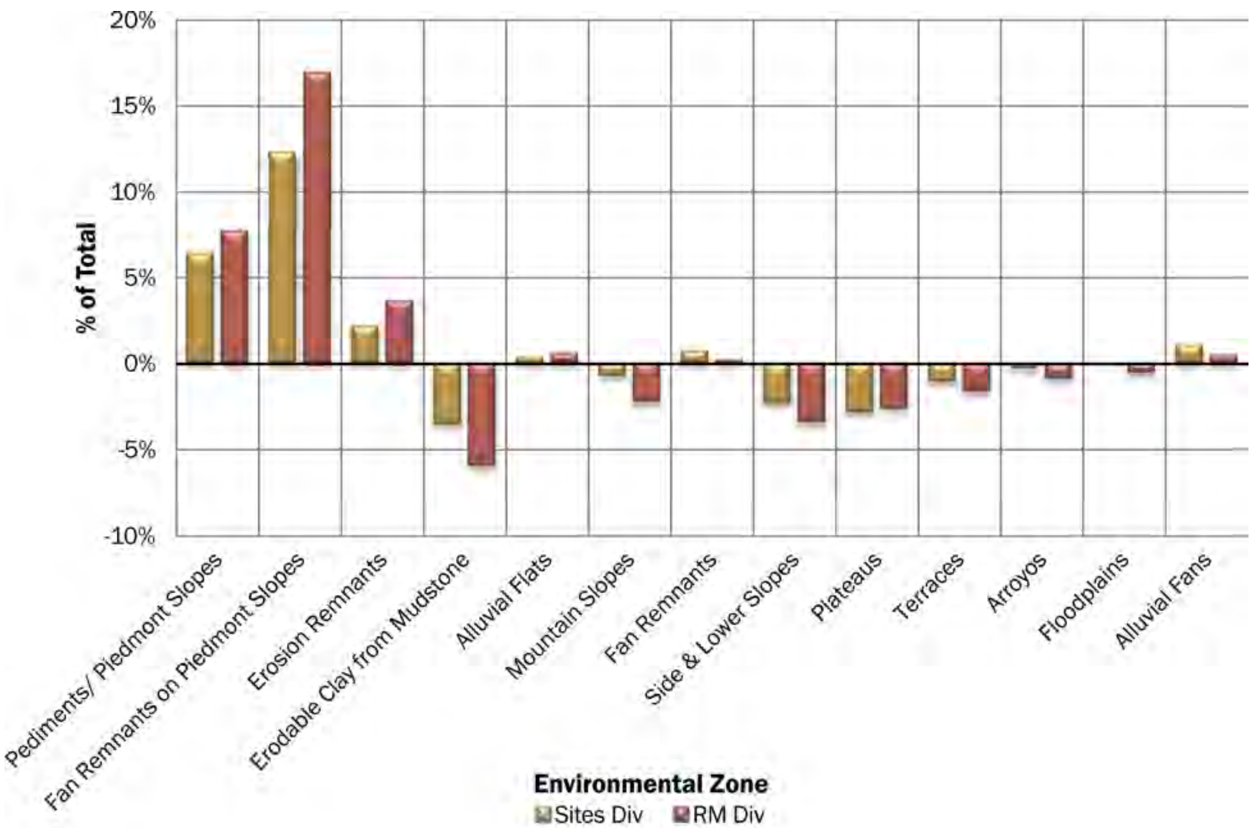


Figure 7.42 Divergence between ring midden occurrence and area surveyed by environmental zone.

ten than expected, and ring middens nearly 8 percent more than expected. Their presence on erosion remnants, despite accounting for 15 percent of all ring midden sites, diverges from expected values by less than 3 percent for sites and less than 4 percent for ring middens.

Just as significant are those zones where ring middens occur less frequently than expected. The data indicates that ring midden sites occur almost 4 percent less than expected, and ring middens almost 6 percent less than expected, in erodable clay from mudstone. They also occur less often than expected in mountain slopes, side and lower slopes, plateaus and terraces, but by less than 3 percent in any one of these zones. Such findings conform well to expectations about these zones. Erodable clay from mudstone is comprised of badlands, a highly erosive environment that often contains shallow soils over tuffaceous bedrock. The lack of soil depth in itself might have made the zone unattractive. Too, the erosive nature of the zone may have buried or disarticulated such features. The other zones tend to correspond to sloping or high-elevation terrain that were likely unattractive locales for constructing earth ovens, or for the succulents targeted for processing.

The highest ring midden occurrence—both as a percentage of the total and as measured divergence from expected values—occurs on fan remnants on piedmont slopes. This zone is found almost exclusively along the northeastern and eastern flanks of the Chisos Mountains. Interestingly, almost every ring-midden bearing site that resides in this zone does so along its edges, not its interior (Fig. 7.43). These sites tend to occur on the upslope side of the zone, bordering the mountain slopes, or—more frequently—the downslope side of the zone, typically bordering pediments/piedmont slopes, which is the zone with the second highest ring midden occurrence.

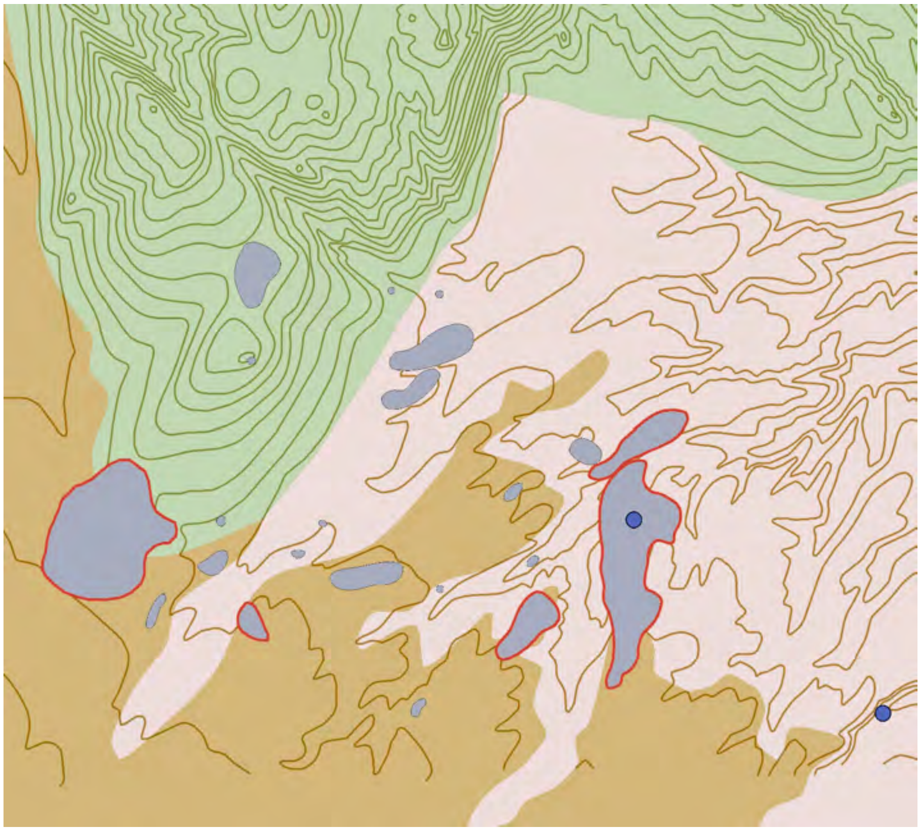


Figure 7.43 Examples of sites with ring middens situated along the edge of the ***fan remnants on piedmont slopes*** *zone, shown in gold. Sites are shown in gray; those outlined in red contain ring middens. The light brown zone is erosion remnants, the green zone is mountain slopes. The blue dots indicate springs.*

But since ring midden-bearing sites are almost always affiliated with a water source—either a spring, tinaja, or watercourse—it may be that the sites occur along the edges of this zone, at least in part, because that is also where many of the springs occur.

However, water availability is only one of several factors that likely made one zone preferred over another. Other factors include the availability of soils deep enough to excavate a pit, the proximity of materials needed to construct earth ovens (rocks and fuel wood), and the proximity of food resources to be processed. Even so, the visibility of ring middens in BBNP is also conditioned by differential preservation such that ring middens in lowland settings (alluvial flats, erodable clay from mudstone, terraces, etc.) may have either been displaced by erosion or buried by fine-grained sediment. As with other analyses, more research will be needed to further examine this issue.

Associated Features and Artifacts

Over 60 percent of ring midden-bearing sites contain only a single midden, by far the most common occurrence. Although a third of the sites contain 2 or 3 ring middens, less than 7 percent of these sites contain more than 5 and the greatest number on any one site is 9 (Table 7.18).

As shown in Table 7.19, only nine ring midden sites (12 percent) lacked formal tools. The majority contained groundstone (68 percent) or bifaces (59 percent), and slightly less than half contained scrapers (47 percent). All ring midden-bearing sites also contained other feature types, nearly 90 percent of which were hearths. Other types of associated features include cairns, rock alignments, and rock groupings. Only three sites (4 percent), however, contained stone enclosures.

Table 7.18 Number of Ring Middens Per Site.

Number of Ring Middens	Number of Sites	% of Total
1	45	61.64%
2	15	20.55%
3	8	10.96%
5	3	4.11%
4	1	1.37%
9	1	1.37%

Table 7.19 Feature and Artifact Associations with Ring Middens.

Association	# Sites	% of Total
No Formal Tools	9	12.33%
Groundstone	50	68.49%
Bifaces	43	58.90%
Scrapers	34	46.58%
Hearths	65	89.04%
Stone Enclosures	3	4.11%
No other Features	0	0.00%

This data suggests that earth ovens were not typically constructed in isolation since they are most often found in conjunction with other features and artifacts indicative of activities such as food preparation and processing (hearths and groundstone), hunting (projectile points), and lithic reduction (indicated by cores, modified debitage, and hammerstones). Indeed, 78 percent of ring midden sites contain more than one artifact type (not including debitage), and the fewer single-artifact sites contain either bifaces (n=2) or groundstone (n=5). The relatively high percentage of formal tools and hearths present suggests that many of these sites had multiple functions and/or were multi-component.

Stone Enclosure Analysis

Stone enclosures—a term that encompasses a variety of prehistoric structural remnants (wickiup rings, Cielo complex rings, tipi rings, etc.)—were encountered fairly often during the project. A total of 268 structures in 92 sites were recorded—amounting to 6 percent of all prehistoric sites. As shown in Table 7.20, the majority of these sites (65 percent) contained only a single stone enclosure with the remaining 35 percent containing 2 or more. However, sites with more than 5 stone enclosures were rare, amounting to only 8 percent of all stone enclosure sites. One exceptional site that contained no less than 58 enclosures comprised a full 22 percent of the total number of stone enclosures recorded.

This unusual distribution may be indicative of different *types* of sites since stone enclosures can indicate habitation, but can also indicate "special purpose" use as is often documented on the tops of elevated landforms. These typically singular, isolated features are most often interpreted as either lookouts or vision quest sites. Rarely containing artifacts or other features types, these sites stand in stark contrast to base camps that often contain several stone enclosures and other feature types, or even small open campsites containing a lone dwelling that was likely used to shelter a single family unit.

Table 7.20 Number of Structures Contained within Sites.

# Stone Enclosures	# Sites	% of Total
1	60	65.22%
2	10	10.87%
3	5	5.43%
4	6	6.52%
5	4	4.35%
6	1	1.09%
7	1	1.09%
9	1	1.09%
14	1	1.09%
17	1	1.09%
18	1	1.09%
58	1	1.09%

Table 7.21 depicts the number of sites with stone enclosures that also contain diagnostic projectile points representing one or more of the major archeological time periods. The table, and accompanying graph below (Fig. 7.44), indicates an association with

Table 7.21 Sites with Stone Enclosure, by Time Period.

Time Period	# Projectile Points	% of Total	# Sites	% of Total	Single Component	% of Total
Late Paleo	5	3.88%	3	4.84%	0	0.00%
Early Archaic	8	6.20%	8	12.90%	0	0.00%
Middle Archaic	19	14.73%	13	20.97%	2	13.33%
Late Archaic	43	33.33%	21	33.87%	8	53.33%
Late Prehistoric	54	41.86%	17	27.42%	5	33.33%
Total	**129**	**100.00%**	**62**	**100.00%**	**15**	**100.00%**

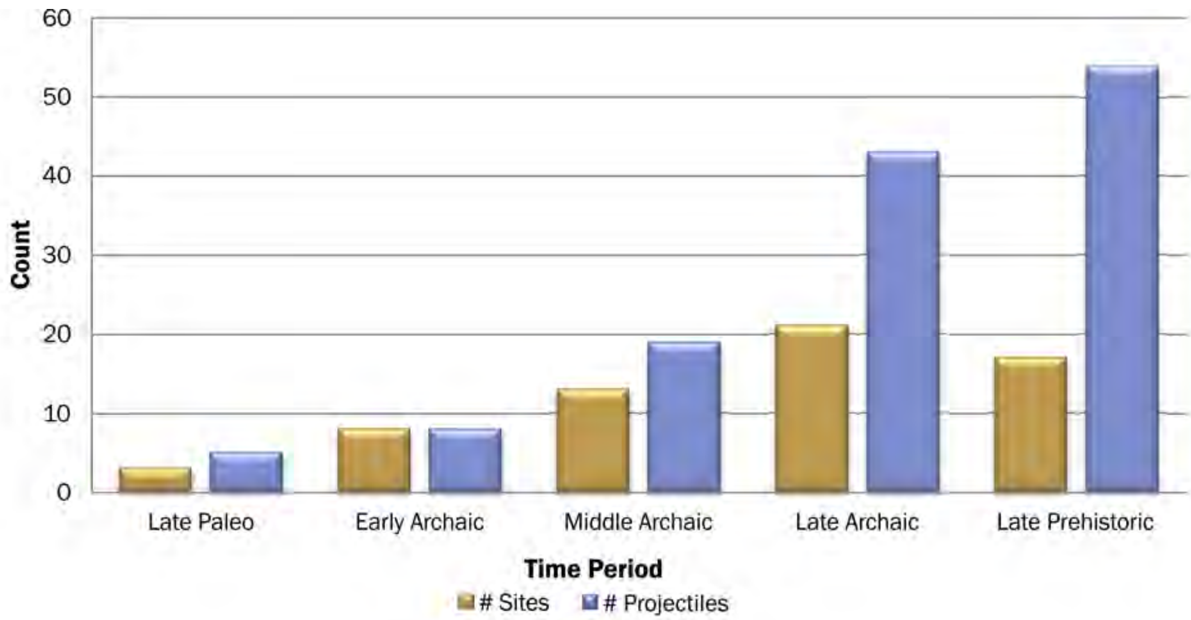


Figure 7.44 Stone enclosure sites, by time period, shown as number of sites and number of projectiles.

every time period, and a general trend of increasing association through time, both in number of sites as well as number of projectiles. The singular break in the trend is a decrease in the number of sites (but not number of projectiles) associated with stone enclosures in the Late Prehistoric. Thus, the strongest possible association is shown between stone enclosures and the Late Archaic (by sites), and between stone enclosures and the Late Prehistoric (by number of projectiles)."The table, and accompanying graph below (Fig. 7.44), indicates an association with every time period, and a general trend of increasing association through time, both in number of sites as well as number of projectiles. The singular break in the trend is a decrease in the number of sites (but not number of projectiles) associated with stone enclosures in the Late Prehistoric. Thus, the strongest possible association is shown between stone enclosures and the Late Archaic by sites, and between stone enclosures and the Late Prehistoric by number of projectiles.Thus, the strongest possible association is shown between stone enclosures and the Late Archaic (by sites), and between stone enclosures and the Late Prehistoric (by number of projectiles)."The table, and accompanying graph below (Fig. 7.44), indicates an association with every time period, and a general trend of increasing association through time, both in number of sites as well as number of projectiles. The singular break in the trend is a decrease in the number of sites (but not number of projectiles) associated with stone enclosures in the Late Prehistoric. Thus, the strongest possible association is shown between stone enclosures and the Late Archaic by sites, and between stone enclosures and the Late Prehistoric by number of projectiles.

Figure 7.45 shows the divergence from expected values (projectwide temporal distribution) by number of projectiles and number of sites, expressed as percentages of the total. Compared to the projectwide distribution of projectile points and affiliated sites, the number of sites containing stone enclosures is shown to be slightly above expected value for the Late Paleoindian period and Early Archaic period, and slightly below expected value for the remaining time periods. By number of projectiles, the Late Paleo and Late Archaic are slightly above expected value and the Late Prehistoric is significantly above expected value whereas the Early Archaic is slightly below and the Middle Archaic is significantly below expected value.

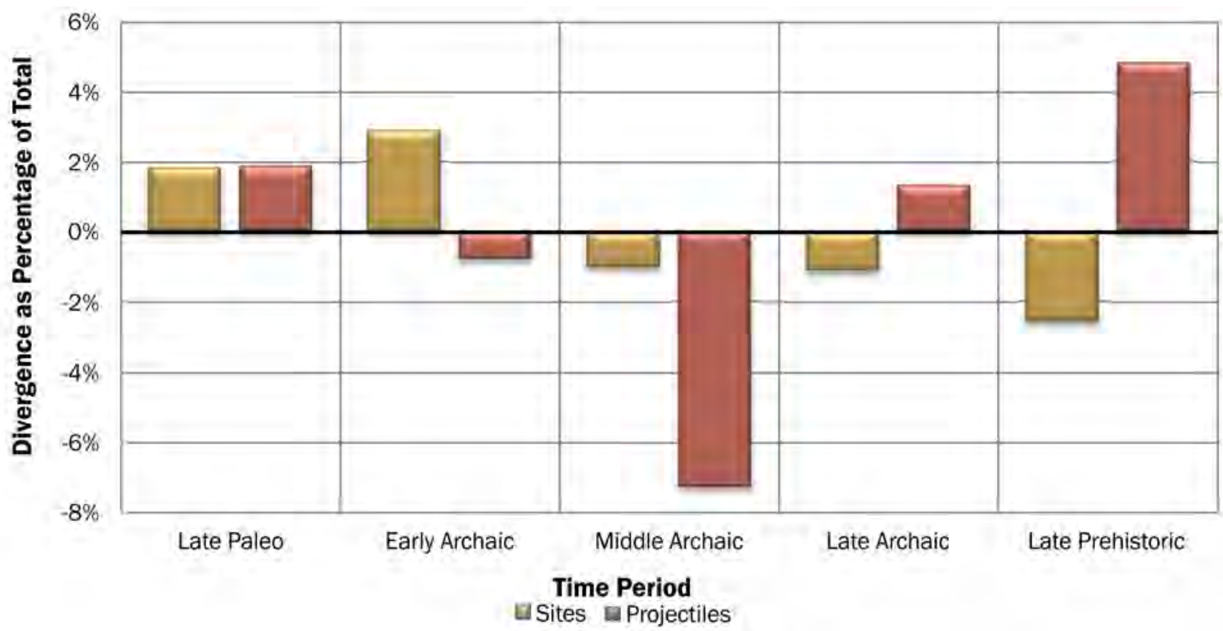


Figure 7.45 Stone enclosures, by time period, divergence from expected values (projectwide temporal distribution) expressed as percentages of total.

The erratic nature of the results is likely a function of the small sample size, which makes the earliest two periods suspect; the higher-than-expected values are likely due to their chance occurrence on stone enclosure-bearing, multi-component sites. Sample size also likely explains the below-expected value for number of *sites* in association with stone enclosures for the Middle Archaic through the Late Prehistoric (if the Paleoindian and Early Archaic association is spurious, then they artificially lower the percentage contribution of other time periods). Sample size, however, does not adequately explain the significantly below-expected value of Middle Archaic projectiles in association with stone enclosures, which is the standout result from the analysis. On the other hand, the slightly-above-expected value of the Late Archaic and significantly-above-expected value of the Late Prehistoric by number of projectiles conforms to intuitive expectations. As with all other analyses, more research will be needed to determine if these patterns can be replicated and, if so, what they might mean.

Examining only potentially single-component sites that contain stone enclosures (Fig. 7.46), the data indicates the same general pattern of temporal associations as was shown for multiple-component sites (see Fig. 7.44). However, in this analysis, the association with the Late Archaic is strongest both by the number of sites as well as by number of projectiles, but lags significantly behind the Late Prehistoric by number of associated structures. What this may suggest is that there are more Late Archaic sites bearing stone enclosures, but that the sites tend to be smaller—or at least contain fewer structures. Conversely, there are fewer Late Prehistoric sites containing stone enclosures, but those sites tend to be larger—or at least contain a significantly higher number of structures than those associated with other time periods.

Although the behavioral association between projectiles and enclosures is speculative without stronger contextual evidence, this pattern is significant, especially in light of conventional thought that such structures are associated primarily (or solely) with the Late Prehistoric period. Much of this thinking has arisen as a result of abundant research into Late Prehistoric architecture regionally (Cielo complex wickiup rings, pithouses) and in adjacent regions (tipi rings, pueblos).

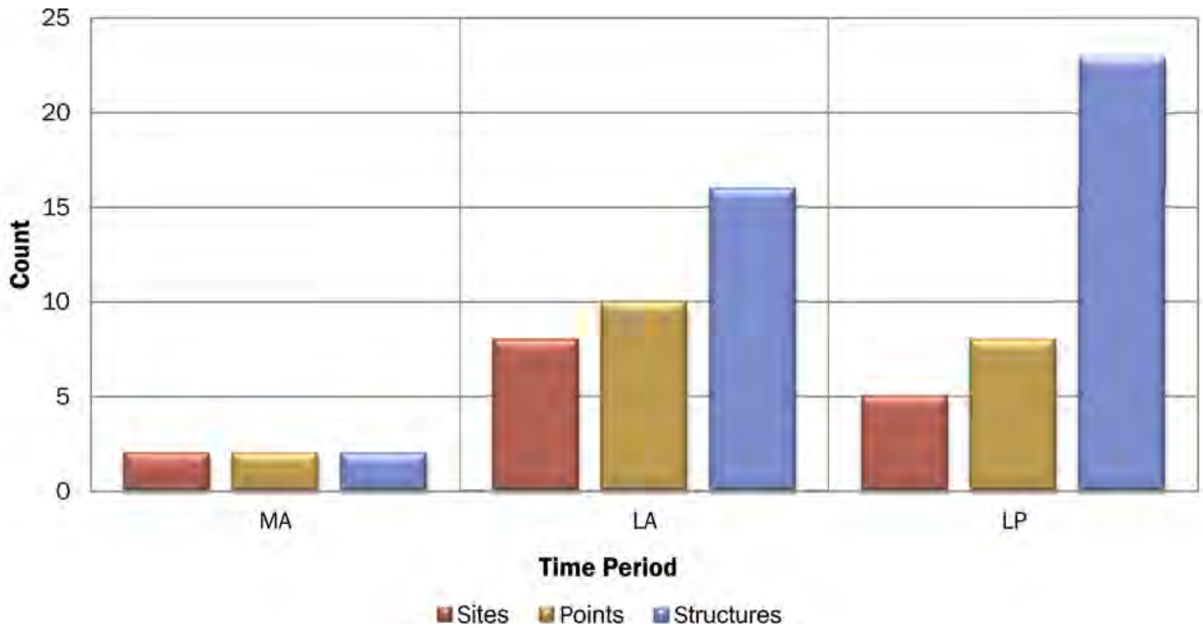


Figure 7.46 Potential single-component sites containing stone enclosures by time period, shown as number of sites, number of projectiles, and number of structures.

In recent years, however, this idea has come under increasing scrutiny and both survey and excavation data are revealing a more complex picture. For example, at site BIBE2501, a Late Archaic dart point was found in excellent context *within* a stone enclosure. Although of more questionable context, a Late Archaic specimen was also recovered from an excavation within a stone enclosure northwest of BBNP (see Cloud 2013b). The present exercise lends additional evidence that stone enclosures in one form or another were not confined to the Late Prehistoric period, but were used throughout time—lending support for what seems a reasonable hypothesis.

Environmental Distribution

Stone enclosures were found in 13 of the 23 environmental zones surveyed during the project (Figure 7.47). Pediments/piedmont slopes are shown to have the highest percentage of sites (20 percent), followed by erosion remnants (15 percent), erodable clay from mudstone (14 percent), and mountain slopes (13 percent). By number of structures, the highest percentage was found in plateaus (23 percent), followed by mountain slopes (17 percent), erosion remnants (12 percent), and pediments/piedmont slopes (11 percent).

The data shows that the four zones containing the most sites also contained the most enclosures (although the relationship was non-linear) with the major exception of plateaus, which contained by far the highest number of enclosures. However, this particular discrepancy is due to a single site containing 58 stone enclosures, which significantly skewed the data. Four additional sites containing more than eight enclosures occurred in igneous hills in basin, mountain slopes, and erosion remnants, which also significantly inflated the percentage of enclosures in those zones.

These discrepancies are accentuated in Figure 7.48, showing the divergence from expected values of stone enclosures and stone enclosure sites. The graph indicates that stone enclosure sites in both mountain slopes and erodable clay from mudstone occur more than 5 percent above expected values. However, aside from erosion remnants, the number of sites containing enclosures does not depart from expected values in any other zones by more than 2 percent. Thus, beyond the

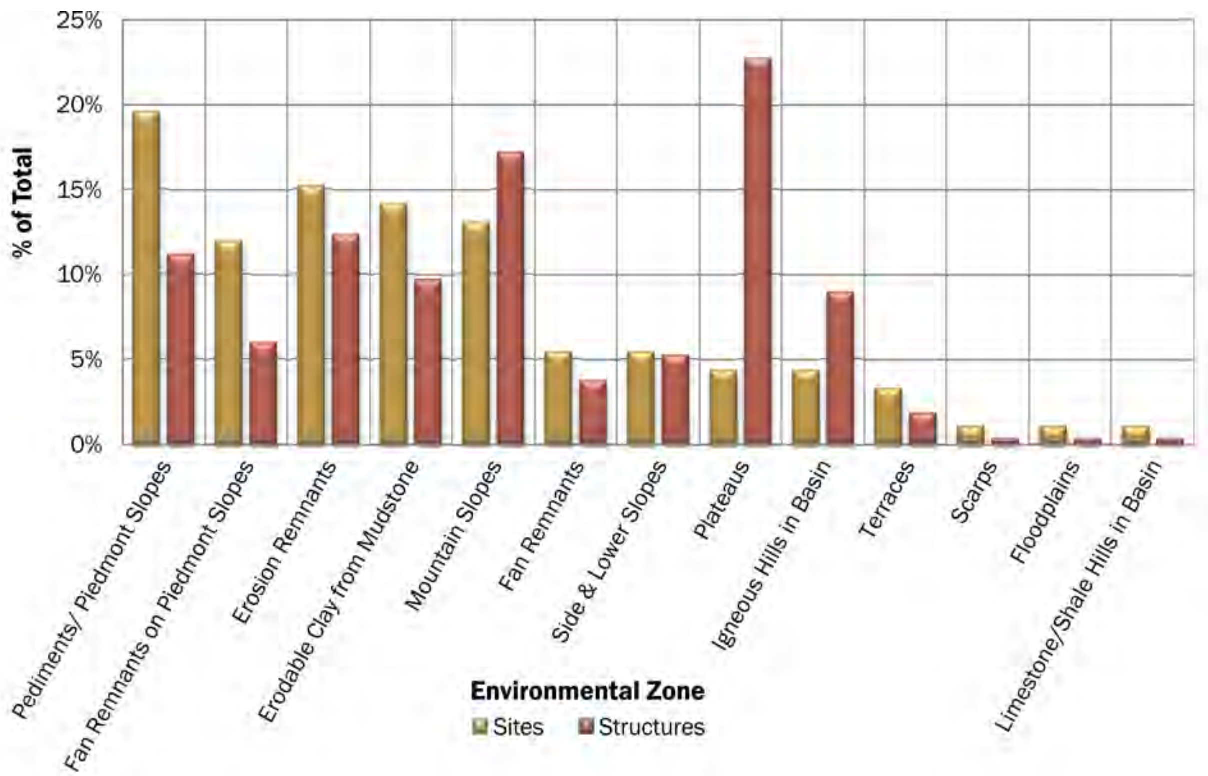


Figure 7.47 Stone enclosure sites by environmental zone, shown as percent of total; presented in descending order by number of sites.

preference afforded mountain slopes and erodable clay from mudstone, these sites are distributed somewhat uniformly across the remaining zones.

The picture is quite different with respect to the number of *structures* per zone. Here, plateaus lead by a significant margin—19 percent above the expected value—followed by mountain slopes (11 percent), and igneous hills in basin (6 percent). However, as noted above, these figures are skewed as a result of a few sites that contain a high number of enclosures. Perhaps of more interest are those zones in which the number of structures is significantly *below* expected values; in this case, pediments/piedmont slopes (-7 percent) and fan remnants on piedmont slopes (-8 percent). Although these values are also affected by the skewness, they highlight two zones that have far fewer *structures* than expected but near expected value for number of *sites*. This merely highlights that these zones contain more single stone enclosure sites compared to the other zones. This may suggest that these zones were utilized less often as base camps than other zones; conversely, they may have been utilized more often as logistical camps.

Summary and Conclusions

This section provides a brief summary of the preceding analyses of Native American archeology followed by concluding statements. Different analytical exercises were performed to examine relationships between the landscape and prehistoric material culture and within the material culture itself. Several significant patterns and trends emerged that shed light on prehistoric behavior and natural processes through time, offering testable hypotheses that could lead to more significant discoveries in future investigations.

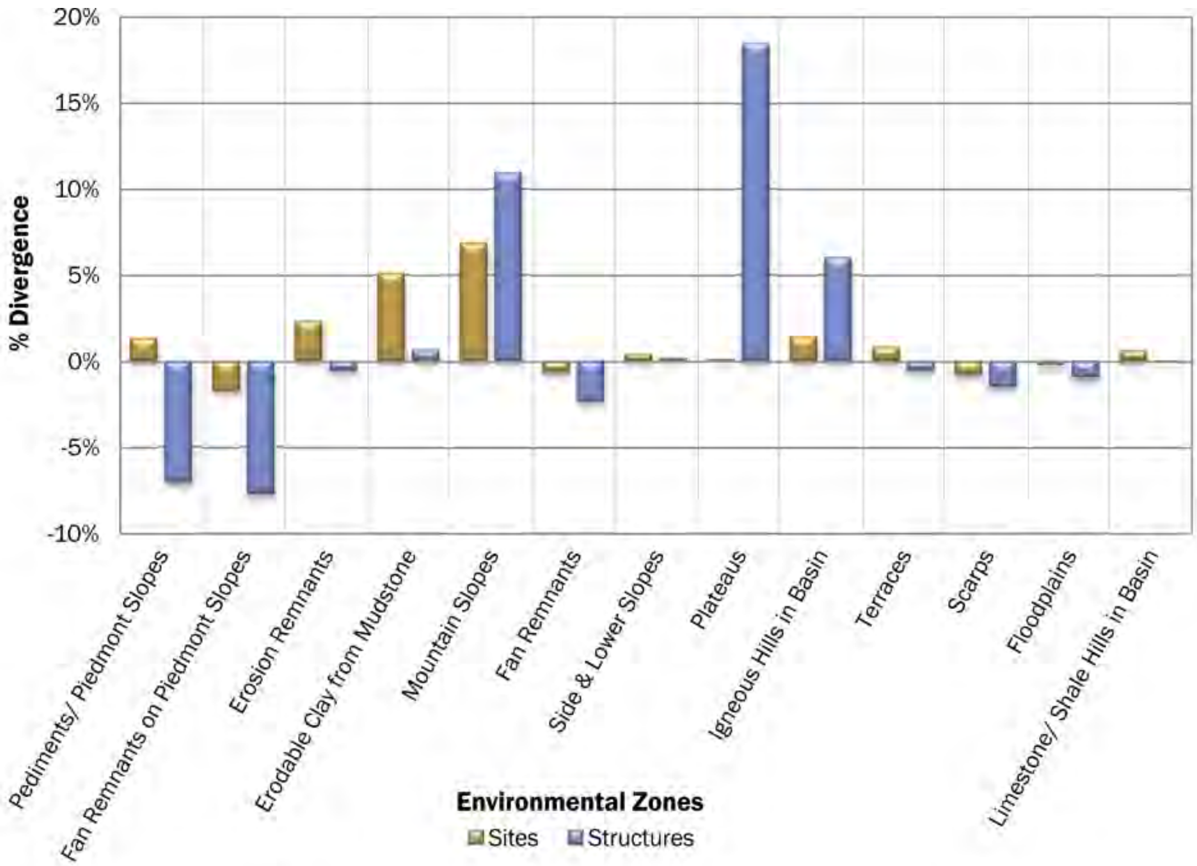


Figure 7.48 Divergence from expected values (area surveyed) of stone enclosure sites and structures by environmental zone, shown as percent of total.

Temporal Distribution

Projectwide, the number of temporally diagnostic projectile points recovered increased significantly for each successive time period, but rose most sharply between the Early Archaic and Middle Archaic. Although the highest number of identified points recovered belonged to the Late Prehistoric, an additional 222 specimens that could not be definitively typed were not included in the original tally. When these points were provisionally added to their most likely time periods, the Late Archaic period gained the lead by number of projectiles and—by a significant margin—by number of sites containing projectiles. The projectile point deposition rate, which takes the length of each time period into account, indicated a steep positive curve such that more points were deposited in each successive period, with the highest deposition rate during the Late Prehistoric.

The number of points per site was calculated as a way to include both the number of sites with projectiles and the total number of projectiles recovered per time period. This clearly showed the general trend through time was a greater number of points at progressively fewer sites with the singular exception of the Late Archaic period when the trend was reversed. The data indicated that, while there are more Late Archaic *sites* containing projectiles, there are fewer *projectiles* per site than for the time periods before or after. Even with the unspecified Archaic projectiles projected into the tally, the Late Archaic remained the time period with the lowest number of points per site, suggesting the pattern was not the result of lower deposition rates, but that these sites were occupied for a shorter duration.

Thus, the projectile data suggests an increasing prehistoric population through time with a sharp spike during the Middle Archaic. It also shows that, while the Late Archaic deposition rate was in accord with the trend through time, Late Archaic sites tend to have fewer points than those from other time periods. These findings indicate that Late Archaic sites were probably occupied for a relatively shorter duration which, in turn, suggests greater mobility. The distribution curve of projectile points served as a baseline by which to compare other analysis results, primarily the distribution of temporally affiliated sites in different environmental contexts.

Site Size

The analysis of site size showed that the spatial extent of sites varied significantly between time periods and that change over time was not linear. Paleoindian and Early Archaic sites were shown to be relatively small and uniform in spatial extent, suggesting that group size was small and that there was little variation in site function. This was followed by a dramatic rise in average site size during the Middle Archaic period, suggesting larger group size and/or episodic (likely seasonal) aggregations of people. The greater *range* in site size during this period may also suggest a higher number of different types of sites, perhaps resulting from increased specialization. During the Late Archaic, sites appear to have grown smaller and more uniform in size, suggesting that, even as overall population levels continued to increase, operable group size declined and sites became more alike in function. Site size increased again in the Late Prehistoric, but never reached that attained during the Middle Archaic.

Site Distribution by Environmental Zone and Time Period

Physiographic Zones

Prehistoric site distribution by physiographic zone indicates a general prehistoric preference for the piedmont zone, followed by the lowland and upland zones. The total site *area* within each zone shows a different trend, with the lowland containing the largest sites, followed by the piedmont and upland zones. Thus, although *more* sites are shown to occur in the piedmont zone than in any other zone (per unit of area), sites tend to be *largest* in the lowland zone. Conversely, there are not only significantly fewer sites in the upland zone, but the sites that do exist tend to be much smaller than average.

When parsed out by time period, the data indicates that the uplands assumed increasing importance from Paleoindian times to the Middle Archaic, before declining during the Late Archaic and Late Prehistoric periods. The piedmont zone—although containing the highest density during two of the time periods—generally decreased in importance through the Late Archaic before rising again during the Late Prehistoric period. The lowland zone is shown to have been most important during Paleoindian times before declining during the Early Archaic then gradually assuming increasing importance throughout the remainder of the prehistoric period.

In sum, the data suggests that elevational preferences in prehistory changed through time such that higher landforms were used more intensively in earlier periods than in later periods (Paleoindian period excepted). Conversely, the lowland zone appears to have assumed increasing importance throughout time. This trajectory likely reflects known climatic trends, notably the Holocene Climatic Optimum that occurred between 9,000 and 5,000 years ago, roughly contemporaneous with the Early Archaic period. The more xeric conditions of this period may have forced an upslope movement of food resources that triggered a cultural shift towards higher landforms. Increasing reliance on the piedmont and lowland zones during subsequent periods likely reflects more mesic conditions.

Environmental Zones

General prehistoric site density was found to be greatest in pediments/piedmont slopes, fan remnants, and erosion remnants, and to be lowest in plateaus, alluvial flats, side and lower slopes, mountain slopes, igneous hills in basin, and alluvial fans on piedmont slopes. Sites were shown to be much *larger* than average in fan remnants, alluvial flats, erosion remnants, and pediments/piedmont slopes. By contrast, sites were shown to be much *smaller* than average in mountain slopes, alluvial fans on piedmont slopes, plateaus, igneous hills in basin, and side and lower slopes.

When examined by time period, the data indicates changing preferences through time. Paleoindian sites were shown to occur most frequently on erodable clay from mudstone, fan remnants on piedmont slopes, and plateaus. Early Archaic sites were shown to occur most often on fan remnants followed by mountain slopes, erodable clay from mudstone, and fan remnants on piedmont slopes. Middle Archaic sites were shown to be more uniformly distributed across zones than earlier periods, with most occurring on fan remnants, mountain slopes, and erodable clay from mudstone.

Late Archaic sites were found to occur most uniformly across zones of any time period and were present in all zones where temporally affiliated sites were located. The highest preference was afforded fan remnants followed by mountain slopes, alluvial flats, and erodable clay from mudstone—all of which are near equal in site density. Late Prehistoric sites were found to occur less uniformly than either Late or Middle Archaic sites, with the majority of sites occurring in just four zones: pediments/piedmont slopes, erosion remnants, alluvial flats, and mountain slopes.

In the broadest terms (and simplifying the environmental zonation), the results show that Paleoindian sites are found most commonly in eroded badlands, igneous mountain fans, and limestone mountains. The Archaic subperiods all shared a preference for three zones: fans around limestone mountains, igneous mountains, and badlands, with the addition of igneous mountain fans during the Early Archaic and alluvial flats during the Late Archaic. Signaling a significant shift in land use, Late Prehistoric sites are found most often on pediments/piedmont slopes, eroded lowlands, alluvial flats, and igneous mountains.

Site Richness

Analysis of site richness by physiographic zone revealed a higher percentage of complex sites in the lowlands and a lower percentage of complex sites in the uplands with the piedmont zone falling in between. By environmental zone, the most complex sites were found in erodable clay from mudstone, mountain slopes, and pediments/piedmont slopes—all of which occur in different elevation zones. The starkest pattern was revealed in two zones—plateaus and side and lower slopes (both located in the limestone mountains)—where site complexity tends to be significantly lower. Other patterns are less certain. Sites located in erosion remnants and fan remnants tend to be less complex whereas both simple and complex sites are found in relative abundance on pediments/piedmont slopes—the environmental zone whose richness distribution most closely follows the general parkwide distribution.

Hearth Analysis

The hearth analysis demonstrated generally weak temporal patterning with respect to pavement hearths, moderate—but questionable—patterning with respect to ring hearths, and very strong temporal patterning with respect to cobble-lined hearths. The analysis also revealed that each of the three hearth types had strong spatial patterning, each unique from the others, supporting the assumption that these are distinct thermal feature types.

Hearths were found to occur in nearly every environmental setting, with pavement style hearths by far the most common hearth type, comprising almost 77 percent of the total number of hearths recorded between 2005 and 2010. These hearths were shown to be affiliated with every time period with increasing association through time and were found to occur on sites containing other feature types and formal tools more often than other hearth types. They occur most often in floodplains, followed by pediments/piedmont slopes, and alluvial flats.

Ring hearths were the second highest in abundance of the three hearth types, accounting for 15 percent of all hearths recorded between 2005 and 2010. This hearth type appears to be associated with all time periods following the Paleoindian period, but most strongly with the Late Archaic. However, temporal analysis suggests that ring hearths were episodically preferred, strong in the Early and Late Archaic, and weak in the Middle Archaic and Late Prehistoric. They were shown to occur with the greatest frequency in fan remnants, pediments/piedmont slopes, and erosion remnants—accounting for over 55 percent of the total ring hearth density.

Cobble-lined hearths were the least common of the three hearth types, amounting to only 8 percent of all hearths recorded between 2005 and 2010. They appear to be associated strictly with the Archaic period and most strongly with the Early Archaic. This hearth type was shown to occur most frequently in erodable clay from mudstone, pediments/piedmont slopes, and low hills from tuff that, taken together, account for nearly 60 percent of the total cobble-lined hearth density.

Midden Analysis

The temporal analysis of middens suggested that the use of earth oven technology—and occupations lengthy enough to result in sheet midden formation—intensified, during the Middle Archaic period and increased substantially during the Late Prehistoric. The analysis also indicated that earth oven use may have declined during the Late Archaic. However, due to the very small sample size, this data should be viewed with caution.

Spatial analysis of middens showed that ring middens are found most often in fan remnants on piedmont slopes—a zone that occurs almost exclusively along the northeastern and eastern flanks of the Chisos Mountains. It also showed that almost every ring midden-bearing site in this zone occurs along its edges rather than its interior (either along the upslope side of the zone, bordering the mountain slopes, or, more frequently, the downslope side of the zone) typically bordering pediments/piedmont slopes (the zone with the second highest ring midden occurrence). Significantly, this is also where a great many of the park's springs are found.

The analysis further showed that ring middens are found most often on relatively rich sites (in conjunction with other feature and tool types). This suggests that they were not solely the by-product of specialized resource procurement or processing activities but often may have served as one of several residential base camp appliances rather than being the singular focus of a logistical camp.

Stone Enclosure Analysis

The analysis of stone enclosures indicated that their association with the Late Archaic is strongest both by the number of sites and by the number of projectiles, but lags significantly behind the Late Prehistoric by number of structures. What this may suggest is that there are more Late Archaic sites bearing stone enclosures, but that the sites tend to be smaller—or at least contain fewer structures. Conversely, there are fewer Late Prehistoric sites containing stone enclosures, but those sites tend to be larger—or at least contain a significantly higher number of structures than those associated with other time periods. The analysis lends additional support for the idea that stone enclosures were not confined to the Late Prehistoric period, but were used throughout time.

The spatial analysis of stone enclosure sites showed a preference for both mountain slopes and erodable clay from mudstone, occurring more than 5 percent above expected values. With respect to the number of structures per zone, however, plateaus lead by a significant margin, followed by mountain slopes, and igneous hills in basin. Pediments/piedmont slopes and fan remnants on piedmont slopes were shown to have far fewer structures than expected but were near expected values for number of sites containing enclosures. This indicates that these zones contain more single enclosure sites compared to the other zones, suggesting that they may have been utilized less often as base camps.

Conclusions

Despite the many shortcomings of survey-level archeology, the analyses of data gathered during the Big Bend National Park project offer a strong argument that trends in prehistoric human behavior can indeed rise above the "background noise" of imperfect surficial data, at least in cases (such as this one) where the sample size is large enough. The argument that these data cannot be trusted enough to be analyzed should be re-evaluated in light of these findings.

The present analyses suggest there were notable changes in population density, social structure, and subsistence strategy throughout prehistory in the Big Bend and that these changes were complex and nonlinear. Despite a very small sample size, the data supports prevailing thought that during the Paleoindian period, groups tended to be small and, likely, highly nomadic, with an adaptive focus on lowland areas which, during the early Holocene, may have offered the best suite of resources. Adaptive strategies appear to have changed during the Early Archaic, coincident with the Holocene Climatic Optimum, when higher elevation landforms became preferred over the lowlands. Although population levels were significantly higher than in the preceding period, group size appears to have remained small and highly nomadic. Among their technological adaptations was a unique feature type that may be completely restricted to this period (cobble-lined pavement hearths), possibly reflecting specific resource processing.

Dramatic cultural changes appear to have occurred during the Middle Archaic period, a sort of cultural flowering that, in many aspects of material culture, far exceeded periods before and after. The data suggests there was a huge leap in both population and group size, likely with large seasonal aggregations of people. Increased specialization is indicated by the wide variation in site type and size. The use of earth oven technology may have expanded during this period, possibly signaling a shift towards an increased use of succulents. Many of these findings also support the idea that Middle Archaic people enjoyed a rich spiritual life as suggested by their use of ritual caches and abstract petroforms (such as the Lizard Hill site).

The Late Archaic witnessed a major shift away from the patterns of the Middle Archaic. Although population levels appear to have continued to rise, the data suggests that group size declined significantly, likely reflecting higher mobility and increasing opportunism in foraging patterns. The data also suggests changing subsistence strategies as reflected in a possible shift away from the use of earth ovens and an increase in the use of ring hearths. Attendant with smaller group size and increased mobility, it appears that specialization also decreased as sites become more uniform in size and composition.

During the Late Prehistoric, both population levels and group size appear to have increased although the latter did not rise to that achieved during the Middle Archaic. Mobility appears to have decreased from the Late Archaic, and the lowlands assumed increasing importance—especially as base camps. The use of earth oven technology and stone-based wickiups appear to have increased, or at least occur in greater numbers within individual sites.

Due to concerns about the integrity of survey-level data, the highly patterned results from the present analyses were unexpected. Yet, it is important that survey data have enough integrity to be subjected to analysis, and that the results of these analyses accurately reflect prehistoric behavior. Otherwise, survey becomes little more than an inventory of material culture. The present analyses appear to demonstrate that survey data can, indeed, rise to the occasion—even if its accuracy is conditioned not only by the quality of the data, but by the quantity as well.

8

Project Summary and Recommendations for Archeological Research

Summary

The Big Bend National Park (BBNP) survey project consisted of an intensive pedestrian survey of 58 survey blocks spanning 24,996 ha (61,766 acres). The blocks ranged in size from 16 to 3,078 ha (40 to 7,606 ac), with an average size of 431 ha (1,065 ac) per block. The blocks spanned some 23 environmental zones within the park but were mostly concentrated in just four zones. The vast majority of surveyed acreage (82 percent) occurred in the desert lowlands rather than mountain settings.

A total of 1,566 sites were recorded during the project. Of these, 127 were either exclusively or predominantly historic, and 1,439 were exclusively or predominantly prehistoric. An additional 34 multi-component sites that were predominantly historic, but with substantial prehistoric components, were included in the prehistoric site tally, bringing the total prehistoric site count to 1,473.

Native American Archeology

Prehistoric projectiles collected during the survey represent some 12,000 years of time, from the Paleoindian period to the Late Prehistoric. However, later periods are much better represented, and the general trend appears to be an increasing number of points with each successive period. For those points that could be identified to sub period (n=1,014), only 2 percent of points can be attributed to the Paleoindian period compared to 7 percent to the Early Archaic, 22 percent to the Middle Archaic, 32 percent to the Late Archaic, and 37 percent to the Late Prehistoric. As proxy for population estimates, this data suggests generally increasing population through time but with a significant spike during the Middle Archaic. The number of projectiles increased by 15 percentage points from the Early Archaic—the highest jump between any two periods. By comparison, the number of projectiles increased by only 9 percent in the Late Archaic and by another 6 percent in the Late Prehistoric.

Diagnostic projectiles were collected from 284 sites, 259 of which contained points that could be identified to sub period. Of these 259 sites, 143 (55 percent) produced projectiles from only one time period. This data subset of potentially single-time-period sites was used extensively in the analysis section.

Prehistoric site density within the surveyed areas averaged 17 ha (42 ac) per site but ranged significantly between survey blocks—from the highest site density 6 ha (14 ac) per site to the lowest site density of 59 ha (145 ac) per site. Density was generally higher in the basin settings than in the mountains although this may partially be a result of visibility. Sites were found to cluster along the margins of some environmental zones, demonstrating a generally higher density in ecotones. Although the Rio Grande and other riparian areas and springs were found to be good indicators of site presence, site patterning around such features varied significantly.

Sites ranged in size from 13 m^2 (140 ft^2) to 1,796,393 m^2 (444 ac) although the largest sites tended to be lithic procurement areas rather than habitation sites. Adjusting for this, sites averaged 10,000 m^2 or 1 ha (2.5 ac) per site. Prehistoric sites were categorized by site type, six of which were identified. The vast majority (90 percent) represent open campsites, followed by artifact scatters (4 percent), special use sites (3 percent), natural shelter sites (2 percent), food processing sites (1 percent), and stone enclosure sites (0.3 percent). In addition, 0.6 percent of sites could not be assigned a site type.

Seven major feature *classes* were identified, each of which contains specific *types* of features. The major classes are thermal features, stone enclosures, other rock features, special use, interments, and redoubts and fortifications. Thermal features were by far the most commonly encountered feature class, constituting roughly 90 percent of all feature classes, followed by stone enclosures (4 percent), and other rock features (3 percent). Special use features, interments, and redoubts and fortifications each comprised less than one percent of the total number of features.

The most common feature type within the thermal feature class was hearths, representing 77 percent of all thermal features. This was followed by fire-cracked rock (FCR) concentrations and scatters (19 percent), and middens (3 percent). Four hearth types were identified during the survey although they were tallied individually in the field only during the second half of the project. From this data subset, pavement hearths dominate the assemblage at 74 percent of the total, followed by ring hearths (13 percent), cobble lined hearths (10 percent), and unspecified (4 percent). Two types of middens were also documented: ring middens, making up 58 percent of all midden features, and sheet middens, making up the remaining 42 percent.

A total of 254 stone enclosures were recorded at 89 sites during the project. Thirty percent of these were classified simply as generic stone enclosures, 33 percent were classified as generic wickiup rings, 23 percent as Cielo complex structures, and 11 percent as tipi rings—the least frequently encountered structure type. Four different types of "other rock features" were also documented during the project, although they occurred primarily outside of sites. These features consist of cairns, rock alignments, rock groupings, and rock clusters—all of which are addressed further in the Isolates section (Chapter 6-IV).

Special-use features recorded during the project consist of vision quest and lookout structures as well as rock imagery. Within the latter category are several types: petroglyphs and pictographs, abraded lines and cupules, and petroforms. Three types of petroforms were documented: medicine wheels, linear alignments, and effigies. With one major exception, the identification and documentation of all these feature types resulted from the present project.

Very few interments or possible interments were encountered during the project. Aside from the one confirmed burial documented at BIBE1849, the remaining six were speculative. These consisted of two stacked-rock features within rockshelters, four stone-filled boulder crevices, and one cairn on an open site.

Only five sites documented during the project contained what were interpreted to be redoubts and fortifications—stone-based prehistoric structures that suggested they were for defensive purposes. In addition to the above-mentioned features, 29 sites were noted to contain buried deposits which hold potential for future subsurface investigations.

Prehistoric artifacts documented during the project consist of chipped stone artifacts, groundstone artifacts, ceramics, ornamental items, and perishable artifacts.

A total of 1,561 prehistoric artifacts were collected, nearly 80 percent of which were projectiles (n=1,236). Of these, 859 are dart points and 360 are arrow points. In addition, 1 dart point preform and 16 arrow point preforms were collected.

In addition to projectiles, 243 other chipped stone artifacts were also collected, consisting of perforators/drills, knives, scrapers, adzes/gouges, spokeshaves, net sinkers, choppers, bifaces, cores, edge-modified debitage, and unmodified debitage. Fifty-six ground- and pecked-stone artifacts were also collected, consisting of manos, shaft abraders, pigment stones, hammerstones, ornaments, a metate, and an incised stone. Eleven shell items were also collected, consisting of ornaments, possible ornaments, and unmodified shells.

Taken together, these prehistoric archeological findings represent the most comprehensive reported in BBNP to date. Documenting the range and variability of prehistoric material culture within the park provides a foundation upon which future researchers can build. As such, data generated during the project should help guide research as well as contextualize and facilitate interpretations of findings from future studies in BBNP and the greater Big Bend.

Euro-American and Mexican-American Archeology

Some 26 percent (n=405) of the 1,566 sites recorded during the project contained historic components although only 8 percent (n=127) of those sites were predominantly so. This body of "predominantly historic" sites formed the basis of the historic findings chapter.

Although the spatial distribution of historic sites was patterned, much of this is explained by the greater abundance of water resources in the southern half of the park as well as the location of the community of San Vicente relative to the total area surveyed. Aside from these factors, however, historic site distribution is largely a function of historical contingencies such as the randomness of the cadastral surveys and state land laws as well as the location of targeted resources such as mercury and candelilla plants.

The 127 historic sites examined were divided into 23 different site types although more than half of the sites were confined to just three groups: campsites, homesteads, and ranching sites. A total of 768 historic features were documented during the project, representing 27 different feature types in six categories: structures, ranching, farming, mining, candelilla wax processing, and miscellaneous.

A total of 895 historic artifacts were placed in 19 functional categories in 5 different major groups: domestic, personal, structural, activities, and miscellaneous. Of these, the domestic group was by far the largest although this was primarily a function of a targeted collection of historic ceramics, which comprised more than 74 percent of the domestic assemblage.

Temporal affiliations of historic artifacts encountered during the project ranged from the Spanish Colonial period to modern times, the earliest of which were found along the Rio Grande. However, most tended to cluster between 1880 and 1940, with the majority dating between 1910 and 1940. Cultural affiliation could sometimes be inferred from material assemblages but most of the time these determinations were not readily apparent and were not systematically tallied. Instead, artifact assemblages between sites tended to be fairly uniform, reflecting the limited variety of goods historically available in the region.

Prior to the present project, relatively little work had been conducted on historic sites in BBNP. Of the 522 sites containing historic components now on record, those documented during the current project represent a full 78 percent of that total. The project also attained an unprecedented level of detail in recording historic features and artifacts, and collections were made on a scale far greater than before. In so doing, the historic data collected during the BBNP project reveal a much lengthier, more nuanced, and more complex picture of the historical record than any regional history has yet brought to light.

Analysis of Survey Results

The analysis of project findings indicate significant changes in population levels, social structure, and subsistence throughout prehistory in BBNP. They also indicate that these changes were complex and nonlinear. Despite a small sample size, the data suggest that during the Paleoindian period groups tended to be small and probably highly nomadic, with an adaptive focus on lowland areas. Strategies appear to have changed during the Early Archaic, coincident with the Holocene Climatic Optimum, when higher elevation landforms became preferred over the lowlands. Although population levels rose above those of the preceding period, group size appears to have remained small and highly mobile. One feature type was identified (cobble-lined hearths) that may be completely restricted to this period, possibly reflecting specific resource processing.

During the Middle Archaic period significant changes appear to have occurred that, in many aspects of material culture, far exceeded the periods that surrounded it. Population levels, as well as group size, appear to have increased dramatically, possibly in conjunction with large seasonal aggregations of people. The greater variation in site type and size suggests increased specialization. There may also have been an increased use of succulents, as some evidence indicates the use of earth oven technology increased during this period. As suggested by their use of ritual caches and abstract petroforms, Middle Archaic people also appear to have enjoyed a rich spiritual life.

A major shift away from these Middle Archaic patterns occurred during the period that followed. Although it appears that Late Archaic population levels continued to rise, the data suggest that group size declined significantly, possibly a reflection of an adaptive adjustment towards higher mobility and increasing opportunism. The data also suggest changing subsistence strategies as reflected in a possible move away from the use of earth ovens and a greater reliance on the use of ring hearths. Attending these changes are suggestions that specialization decreased as sites became more uniform in size and composition, consistent with the idea of smaller group size and increased mobility.

Population levels, as well as group size, appear to have increased again during the Late Prehistoric period, although not as dramatically as during the Middle Archaic. Data indicates that mobility decreased from that of Late Archaic times and that the lowlands assumed increasing importance—especially as base camps. Increased use of earth ovens and stone-based wickiups within individual sites suggest longer occupations.

National Register Historic Context

In addressing mandates from Section 110 of the National Historic Preservation Act of 1966 (NHPA), in particular "that historic properties under the jurisdiction or control of the [Federal] agency, are identified, evaluated, and nominated to the National Register," one historic context was developed (vernacular architecture) and several more were proposed. These are detailed in Appendix 19. As an aid in determining site significance, a set of criteria was developed and is outlined in Appendix 18.

Recommendations for Future Research

The following section contains recommendations for future research, and is divided into two main sections: one dealing with prehistoric archeology and one dealing with historical archeology. The most pressing regional archeological research problems concern the time periods we know the least about as well as thematic topics stemming from recent research that provide new insight into past human behavior. Because these all fall within the realm of prehistory, more space is devoted to this topic.

Prehistoric Archeology

This section begins with recommendations for research using the existing data set followed by research requiring new data—survey as well as excavation data. This is followed by a brief discussion of geomorphological studies, experimental archeology, collections research, special studies, and regional research themes—both temporally- and thematically-based. Due to the paucity of subsurface investigations in BBNP, much of the following discussion is geared toward excavation as opposed to survey data which, with the completion of the present project, is one deficiency that has been partially addressed.

Research Using Existing Data Set

Most of the discussion below proposes research requiring further data collection. However, the range of analytical possibilities using the project data set has been far from exhausted. During the latter portion of the project, changes in site recording methodology, in conjunction with new technology, allowed for more refined spatial recording of individual features and artifacts. The increased spatial accuracy allowed for a level of detail previously unattainable. Consequently, research that requires this level of detail, such as examining intra-site patterning or correlating specific feature types to certain environmental characteristics, is possible.

Countless exercises could be performed with the project data set that were not part of the present analysis, either due to time constraints or because they were deemed beyond the scope of the present project. In lieu of an exhaustive list exploring the range of possibilities, one sample analysis is offered here: to develop a set of criteria for determining site types along the "mobility spectrum," which illuminates one aspect of site function (in particular, its function relative to a group's annual foraging round or migration). Among these site types might be *base camps*, *field camps*, *logistical localities*, or *procurement* sites. Derived from Binford's *forager-collector continuum* (1980), such an approach is specific to nomadic human adaptations such as those practiced prehistorically in the Big Bend. In Binford's continuum, foragers, on the one hand, are seen as practicing "residential mobility" (many base camps throughout the year), which is typically found in warmer climates where seasonal food shortages are not as pronounced, resulting in a limited variety of site types (base camps and logistical camps). In contrast, collectors practice high "logistical mobility" where there are fewer residential moves but often seasonal shortages, resulting in a greater variety of site types.

Using a combination of proxy factors including site size, complexity, diversity, and material content, a *site typology* could be formulated using this model. Small, less complex sites with low diversity and specific tool forms could be typed as "logistical" whereas larger, more complex and more diverse sites could represent "residential" bases. Once sites are classified according to type, they may be further differentiated with an ordinal scale (e.g., orders of magnitude of residential camps) so that the degree of diversity and complexity help to rate residential and logistical sites along a continuum. This would make it possible to compare the frequency and distribution of different site types in various environments between time periods, potentially illuminating changing mobility and settlement systems across time and space in BBNP and the larger Big Bend region.

There are many other examples of analyses that could be performed with the present data set that are similarly appropriate for examining desert hunter-gatherer lifeways. In addition, analyses similar to those performed in this report could be further refined to potentially reveal additional insights. For example, temporally affiliated sites were examined relative to the environmental zones in which they were located. The same analysis could be conducted using different environmental zones, different parameters, or different proxies. One option would be to examine temporally affiliated sites relative to geological, vegetative, or soil classifications as was ultimately done with the predictive model.

Survey Data Collection

Although the present survey project has gone a long way toward addressing the most pressing needs for better understanding the nature and diversity of archeological materials within BBNP, only about 10 percent of the park has been intensively surveyed. The remaining 90 percent we know little about, much of which is in the mountainous areas or in otherwise remote and inaccessible parts of the park.

Initially intended to be an environmentally stratified survey such that each environmental zone would receive equal coverage, the current project was scaled back after realizing those objectives were not feasible in the given time frame. Consequently, additional survey is needed in environmental zones that were not addressed. This need is perhaps greatest in the Mountain Zone, including both igneous as well as limestone mountains. The former includes such ranges such as the Chisos and Rosillos mountains as well as smaller ones like the Grapevine Hills. The latter consists primarily of the Dead Horse and Mariscal mountains as well as Mesa de Anguila.

Survey should also be conducted in the more remote areas that were undersampled during the project. The largest "blank spot" on the map is the Sierra Quemadas and the broad mountainous area comprising the southern extension of the Chisos Mountains, followed by the Dead Horse Mountains and Mesa de Anguila. The archeology in these areas remains poorly understood and backcountry surveys are needed to address this deficiency.

In addition to the mountainous zones and backcountry areas, the entire length of the Rio Grande corridor within BBNP should be targeted for systematic intensive survey. Not only is site density significantly higher in this area, but sites are also under greater threat of disturbance. Major erosional and depositional events attend annual or semi-annual flooding of the river and, due to changes in water flow regimes and vegetation density, these floods are having increasingly detrimental effects upon cultural resources. In addition, sites along the river are subject to greater visitation both from park visitors as well as river runners. Trespass livestock from Mexico also remains a problem, and their effects upon archeological sites, while well documented, have not been systematically examined. It is strongly recommended that these important sites along this riparian corridor be recorded and monitored for these and associated impacts.

Subsurface Data Collection

Very few subsurface investigations have occurred within the park, and most of those that have were early and utilized methodologies that are outdated at best. More recent excavations have been mostly compliance-driven, intended to mitigate impacts of park undertakings rather than having specific research objectives (see History of Investigations).

Ideally, excavation projects should be conducted in BBNP that have well-defined research purposes and that seek to answer pressing questions concerning prehistory. Although the research potential is typically greatest in large block excavations, these are usually cost prohibitive and are rarely undertaken except when required by antiquities laws. This is unfortunate, because a problem-oriented research program holds perhaps the greatest promise in terms of data return and its ability to address regional research concerns.

Testing Projects

Testing projects offer one possible avenue for subsurface investigations that can be more effectively scaled to budget or time constraints. A variety of different subsurface testing projects could be undertaken that would greatly enhance our understanding of prehistoric cultures and environments. One that is strongly recommended is a project to test a variety of different settings within the park to determine their potential for containing intact buried deposits. Despite the fact that most of the lowlands within the Big Bend are erosional, due to the high topographic diversity of the region, there are numerous spatially discrete depositional micro-settings that are likely to have excellent subsurface integrity. One example of this type of setting occurs at the base of some sandstone cuestas, such as those found in the Dawson Creek area and that occur widely in Aguja Formation settings. These high-relief sandstone features erode fairly rapidly, depositing the sediment along the toeslope. If the surrounding terrain is level, or nearly so, such deposition can occur faster than erosive forces can strip it away. Where an archeological site intersects such an environment, the possibility of intact buried deposits is high.

Other major depositional "exceptions" within the erosional "rule" include areas with midslope catchments along the flanks of mountains or remnant streamside terraces, especially those along the Rio Grande. Although flooding has either scoured or deeply buried most archeological deposits within the active Rio Grande floodplain, there are remnant terraces that have been preserved either by the accident of river geometry (changing course) or because they are positioned higher than the existing floodplain due to channel narrowing and incising. In these cases, such terraces can contain deep soils with well-stratified, intact deposits. Examples of this can be seen at BIBE1910 and BIBE1942 where multiple cultural occupations are exposed in the cutbank, preserving untold hundreds (perhaps thousands) of years of prehistory.

Feature Excavations

A wide range of prehistoric feature types exist within BBNP, including a variety of thermal features as well as structures, caches, and petroforms. Although thousands of these features have been recorded in the park and solid morphological data collected, very few of these features have been excavated, and none have been as part of a larger feature-oriented excavation project. As a result, subsurface morphological characteristics as well as temporal and functional affiliations of features in BBNP remain poorly understood.

Consequently, one of the greatest—and most easily achieved—suggested research objectives is that of feature excavations. As an extension of the present project, the data from such excavations could serve as a critical addition to existing data on feature distribution, density, and morphology. In this way, such a project could greatly enhance our interpretation of these features and their role in prehistory. With respect to thermal features, in particular, such a project could form the basis of a formal typology.

Ideally, several features of each type should be excavated, preferably in different environmental settings. Features should be exposed in plan view as well as bisected to expose their cross section. Excavation should encompass an area beyond the confines of the feature itself to capture pertinent subsurface data outside the feature. For example, where conditions permit, a standardized 3m^2 (32 ft^2) area could be excavated around thermal features and a 10 m^2 (108 ft^2) area could be excavated around structures. Feature recording forms should also be standardized and be comprehensive enough to bear on a number of different research questions. In addition to excavation notes, sketches, and photographs, special samples should be taken of the feature fill, including chronometric, macrobotanical (flotation), pollen, phytolith, starch grain, and isotope samples.

Although such feature excavations could help address a broad range of research questions, the most pressing are those dealing with temporal affiliation and function: the time period(s) during which the features were used as well as the task they performed. In the case of thermal features, this would involve analysis of feature content to reveal the kinds of resources being processed.

Features should be prioritized according to the greatest return: those that have projectiles or other diagnostic artifacts in good association, those located on probable single-component sites, those that are morphologically distinct, and those morphologically typical of their class. In all cases, the most undisturbed and intact features should be targeted so the features with the highest potential to yield meaningful data would be addressed first, and the results of these excavations could help guide additional research.

While discrete hearths, containing datable deposits as well as possible remains of foodstuffs may offer the most return for time expended, other feature types also warrant investigation. In the case of ring middens, or earth ovens, for example, excavations could reveal temporal range of use, morphological variability, resources that were processed, and help determine if the feature was the result of a single event or if it was formed over several episodes.

Excavations could reveal equally important data on prehistoric stone enclosures, including the time period in which they were used, specific function, associated cultural complexes, and associated features and artifacts. By determining those instances where stone enclosures are a component of base camps, it may also be possible to learn more about the role such features played in larger settlement and mobility strategies.

Due to the destructive nature of archeological excavations, however, not all features lend themselves well to this methodology. With features that are extremely rare, unusually intact, or fragile, excavation may be inappropriate, and nondestructive methods of investigation should be considered. This is especially true of prehistoric petroforms that are rare and individually distinct. Aside from standard surface documentation, a variety of remote sensing techniques offer great returns with such features, including aerial photogrammetry or, if warranted, ground-penetrating radar (GPR). In these cases, the potential data return must be balanced with preservation goals of such irreplaceable cultural resources.

Geomorphological Studies

Geomorphology—the scientific study of landforms and the processes that shape them—has been of great use to archeologists. In particular, the focus on processes has helped archeologists to better understand both site formation and taphonomic processes that cause these sites to deteriorate.

Within BBNP geomorphological studies could help identify key sedimentary units and natural features in different settings in the park. Such studies could help explain the intricacies of alluvial stratigraphy in the Lowland Zone (terraces, erosion remnants, floodplains, etc.), as well as the different processes at work in the formation of alluvial fans and slopes in the Piedmont Zone. Such studies could model the age of different land surfaces which could help explain characteristics of archeological sites on such surfaces, including their age, degree of exposure, and preservation status.

Experimental Archeology

Aside from casual experimentation with earth oven technology, no formal experimental archeological studies have been conducted in the region. Yet replicating different types of prehistoric thermal features based on observable morphological characteristics and excavation data could help illuminate the many variables involved in their construction and use. By using a standardized amount of fuel, food, rocks, etc., such experiments could provide data on the effects of heat upon different stone types or the thermal efficiency of different kinds of thermal features. This data could then be used to formulate or test hypotheses involving such features. Similar experimentation with historic feature types, such as "heap method" lime kilns, could offer quantitative data to support field observations and provide a better understanding of these poorly understood features.

Collections Research

Investigations of regional material collections help form the foundation of archeological inquiry and are paramount in developing chronologies and identifying similarities and differences between endemic assemblages and those from adjacent regions. They also offer important data regarding diet, mobility, group size, and other aspects of prehistoric lifeways. Here, two recommendations regarding material culture are proposed: (1) repatriate collections back to the park repository, and (2) conduct material collections studies to analyze or re-analyze previously collected artifacts to reflect more recent archeological understanding.

Repatriating Collections

Many of the artifacts that have been collected from BBNP through the years reside at distant repositories and have remained largely unavailable (or, at least, inconveniently located) to regional researchers. It is recommended that these collections be repatriated to BBNP when possible or, minimally, that they be re-analyzed in the context of more recent regional typological efforts (as in the present volume).

By far the largest single BBNP artifact collection that resides outside the park is one collected under the direction of T.N. Campbell of the University of Texas at Austin during his 1966-67 survey in the park. Currently housed at the Texas Archeological Research Laboratory (TARL) in Austin, Texas, this collection contains more than 3,900 specimens, including 734 projectile points; 1,499 knives and heavy bifaces; over 1,000 scrapers; 252 ground and/or pecked artifacts; 36 ornaments or ornament blanks; and 12 faunal specimens. This collection should properly reside in BBNP, and efforts should be expended to facilitate its return.

Collections made before the national park was established may be most appropriately housed with the institution that sponsored the work. Thus, artifacts collected by M.R. Harrington in 1928, by Edwin F. Coffin and Claude S. Young in 1929, by George C. Martin in 1931, and by Frank Setzler in 1932 should remain with the Museum of the American Indian, the Witte Museum, and the Smithsonian Museum, respectively.

Collections from most of the BBNP Cultural Resource Management projects reside at BBNP's curatorial facility. But in cases where they do not, such as the materials collected during the 1978 Baskin project that reside at TARL, these items should also be repatriated to the park.

In some cases, inventories or other data on previously collected artifacts are available online or by request. Minimally, these should be included within the park's material culture database. It would be preferable, however, to re-examine these collections in order to gather metric data and digital photographs so that this information can be readily available to researchers.

Material Culture Studies

One of the largest gaps in material culture studies at BBNP is the complete analysis of artifacts collected from past research efforts within the park. In recent years, major strides have been made toward developing a regional projectile point typology, including the analysis in this report. Collections made previously stand to benefit from a re-examination in light of current thought and understanding of typological issues, allowing for a better grasp of the range of forms and metric attributes of individual types.

As stated above, the largest, and most important, collection that should be examined is that of the Campbell survey (see History of Investigations and above). Although nearly 4,000 artifacts were collected, due to time and budgetary constraints they were not systematically analyzed. This collection, in particular, should be re-analyzed and reported with the full suite of metric data and photographs. This, combined with the results of the present analysis, as well as those from Big Bend Ranch State Park, and several large collections from private area ranches, would provide a significant baseline of data for future typological efforts in the region.

Although research needs may be most pressing for diagnostic projectiles, largely to further refine the prehistoric chronology, other artifact types also deserve recognition. There have been virtually no systematic studies of regional tool forms aside from projectiles, despite the fact that unique regional variants are known to exist (one example, recently termed the "La Junta Abrader," was first identified by J. Charles Kelley in the 1930s but is only now being systematically examined by the CBBS). Scrapers, knives, hammerstones, flake tools, and all manner of groundstone have been collected during the course of numerous survey projects over the years and these should be analyzed in greater depth to determine the range of forms, possible regionally unique variants, and—ideally—their function. With new technology and analytical techniques available today, we stand to learn far more than was possible with traditional lithic analysis.

Of the various artifact types, probably the one most likely to broaden our understanding of late prehistory, after projectiles, is ceramics. The present report, which includes the first analysis of ceramics in BBNP to date, will form the foundation for future ceramics research in the park. But many questions remain. One of the most pressing issues is the *temporal range* of different ceramic types, especially the poorly understood locally made varieties.

To address this, future research in BBNP should include dating of features in association with prehistoric sherds as well as direct dating of the sherds themselves through Optically Stimulated Thermo-Luminescence (OSL) dating as discussed below. Future ceramic studies should also include petrographic analyses and Instrumental Neutron Activation Analyses (INAA) as well as in-field collection of possible pottery clays for comparison with the ceramic pastes of potentially local ceramics. Such a body of data would allow the development of a ceramic typology and chronology based on absolute dating and compositional attributes, which could greatly enhance our understanding of Late Prehistoric to Historic regional ceramics.

Special Studies

There is a wide range of special studies available to archeologists today that were inconceivable only a generation ago. As such, they offer great promise to enhance our understanding of past environments and past human behavior. Although dozens of these special studies exist, only a few are mentioned here, identified for their particular utility in addressing regional research concerns.

Standard radiocarbon dating and Accelerator Mass Spectrometry (AMS) radiocarbon dating have become routine in archeological investigations, forming the basis for absolute dating of archeological features and sites and serving as the foundation for prehistoric chronologies. Where datable deposits can be found in good context, they should always be collected for analysis. Woody charcoal is always preferred, which can be used not only for dating, but also for fuelwood identification. Where several species of wood are present, the one with the shortest life span should be chosen for AMS radiocarbon dating to obtain the most accurate results. Although dendrochronological analysis could also further refine chronologies (at annual-level resolution), no such regional database has been developed.

When excavating features, especially thermal features, matrix samples should always be collected. Similar samples can be taken from stratigraphic columns within a site (which can inform on the human activities undertaken) and outside the site (which can inform on contemporaneous environmental conditions). From these samples macrofloral analysis can identify charcoal, seeds, wood fragments, and other larger plant parts whereas microfloral analysis focuses on more cryptic floral elements such as pollen, phytoliths, and starch grains. Along with studies of indicator species such as snails, diatoms, and ostracods, such analyses can help answer questions regarding past environments, diet, seasonality, trade, and site function, among others.

In cases where carbon is not present for dating needs, OSL analysis—which dates the last time sediments were exposed to sunlight (or to intense heat)—has proven a useful technique. It has the particular advantage of dating the actual artifact or sediment rather than organic materials whose association to the occupation is often assumed. Regionally, it has been used to date ceramics from contact period sites (Walter and Keller, in prep), and this method could be used to help establish chronometric control for a regional ceramic typology.

A number of special studies are applicable specifically to stone tools. Among these is digital microscopy in which high magnification allows use-wear studies to determine the function of stone tools. With artifacts such as projectiles, scrapers, or groundstone, protein residue analysis can determine the plants or animals that were being processed. Similarly, Fourier Transform Infrared Spectroscopy (FTIR) uses infrared spectroscopy to create an absorbance signature of organic compounds, allowing detection of these same resources.

Instrumental neutron activation and X-Ray fluorescence (XRF) analyses are used to characterize the composition of lithic artifacts as well as to determine their source by nondestructive means. By analyzing the concentrations of various mineral elements that create a signature for a given rock type, stone tools can be keyed to their point of origin. X-Ray fluorescence analysis, in particular, has determined the source provenience of obsidian artifacts from a number of sites in the greater Big Bend and should also be conducted on the small collection of obsidian artifacts recovered during the present survey (Shackley 2010).

Finally, DNA analysis can be used to indicate what types of resources were being targeted prehistorically, as well as to provide genetic information about the people themselves. Where DNA is found in microscopic residues on stone tools, it can be used to identify which animals the tool was used to process. Similarly, human DNA can be extracted from human remains and perishable artifacts such as wooden tools as well as quids (chewed and discarded wads of plant material) and coprolites (fossilized dung), all of which are common in dry rockshelters across the region. Such data can offer insight into a range of research questions including kinship, prehistoric migration patterns, and interactions with outside groups.

Regional Research Themes

This section introduces a few of the broad research themes that address known gaps in our knowledge of regional prehistory. Following a brief discussion of temporally based research problems is a discussion of specific thematic research avenues.

Temporally Based Research

Based on their relative abundance, we tend to know more about later cultures than earlier ones. Thus, to some degree, a site's significance is based upon its age, with earlier sites higher in relative importance. Evidence indicates that regional population levels increased throughout prehistory, such that there are many more Late Prehistoric sites than there are Early Archaic ones. As a result of their scarcity, then, Paleoindian sites in particular are of great interest to regional researchers. Until recently, there was only a single known buried Paleoindian site in the Big Bend—the J. Charles Kelley site/41BS908 in BBNP—although we now have several dating to that period, one of which has undergone extensive excavations (Genevieve Lykes Duncan site). As a result of data recovered from this site, we have gained a much better understanding of regional Paleoindian adaptations, which appear to have become regionally specialized and resource-specific as early as the Late Paleoindian period.

These initial findings suggest that Late Paleoindians were more common in the region than previously thought and that they had developed a place-based adaptation that appears to be significantly different from the big game hunting adaptations of the adjacent Southern High Plains, for example. But so far, these buried sites have been found in very limited environmental contexts—either in central mountain basins (the BBNP "Basin"), or along the upper reaches of major drainages (Terlingua Creek). It is believed that Paleoindian sites in many other environments within the greater Big Bend have been destroyed by erosion and sites dating to this period may only be discoverable in such discrete settings. However, far more questions remain than have been answered, both about site distribution and preservation as well as the environmental adaptations of these earliest Big Bend residents.

This same pattern of scarcity holds true for Early Archaic sites in the Big Bend although they are far more common than their predecessors. Two such sites have been investigated as part of the CBBS Trans-Pecos Archaeological Program, and preliminary evidence indicates an even further developed desert-archaic lifeway in an environment where classic Chihuahuan Desert flora had already taken hold. Perhaps the greatest inroads in recent years have been made into the Middle Archaic period in the Big Bend, including one block excavation as well as the excavation of a Middle Archaic dart point cache discovered during the present project (see Appendix 20). In addition, a synthesis of our knowledge of this period was recently completed (Ohl 2014). A number of compliance-driven projects as well as small excavations in the region have yielded significant data on the Late Archaic and Late Prehistoric periods. However, as suggested by the results of the present analysis, many questions remain about these later periods.

The main exception to the "earlier is scarcer" rule is that of historic Indian occupations. Despite rather abundant historical documentation of their presence in the region (both in popular lore as well as in official military records), the known archeological expression of this time period is virtually nonexistent. This project serves as a case in point. Despite a targeted effort to locate artifacts, sites, and trails (i.e., the Comanche Trail) from this period, the singular result of that effort—after nearly 25,000 ha (61,766 ac) had been surveyed and over 1,500 sites recorded—was a lone metal tinkler. Although this period was marked by rapid cultural and technological change, and techniques of evasion had been honed over generations through engagements with the Spanish, Mexican, and U.S. military, we should expect that this period would be more readily visible in the archeological record. However, as this and other surveys have demonstrated, it is not. Research projects focused on this time period will need to make use of metal detectors in their methodologies as well as more extensive use of written documents and other sources in order to locate such sites and, possibly, to identify a heretofore unrecognized archeological signature.

Thematically Based Research

The following research themes have been identified based on past work in the region, both with regard to the discoveries made as well as the questions they generated. Although cursory, these research themes can serve as a foundation for more refined research questions.

As noted above, we are only now beginning to understand some aspects of the Paleoindian period in the region. But there is much yet to learn. We know that by the Late Paleoindian period, desert archaic lifeways were already being practiced in the region. What we do not know is when exactly this shift from "Paleoindian lifeways" to "Archaic lifeways" occurred—whether during the Early Paleoindian period, or whether it developed later. Further, what environmental constraints shaped this adaptation, and in what ways did culture and technology allow them to adapt? Specifically, at what point in the regional archeological record did people begin to use rocks as heating elements, construct earth ovens, or use stemmed dart points? Were the typically diminutive Late Paleoindian points we find simply a technological adaptation reflecting a focus on smaller game, or was it a style that was somehow culturally derived?

During the present project, in addition to other recent archeological efforts (i.e., the Rosillo Peak site investigation), significant strides were made in documenting prehistoric ritualism that we now know was evident at least as early as the Middle Archaic period. A number of sites containing abstract petroforms and one containing a contracting stem dart point cache are believed to date to the Middle Archaic period. We also have evidence of Late Prehistoric ritualism (medicine wheels and effigy petroforms are believed to date to this period) both within the park and beyond. Abundant rock art across the region, especially the figures documented in Tall Rockshelter and Wolf Den Cave in the Davis Mountains, attests to a rich spiritual life. However, as relatively abundant as the evidence is for prehistoric ritualism during these two separate time periods, we have very limited evidence of ritualism during other time periods. For example, despite a generally higher presence in the archeological record, evidence of definite Late Archaic ritualism is confined at present to a single painted pebble. This may well reflect the higher degree of mobility during this period, as suggested by the present analysis; however, many questions regarding regional prehistoric ritualism, and how it changed through time, remain.

As noted above, the Late Prehistoric period in the region was one that was extremely dynamic culturally. The introduction of the bow and arrow, agriculture, and ceramics marked major technological shifts. At the same time, interactions between nomadic groups and newly sedentary or semi-sedentary agriculturalists at La Junta encouraged very different relations than were believed to have existed earlier. Trade networks were further expanded and refined and cultural interaction appears to have quickened. New archeological structural remains also appear at this time—pithouses in lowland village sites and stacked rock wickiup rings in elevated settings, some of the latter in defensive arrangements suggestive of intergroup conflict. Significant inroads were made in the 1930s and 1940s in examining the agricultural village adaptations in the La Junta area through the work of J. Charles Kelley and Donald Lehmer; and later work by Robert J. Mallouf identified at least one cultural complex (the Cielo complex) of nomadic Indians from the period, and symbiotic relationships between the two have been proposed. But in spite of this work, the cultural interactions during this period are still poorly understood. While there is a significant body of evidence suggesting an increase in such interactions, their extent and nature remain obscure.

Conventional knowledge holds that the La Junta district was bounded by Colorado Canyon on the south and by the narrowing gorge north of Candelaria on the north. However, based on a very small number of prehistoric ceramic sherds found along the Rio Grande in BBNP (from the present project as well as one earlier testing project near Santa Elena Canyon), the possibility arises that the La Junta district—or at least the lifeway practiced within it—may have spread farther downstream, even if only temporarily. While ceramics are not definitive evidence of agriculture and sedentism, they do suggest the possibility. Aside from these sherds, however, there is no solid evidence to support this idea. No pithouses or prehistoric agricultural products have been discovered in BBNP.

Rock art abounds in the Big Bend, and BBNP has several significant rock art sites, notably the one at Indian Head Mountain in the park's far northwestern corner. Through the efforts of the Rock Art Foundation, the park archeologist, and CBBS researcher Reeda Peel, among others, we have a much better grasp of the range of forms in the region and at least a preliminary grasp of their chronology. However, regional rock art appears to be distinct from styles in adjacent regions to the east (Lower Pecos) and west (western Trans-Pecos). Less is known about possible similarities with styles to the north and south, and the question of whether the regional styles evolved in place or were influenced by extra-regional sources is not known.

One of the most exciting discoveries made during the present survey project was that of prehistoric petroforms. Only a single "medicine wheel" had been discovered in the park prior to the present project, and, as a feature class, it had not been formalized. Two additional medicine wheels, several turtle effigies, and a number of abstract petroforms were documented during the project—including one associated with a Middle Archaic dart point cache (BIBE 1853). At least two other effigies (probable turtles) have been found outside the park but none have been documented in adjacent regions. The closest known analogs occur on the Northern Plains, especially in Wyoming, Montana, and the Canadian provinces of Alberta and Saskatchewan but comparisons of these features with regional ones have not been conducted. Aside from the one BBNP site believed to be affiliated with the Middle Archaic period, the temporal affiliation of these features is unknown, although most are presumed to be Late Prehistoric. However, the distribution and temporal affiliation(s) of this class of feature remain poorly understood. Research should be conducted that will attempt to answer some of the most pressing questions related to these obscure but distinctive feature types.

The last thematically based research question involves the transition from the Late Prehistoric to the Historic period. Written documentation about the region began with the journals of Cabeza de Vaca and continued with the accounts of the many Spanish *entradas* that passed through the region. Positioned as they were at a major crossroads, the villages around La Junta were relatively well documented during this period. The nomadic Indians, however, were much less so. The complex cultural interactions between native groups that began during the Late Prehistoric period accelerated dramatically following European contact. By 1650 the Apaches were pressing into the region and, within a short while, appear to have vanquished or assimilated the Chisos and Jumanos—the latter of which ceased to be mentioned in Spanish documents after 1720. Research that addresses this highly dynamic time period could help clarify the nature and extent of these complex cultural interactions.

Historical Archeology

Thanks to a fairly abundant suite of written resources, we have a reasonably good understanding of the historic period in the Big Bend. This is especially true of the Spanish period, with the various journals of Spanish *entradas* through the region and the meticulous recordkeeping required of Spanish officials. It is also true of the later Euro-American occupation that began in earnest around 1880. But the half century between Mexican Independence in 1821 and the arrival of the railroad to the region in 1882 is far less well documented.

Although Mexican documents exist, they are typically scattered between individual municipalities and state archives. A great many more documents have been lost to time or through catastrophic events (for example, a trove of pre-1930 Mexican documents from San Carlos and other municipalities were reportedly destroyed in 1989 in Villa Aldama following a major rain event that caused the archive's roof to collapse) (Willeford 1999). Research into these documents by U.S. researchers has been minimal and sporadic. This is a serious oversight, for there is untold precious data contained within these records that would greatly aid early historic interpretations. However, because of the continued instability in Mexico as a result of drug cartels, the dearth of Spanish-speaking archeologists in the region, and the lack of a program that would direct such research, this remains a notable deficiency in the regional historical record.

Although there have been a number of oral histories conducted in communities along the Rio Grande, they were typically part of other projects, and—for the most part—are unpublished or unavailable to researchers. One key example of this is a project conducted by the Office of the State Archeologist in the late 1970s based on interviews conducted on both sides of the international border. The resulting roughly 600-page manuscript still resides at the Texas Historical Commission (THC) with an additional copy believed to be on file at the Texas Parks and Wildlife Department (Robert J. Mallouf, personal communication 2014). Despite the significance of this study, and the fact that most, if not all, of the original informants are now deceased, it remains unpublished.

A similar body of oral history is contained within a collection of Joe Stanley Graham now housed at the Archives of the Big Bend at Sul Ross State University (Robert J. Mallouf, personal communication 2014). Graham, who was born and raised in the Big Bend and later became a professor of anthropology and folklore at Texas A&M at Kingsville, conducted numerous interviews with local residents. These interviews are included in his collection, but have never been in print. Likewise, in the late 1990s, historian John Klingemann interviewed elderly Hispanic individuals along the Rio Grande for the CBBS and the Texas Parks and Wildlife Department but has yet to be published. These resources likely contain a wealth of information and it is strongly recommended that these projects be published, ideally as companion volumes, or that their transcriptions otherwise be made available to the public

Aside from these efforts, which remain inaccessible, no oral histories are known to have been conducted on the Mexican side of the river. This is a serious oversight because, due to its remoteness and lack of amenities, the area has retained many of the practices that have long been abandoned in the U.S. Examples of this include the production of candelilla wax, local pottery, and calcining of lime, all of which have been reported to persist south of the border. Thus, an oral history project targeting elders living along the Rio Grande and in nearby towns could greatly enhance our understanding, not only of local history, but more importantly, of archeological features that have been known or presumed to be historic but which lack a basis for interpretation.

It is also likely that elders remember stories of practices that originated with the Indians, were adopted by *mestizos*, and have persisted through Mexican culture. Considering that Mexican citizens in the region are primarily Native American (as demonstrated in a 2000 paper on a sample of people from Ojinaga that showed more than 90 percent of their mtDNA haplotypes were of Native American origin [Green et al. 2000]), indigenous practices might be expected to persist within that population. Thus, such an oral history project would have the potential to shed light on questions dealing with prehistoric as well as historical archeology. But with each passing year this information is lost as elders pass away. Consequently, this is a rather urgent and pressing research need.

Aside from the scarcity of Mexican archival and oral history resources, another gap in our understanding of regional historical archeology is the timing of the earliest settlements. Conventional histories hold that the region remained largely unpopulated until Euro-Americans arrived. However, a few written documents and a growing body of archeological evidence argues otherwise. While settlement may have been sporadic and tentative, it appears that areas such as San Vicente, Pantera, and Terlingua Abajo in BBNP were likely occupied as early as 1800, and certainly were prior to 1880. Additional research is needed that will address these questions through direct dating of archeological materials and excavations that can reveal the earliest sequence of occupations.

Appendices

Appendix 1

Archeological Site Data

The following table of select archeological site data consists of all 1,566 sites recorded during the project, including 1,462 new sites and 104 sites that had been previously recorded. Breaks in the numbering sequence represent sites previously recorded or other projects that occurred during the present survey.

Table Abreviations

Site Type

BRID	Bridge	**GRAV**	Gravesite	**RANC**	Ranching	**SURV**	Survey (Topo / Cadastral)
CAMP	Open Campsite	**HASC**	Historic Artifact Scatter	**SCHO**	School	**TANK**	Tank
CEME	Cemetery	**HOME**	Homestead	**SHBO**	Boulder Shelter	**TRAC**	Tracking Station
COMM	Community	**KILN**	Kiln	**SHCA**	Cave Shelter	**UNDT**	Undetermined
DAM	Dam	**LISC**	Lithic Scatter	**SHCL**	Cliff Shelter	**WAXC**	Wax Camp
DUMP	Dump	**MILI**	Military	**SHRO**	Rockshelter	**WELL**	Well
FARM	Farmstead	**MINE**	Mining	**SPEC**	Special Use		
FOPR	Food Processing	**QUAR**	Quarry	**STOR**	Store		

Prehistoric Features

CA	Cairn	**PBR**	Possible Burial	**PTG**	Petroglyph	**RG**	Rock Grouping
LS	Lithic Scatter	**PCG**	Pictograph	**RA**	Rock Alignment	**SE**	Stone Enclosure
MH	Mortar Hole	**PTF**	Petroform	**RC**	Rock Cluster	**SP**	Stone Pavement
ORF	Other Rock Feature						

Prehistoric Artifacts

BF	Biface	**DEB**	Debitage	**MH**	Mortar Hole	**OT**	Other
CE	Ceramic	**HA**	Hammerstone	**MD**	Modified Debitage	**SC**	Scraper
CO	Core	**MA**	Mano	**ME**	Metate		

Historic Artifacts

BO	Bottle	**FC**	Firearm Cartridge	**ML**	Milled Lumber	**TC**	Tin Can
BU	Button	**FE**	Fence	**MTL**	Metal	**TT**	Tobacco Tin
BW	Barbed Wire	**GL**	Glass	**NA**	Nail	**WI**	Wire
CE	Ceramic	**HSH**	Horseshoe	**RD**	Road		

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
44	2.922	X	X	CAMP	1	1				MD, CO			FC, HSH
45	1.296	X		CAMP	13	12		ORF		BF, SC, OT, MD, CO			
46	0.312	X		CAMP	1	1				MD			
47	2.008	X		CAMP	5	3				ME, SC, MD, CO			
48	3.269	X		CAMP	9	6		MH	3	MA, ME, BF, SC, HA			
49	1.161	X		CAMP	11	9			1	MA, BF, SC, OT, MD, CO			
50	4.516	X		CAMP	36	32		RG, ORF	2	ME, BF, SC, OT, MD			
51	0.750	X		CAMP	5	5				ME, BF, SC, MD, CO			
52	0.491	X		CAMP	3	3				SC, MD			
92	1.733	X		CAMP	10	6		RC		ME			
93	6.195	X	X	CAMP, SHRO	18	8		CA, RC, RA		MA, BF, MD, CR	1		FC, TT, GL, WI, BO
94	0.862	X		CAMP	6	5							
123	2.930	X	X	CAMP	22	20		ORF	1	MA, ME, BF, SC, OT, MD, HA, CO			MTL, TC
124	14.412	X		CAMP	112	90		RA	3	ME, MH, BF, SC, OT, MD			
135	1.146	X		CAMP	12	8				BF, MD, CO			
136	2.802	X		CAMP	23	23			1	MD			
152	1.495	X	X	CAMP	5	4				ME, BF, CR			TT, FC
185	1.505	X	X	HOME, CAMP	1	1					7	3	TC, CE, GL, BW, WI, NA, FC, BU, HSH, TT
186	1.594	X	X	CAMP, HASC	13	14		RA, ORF		MA, ME, BF, SC, HA, CO			FC, ML
187	0.210	X		CAMP	5	2		RG		ME, CO			
246	17.743	X	X	CAMP, SHRO	50	42	4	ORF, PTG	14	MA, ME, MH, BF, SC, OT, MD, HA			CE, FC
284	3.409	X	X	CAMP	57			RA	13	MA, ME, MH, CO			BO, GL, TC, CE
296	8.349	X	X	UNDT	61	58			2	ME, BF, SC, CO			FC
297	0.193	X		CAMP	3	1				SC, CO			
338	25.524	X	X	CAMP, SHRO	196	170	7	CA, RA, ORF	5	MA, ME, MH, BF, SC, OT, MD, CO	3		FC, TC, GL, BO
415	7.608	X	X	HOME, RANC, CAMP	21	18		RA, ORF	11	MA, ME, MH, BF, SC, OT, MD, HA, CO	5	2	FC, CE, BO, HSH, TC, NA
418	13.417	X		CAMP	129	101	3		43	MA, ME, BF, SC, OT, MD			
430	17.407	X	X	CAMP	43	43			2	MA, ME, BF, SC, OT, MD, CO			BO, GL,C E, WI, TC, HSH, FC
438	19.307	X	X	CAMP	37	24		CA, RG, RA, ORF	7	BF, OT, CO			TC
448	0.347	X		CAMP		1				BF, OT, MD, CO			
449	0.002	X		SHCA	1					OT			
450	0.012	X		SHRO	1					ME, BF, SC, OT			
462	0.473	X		CAMP	4			RA		OT			
497	0.087	X		SHRO	1			CA, RA		MA, ME, SC			

498	0.260	X		CAMP	1		1			ME, BF, SC, MD			
503	0.146	X		CAMP	1		1			ME			
536	0.057	X	X	SHRO	1			ORF		OT	1		TC
537	8.995	X		CAMP	16	9	3	RA	7	MA, ME, BF, SC, OT, MD			
545	1.788	X	X	CAMP	5	4	3	SE		MA, ME, SC, MD, CO			TC
546	1.613	X	X	CAMP	1	3	2	SE	2	MA, ME, SC, HA, CO			TC
547	2.913	X		CAMP	6	15	1			MA, ME			
548	0.097	X		CAMP	1	2		SE	1	SC			
549	0.680	X		CAMP	4	3		CA		MA, BF, SC			
593	5.124	X	X	MILI, FOPR	4		4		3	MA, MH, BF, SC, HA, CO	7	2	BO, GL, CE, FC, NA, TC, HSH, MTL, BU
603	2.320	X		CAMP	2	2	1	ORF		SC			
604	2.127	X		CAMP	9	5	3		6	MA, ME, MH, BF, SC, OT, MD, HA, CO			
607	6.967	X		CAMP	5	5	1						
608	0.049	X		CAMP	14			PTG		MH			
609	0.004	X	X	SHCA	1					MH			GL, FC
630	1.161	X		CAMP	10	13				MA, ME, BF, MD			
747	0.020	X		CAMP	2					MH			
748	0.329	X	X	CAMP	10	5				BF, OT, MD, CO			FC
749	0.006	X		SHCL	1			RG, PTG	1	ME, MH, BF, SC, OT, MD, HA, CO	1		
755	3.257	X		CAMP	3	3	2		1	ME, BF, SC, OT, CO			
758	1.291	X		CAMP	3	2	3			ME, SC, OT, MD			
760	4.864	X		CAMP	25			SE, RA, ORF	25	MA, ME, MH, BF, SC, OT, MD, HA			
761	1.405	X		CAMP	5	1	1	SE, RA, ORF	22	MA, ME, BF, SC, OT, MD, HA			
767	0.653	X		CAMP	4	4	1	SE		MA, ME, BF, SC, MD, HA, CO			
771	5.153	X		CAMP	9	8	2			ME, BF, SC, OT, MD, HA, CO			
775	18.502	X	X	HOME, RANC, CAMP	1		4		9	BF, SC, OT	4	1	CE, TC, GL, FC, TT, ML, NA
812	1.273	X		CAMP	17	22	1			MA, ME, BF, SC, OT, CO			
813	0.499	X		CAMP	13	11	3	SE		BF, SC, CO			
814	1.414	X		CAMP	7	14	1	CA, RA		ME, BF, SC, OT, CO			
817	7.741	X		CAMP	45	55	1		2	ME, MH, SC, OT, CO			
853	5.973	X	X	CAMP	33	32	1			MA, ME, OT, MD, HS			BO
856	3.404	X	X	CAMP, RANC	3	3				MA, BF, SC, OT, CO	5	5	FC, CE, TT, GL, BU
857	0.972	X		CAMP	7	5				SC, OT			
859	7.586	X	X	COMM					1	MA, ME, CO	45	14	FC, NA, CE, BO, GL, WI, BU, TC, TT, ML
908	0.826	X		CAMP	8					BF			
920	0.130	X		CAMP	1	1				MA, ME, BF, SC, HA, CO			
921	0.178	X	X	CAMP		1			1	MA, ME, BF, SC, OT, MD, HA, CO			ML, FC, TC, GL
951	0.055	X		SHRO				RA		ME, MD			
952	0.180	X	X	SHRO, SPEC	27	8	1	ORF, PTG, LS		ME, SC, MD, CO			TC, TT, CE
953	0.057	X	X	SHCA				ORF		MA, ME, SC, OT, MD, HA			

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
970	6.247	X	X	CAMP	49	14	3	SE	7	MA, ME, MH, BF, OT, MD			TC
971	0.025	X		SPEC, CAMP	1								
972	1.049	X		CAMP	10	2		SE, RG, ORF		MA, ME, BF, OT, MD			
978	1.778	X	X	CAMP, SHCL	6	8	2		2	MA, ME, MH, BF, SC, MD, HA, CO			MTL, HSH, ML
979	0.055	X		CAMP	1	1							
985	1.170	X	X	CAMP	4	4				BF, OT, MD, CO			BU, NA, GL, CE, MTL, ML, BW
986	0.042	X		SHRO, CAMP	3			ORF		ME, MH, OT			
987	0.336	X	X	CAMP	2	4	1		5	MA, ME, BF, MD	1		FC, HSH
988	1.048	X	X	CAMP, SHBO	6		1	ORF	4	MA, ME			FC, TT
989	0.053	X		SPEC	4					ME			
990	21.213	X	X	HOME, RANC, CAMP	20	27	1	CA, RA		MA, ME, SC, HA, CO	6	1	GL, ML, NA, CE, HSH, TC, FC, CE
991	2.567	X	X	RANC, CAMP						ME	6		TC, GL, BU, HSH, TT, FC, WI, ML, BO
1003	1.786	X	X	RANC, CAMP	3	3				BF, SC, MD	1	1	FC, BW, WI, TC, CE, HSH, BO, GL, NA
1040	0.088	X	X	CAMP						MA, DEB			TC GL
1071	0.427	X	X	CAMP	7	9	1						ML
1082	0.149	X	X	HOME	2	2				DEB	4	1	TT, TC, GL, BO, WI, NA
1083	1.047		X	HOME, GRAV							11	1	GL, BO, WI, NA, BU, FC, CE, TC, ML
1100	3.721	X		CAMP	40	40			12	MA, ME, BF, SC, CO			
1101	0.067	X		CAMP	3	3				ME			
1102	1.085	X		CAMP	7	7			2				
1103	0.012	X		CAMP	1	1							
1104	0.019	X		CAMP	2	2							
1105	3.032	X		CAMP	2	2			1	ME, BF, CO			
1106	0.102	X		LISC						CO			
1107	0.007	X		CAMP	1	1				BF			
1108	5.159	X	X	CAMP	7	7			1	BF	9	1	ML, NA, GL, BO
1109	2.905	X	X	CAMP	30	28	1	CA	7	SC	2		BW, CE, WI, TC, FC, ML, TT
1110	7.935	X		CAMP	8	7		CA	1	BF, OT			
1111	1.716	X		CAMP	7	5			6	ME, BF, MD			
1112	0.414	X		CAMP	12	12			2	BF, MD			
1113	0.213	X		CAMP	3	3				SC, MD, CO			
1114	0.822	X		CAMP	3	3				BF, SC, MD, HA			
1115	0.016	X		CAMP	1	1							

1116	0.100	X		CAMP	3	2				BF, MD			
1117	0.102	X		CAMP	1	1				BF, OT			
1118	2.460	X	X	CAMP	26	19		CA, ORF	24	MA, ME, MH, BF, SC, OT, MD, CO			FC
1119	1.736	X		CAMP	15	13			30	ME, BF, OT, MD, CO			
1120	0.084	X		CAMP	2	2				OT, MD, HA, CO			
1121	0.659	X		CAMP	2	2				BF, MD			
1122	0.363	X		CAMP	5	5				BF, MD, CO			
1123	0.439	X		CAMP	2	2				CO			
1124	1.390	X		CAMP	16	16			6	ME, BF, MD			
1125	0.021	X		CAMP	1	1				BF			
1126	0.057	X		CAMP	1	1							
1127	0.600	X		CAMP	4	5				BF, OT, MD, CO			
1128	0.934	X		CAMP	6	6							
1129	0.101	X		CAMP	1	1				BF, MD			
1130	0.093	X		CAMP	1	1				SC			
1131	0.130	X		CAMP	2	2				MD			
1132	0.115	X		CAMP	1	1				BF, CO			
1133	0.008	X		CAMP	1	1							
1134	0.176	X		CAMP	1	1			1				
1135	0.125	X		CAMP	5	5			2	BF, OT			
1136	0.259	X		CAMP	1	1			2	BF			
1137	0.033	X		CAMP	1	1							
1138	0.148	X		CAMP	3	3			1	MD			
1139	0.136	X		CAMP	1	1				BF, MD, CO			
1140	1.790	X		CAMP	5	5			2	ME, BF, MD			
1141	0.259	X		CAMP	1	1			1	BF			
1142	0.009	X		CAMP	1	1							
1143	1.106	X		CAMP						BF, CO			
1144	1.877	X		CAMP	4	3			1	BF, SC			
1145	0.841	X		CAMP	6	5			3	MA, ME, BF, CO			
1146	0.390	X		CAMP	5	2							
1147	0.142	X	X	CAMP	1	1			1	SC			SUCKER ROD
1148	0.193	X		CAMP	6	6				BF, CO			
1149	1.355	X		CAMP					2	ME, BF, CO			
1150	1.290	X		CAMP	3	3			3	BF, SC, OT, MD			
1151	0.022	X		CAMP	1	1							
1152	4.579	X		CAMP	70	67			9	MA, ME, BF, OT, MD, CO			
1153	0.140	X		CAMP	1	1							
1154	0.129	X		CAMP	1	1				OT			
1155	0.437	X		CAMP	4	1			1				
1156	0.323	X		CAMP	3	3			1				
1157	0.327	X		CAMP	13	10			5	ME, BF, SC, MD			
1158	0.108	X		CAMP	5	5							
1159	0.266	X		CAMP	7	6				MD, CO			

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
1160	0.151	X		CAMP	1	1				MA			
1161	0.221	X		CAMP	1	1				BF, OT, MD			
1162	0.189	X		CAMP						ME, MD			
1163	6.781	X	X	CAMP	37	21			23	MA, ME, BF, SC, MD, CO	1		GL, BW, NA, ML, HSH
1164	0.022	X		CAMP	1	1				MD			
1165	0.139	X		CAMP	8	6				OT			
1166	0.116	X	X	CAMP	1	1				BF, MD, CO			LICENSE PLATE
1167	0.235	X		CAMP	3	1				BF, SC, MD			
1168	0.276	X		CAMP	4	4				SC, MD			
1169	0.147	X		CAMP	2	2				BF, OT			
1170	0.342	X		CAMP	4	4				BF, MD			
1171	0.228	X		CAMP	2	1				CO			
1172	2.112	X		CAMP	10	8				SC, OT, CO			
1173	0.123	X		LISC	1					CO			
1174	0.071	X		CAMP	2	1				CO			
1175	0.191	X		CAMP	5	5			1	BF			
1176	1.431	X		CAMP	8	5				BF, OT, MD, CO			
1177	0.204	X		CAMP	2	2							
1178	0.402	X		CAMP	2	2				ME			
1179	0.264	X		CAMP	3	3				BF, SC, OT, MD, CO			
1180	0.131	X		CAMP	2	2				MA			
1181	0.124	X		CAMP	2	1				ME, OT, MD, CO			
1182	0.573	X		CAMP	14	12			1	MA, BF, SC, OT			
1183	0.049	X		CAMP	1	1							
1184	1.357	X		CAMP	17	5				ME, SC, OT, MD, HA			
1185	0.166	X		LISC					1	OT, MD, HA			
1186	0.034	X		LISC	1					MD, CO			
1187	0.113	X		LISC	1					CO			
1188	1.467	X		CAMP	5	2			1	BF, OT, MD, CO			
1189	0.631	X		LISC	3					BF, SC, OT, MD, CO			
1190	0.083	X		LISC						SC, OT, MD			
1191	1.011	X		LISC	2					BF, OT, MD			
1192	0.074	X		LISC						BF, MD			
1193	0.062	X		LISC	1								
1194	0.029	X		LISC	1								
1195	0.359	X		CAMP	3	3				SC, OT, MD			
1196	0.107	X		CAMP	5	5				MD			

1197	0.096	X		LISC	1					CO			
1198	1.712	X		LISC						OT, MD, CO			
1199	1.063	X		LISC						OT, MD, CO			
1200	0.537	X		LISC	1			RA		BF, OT, MD			
1201	1.190	X		LISC	1					MA, BF, SC, OT, MD, CO			
1202	0.078	X		LISC						BF, MD			
1203	0.318	X		CAMP	10	9			5	MA, ME, BF, SC, OT, MD, CO			
1204	0.397	X	X	CAMP	1				1	MA, ME, BF, SC, OT, MD, HA, CO			FC, BO, GL, TC, ML, NA, HSH
1205	11.571	X	X	CAMP	68	46		ORF	20	MA, ME, BF, SC, OT, MD, HA, CO			GL, BO, FC, TC
1206	0.040	X	X	LISC	1					MD, CO			FC
1207	0.033	X		LISC	1					MD, CO			
1208	0.149	X		LISC						OT, MD, CO			
1209	2.405	X		CAMP	54	50		ORF		ME			
1210	0.401	X		CAMP	7	1				BF, OT, MD			
1211	3.049	X		CAMP	18	7			2	MA, ME, BF, OT			
1212	0.090	X		CAMP	1								
1213	0.090	X		LISC	1								
1214	0.607	X		CAMP	18	7			9	ME, OT, MD			
1215	0.552	X		CAMP	11	11			1	BF, SC, MD			
1216	1.187	X	X	CAMP	52	30	1	ORF	5	MH, BF, SC, MD, CO			TC
1217	1.408	X	X	CAMP	10	10				BF, CO			FC
1218	6.449	X	X	CAMP	117	105		CA, RA	12	MA, ME, BF, SC, OT, MD, HA, CO			FC, TC, HSH
1219	0.193	X		CAMP	2	2				OT, MD			
1220	0.161	X		CAMP	2	2				ME, OT, MD			
1221	1.259	X		CAMP	10	6				MA, ME, BF, SC, CO			
1222	0.070	X		LISC						OT, MD, CO			
1223	0.446	X		CAMP	6	6				ME, OT, MD			
1224	1.407	X		CAMP	7	6		RG	5	MA, ME, BF, OT, MD			
1225	1.251	X	X	CAMP	4	2				BF, MD, CO			FC ,GL
1226	1.555	X		CAMP	15	4				BF, SC, OT, MD, CO			
1227	0.598	X		LISC	2					MD			
1228	0.015	X		LISC	1					CO			
1229	0.040	X		CAMP	2					ME, OT, MD, CO			
1230	0.060	X		LISC	1					CO			
1231	0.042	X		CAMP	1	1							
1232	0.124	X		CAMP	5	4				OT, MD			
1233	0.066	X		CAMP	4	4				OT, MD			
1234	0.234	X		CAMP	4	3				MA, ME, OT, MD, HA, CO			
1235	0.151	X		CAMP	2	1				MA, HA, CO			
1236	0.152	X		CAMP	2	1				CO			
1237	0.771	X	X	CAMP	5	1				ME, MD			WI, ML
1238	0.108	X		CAMP	3	3		RG		ME			
1239	0.092	X		CAMP	2	1							
1240	0.150	X		CAMP	2	2		ORF		ME, OT, MD			

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
1241	0.056	X		CAMP	2	2				OT, MD			
1242	0.188	X		LISC						OT, MD, CO			
1243	0.197	X	X	CAMP	3	3				OT, MD, CO			GL, BO, TC
1244	0.000	X		QUAR	2					BF, OT, MD, HA, CO			
1245	0.611	X		CAMP	2	2				ME, BF			
1246	0.279	X		CAMP	2	1				ME			
1247	2.779	X		LISC	2			RG		MD, CO			
1248	0.662	X		CAMP	1	1				OT			
1249	1.667	X		LISC	14					OT, CO			
1250	0.303	X		LISC									
1251	0.148	X		CAMP	2				3	BF, MD			
1252	0.088	X		CAMP	1	1				BF, MD			
1253	0.315	X		CAMP	5	5				MA, ME, MD			
1254	0.195	X	X	LISC						BF, SC, MD, CO	1	1	ML, TC
1255	0.496	X		CAMP	2	2				OT, CO			
1256	0.187	X		CAMP	1	1				CO			
1257	0.124	X		CAMP	3		1		10	MA, BF, SC, OT, HA, CO			
1258	0.089	X		CAMP	2		1			MA, ME, SC, MD, HA			
1259	0.207	X		CAMP	1				1	MA, ME, BF, SC, OT, MD, HA			
1260	0.647	X		CAMP	1	1				MA, SC, OT, MD			
1261	0.478	X		LISC						CO			
1262	2.584	X	X	CAMP	25	25				BF, MD			HSH, FC
1263	0.328	X		CAMP	5	5				MA, BF, SC, OT			
1264	1.456	X		CAMP	62	50		CA, ORF	2	MA, ME, BF, SC, MD, CO			
1265	1.467	X	X	CAMP	14	10	1	ORF	2	ME, MH, SC, OT, MD			FC
1266	0.133	X	X	CAMP	3	2				MA, ME, SC, MD			BW
1267	0.098	X		CAMP	1	1				BF, MD, CO			
1268	0.291	X		CAMP	2	1		RA		BF, CO			
1269	0.276	X		LISC						BF, CO			
1270	4.837	X	X	CAMP	20	18		ORF	3	ME, BF, SC, OT, CO			TC, WI, FC, HSH
1271	0.354	X	X	CAMP	8	4				OT, CO			FC
1272	0.153	X		LISC	1	1				OT, MD, CO			
1273	0.182	X		CAMP	1	1			1	CO			
1274	0.293	X		CAMP	1	1				MD, CO			
1275	0.625	X		CAMP	1	1				MA, ME, MD			
1276	0.153	X		CAMP	1	1				MD, CO			
1277	0.082	X		CAMP	1					MD			

1278	1.426	X		CAMP	3	3			5	ME, BF, SC, OT, CO			
1279	0.047	X		CAMP	2	2				MD, CO			
1280	0.648	X		CAMP	13	13				MD			
1281	0.220	X	X	CAMP	2	1				MD			HSH
1282	0.105	X		CAMP	3	3							
1283	0.115	X		CAMP	2	1				OT			
1284	0.305	X		LISC	2					CO			
1285	2.705	X		CAMP	28	27				ME, OT, MD			
1286	1.422	X		CAMP					3				
1287	0.443	X		CAMP									
1288	0.130	X		CAMP					1				
1289	0.046	X		CAMP									
1290	0.038	X		CAMP									
1291	0.322	X		CAMP					4				
1292	0.249	X		CAMP									
1293	0.161	X		CAMP									
1294	0.202	X		CAMP					1				
1295	0.618	X		CAMP					1				
1296	0.418	X		CAMP					1				
1297	0.825	X		CAMP									
1298	0.378	X		CAMP									
1299	0.091	X		CAMP									
1300	0.738	X	X	CAMP	3	3			2	ME, BF, SC, MD			
1301	0.091	X		CAMP	2	2				MD			
1302	0.486	X		CAMP	2	2				ME, BF, MD			
1303	0.429	X		CAMP				RG		ME, BF, SC			
1304	0.930	X		CAMP	18	18	2			BF, MD, CO			
1305	0.197	X		CAMP	4	4							
1306	0.048	X		CAMP	5			ORF					
1307	0.085	X		LISC						BF			
1308	1.542	X	X	CAMP	14	13		ORF	1	ME, SC, MD, CO			MTL
1309	0.236	X		CAMP, SHBO	5	1		ORF	1	ME, BF, MD			
1310	3.195	X		CAMP	43	42				BF, SC, MD, CO			
1311	0.027	X		CAMP	1	1							
1312	0.068	X		CAMP	5	5				ME			
1313	0.166	X		CAMP	3	3				ME, SC, MD			
1314	0.263	X		CAMP	1	1			2	ME, SC			
1315	0.458	X		CAMP	5	5			1	MA, BF, SC, MD, HA			
1316	0.614	X		CAMP	14	14				MA, ME, BF, SC			
1317	0.095	X		FOPR						ME, BF, MD, HA			
1318	0.191	X	X	RANC, CAMP						DEB	2		FC, BO, CE, GL
1319	0.041	X		CAMP	2	2							
1320	0.049	X		CAMP	1	1				MD			
1321	0.083	X	X	CAMP	4	3				ME, BF, SC, OT, MD	1		

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
1322	0.108	X	X	CAMP	1	1							BW
1323	0.573	X	X	CAMP	9	9			1	ME, BF, MD, CO			HSH, WI
1324	0.676	X	X	CAMP	21	9	1	RA, ORF	1	MA, ME, MH, BF, SC, MD, HA, CO			GL, NA, WI, MTL, TC
1325	1.373	X	X	RANC, CAMP	16	14	1		3	MA, ME, OT, MD	9	2	FC, WI, BU, GL, ML, BO, CE
1326	0.805	X		CAMP	9	8		CA	2				
1327	0.407	X		CAMP	3	3				BF, CO			
1328	0.050	X	X	CAMP, GRAV	2			CA			2		
1329	0.246	X		CAMP	2	2				BF, SC			
1330	0.260	X	X	UNDT	1			CA, ORF, LS		BF	2		FC, ML
1331	0.331	X		CAMP	5	4		CA		OT, MD			
1332	0.240	X		CAMP	6	6				MA, BF, SC, OT, HA			
1333	0.029	X		CAMP	2	1			1	BF, OT, MD			
1334	0.137	X		CAMP	1	1				SC			
1335	0.060	X		CAMP	2	2			1	MD			
1336	0.233	X		CAMP	3	3			3	BF, OT, MD			
1337	0.102	X		CAMP	1	1				MD			
1338	0.049	X		CAMP	3	3			1	OT			
1339	0.280	X	X	CAMP	5	5				BF, MD, CO			BO, BU, GL, ML, NA, TC
1340	0.339	X		CAMP	2	2				SC, MD			
1341	0.018	X		CAMP	1	1				BF, SC			
1342	0.046	X		CAMP	1	3				SC, MD			
1343	0.073	X		LISC					2	BF, MD			
1344	0.024	X		SPEC	5			CA, ORF					
1345	0.066	X		SHRO	1			ORF, PBR		BF			
1346	0.037	X		CAMP	1	1							
1347	0.187	X		CAMP	4	4				MD			
1348	0.029	X		SHRO				LS		SC, MD			
1349	0.021	X		CAMP	2	2				MD			
1350	0.038	X		CAMP	1			ORF		MA			
1351	0.018	X		SHRO	2			CA, PBR	1				
1352	0.123	X		CAMP	1					MD			
1353	0.022	X		SHRO				LS		MA, BF, SC			
1354	0.073	X		CAMP	4	4				BF, SC			
1355	0.072	X		CAMP	2	1	1			BF, OT, MD, CO			
1356	0.044	X		CAMP						BF			
1357	0.103	X	X	CAMP	1	1				BF	1		
1358	0.159		X	CAMP	1			ORF		BF	1		BO, FC, WI, ML, TC

1359	0.068	X		CAMP						MA			
1360	0.059	X		CAMP	1	1							
1361	0.091	X		CAMP	5	5			1	MD			
1362	0.017	X		SHRO									
1363	0.008	X		SHRO						BF, HA			
1364	0.018	X		SHRO	2			RA					
1365	0.137	X		CAMP	35	35				OT, MD, CO			
1366	0.047	X		CAMP	5	5				MD			
1367	0.017	X		CAMP	1	1							
1368	0.142	X		CAMP	16	13	1			SC, MD			
1369	0.049	X		CAMP	11	15				MA, BF			
1370	0.024	X		SHRO									
1371	0.143	X		CAMP	3	3							
1372	0.225	X		CAMP	13	12	1			MA, BF, MD			
1373	0.333	X		CAMP	16	15				SC, MD, CO			
1374	0.027	X		CAMP	5	5							
1375	0.062		X	WAXC							2		GL, WI
1376	0.015	X		CAMP	2			CA, ORF					
1377	0.076	X	X	CAMP	2	1		CA					
1378	0.314	X	X	CAMP	2	2				BF, OT, CO			TC, WI, ML
1379	0.041	X		CAMP	1	1							
1380	0.036	X		CAMP	4	4			1	BF, MD, CO			
1381	0.172	X		CAMP	13	12			1	SC, CO			
1382	0.051	X		CAMP	4	4							
1383	0.053	X		CAMP	1	1							
1384	0.071		X	CAMP		1					2		TC
1385	0.148	X		CAMP	2	2				MD			
1386	0.041	X		CAMP	4	4							
1387	1.211	X		CAMP	10	9		ORF					
1388	0.029	X		CAMP	3					SC, CO			
1389	0.036	X	X	CAMP	1	1							TC
1390	0.095	X	X	CAMP	6	6				SC			CE
1391	0.100	X		CAMP	4	4				SC, MD			
1392	0.108	X		CAMP	2	2							
1393	0.089	X		CAMP	3	3							
1394	0.220	X		CAMP	4	6				MD, CO			
1395	0.633	X		CAMP	25	25				BF, SC, CO			
1396	0.280	X		CAMP	6	6							
1397	0.121	X	X	CAMP	1			RA		MD, CO			FC, WI
1398	0.022	X		CAMP	1	1				MA			
1399	0.018	X		SHRO				LS		MD			
1400	0.057		X	CAMP									ML, TC, WI, GL
1401	0.103	X		CAMP	3	3				BF, CO			
1402	0.052		X	CAMP		1					1		TC, CE

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
1403	0.060	X		CAMP	2			CA, RA		MA, BF, MD			
1404	0.121	X		CAMP	3	3				MA, BF, SC, OT, MD, CO			
1405	0.031	X		CAMP	2	2				MA, BF			
1406	0.100	X		CAMP	1	1				MD, CO			
1407	0.055	X		CAMP	1	1				MA			
1408	0.621	X		CAMP	2	2				SC, MD, CO			
1409	0.061	X		CAMP	1	1				CO			
1410	0.229	X		CAMP	3	2				CO			
1411	0.031	X	X	CAMP	1	1				CO			GL, WI
1412	0.572	X		CAMP	7	6				BF, MD, CO			
1413	0.062	X	X	CAMP	1	1							TC
1414	0.153		X	HASC									CE, BO, WI, TC
1415	0.463	X		CAMP	9	9				BF			
1416	0.051	X		CAMP	5	5				MD			
1417	0.017	X		CAMP	1	1							
1418	0.168	X		QUAR	4			LS		MD, CO			
1419	0.174		X	HASC									TC, WI
1420	0.100	X		CAMP	1	1				MD			
1421	0.497		X	HASC, CAMP									TC, NA, CE, FC
1422	0.311	X	X	RANC	1	1				DEB	1		TC, GL
1423	0.120	X	X	CAMP						DEB			GL, BO, TC, WI
1424	0.529	X		CAMP	7	5				CO			
1425	0.018	X		SHRO	1			PTG					
1426	0.293	X		QUAR						HA, CO			
1427	0.039	X		CAMP	1	1		PTG					
1428	0.086	X	X	SPEC	15			PTG					
1429	0.035	X	X	CAMP, SHRO	3		1	CA, ORF			1	1	BO, NA, CE, TC
1430	0.843	X		QUAR						BF, SC, MD, HA, CO			
1431	0.088	X		CAMP	4	3				MD			
1432	2.944	X		QUAR						HA, CO			
1433	0.047	X		CAMP	2	2				MD, CO			
1434	0.096	X		CAMP	1	1			1	MD			
1435	0.633	X		CAMP	4	4				MA, ME			
1436	0.048	X		CAMP	1	1							
1437	0.188	X		CAMP	1	1				BF, CO			
1438	0.134	X		CAMP	1	1			1	BF, OT, CO			
1439	0.049	X		CAMP	5	5				CO			

1440	0.055	X		CAMP	1	1							
1441	0.149	X		CAMP	4	4			1	BF			
1442	0.111		X	DUMP							2		TC, WI, BU, CE, GL, BO
1443	0.709	X	X	CAMP						ME			TC
1444	0.045	X		SHBO				LS		MA, ME, CO			
1445	0.126		X	DUMP							3	3	GL, CE, TC, NA
1446	0.109		X	MINE							7		ML, TC
1447	0.078	X		CAMP						OT, MD, HA, CO			
1448	0.287		X	WELL							4	2	NA, ML, WI, GL, CE
1449	0.065	X	X	CAMP	1	1					1		TC
1450	0.197	X	X	CAMP						BF, MD			TC
1451	0.011	X		CAMP									
1452	0.195		X	TANK							1		TC, BO
1453	0.061		X	MINE							1		
1454	0.028	X		SHRO				LS		MA, ME			
1455	0.047		X	TANK, RANC							1	1	TC, WI
1456	0.078	X		SHBO									
1457	0.035	X	X	CAMP						MA, ME, OT			BO
1458	0.151	X		CAMP						ME, BF, MD			
1459	0.091	X	X	SHRO				LS		BF, SC, MD			
1460	0.054	X		CAMP						ME, OT, MD, CO			
1461	0.128	X		CAMP	1	1				ME			
1462	3.219	X	X	CAMP						MD			ML, GL, NA
1472	0.812	X		CAMP	7	7		RG		BF, CO			
1519	2.358	X	X	CAMP	28	27				MA, ME, SC, HA, CO			BO, WI, GL, FC
1520	9.141	X		CAMP	88	88			17	MA, ME, BF, CO			
1522	1.225	X	X	CAMP	14	10				ME			BO, TT
1523	0.053	X		CAMP	2	2				OT, MD			
1524	6.116	X	X	HOME, RANC, CAMP	7	7		CA, RA, ORF, PBR		MA, ME, MH, BF, SC, MD, CO	10	4	TT, WI, HSH, ML, CE, NA, FC
1535	0.374	X		CAMP	3	6				SC, MD			
1553	0.060	X		CAMP	2	2				ME			
1554	6.344	X		CAMP	43	50	1		1	MA, ME, BF			
1562	0.034	X	X	CAMP	1								TC
1573	4.901	X		CAMP	31	27							FC
1575	0.148	X		CAMP, QUAR	3	3		SE	1	BF, SC, HA, CO			
1594	12.676	X	X	HOME, RANC, CAMP	6	9			52	MH, BF, SC, OT, MD	6	5	GL, WI, HSH, FC, ML, CE, TC, BO, BU, TT
1600	0.274	X		CAMP	2	2							
1601	0.412	X		CAMP	5	1		RG, ORF		SC			
1602	0.034	X		CAMP	1	1							
1603	0.288	X	X	CAMP	9	7			1	MA, ME, SC			FC, ML, TC
1604	2.386	X		CAMP	3	12		ORF	3	ME, BF, SC			
1605	4.037	X	X	CAMP	12	13				ME, BF			BO

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
1606	0.300	X		CAMP	3	3				ME			
1607	0.848	X		CAMP	1	2				ME			
1608	0.296	X		CAMP	2	1		RG		CO			
1609	0.380	X		CAMP	3	1		CA, ORF		ME			
1610	0.110	X		CAMP	2			ORF		ME			
1611	1.317	X		CAMP					1	ME, BF, SC, CO			
1612	44.239	X	X	QUAR		1		CA		CO,, DEB	2		
1613	2.899	X	X	CAMP	17	17				MA, SC, HA			TC
1614	0.554	X	X	CAMP	3	6		CA, RA		BF, MD, CO	1		
1615	0.056		X	CEME							8		ML
1616	0.293	X		CAMP	3	3							
1617	0.025	X		CAMP	1			ORF					
1618	0.050	X		SPEC	1			ORF					
1619	0.018	X		CAMP	1	1							
1620	2.275	X		CAMP	10	10							
1621	1.929		X	WAXC							6	2	BO, GL, CE, NA, TC, TT
1622	0.285	X		CAMP	3	3				MA, ME, MD, CO			
1623	0.814	X	X	HOME, RANC	1			CA			2	2	BO, GL, TC, ML, CE, TT
1624	0.106	X		CAMP	1	1							
1625	4.183		X	COMM, WAXC, RANC							38	38	TC, GL, BO, CE, ML, NA, FC, TT
1626	0.483	X	X	HOME, CAMP						SC	3	3	ML, NA, TC, GL, BO, CE, FC, TT
1627	0.292	X	X	CAMP	2	2				BF, OT	1		TC
1628	1.300	X		CAMP	4	10		CA	8	MA, ME, BF, SC, OT			
1629	1.168		X	CAMP, RANC							1		WI, ML, HSH, NA, TC, CE, GL, BO, FC, TT
1630	31.562	X		QUAR					1	BF, MD			
1631	0.027	X		CAMP	2	2				MA			
1632	0.182	X	X	CAMP	3	3				BF, MD			WI HANDLE
1633	0.392	X		CAMP	9	5		CA, ORF		ME, CO			
1634	2.002	X		CAMP	1	4				CO			
1635	0.058	X		CAMP	1	1				MA, BF, MD			
1636	0.928	X		CAMP, QUAR	2	3			1	MA, ME, BF, SC, HA, CO			
1637	0.248	X		CAMP	2	5			2	ME, BF, MD			
1638	1.801	X	X	CAMP	9	4		CA	4	BF, SC, OT, MD	1		WI, TC, TT
1639	0.185	X		CAMP	5	1		CA, RG, ORF	2	ME, MD			

1640	0.393	X	X	CAMP, RANC	6		2		3	BF, SC, MD			TC, FC
1641	1.306	X	X	CAMP, RANC	7	7				MA, ME, BF, SC			CE, TC, GL, WI, TT
1642	0.044		X	DAM							1	1	TC
1643	0.367	X	X	CAMP		3				ME, SC			FC
1644	0.255	X	X	CAMP	1		1		3	ME, MH, BF, SC, MD			FC
1645	1.035	X	X	CAMP, RANC		2				ME, DEB	1	1	WI, ML, GL, TC
1646	0.115		X	CAMP, RANC							2	1	BO, GL, TC, CE, ML, WI, NA, TT
1647	3.063	X		CAMP	40	40			1	BF, SC, OT, MD, CO			
1648	1.528	X	X	CAMP	11	10		CA	1	BF, CO			FC
1649	0.192	X		CAMP	4	4							
1650	0.066	X	X	CAMP						BF, MD			FC
1651	0.204	X	X	CAMP	5	5				BF, OT, MD, CO	1		TC, TT
1652	0.002	X		CAMP	1	1							
1653	1.049	X		CAMP	10	10			1	MA, ME, BF, SC, OT, MD, CO			
1654	1.921	X		CAMP	5	5		RG	4	ME, BF, SC, HA, CO			
1655	20.387	X		CAMP, QUAR	8	7	2		24	MA, ME, BF, SC, MD, HA			
1656	1.254	X		CAMP	2				1	SC, MD, CO			
1657	4.677	X	X	CAMP	21	20	1		2	MA, ME, BF, SC, HA			WI HANDLE
1658	0.066	X	X	CAMP						CO, DEB	1	1	FC, TC, BO, GL, TT
1659	96.436	X		QUAR									
1663	0.011		X	GRAV				RG			1		CE
1664	6.610	X		CAMP	12	12				BF, SC, MD			
1665	17.728	X		LISC	16					CO			
1666	0.009	X		CAMP	1	1							
1667	0.002	X		CAMP	1	1				BF, CE			
1668	0.932	X	X	CAMP	8	5			4	ME, BF, SC			FC
1669	0.059	X		CAMP	2	1		ORF		SC			
1670	0.340	X		CAMP	3	2		RG		BF, MD, CO			
1671	7.418	X		CAMP	17	17			2	MA, ME, BF, SC, MD, CO			
1672	62.137	X	X	CAMP	46	45			1	MA, ME, BF, MD			
1673	0.526	X		CAMP	2	2							
1674	0.089	X	X	CAMP						ME, MD, CO	2	1	CE, BO, WI, GL, FC, NA, ML
1675	0.156	X	X	RANC						MA	2	1	CE, TC, GL, ML, NA, BO, TT
1676	1.270	X		CAMP	1	19			4	MA, ME, BF, HA			
1677	0.010	X		CAMP	1	1							
1678	0.009	X		CAMP	1	1				MD			
1679	0.254	X		CAMP	6	6							
1680	0.113	X		CAMP	4	4							
1681	2.901	X		CAMP	5	5			2	MA, ME, SC, MD, HA, CE			
1682	1.375	X		CAMP	1				16	MA, ME, BF, SC, OT			
1683	0.864	X	X	CAMP	2	2					1		GL, BO, TC, FC, TT
1684	0.731	X		CAMP	7	7			1	MA, ME, MD, CO, CE			CE
1685	0.265	X		CAMP	3	3		RG		HA, CO			
1686	0.008	X		CAMP	2	2				HA, CO			

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
1687	3.037	X		CAMP	6	7				BF			
1688	3.109	X		CAMP	29	24		ORF	4	MA, BF, CO			
1689	0.553	X	X	CAMP	4				1	SC, MD, HA, CO			GL
1690	4.994	X	X	LISC	1	2		ORF	1	MD, HA, CO	1		
1691	0.110	X		CAMP	3	3				SC, MD, CO			
1692	0.365	X		CAMP	1	1				BF, MD, CO			
1693	1.728	X		SPEC	1			PTF	1	CO			
1694	3.322	X		CAMP	4	3		RG	3	ME, MH, BF, SC			
1695	2.843	X	X	CAMP	21	14		RG		BF, CO	1		CE
1696	0.012	X		CAMP	1	2				MD, CO			
1697	0.121	X		CAMP	2	2							
1698	0.335	X		CAMP	3	2		RG		BF, MD			
1699	0.231	X		CAMP	3	3				CO			
1700	0.282	X		CAMP	2	2			1	OT			
1701	0.010	X	X	CAMP	1	1							TT
1702	24.295	X		CAMP	34	32			16	MA, ME, MH, BF, SC, OT, MD, HA, CO, CE			
1703	0.588	X		CAMP	5	5				BF, MD, CO			
1704	0.032	X	X	CEME						CO	6		ML
1705	0.036	X		CAMP	1	1				BF, CO			
1706	0.032	X		CAMP	1			ORF	2	MA, BF, SC, MD, HA, CO			
1707	0.580	X	X	CAMP	1	2		RG			10	1	CE, GL, BU, NA, FC, BO
1708	0.178		X	HOME							2	1	ML, WI, TC, BO, GL, CE
1709	0.987	X	X	RANC	1	2		RG		BF, SC, MD, CO	1		WI, TC, NA, FC, BO, GL
1710	0.335	X		CAMP	7	4		RG		BF, MD, CO			
1711	0.106	X	X	CAMP, DUMP	1	1		RG		DEB	3		TC, GL, BO, CE, NA, WI, FC, TT
1712	0.122	X	X	CAMP	1	1				MD, CO			GL
1713	0.433	X	X	CAMP	24	2		RG, RA, ORF	1	BF, MD, HA, CO	6		WI, ML, BO, GL
1714	0.070	X	X	CAMP	2	1		RG		BF, MD, CO			WI, FC
1715	0.117	X	X	CAMP	1	1				MD			FC, BW
1716	1.448	X	X	CAMP	10	10				MD			FC, MTL
1717	0.009	X		CAMP	1	1							
1718	179.639	X	X	CAMP, QUAR	4	3		RG, RA		BF, CO	3		GL
1719	0.299	X	X	CAMP	4	1		RG, ORF		CO	1		WI, HSH, FC, GL, TC, BO, CE, ML, TT
1720	0.040	X		CAMP	2	2							

1721	0.008	X		CAMP	1	1							
1722	0.090	X	?	CAMP	4	2		CA, RG		BF, MD, CO	2?	1?	
1723	0.521	X	X	CAMP	2	1		ORF		MA, ME, HA, CO			FC
1724	0.520	X		CAMP	4	4			1	BF, SC, OT, MD, CO			
1725	0.017	X	X	SURV				RG		CO, DEB	8		ML, NA, WI
1726	3.518	X	X	HOME, RANC, CAMP							16	4	TC, WI, HSH, FC, CE, GL, BO, NA, BU, ML, TT
1727	3.751	X	X	CAMP	24	19		CA		MA, ME, BF, OT, MD, HA, CO			FC, MTL
1728	0.766	X	X	CAMP	7	4		CA, RG		BF, MD, CO	1		HSH, FC
1729	2.499	X	X	CAMP	18	7		RG, RA		BF, CO			WI, TC, TT
1730	0.118	X		CAMP	1	1				BF, SC, MD, CO			
1731	0.011	X		CAMP		2				CO			
1732	0.241	X	X	CAMP	2	1		ORF		MA			RUBBER BOOT HEEL
1733	2.284	X	X	CAMP	14	17		RA		MA, CO	2		TC, HSH
1734	0.307	X		CAMP	2	1		SP	1	MA, BF, CO			
1735	0.009	X		CAMP	1								
1736	0.067	X		CAMP	3	3				BF			
1737	0.189	X	X	CAMP	2	2				ME	1		
1738	13.158	X	X	CAMP	25	25			21	MA, ME, BF, SC, OT, MD, HA, CO, CE			HSH, TC, TT, BO, GL
1739	0.032	X		CAMP	1	1				MA, ME, MD			
1740	4.557		X	CAMP, RANC	10	1		RG, RA, ORF		CO	1		FC, CE, BO, GL
1741	1.850	X	X	CAMP	8	7		RG		CO			FC
1742	0.010	X		CAMP	1	1							
1743	1.382	X	X	CAMP	15	5		RG, ORF		MA, BF, SC, MD, CO	1		
1744	0.201	X	X	CAMP	8	10		CA, RG		MA, BF, OT, MD, CO			FC
1745	0.032	X		CAMP	1	1		RG					
1746	0.104	X		CAMP	2	2				CO			
1747	0.265		X	HOME							3	1	CE, BO, HSH, NA, GL , FC, TC
1748	0.121	X		CAMP	5			RG, ORF					
1749	0.830	X	X	CAMP	5	4		RG	1	MH, BF, MD, HA, CO			GL
1750	0.148	X		CAMP	2	1		CA		MD			
1751	0.100	X		CAMP	1	1			2	BF, MD			
1752	0.235	X		CAMP	8	10			1	BF, MD, CO			
1753	0.679	X		CAMP	7	8			2	MA, BF, MD, CO			
1754	0.069	X		CAMP	1			ORF					
1755	0.030	X		CAMP	1	1		RG		MD, CO			
1756	0.133	X		CAMP	4	4				CO			
1757	0.006	X		UNDT	2			ORF					
1758	0.259	X		CAMP	3	3		RG		SC, OT, MD, CO			
1759	0.065	X		CAMP	5	1		RG, RA		MD, CO			
1760	0.860	X		CAMP	11	9		RG, RA		CO			
1761	0.049	X		CAMP	3	3				MD, CO			
1762	2.099	X	X	CAMP	9	7		RG		MD			FC, ML, TC, BO, GL

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
1763	0.363	X		CAMP	9	8		RG, RA					
1764	0.008	X		CAMP	2	3				CO			
1765	0.011	X		CAMP	2	1		RG					
1766	0.009	X		CAMP	1	3				MD, CO			
1767	0.026	X		CAMP	2	2							
1768	0.015	X		CAMP	1	1							
1769	0.173	X		CAMP	8	8							
1770	0.007	X		CAMP	1	1							
1771	0.028	X	X	CAMP	2	2							TC
1772	0.008	X		CAMP	1	1							
1773	0.035	X		CAMP	3	1		RA					
1774	0.009	X		CAMP	1	1				CO			
1775	0.008	X		CAMP	1	1				CO			
1776	0.146	X		CAMP	3								
1777	0.068	X		CAMP	2	2				CO			
1778	0.011	X		CAMP	1								
1779	0.360	X		CAMP	7	6				CO			
1780	0.053	X		CAMP	3	3				BF, SC, MD, CO			
1781	0.143	X		CAMP	5	4							
1782	1.488	X	X	CAMP	7	8				MD, CO			TC
1783	0.316	X		CAMP	7	4		CA, RG		MA, MD, CO			
1784	0.226	X		CAMP	7	8		RG		OT, MD, CO			
1785	0.034	X		CAMP	4	4							
1786	0.030	X		CAMP	1	2							
1787	0.007	X	X	CAMP	1	1							TC
1788	0.475	X		CAMP	5	5				MD, HA, CO			
1789	0.260	X		CAMP	10	10				CO			
1790	0.401	X		CAMP	4	4				CO			
1791	0.057	X	X	CAMP	4	3		RG		MD, CO			HSH
1792	0.047	X		CAMP	2	2							
1793	0.008	X		CAMP	1	1							
1794	0.027	X	X	CAMP	1	1							BO
1795	0.195	X		CAMP	2	2				MD, CO			
1796	1.140	X		CAMP	16	15			1	ME, CO			
1797	0.075	X		CAMP	1	6				CO			
1798	0.205	X		CAMP	3			RG		CO			
1805	1.329	X		CAMP	8	8				MA, MD, CO			

1806	0.166	X		CAMP	4	4				CO			
1807	0.008	X		CAMP	1	1							
1808	0.611	X		CAMP	7	7				MD			
1809	0.008	X		CAMP	1	1				CO			
1810	0.338	X		CAMP	5	3		CA		BF, MD			
1811	0.359	X		CAMP	3	3							
1812	0.009	X		CAMP	1	1				CO			
1813	0.173	X		CAMP	2	2							
1814	0.055	X		CAMP	3			SE, ORF		HA			
1815	0.121	X		CAMP	2	2		RG, RA	1	MA, BF, SC, MD, HA, CO			
1816	0.074	X	X	CAMP	1	2			1		1		
1817	0.328	X		CAMP, SP,EC	2			CA		ME, MH, CO			
1818	1.625	X		CAMP	5	5				MD, CO			
1819	0.058	X		CAMP	1	1				HA			
1820	3.280	X		CAMP	8	12				ME, CO			
1821	2.243	X		CAMP	10	10				MA, MD, CO			
1822	0.032	X		CAMP	1	1							
1823	4.138	X		CAMP	13	13				MD			
1824	0.162	X		CAMP	2	2				MA, HA			
1825	0.692	X	X	CAMP	2	2			1	SC, MD			FC, BO, GL
1826	0.225	X		CAMP	7	7				MA, BF, MD, CO			
1827	0.127	X		CAMP	2	2							
1828	0.033	X		CAMP	1	1							
1829	6.476	X	X	CAMP	32	14		CA, RG, PTG	2	MA, ME, MH, BF, SC, MD			FC, TT, ML, WI, TC, BU
1830	0.287	X		CAMP	2	2							
1831	0.018	X		CAMP	2	2							
1832	0.132	X		CAMP	3	3							
1833	0.627	X		CAMP	5	5							
1834	0.036	X		CAMP	2	2							
1835	0.983	X		CAMP	10	10							
1836	0.509	X		CAMP	1	2							
1837	0.467		X	MINE							11	3	TC, TT, BO, GL, FC, CE, ML, NA
1838	0.816		X	MINE							2		FC, TC
1839	0.022	X		CAMP	2	2				ME			
1840	3.111	X	X	CAMP		2			1	MA, BF, SC, MD, CO			FC, BW, WI
1841	0.055	X		CAMP	4	4				MA			
1842	0.132	X	X	CAMP						CO	3		BO, GL, CE, WI, NA, ML
1843	1.843	X	X	CAMP						MA, ME, CO			HSH, WI, BULLET
1844	2.346	X		CAMP	13	13			3	MA, ME, BF, MD			
1845	0.045	X		CAMP	3	3				CO			
1846	0.035	X		CAMP	1	1		RG		CO			
1847	0.143	X		CAMP	3	3		RG					
1848	0.641		X	HOME							6	3	CE, TC, WI, TT, BO, GL, NA

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
1849	49.572	X	X	CAMP, GRAV	34	34		CA, PBR, ORF	42	MA, ME, BF, SC, OT, MD, HA, CO			TC, TT, BO, GL, HSH, BU
1850	1.306	X	X	CAMP	9	9			7	BF, CO	1		BO, GL
1851	1.389	X	X	GRAV, CAMP	2	2				DEB	1		HSH, GL
1852	1.649	X	X	CAMP	3	2		CA		BF, CO			HSH
1853	1.302	X	X	SPEC	6			CA, RG, RA, ORF	13	MA, BF, CO			
1854	1.785	X	X	CAMP	18	14		RG, ORF		MA, BF, HA, CO			MTL, GL
1855	0.041	X		CAMP	2	2							
1856	0.230	X		CAMP	3	3		CA					
1857	0.032	X		CAMP	1	1							
1858	0.371	X		CAMP	3	3							
1859	0.424	X		CAMP	7	7			2	ME, BF, SC, MD, CO			
1860	0.095	X		CAMP	2	2							
1861	0.594	X		CAMP	1	3				CO			
1862	1.092	X		CAMP	12	12				MD, CO			
1863	0.201	X		CAMP	3	3							
1864	0.049	X		CAMP	1	1							
1865	0.080	X		CAMP	2	2				MA, MD			
1866	0.114	X		CAMP	3	3							
1867	0.148	X		CAMP	2	2				MA, MD, HA, CO			
1868	0.173	X		CAMP	2	2							
1869	0.086	X		CAMP	4	4							
1870	0.046	X		CAMP	1	1							
1871	0.059	X		CAMP	3	3							
1872	0.074	X		CAMP	2	2							
1873	0.411	X		CAMP	8	8				MA, MD, HA			
1874	0.135	X		CAMP	2	2				MD, CO			
1875	0.049	X		CAMP	1	1				MD, CO			
1876	0.071	X		CAMP	2	2							
1877	0.061	X		CAMP	3	3							
1878	2.269	X	X	CAMP	13	10		ORF		SC			MTL
1879	0.109	X		CAMP	2	2							
1880	1.068	X		CAMP	3	3				CO			
1881	0.077	X		CAMP	3	3							
1882	1.925	X		CAMP	6	4	2		2	MA, BF, SC, MD, CO			
1883	0.097	X		CAMP	4	4				MA, MD, CO			
1884	0.348	X		CAMP	3	3				CO			

1885	0.040	X		CAMP	1	1				CO			
1886	0.186	X		CAMP	5	5				CO			
1887	0.102	X		CAMP	1								
1888	0.535	X		CAMP	4	4				CO			
1889	0.052	X		CAMP	3	3							
1890	0.077	X		CAMP	1	1				BF			
1891	0.258	X		CAMP	5	5				ME, BF, HA			
1892	1.401	X	X	CAMP	4	4					1		TC, GL
1893	0.106	X		CAMP	3	2	1			MA, BF, CO			
1894	0.032	X		CAMP	1	1							
1895	0.101	X		CAMP	2	2							
1896	0.822	X		CAMP	7	7				MA, MD			
1897	0.242	X		CAMP	7	7				HA, CO			
1898	1.639	X		CAMP	13	13			1	BF, MD, HA, CO			
1899	0.722	X		CAMP	4	4				MD, HA			
1900	0.090	X		CAMP	1	1							
1901	0.199	X		CAMP	4	1		RG		CO			
1902	0.662	X	X	CAMP	2	1		RA	2	MA, BF, HA, CO			WI, FC, GL, BO, CE
1903	0.124		X	CEME							2		TC, ML, NA
1904	0.117	X	X	CAMP	2	1				CO			HSH, BO, GL
1905	0.145	X		CAMP	2	2							
1906	0.123	X		CAMP	1			RG					
1907	0.631	X	X	CAMP	4	4				CO			HSH
1908	0.219	X		CAMP	3			CA, RA, SP					
1909	1.138	X	X	CAMP	5	5				MA, ME, BF, MD, CO			FENCE STAPLE
1910	6.540	X	X	CAMP, FARM	11	9			9	MA, ME, BF, SC, OT, MD, HA, CO, CE	4	1	WI, TC, TT, HSH, FC, CE, GL, BO, ML
1911	0.338	X		CAMP	3	3				SC			
1912	0.593	X	X	HOME	3	3				CO	3	1	TC, BO, WI, NA, GL, FC, ML, CE
1913	1.855	X	X	CAMP, CEME	19	14	1	RG	1	BF, MD, CO	4		GL, ML, WI, NA, FC, TC, BO
1914	0.032	X		CAMP	1	1							
1915	0.579	X	X	CAMP	6	3		CA		CO			TT
1916	0.104	X		CAMP	2	2							
1917	1.042	X		CAMP, SP,EC	5	4		RG, RA		OT, MD, CO			
1918	0.077	X		CAMP	2	2							
1919	0.084	X		CAMP	2	2				BF, CO			
1920	1.168	X	X	HOME						CO,, DEB	13	1	CE, BU, FC, GL, WI, NA, HSH, BO, TC, TT, ML
1921	0.032	X		CAMP	1	1							
1922	1.262	X		CAMP	8	8				ME			
1923	0.253	X	X	CAMP	1	1				CO			TT, TC, ML
1924	0.248	X	X	CAMP	3	3		ORF		MD, CO	1		
1925	0.032	X		CAMP	1	1							

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
1926	0.038	X		CAMP	2	2							
1927	0.711	X		CAMP	9	8		RG		MD, HA, CO			
1928	0.222	X		CAMP	3	3							
1929	0.159	X		CAMP	2	2				CO			
1930	0.692	X		CAMP	8	8				MD, CO			
1931	0.032	X		CAMP	1	1							
1932	0.146	X		CAMP	1	1				BF			
1933	0.078	X		CAMP	2	2							
1934	0.193	X		CAMP	7	6		RG		CO			
1935	0.223	X		CAMP, SP,EC	4			RG, RA		BF, MD, CO			
1936	0.137	X	X	CAMP	1					BF, MD, CO			MTL
1937	0.446	X		CAMP	4	4				BF, SC, MD, CO			
1938	0.382	X		CAMP	5	4				CO			
1939	0.129	X		CAMP	4	3		RG, ORF		CO			
1940	0.584	X		CAMP	7	7				CO			
1941	0.096	X		CAMP	2	2				MA, CO			
1942	11.078	X	X	COMM, CAMP	25	21	1	RG	51	MA, ME, BF, SC, OT, MD, HA, CO	19	12	CE, GL, BO, NA, WI, ML, TC, TT, HSH, FC, BU
1959	0.251	X	X	CAMP	8	6	1		10	MA, ME, BF, HA, CO			FC
1960	4.509	X		CAMP	14	12		CA, RG, RA		MD, CO			
1961	1.411	X		CAMP	4	4							
1963	0.470	X		CAMP	2	2		RG		CO			
1964	0.005	X		CAMP	3	1		CA					
1965	0.053	X		CAMP	5	5				MA, MD, CO			
1966	0.312	X		CAMP	7	5		RG, RA		ME, MD			
1967	0.035	X		CAMP	1	1							
1968	0.423	X		CAMP	4	4		RG		CO			
1969	0.032	X		CAMP	1	1							
1970	0.395	X		CAMP	1	2				ME, CO			
1971	0.097	X	X	CAMP	1	1				ME			TC
1972	0.404	X	X	CAMP	4	4							HSH
1973	0.053	X		CAMP	1	1							
1974	0.019	X		CAMP	1	2							
1975	2.997	X	X	CAMP	17	17			2	ME, BF, MD			BO, NA, TC, GL
1976	2.473	X	X	CAMP	32	19		RA, ORF	3	MA, ME, BF			TC, TT
1977	0.038	X		SPEC	5			RG, ORF		MD			
1978	2.669	X	X	CAMP	15	11		RG	1		1		BO, ML, TC, TT, GL

1979	0.727	X		SPEC	9			CA, RG, RA		MA, MD, CO			
1980	2.159	X		CAMP	8	9		RG, RA		OT, CO			
1981	0.815	X	X	CAMP	4	4				MA, ME			GL
1982	2.747	X	X	CAMP	31	25	1	RG, ORF	3	MA, ME, MH, BF, CO			HSH, NA
1983	1.453	X		CAMP	9	9		RG		MA, ME, BF, CO			
1984	1.958	X	X	SPEC	5	4		CA, RG, PTF	1				HSH
1985	1.930	X		CAMP	35	22		RG, ORF		MH			
1986	1.447	X		CAMP	7	7		RG					
1987	0.612	X	X	HOME						DEB	5	1	BU, TC, TT, FC, GL, BO, WI, CE, ML
1988	0.497	X		CAMP	6	3		RA	1	MA, BF, MD			
1989	0.274	X		CAMP	6	6							
1990	0.015	X		CAMP	2	2							
1991	0.106	X		CAMP	2	2							
1992	0.241	X		CAMP	2	2							
1993	2.221	X		CAMP	6	3		RA					
1994	0.141	X		CAMP	2	4				MD, CO			
1995	0.037	X		CAMP	2	1							
1996	0.146	X		CAMP	4	3		RG					
1997	0.052	X	X	CAMP	1	1				CO			HSH
1998	1.214	X	X	CAMP	6	6				CO	1		TT, TC
1999	0.923	X	X	CAMP	8	1		RG, ORF		CO	1		BO, TC, WI, CE, GL
2000	0.030	X		CAMP	1	1							
2001	0.038	X		CAMP	1	1				MD			
2002	0.095	X		CAMP	3	2							
2003	0.149	X	X	CAMP	3	3				CO			GL
2004	1.100	X	X	CAMP	6	7		RG	2	MD, CO			FC, HSH
2005	0.466	X	X	CAMP	1	2					1		
2006	2.125	X		CAMP	12	12				BF, CO			
2007	0.198	X		CAMP	5	5							
2008	0.158	X	X	CAMP	2	2		CA		BF, CO			GL
2009	0.401		X	HOME							4	4	GL, BO, TC, TT, BU, FC, NA, WI
2010	0.530	X	X	CEME	4	4				DEB	4		GL
2011	0.070	X		SPEC	1			RA					
2012	0.040	X		CAMP	1	1							
2013	0.036	X		CAMP	1	1							
2014	0.047	X		CAMP	1	1							
2015	0.238	X		CAMP	6			RG, ORF		CO			
2016	0.028	X		CAMP	2	2							
2017	0.424	X		CAMP	7	5		RG					
2018	0.085	X		CAMP	2	1				MD			
2019	0.067	X		CAMP	2	1		RG					
2020	0.172	X	X	CAMP	3	3							MTL, TC, GL, BO
2021	0.071	X		CAMP	1	1							

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
2022	0.390		X	CEME							31		ML, NA, GL, BO
2023	4.509	X	X	CAMP	14			CA, RG, RA		CO	1	1	
2024	0.031		X	GRAV							1		
2025	0.541	X	X	SCHO					1		6	2	CE, TC, WI, NA, GL, BO, ML, BU, FC, TT
2026	5.049	X	X	CAMP	12	12				DEB	1		TC, BU, GL
2027	0.489	X	X	CAMP						CO			NA, TC
2028	0.115		X	DUMP							1		TC, GL, BO, CE
2029	0.171	X		CAMP	3	1							
2030	40.270	X	X	COMM	17	11		RG	1	MA, CO	94	23	TC, TT, BO, GL, ML, BU, FC, WI, NA, CE, HSH
2031	0.081	X	X	CAMP	1	1					2		TC, TT, BO, GL
2032	0.015	X		CAMP	1	1					1	1	TT, TC, GL, BO
2033	0.032		X	DUMP									TC, GL
2034	0.242	X		CAMP	6	1		RG		MD			
2035	0.161	X	X	CAMP	1	1				MA, HA, CO			WI
2036	0.529	X	X	CAMP	3	3							GL, WI
2037	0.270	X		UNDT	5			RG, ORF		BF, MD, CO			
2038	0.758	X	X	CAMP	3	1					7		WI, TC
2039	0.051	X		CAMP	1	1							
2040	0.011	X		CAMP	2	2							
2041	0.125	X		CAMP	1	1							
2042	1.387	X	X	CAMP	3	3							TC, GL
2043	0.262	X	X	HOME						DEB	3	1	BO, GL, TC, NA, CE, ML, FC
2044	0.882	X	X	COMM					1	PP	6	2	TC, ML, TT, CE, NA, BU, GL, BO, FC
2045	0.114	X	X	CAMP	2	2					1		FC
2046	0.756	X	X	CAMP	10	9		RG		MD, CO			FC
2047	0.337	X	X	CAMP	13	13				MD	1		
2048	2.941	X	X	HOME					1		3	1	GL, BO, TC, CE, FC, ML, NA
2049	2.700	X	?	SPEC	31?			RG, RA, ORF		CO	31?		
2050	1.206	X		CAMP	3	2		RA					
2051	0.103	X		CAMP	6	2		RA		MA, CO			
2052	0.836	X		CAMP	5	4		ORF					
2053	0.552	X		CAMP	4	1		CA, RG		MD			
2054	0.210	X		CAMP	4	4							
2055	0.128	X		CAMP	1	2							

2056	0.028	X		UNDT	3			CA, RG, ORF					
2057	0.012	X		CAMP	2	2							
2058	1.443	X	X	LISC	16	3		CA, RG, RA		MD, HA, CO			ML, TT
2059	0.074		X	SURV							5		TC, ML
2060	0.059		X	CEME							38		ML, WI, NA
2061	0.275	X	X	STOR						MD	4	2	GL, NA, CE, FC
2062	0.670		X	QUAR							2		
2063	0.824		X	HOME, FARM							9	3	GL, BO, CE, NA, WI, FC, BU, TC, ML
2064	0.479	X	X	CAMP	3	2		ORF		MD, CO	1		FC, ML, WI, CE
2065	0.985	X	X	CAMP	7	5		RA			1		BO, GL, CE
2066	0.071	X	X	HOME						MH	2	2	GL, BO, TC, CE
2067	2.202		X	HOME							6	2	CE, GL, BO, WI, ML, TC
2068	1.043		X	QUAR							1		ML, NA, GL, BO
2069	0.815		X	DAM		1					1		FC, TC, CE, GL, BO
2070	0.021	X		CAMP	1	1				BF, MD, CO			
2071	1.234	X	X	CAMP, HASC	1	1				CO	6	3	BU, FC, GL, BO, TC, WI, HSH, NA, CE
2072	0.015		X	KILN							2		
2073	0.046	X		CAMP	1	1							
2074	0.032	X		CAMP	2	2							
2075	0.214	X		CAMP	2	2							
2076	0.034	X		CAMP	1	1							
2077	0.046	X		CAMP	6	6							
2078	1.987	X		CAMP	5	6				BF			
2079	0.153	X		CAMP	4	4							
2080	0.334	X		CAMP	2	1		RG		BF			
2081	0.347	X	X	CAMP	4	2		RG, RA		BF, MD, CO			BUCKLE
2082	0.364	X		CAMP	2	3							
2083	0.057	X		CAMP	1	1				BF, MD			
2085	18.880	X	X	CAMP, HOME	49	48	1		11	MA, ME, BF, HA, CO	2	2	TC, BO, GL, CE, BU, FC, HSH
2086	1.794	X	X	DUMP, CAMP				RG		SC	4		TC, BO, GL, CE, TT, WI, NA
2091	1.795	X		CAMP	12	16	1	RA		MA, SC, MD, CO			
2092	0.033	X		CAMP	1	1							
2093	0.032	X		CAMP	1	1							
2094	0.601	X		CAMP	8	7		RG		MA, ME			
2095	0.345	X		CAMP	4	4				BF			
2096	1.432	X	X	CAMP	26	20	4		2	MA, BF, MD, HA, CO			HSH, FC
2097	0.919		X	DAM							2		ML, TC
2098	0.089	X	X	CAMP	1		1			MA, ME, BF, MD, CO			
2099	2.381	X	X	CAMP	20	20			1	MA, ME, BF, MD			HSH
2100	0.361	X	X	CAMP	5	5				BF, SC	1		GL, CS, CE, TC, FC
2101	0.266	X	X	CAMP	8	8			1	OT			FC
2102	0.644	X	X	DAM, RANC							1		

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
2103	0.015	X		CAMP		1							
2104	0.212	X		CAMP	1	1				MA, MD			
2105	0.884	X		CAMP	8	8				MA, ME, BF, MD			
2106	2.338	X	X	CAMP	6	3		RG, RA		BF	2		GL, TC, WI
2107	1.991	X		CAMP	4	2		CA		MA			
2108	0.089	X		CAMP	3	3				OT			
2109	0.202	X	X	CAMP	3	2		CA		BF, SC, MD			HSH
2110	0.054	X		CAMP	1	1							
2111	0.065	X		CAMP	1	1							
2112	1.119	X		CAMP	8	4		RG		BF			
2113	0.082	X		CAMP	1	1							
2114	0.221	X		CAMP	3	3							
2115	0.265	X		CAMP	2	2							
2116	0.093	X		CAMP	2	2				MA, ME			
2117	1.046	X	X	CAMP	15	14	1		3	MA, ME, SC, MD			HSH
2118	0.074	X		CAMP	2	1				MD			
2119	0.097	X		FOPR	2		1	RG		MD			
2120	0.279	X		CAMP	1	1				MD			
2121	0.157	X		CAMP	2	2							
2122	3.128	X		CAMP	4	3				SC, MD, HA, CO			
2123	0.097	X		CAMP	2	2				BF, MD			
2124	0.439		X	BRIDG							1		GL WI, MTL
2125	0.369		X	SURV							1		GL, WI, TT, TC
2126	0.853	X	X	CAMP	4	4			3	ME, BF, MD, CO			TT, TC, BW, BO, GL
2127	0.063	X		CAMP	1	1							
2128	0.044	X		CAMP	1	1							
2129	0.141	X		CAMP	3	3							
2130	1.514	X	X	MINE						BF	2		FC, GL, HSH, ML, BO, NA, TC, CE, BW
2131	0.188	X		QUAR	1			ORF		BF, OT, CO			
2132	1.091	X		CAMP	4	4				SC			
2133	0.038	X	X	CAMP	1	1							ML
2134	0.085	X	X	CAMP	1	1							HSH
2135	0.802		X	DAM							3		ML, TC, BO
2136	1.163	X	X	CAMP	7			CA, RG, RA	3	MA, ME, OT, MD, HA, CO			TC, BO, HSH
2137	0.084	X		CAMP	2	2				MD, CO			
2138	0.582		X	HASC							2		FC, BO, TC, ML, NA

2139	0.079	X		CAMP	2	1		RA					
2140	1.475	X		CAMP	5	4	1			BF, MD			
2141	0.647	X	X	CAMP	4	4				ME			TC
2142	1.927	X		CAMP	11	11			4	ME, SC, MD, CO			
2143	0.297	X	X	CAMP	3	3		RG		ME			CAR JACK
2144	0.906	X		CAMP	2	2				MD, CO			
2145	1.228	X	X	CAMP	7	6				ME, BF, SC	1		TC, HSH, WI, GL
2146	1.877	X	X	CAMP	10	10				MA, MD, CO	1		FC, HSH, TC, GL,CE
2147	0.569	X	X	CAMP	7	7				ME			TC
2148	1.241	X		CAMP	4	4				MA, MD			
2149	1.224	X	X	CAMP	12	11		CA		MA, SC, OT, HA, CO			FC, TT, TC
2150	0.482	X		CAMP	3	2				SC			
2151	3.901	X	X	CAMP	19	17	3			BF, OT, MD, CO	2		WI, GL, BO, FC, TC
2152	0.122	X		CAMP	1								
2153	0.788	X	X	HOME, CAMP	2	1		RA, SP			6	1	HSH, TC, GL, FC, ML, NA, WI, CE, BU, TT
2154	0.086	X		CAMP	1	1				BF			
2155	0.819	X		CAMP	4	4	1	RG	8	MA, ME, BF, SC, OT, MD, HA, CO			
2156	0.064	X		CAMP	1	2				ME			
2157	0.375	X		CAMP	4	4		RG, RA					
2158	0.186	X		CAMP	1	1							
2159	0.054	X		CAMP	2	2				CO			
2160	0.121	X		CAMP	2	1		CA					
2161	0.036	X		CAMP	1	1							
2162	0.102	X		CAMP	1								
2163	0.148	X		CAMP	1	1				MD			
2164	1.709	X		CAMP	11	12				MD			
2165	0.492	X		CAMP	1			RG					
2166	0.250	X		CAMP				RG					
2167	0.044	X		CAMP	1								
2168	0.026	X		CAMP	1	1							
2169	0.371	X		CAMP	2	2							
2170	0.342	X		CAMP	2	2		CA, RG		BF, MD			
2171	0.737	X		CAMP	6	4	1	CA, RG					
2172	0.047	X		CAMP	1	1							
2173	0.589	X		CAMP	6	4		RG		CO			
2174	0.367	X		CAMP	3	3							
2175	1.258	X		CAMP	6	5		CA, RG		SC			
2176	0.044	X		CAMP	1								
2177	0.065	X		CAMP	3	3							
2178	0.273	X		CAMP	3	2		RG		MA			
2179	0.054	X		CAMP	2	1		CA					
2180	0.116	X		CAMP	1	1							
2181	1.170		X	QUAR							4		TC, ML, BO

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
2182	2.601		X	TRAC							13		TC, WI, GL, ML, CE
2183	0.473	X	X	CAMP	8	7				ME, BF, MD			FC
2184	0.148	X		CAMP	2	2							
2185	0.100	X		CAMP	1	1				MD			
2186	0.200	X		CAMP	3	3				MD			
2187	0.046	X		CAMP	1	1							
2188	0.779	X		CAMP	5	3		RG		MD, CO			
2189	0.044	X		CAMP	1	1							
2190	0.033	X		CAMP	1	1							
2191	0.220	X		CAMP	3	3							
2192	0.045	X		CAMP	1	1							
2193	0.160	X		CAMP	2	2							
2194	0.040	X		CAMP	1	1							
2195	0.889	X		CAMP	17	12			2	ME, BF, MD, CO			
2196	0.315	X	X	CAMP	5	2		CA, RA	1	ME	2		
2197	0.324	X		CAMP	4	3				BF, CO			
2198	0.081		X	CAMP		1					2	1	BU
2199	0.051		X	UNDT							1	1	
2200	0.073		X	UNDT							1		BOLT
2201	0.063	X		UNDT	1			ORF					
2202	0.181	X	X	CAMP	4	3				BF, MD, CO			TC
2203	0.432	X	X	CAMP	8	7				BF, HA, CO			FC
2204	1.511	X		CAMP	17	13				MA, ME, BF, SC, CO			
2205	0.440	X		CAMP	3	3				MD			
2206	0.368	X	X	CAMP	3	2		ORF					WI
2207	0.357	X	X	CAMP	19			CA, RG, ORF		MA, ME, MH, SC, MD, HA, CO	1		TT
2208	3.154	X	X	CAMP	2	2							BW, WI
2209	0.230	X		CAMP	3	1				CO			
2210	0.374	X		CAMP	8	8							
2211	0.207	X		CAMP	3	2		CA		MA, ME, MD			
2212	0.032	X		CAMP	1	1							
2213	0.297	X		CAMP	3	3				ME			
2214	0.482	X		CAMP	1					MA, ME, MD			
2215	4.641	X	X	CAMP	22	18		RG	1	CO	2		BO, TC
2216	2.314	X		CAMP	16	15				BF, MD			
2217	0.083	X		CAMP	1	1		RG		ME			
2218	0.115	X		CAMP	2	2		RG					

2219	0.212	X		CAMP	8	7		CA		ME			
2220	0.054	X		CAMP	4	2				MD			
2221	0.334	X		CAMP	3	2		CA		MD			
2222	0.241	X	X	LISC	1			RG		MD, CO			HSH, GL,
2223	0.199	X		CAMP	3	2		CA		MD, CO			
2224	1.182	X	X	CAMP	10	4				MD, HA, CO			BO, TC
2225	0.199	X		CAMP	5	5				CO			
2226	0.892	X		CAMP	12	6				MD, CO			
2227	0.552	X		CAMP	8	7				BF, MD, HA, CO			
2228	0.103	X		CAMP	3	3				BF, MD			
2229	0.219	X		CAMP	5	5				CO			
2230	1.574	X		CAMP	12	11				BF, MD, CO			
2231	0.039	X		CAMP	1	1							
2232	0.056	X		CAMP	1	1				MD			
2233	0.485	X		CAMP	3	1		ORF		MA, ME, MD, HA, CO			
2234	0.186	X		CAMP	4	4				ME			
2235	0.037	X		CAMP	1	1				CO			
2236	2.750	X		CAMP	14	12		CA, RG		ME, HA, CO			
2237	0.398	X		CAMP	4	3		RG		CO			
2238	0.054	X		CAMP	1			SE, ORF		HA, CO			
2239	0.047	X		CAMP	1	1							
2241	0.132	X		CAMP	3	3		RG					
2242	0.046	X		CAMP	1	1							
2243	0.038	X		CAMP	1	1							
2244	0.024	X		CAMP	1	1							
2245	0.238	X		CAMP	6	1		RG, RA		MD			
2246	0.120	X		CAMP	3	1		CA					
2247	0.046	?	?	SPEC	4?			ORF			4?		
2248	0.047	X		CAMP	1	1				MD			
2249	0.335	X		CAMP	4	1		RG					
2250	0.066	X	X	CAMP	1	1							FC
2251	0.016	X		FOPR	3					MA, ME			
2252	0.308	X	X	CAMP	1			RG, RA, ROFT		BF, MD	1		
2253	5.924	X		LISC				RG		BF, MD			
2254	5.078	X	X	CAMP					7	BF, SC, MD			TC, BO, FC, WI, CE, ML, NA
2255	2.662	X	X	CAMP	2	1			5	BF	1		FC, PIPE, BO
2256	0.103	X	X	SPEC	2			RA, ORF		DEB			
2257	0.817	X		CAMP	4			RG, RA	2	MA, ME, MD			
2263	0.404	X		LISC	1					MD			
2264	0.095	X		CAMP	1	1				MA, ME			
2265	0.163	X		CAMP	4	4							
2266	0.173	X		SPEC	2			RA, LS		BF			
2267	0.189	X	X	CAMP						BF			BO
2268	0.401	X		CAMP	3	3		RG		BF			BO

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
2269	0.054	X		CAMP	2			CA, RG, RA,		MA			
2270	0.437	X	X	CAMP	3	5				BF			TC, WI
2271	3.880	X		CAMP	29	31		RG		ME, BF, MD			
2272	0.085	X		CAMP	3	4				BF			
2273	0.032	X		CAMP	1	1							
2274	0.775	X		CAMP	3	3							
2275	0.329	X		CAMP	3	7				BF, SC			
2276	0.032	X	X	CAMP	1	1							FC
2277	0.272	X		CAMP	2	2				MA, ME, SC			
2278	0.235	X	X	CAMP	5	5				BF			TC
2279	0.256	X		CAMP	4	3							
2280	1.601	X	X	CAMP	4	2		CA, RA	1	MA, BF, MD			BW, MTL, ML, NA, TC, TT, GL, HSH
2281	0.091	X	X	CAMP		3				BF			
2282	0.123	X	X	CAMP	1	2							BW, TC
2283	0.027	X		CAMP	2	2						1	
2284	0.027	X		CAMP	2	2							
2285	0.031	X		CAMP	2	3							
2286	0.252	X		CAMP	2	3							
2287	0.043	X		CAMP	2	2							
2288	0.094	X		CAMP	2	4				BF			
2289	0.272	X		CAMP	5	5				MD			
2290	0.038	X		CAMP	1	1							
2291	0.802	X		CAMP	7	8				ME			
2292	0.053	X		CAMP	1	2				BF			
2293	0.049	X		CAMP	1	2							
2294	0.021	X		SPEC	1			PTF					
2295	0.062	X		CAMP	1	1		RG					
2296	0.030	X		CAMP	1	1							
2297	0.388	X		CAMP	3	3				ME, MH			
2298	0.281	X		CAMP	3	5				BF			
2299	0.033	X		SPEC	1			SP					
2300	0.133	X		CAMP	3	3		CA		MD			
2301	1.368	X		CAMP	7	8		RG, RA		MA, ME, MD			
2302	0.046	X		CAMP	1	2				BF			
2303	0.025	X		CAMP	1	1							
2304	0.085	X		CAMP	2	2							

2305	0.342	X		CAMP	4	2							
2306	0.026	X		CAMP	2	2							
2307	0.035	X		CAMP	1	1							
2308	0.036	X		CAMP	1	1							
2309	0.125	X		CAMP	2	1		CA					
2310	0.022	X		SPEC	1			RA					
2311	0.041	X		CAMP	1	2							
2312	0.647		X	HOME, FARM							4	3	MTL, KNIFE
2313	0.688		X	HOME, FARM							3	3	TT, TC, BU, WI, NA, FC, GL
2314	0.237	X	X	CAMP	1	2							GL
2315	0.057	X		CAMP	1	2		RG					
2316	0.219	X		LISC						MD			
2317	0.254	X		CAMP	7	9				ME, MD			
2318	0.069	X		CAMP	2	6							
2319	0.299	X		CAMP	2	3		CA, RA		ME			
2320	5.804	X	X	CAMP	16	9		CA, RG, RA, SP		MA, ME			CE
2321	0.421	X		CAMP	1	3		RG, RA		ME			
2322	1.326	X	X	CAMP	4	2		RA, SP		MA, ME, BF	1		
2323	1.040	X		CAMP	1	4		RG	2				
2324	0.180	X		CAMP	1	1		RA		BF			
2325	1.221	X		CAMP	4	2		RG		MA, ME, BF, CO			
2326	0.198	X		CAMP	1	2		RG		BF			
2327	3.414	X	X	CAMP	9	10		RG		MA, ME, CO			TT, GL, ML
2328	0.079	X		CAMP	2	3		RG		ME, BF, CO			
2329	0.232	X		CAMP	1	2		RG		MA, BF, MD, HA			
2330	0.036	X		CAMP	1			SP		BF, CO			
2331	0.327	X		CAMP	1	6				MD			
2332	0.046	X		CAMP	2	1		RA		MA, ME			
2333	0.045	X		CAMP	3	3							
2334	0.218	X		UNDT	6	1		RA		BF, SC, MD, CO			
2335	0.088	X		SPEC	1					ME, BF, CO			
2336	0.213	X		UNDT	4			RA		CO			
2337	0.058	X		CAMP	2	1		RA	2	ME			
2338	0.280	X		CAMP					15	MA, OT, MD, CO			
2339	0.089	X		CAMP	1	4				ME, BF, OT			
2340	0.138	X		CAMP	3	6		RA		MA, ME			
2341	0.044	X		SPEC	1					BF, CO			
2342	0.352	X	X	CAMP	6	3		RA		MD			HSH
2343	0.045	X		SPEC	2			CA, ORF					
2344	0.067	X		CAMP	2			RG		BF, CO			
2345	0.049	X		CAMP	2	2				MD			
2346	0.203	X		CAMP	9	6		RG		MA, ME, BF, MD			
2347	0.249	X	X	CAMP	2	1							TC, GL
2348	0.254	X		CAMP	2	4				CO			

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
2349	0.448	X		CAMP	5	1				ME, MD, CO			
2350	0.156	X		CAMP	2	2							
2351	0.011	X		SPEC	1			PTF					
2352	0.029	X		CAMP	1	1							
2353	0.011	X		CAMP	2	2							
2354	0.086	X		CAMP	1			RG					
2355	0.057	X		SHRO	1			ORF					
2356	0.166	X		CAMP	3	3				BF, MD, CO			
2357	0.363	X	X	RANC				RG		CO,, BF	1		TT, FC, GL, WI, HSH, BO, CE, MTL
2358	12.335	X		CAMP	6	6	1						
2359	0.066	X		CAMP	2	1		RA		MD, CO			
2360	0.038	X		CAMP	1	1							
2361	0.025	X		CAMP	1	1							
2362	0.144	X		CAMP	3	3				MD, CO			
2363	0.211	X		CAMP	4	2				ME, MD, HA, CO			
2364	2.043	X	X	CAMP	4	3	1	RG, RA	2	MA, ME, BF, MD, CO			TC, FC, BW, GL,BO
2365	0.023	X		CAMP	1	1							
2366	0.196	X		CAMP	4	2							
2367	0.607	X	X	CAMP	2	1	1		1		3	1	FC, WI, HSH, BO, GL, TC, CE, TT
2368	0.371	X		CAMP	5	5				MD, CO			
2369	0.021	X		CAMP	1	1							
2370	0.361	X		CAMP	7	11				MA, BF, MD, CO			
2371	0.489	X		SPEC	2			CA, RG, PTF					
2372	0.501	X	X	CAMP	6	3		RA		ME, MD, CO	3		TT, GL, BO
2373	0.171	X	X	CAMP	4	2		CA, RA			4		TC, BO, GL, TT, ML, NA
2374	0.246	X		CAMP	4			RA		MA, ME, CO			
2375	0.771	X		CAMP	5	5				MD, CO			
2376	0.059	X		SPEC	3			RG, RA					
2377	0.247	X	X	SPEC	2	2		CA		BF, CO	1		
2378	0.560	X		CAMP, SP,EC	13	1		RG, RA, ORF		BF, OT, MD, HA, CO			
2379	0.069	X	X	MILI						CO	3		FC
2380	0.601	X		CAMP	8	8				BF, MD, CO			
2381	0.037	X		CAMP	2	2				CO			
2382	0.026	X		CAMP	3	3							
2383	0.444	X		CAMP	4	4							

2384	0.469	X	X	CAMP	3	3				BF			TT, TC, BW
2385	0.042	X		CAMP	1	1							
2386	0.030	X		CAMP	1	1							
2387	0.096	X		CAMP	1	1				MA, ME, CO			
2388	0.415	X	X	CAMP	9	3				CO			BO
2389	0.565	X		CAMP	8	6		RG		MA, SC, MD			
2390	0.091	X		CAMP	3	1		RG		MA, ME, BF, MD, CO			
2391	0.038	X		CAMP	2	1				CO			
2392	0.479	X		CAMP	5	5		RG, PTF		MA, BF, CO			
2393	0.095	X		CAMP	5	3		RG					
2394	0.433	X	X	SHRO	2		1	RA	9	MA, ME, BF, OT, MD, HA, CO			BO, CE, TC, TT, GL
2395	0.028	X		CAMP	1	1							
2396	0.028	X		CAMP	1	1							
2397	0.019	X		CAMP	1								
2398	0.020	X		CAMP	1	1							
2399	0.124	X	X	CAMP	5	1		CA, PTF		ME, BF, MD			FC
2400	6.553	X		CAMP	6	16		RG, ORF	1	ME, BF, SC, MD, HA, CO			
2401	0.561	X	X	CAMP	9		1	CA, RG		MA, MH, BF, OT, MD, HA, CO			BO
2402	0.034	X		CAMP	2	2							
2403	0.193	X		SHRO	2	1	1		1	MA, BF, SC, MD, HA, CO			
2404	0.151	X		SPEC	2			PTF					
2405	0.083	X		CAMP	2	2							
2406	0.156	X		CAMP	2	2				ME			
2407	0.370	X		CAMP	5		2			ME			
2408	1.076	X		CAMP, SP,EC	6	2	4			BF			
2409	0.048	X		CAMP	2	2				BF			
2410	0.021	X		CAMP	1	1							
2411	0.735	X	X	CAMP	4	4			1				MTL
2412	0.244	X		CAMP	1	1							
2413	0.038	X		CAMP	1								
2414	0.044	X		CAMP	2	3							
2415	0.021	X		CAMP	1	1							
2416	0.105	X	X	CAMP	1	2				BF			HSH
2417	0.317	X		FOPR	3	3	1		1	ME, BF, CO			
2418	1.216	X	X	FOPR	9	3	2		2	MA, BF, MD			FC, BW
2419	0.069	X		CAMP	4	4				MD			
2420	0.098	X		CAMP	1	2	1						
2421	0.420	X		CAMP	8	8				ME			
2422	0.237	X		CAMP	4	3		ORF					
2423	1.628	X		CAMP	16	14		RA		BF, SC			
2424	0.392	X		CAMP	7	6	1	RA		MA			
2425	1.220	X		CAMP	10	9		RA		MD			
2426	0.083	X		CAMP	3	3							
2427	0.044	X		CAMP	1	1							

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
2428	5.955	X		CAMP	11	11	1		1	BF, SC, MD, HA, CO			
2429	4.959	X		CAMP	33	31	2			ME, BF, SC, MD, CO			
2430	2.921	X	X	CAMP	7	5	1		4	MA, ME, BF, SC, OT, MD, CO			ML, HSH, RD, NA, TC, FC
2431	0.072	X		SPEC	1	1		CA					
2432	0.181	X		CAMP	3			RA, ORF	1	ME, BF, SC, MD, CO			
2433	1.515	X		CAMP	11	12	4		1	MA, SC, HA			
2434	0.252	X		CAMP	5	5							
2435	1.696	X		CAMP	4	7							
2436	0.065	X		CAMP	1					SC			
2437	0.014	X		CAMP	1	1			1				
2438	0.065	X		CAMP	3	2	1			MA, ME			
2439	0.616	X		CAMP	2	1				ME			
2440	0.627	X		CAMP	8	5	1	RA		ME, BF, MD			
2441	0.592	X		CAMP	3	2	1	RG, ORF		HA, CO			
2442	0.434	X		CAMP	1	1				MD			
2443	0.067	X		CAMP	2	2	1			SC			
2444	0.182	X		CAMP	2	1	1			ME, MD			
2445	0.439	X		CAMP	1		1		1	MA			
2446	0.596	X		CAMP	2	1	1		2	MA, ME			
2447	0.135	X		CAMP	5	5			1	BF			
2448	0.299	X	X	CAMP, HASC						SC			HSH, HS
2449	0.738	X		CAMP	3	3				MD			
2450	0.274	X		CAMP	4	4				BF			
2451	0.012	X		SPEC	1								
2452	0.007	X		CAMP	1	1							
2453	0.438	X		CAMP	2	2				SC, MD			
2454	0.590	X		CAMP	3	3	4		1	MA, ME, HA, CO			
2455	0.309	X		CAMP	8	7				MA, BF, SC			
2456	1.480	X		CAMP	6	5	1			ME			
2457	0.104		X	HOME							1	1	GL, CE
2458	0.052	X		CAMP	5	5							
2459	0.015	X		CAMP	1	1				CO			
2460	0.087	X	X	SPEC	3			RG, RA		MA, SC, HA			HSH
2461	0.072	X		CAMP	1	1	1			MA, ME, BF, SC, MD, HA, CO			
2462	0.079	X		CAMP	2	2							
2463	0.023	X		SPEC	1			CA, RG		BF			
2464	1.116	X	X	CAMP	3	1		CA		MA, BF			BO, GL, NA, WI

2465	0.008	X		CAMP	2	2							
2466	0.245	X		CAMP	2	4							
2467	0.043	X		CAMP	1	1							
2468	0.025	X		CAMP	1	2							
2469	2.465	X		CAMP	10	13			1	ME, BF, SC, CO			
2470	0.303	X		CAMP	3	8				BF			
2471	0.004	X	X	SHRO	2			RG, ORF, PBR		OT, MD			TRAP
2472	0.002	X		SHRO	1			PTG		OT, CO			
2473	1.410	X		CAMP	19	22	1		1	MA, ME, MH, BF, SC, MD, CO			
2474	0.163	X		CAMP	3	5							
2475	0.399	X		SHBO	3		1		1	ME, MH, BF, SC, MD, HA, CO			
2476	0.874	X		CAMP	9	6		ORF		ME, BF			
2477	0.012	X		CAMP	1	1				MD			
2479	0.198	X		SPEC	5			ORF					
2480	0.359	X		CAMP	3	3				MA, ME, MD			
2481	0.006	X		CAMP	1	1							
2482	0.040	X	X	CAMP	1	1							FC
2483	0.957	X	X	CAMP	8	5	3			MA, ME, BF, MD, CO			FC, BU
2484	0.342	X		CAMP	1	1							
2485	0.040	X		CAMP	1	1							
2486	2.806	X	X	CAMP	14	10		CA	1	MD			GL, HSH
2487	5.235	X	X	CAMP	28	19	9		1	MA, ME, BF, SC, OT, MD, HA, CO			GL, HSH, FC, TC
2488	0.455	X		CAMP	1		1		1	BF, MD			
2489	0.032	X		CAMP	1	1				ME			
2490	0.731	X		CAMP	6	1	5		4	MA, MD, CO			
2491	2.258	X	X	CAMP	9	8			9	MA, ME, BF, HA, CO			GL
2492	1.245	X		CAMP	1	1			4	BF, MD, CO			
2493	2.842	X		CAMP	1	1				MA, ME, BF, OT, MD			
2494	0.179	X		CAMP	1	1		RA	1	BF, SC, MD, CO			
2495	0.914	X		CAMP	1	1			1	BF, MD			
2496	0.138	X		CAMP	1	1				MD, HA, CO			
2497	2.746	X		CAMP	19	17	1	RG	9	MA, ME, BF, SC, OT, MD, HA, CO			
2498	0.670	X		CAMP	4	3	2		1	MA, ME, BF, SC, MD, HA, CO			
2499	0.008	X		CAMP	1	1							
2500	2.851	X	X	CAMP	9	9				ME, BF			HSH
2501	0.235	X		CAMP	2				2	ME, MD, CO			
2502	0.583	X	X	CAMP	2	2		RG	1	ME, BF, HA			FC
2503	0.178	X		CAMP					3	ME, MD, CO			
2504	0.056	X		CAMP	2	1		RA		ME			
2505	0.038	X		CAMP	1	1							
2506	1.318	X		CAMP	7	8		RG, RA	7	MA, BF, SC, HA			
2507	0.471	X		CAMP	13	13				BF, SC, MD, CO			
2508	4.439	X	X	CAMP	24	38		RG		MD			HSH
2509	0.144	X	X	CAMP	3	2			1		1		

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
2510	0.271	X		CAMP	3	4							
2511	0.017	X		CAMP	1	1							
2512	0.011	X		CAMP	1	1							
2513	7.983	X		CAMP	10	16				MA			
2514	1.305	X	X	CAMP	6	11				BF			GL
2515	0.151	X	X	HOME						DEB	2	1	GL, BO, BW, CE, TC
2516	0.690	X		CAMP	1	1			2				
2517	0.113	X		CAMP	1	2				SC, MD			
2518	0.136	X		CAMP	1	1				ME			
2519	7.703	X		CAMP	7	26			6	MA, ME, BF, SC, MD, HA, CO			
2520	0.573	X		CAMP	1	2			1	MA, BF, MD, HA, CO			
2521	0.047	X		CAMP	1	1							
2522	0.301	X		CAMP	1	1							
2523	0.097	X		CAMP	1	1			1				
2524	1.227	X	X	CAMP	29			RG, RA, ORF	3	SC, CO			HSH, FC, TC, WI,
2526	0.066	X	X	CAMP	2	2			1	MD			FC
2527	5.200	X	X	CAMP, SP,EC	22	25	1	RG, RA	13	MA, ME, MH, BF, SC, OT, MD, HA, CO			FC, LOOTERS SCREEN
2528	0.100	X		CAMP	3								
2529	0.509	X		CAMP	2	6				MD, CO			
2530	0.013	X		CAMP	1	1							
2531	28.901	X	X	CAMP, RANC	14	38		RG, RA	9	MA, ME, BF, SC, OT, MD, CO	5	1	GL, TC, BU, CE, FC, BO
2532	0.887	X	X	CAMP	2	9				BF, MD, CO			TC
2533	0.027	X		CAMP	1					BF, OT, MD			
2534	0.751	X		CAMP	5					ME, MD			
2535	0.028	X	?	CAMP	1			SE	1		1?	1?	
2536	0.066	X		CAMP	1								
2537	1.059	X		CAMP	3	3				MA, ME, SC, MD			
2539	0.003	X		CAMP	1	1							
2540	0.002		X	CAMP							1		TC
2541	0.019	X		CAMP	1	1		RG, RA					
2542	0.023	X	X	UNDT						DEB	1	1	
2543	0.563	X	X	CAMP	4	3		RA			1		
2544	1.153	X		CAMP	9	9							
2545	0.159	X	X	CAMP	2	3		RA, ORF		SC, MD			FC
2546	0.017	X		CAMP	1	1							
2547	0.013	X		CAMP	1	1							

2548	0.085	X		CAMP	2	2							
2549	0.103	X		SPEC	4			RG, SP					
2550	0.052	X	X	CAMP	1	1		ORF					GL
2551	0.053	X		CAMP	2	1			1				
2552	0.062	X	X	CAMP	3	2	1	RG					ML
2553	0.015	X		SPEC, GRAV(?)	3			RG, RA					
2554	0.024	X		CAMP	4	4							
2555	0.019	X		CAMP	1	1							
2556	0.032	X		CAMP	1	1							
2557	0.009	X		CAMP	1								
2558	0.136	X		CAMP	4	3							
2559	0.021	X		CAMP	1								
2560	0.034	X		FOPR	1		1						
2561	0.846	X		CAMP	5	13		RG		MD, CO			
2562	13.384	X	X	CAMP	47	78			1	ME, BF, MD			ML
2563	0.129	X	X	CAMP	3	3							TC
2564	0.098	X		CAMP	2	1	1						
2565	0.131		X	RANC							1		TC, GL
2566	0.021	X		CAMP	1	1							
2567	2.661	X		CAMP	15	17			1				
2568	0.558	X		CAMP	2	6							
2569	0.019	X		CAMP	1	1							
2570	1.289	X		CAMP	5	8				CO			
2571	0.054	X		CAMP	1	1							
2572	2.748	X	X	CAMP	13	20	2	RA	6	MA, ME, MH, OT, MD			TC, WI
2573	1.615	X	X	CAMP	10	16	2			ME			TC
2574	0.435	X	X	FOPR	2		3		1	MA, BF			FC, MTL BARREL
2575	0.736	X	X	SHRO, CAMP	5	2	1	ORF	4	MA, ME, BF, SC, MD, HA, CO			TC, METALPIPE
2576	0.038	X		CAMP	1	1							
2577	0.435	X	X	CAMP, HASC					3	BF			CE, FC, GL, TC, HSH
2578	0.033	X		SPEC				CA, PBR					
2579	0.115	X		CAMP	1	1				ME			
2580	0.014	X		CAMP	1	2							
2581	0.106	X		CAMP	2	2							
2582	0.476	X	X	HASC						DEB	2		TC, GL, CE
2583	0.030	X		CAMP	1	1							
2584	0.381	X	X	CAMP	3	3				CO			FC,
2585	0.062	X		CAMP	2	2							
2586	0.322	X	X	CAMP, HASC	1	2				ME			TC, FC
2587	0.766	X		CAMP	3	4				ME			
2588	0.749	X	X	CAMP	8	7		ORF	2	MA, ME, MH, BF, MD, HA, CO			HSH, TC, MTL
2589	0.201	X		CAMP	1	1				ME			
2590	0.408	X		CAMP	1	4							

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
2591	7.967	X	X	CAMP	25	28	5	RG		MA, ME, BF			TC, GL
2592	0.795	X		CAMP	2	1	1			ME, OT, CO			
2600	0.236	X		CAMP	4	4							
2601	0.987	X		CAMP	9	10	2						
2602	0.063	X		CAMP	3	2	2			MA			
2603	0.029	X		CAMP	1		1						
2604	0.450	X		CAMP, SP,EC	5	3	1		4	BF, SC, MD, CO			
2605	0.082	X		CAMP	2	2							
2606	0.724	X		CAMP, SP,EC	9	7							
2607	0.066	X		CAMP	2	5							
2608	0.605	X		CAMP	5	3	1	RA		ME, MD			
2609	3.650	X		CAMP	11	11				ME, SC			
2610	0.856	X		CAMP	6	6				ME, CO			
2611	0.065	X		CAMP	2	2							
2612	0.103	X		CAMP	2	1		ORF		BF			
2613	0.482	X		CAMP	3	6							
2614	0.575	X		CAMP	4	7							
2615	0.183	X		CAMP	5	5							
2616	0.159	X		CAMP	2	3							
2617	0.219	X		CAMP	4	6							
2618	0.042	X		UNDT	1			ORF					
2619	0.135	X		CAMP	3	1		CA, ORF		MA, ME, BF, MD, CO			
2620	0.026	X		SPEC	1			CA					
2621	0.283	X		CAMP	1	4				MA			
2622	5.229	X	X	CAMP	18	32	1			ME, BF, SC, CO			FC, CANTEEN
2623	3.612	X		CAMP	6	4	1	CA, RA, ORF, PTG		MA, ME, BF, HA			
2624	7.420	X	X	CAMP	10	7		RA	2	ME, BF, MD, CO	1		HSH, FC, WI, CE, MTL
2625	0.001	X		SPEC	1			ORF					
2626	0.089	X		CAMP	2	1		CA, ORF		CO			
2627	0.048	X		SPEC	2			CA, ORF					
2628	0.476	X		CAMP	5	6		CA, ORF	1	MA, BF, SC, MD, HA			
2629	0.866	X		CAMP	4	3		CA	1	MA			
2630	0.174	X		CAMP	1	4				MD			
2631	0.021	X		CAMP	1	1							
2632	3.266	X		CAMP	11	11			1	ME			
2633	6.371	X		CAMP	27	23	4		2				

2634	0.089	X		CAMP, SP,EC	1				2	MA, ME, BF, CO			
2635	0.413	X		CAMP	7	7				BF			
2636	0.684	X		CAMP	6	6	1		3	MA, ME, BF, SC, CO			
2637	2.508	X		CAMP, SP,EC	19	18				ME, BF			
2638	0.086	X		CAMP	7	6	1			BF			
2639	2.373	X		CAMP	18	16	1			MA, ME, SC, MD, CO			
2640	0.021	X		CAMP	1	1			1				
2641	0.259	X		CAMP	2	2				MA, ME, SC			
2642	0.036	X		CAMP	3	3							
2643	0.128	X		CAMP	1	1				MA, BF			
2644	0.072	X		FOPR	15					MH			
2645	0.025	X		CAMP	1	1			1				
2646	0.108	X		CAMP	3	3							
2647	0.051	X		CAMP	2	2							
2648	0.409	X		CAMP	9	9			1	MA, ME, SC, MD, CO			
2649	0.005	X		CAMP	1	1							
2650	0.006	X		CAMP	1	1							
2651	0.043	X		CAMP	1	3							
2652	0.619	X		CAMP	4	1	1		2	MA, CO			
2653	0.003	X		CAMP	1	1							
2654	2.206	X		CAMP	13	14			1	MA, BF, MD			
2655	0.067	X		SPEC	1			CA					
2656	0.175	X		CAMP	5	4			1				
2657	0.012	X		CAMP	1	2				BF			
2658	0.035	X		CAMP	1	1							
2659	0.143	X		CAMP, SP,EC	3	1		RG, ORF					
2660	0.207	X		CAMP	3	3							
2661	0.050	X		CAMP	2	2							
2662	1.480	X	X	CAMP	2	1	1		6	ME, SC			HSH, WI
2663	0.069	X		CAMP	2								
2664	2.206	X	X	CAMP	13	9		RG, ORF	1	ME, BF, MD, CO			HSH
2665	0.195	X	X	CAMP	5	2		ORF	1	MA, BF, SC, MD, HA, CO			HSH
2666	1.923	X		CAMP	11	10				MA, ME, CO			
2667	0.037	X	X	CAMP	2	1				CO			HSH
2668	0.008	X		CAMP	2	2			1	CO			
2669	0.563	X	X	CAMP	2			RG, RA, ORF			1		
2670	0.017	X		CAMP	1	1			1				
2671	0.953	X		CAMP	5	4		ORF		MH			
2672	0.038	X	X	CAMP	1	2							
2673	0.007	X		CAMP	1								
2674	0.087	X		CAMP	5	2	2			BF, MD, HA, CO			
2675	0.028	X		CAMP	5	5				ME, MD			
2676	0.008		X	UNDT							1	1	
2677	0.032	X		CAMP	1	1							

BIBE #	Site Hectares	Prehistoric Component	Historic Component	Site Type	# Prehistoric Features	# Hearths And Remnants	# Middens	Other Prehistoric Features	# Projectiles	Other Prehistoric Artifacts	# Historic Features	# Historic Structures	Historic Artifact Types
2678	0.005	X		CAMP	1	1							
2679	7.375		X	DUMP							12		GL, CE, FC, MTL, WI, BU
2680	0.053	X		CAMP	3	3				MD			
2682	0.609	X		CAMP	7	7				MD, CO			
2684	1.146	X	X	CAMP	14	12	1			MA, ME, SC, MD, HA, CO	1		GL, CE, TC, MTL
2685	0.008	X		CAMP	1	1							
2686	0.188	X	X	MILI						ME	6	5	FC
2687	0.253	X		CAMP	3	3	1		1	MA, ME, MD			
2688	0.014	X	X	CAMP	1	2							FC
2689	0.735	X		CAMP	2	2				ME, BF, MD, HA, CO			
2690	1.151	X		CAMP	2	2				BF			
2691	0.071	X		CAMP	3	2	1						
2692	0.010	X		CAMP	1	1							
2693	0.479	X		CAMP	3	1	2			OT			
2694	0.265	X		CAMP	3		3		1	SC, MD, CO			
2695	0.401	X		CAMP	2	4			1				
2696	0.063	X		CAMP	2		2		1	MD, CO			
2697	0.715	X		CAMP	4	2	2		14	BF, SC, MD, CO			
2698	0.011	X		CAMP	1	1							
2699	0.467	X		CAMP	7	5	1			ME, BF			
2700	0.052	X		SHRO	3			PTG		SC, CO			
2701	2.894	X	X	CAMP	2	2		CA, RG		ME, BF, SC, MD, CO			FE, HSH
2702	1.904	X		CAMP	2	2				MA, ME, MD			
2703	0.034	X		CAMP	1	1							
2704	0.020	X		SPEC	4			CA		BF			
2705	0.081	X		QUAR	2			RG, ORF		CO			
2706	0.110	X		CAMP	3			RG, ORF		ME, MD, CO			
2707	0.022	X		CAMP	1	1							
2708	0.008	X		SPEC	4								
2709	0.325	X		LISC	2			ORF		HA, CO			
2710	0.273	X		CAMP	1	1				MD, CO			
2711	0.756	X		CAMP	1	2		CA, RG		ME, CO			
2712	0.076	X		CAMP	2	3							
2713	0.062	X		CAMP	1	1							
2714	0.425	X	X	CAMP	3	1		RG, ORF		MA, ME, BF, CO			ML
2715	0.403	X		CAMP	2	3				MA, ME			
2716	0.665	X		CAMP	6	4		CA, RG, ORF	7	MA, BF, SC, OT, MD, HA, CO			

2717	0.325	X		CAMP	5	12	2		5	MA, ME, BF, SC, OT, MD, HA, CO			
2718	1.047	X	X	CAMP	4	6		RG		MA, ME, BF, MD, CO	2		
2719	4.238	X	X	CAMP	16	12		CA, ORF, PBR	1	MA, CO			TC, HSH
2720	0.022	X		CAMP	1	1							
2721	0.047	X		CAMP	1	2		RG					
2722	0.052	X		CAMP	3	2							
2723	2.626	X	X	CAMP	2	7			1				HSH
2724	0.117	X	X	CAMP	1	2							TC, MTL
2725	0.416	X		CAMP	3	3				ME			
2726	0.882	X	X	CAMP	3	4							GL
2727	0.010	X		CAMP	1	1							
2728	1.024	X		CAMP	2	2				ME			
2729	0.451	X		CAMP	3			CA, ORF		MA, ME, MH, BF, SC			
2731	0.109	X		CAMP	2					MA, ME, MD, CO			
2732	0.124	X		CAMP	1		1			MD, CO			
2733	0.019	X	?	CAMP	1	1					1?		
2734	0.123	X		CAMP	4	6							
2735	0.376	X		CAMP	3	3							
2736	0.031	X		CAMP	1	1							
2737	0.011	X		CAMP	1	1				MD			
2738	0.017	X		CAMP	1	1							
2739	0.064	X		SPEC	12			SE, ORF					
2740	0.126	X		CAMP	2	2							
2741	0.330	X		CAMP	5	5							
2763	1.335	X		CAMP	4	4			12	MA, BF, SC, MD, HA, CO			
2764	0.055	X		CAMP	2	2			1				
2765	0.016	X		CAMP	1	1							
2766	0.023	X		CAMP	1	1			1				
2767	0.186	X		CAMP	4	4							
2768	1.484	X		CAMP	3	2			1				
2769	1.346	X		CAMP	3	3			2	MA, ME			

Appendix 2

Isolated Occurrences

IF #	Object	Description	Material Type, Etc.	General	
1	Metate	Slab, single-sided	Unknown	Prehistoric	
2	Dart point	Expanding stem	Silicified tuff	Prehistoric	Archaic
3	Dart point	Expanding stem, convex base	Off white silicified tuff	Prehistoric	Archaic
4	Dart point	Possible Pandale	Tan gray chert	Prehistoric	Archaic
5	Dart point	Small expanding stem	Variegated agate	Prehistoric	Archaic
6	Arrow point	Contracting stem	Off-white chert with blue black spots	Prehistoric	Late Prehistoric
7	Biface	Probable knife	Black rhyolite?	Prehistoric	
8	Dart point	Expanding stem, fragment	Pinkish chert / tuff	Prehistoric	Archaic
9	Bottle	Medicine bottle, threaded		Historic	
10	Arrow point	Distal fragment, serrated	Pinkish chert	Prehistoric	Late Prehistoric
11	Core	Fragment	Brown agate	Prehistoric	
12	Biface	Probable dart point base			
13	Biface	Fragment	Cream to tan chert	Prehistoric	
14					
15	Dart point	Contracting stem, fragment	Gray chert with mottling	Prehistoric	Middle Archaic?
16					
17	Bottle	Screw top	"Federal law forbids sale or reuse of this bottle"	Historic	
18					
19	Dart point	Medial fragment with barbs	Off white silicified tuff	Prehistoric	Late Archaic?
20					

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
21	Dart point	Lanceolate, concave base	Brown silicified wood	Prehistoric	Archaic
22	Biface	Fragment, possible preform	Mottled gray chert	Prehistoric	
23	Arrow point	Contracting stem	Mottled gray chert	Prehistoric	Late Prehistoric
24	Bottle	Mentholatum jar, steel lid	Milk glass	Historic	
25	Spoon	"Made in USA" and "900 WB" and "W"	Metal	Historic	
26	Biface	Possible medial dart point fragment	Dark red chalcedony	Prehistoric	
27	Scraper	End, fractured	Pink gray chalcedony	Prehistoric	
28	Dart point	Contracting stem	Yellow white chert	Prehistoric	Middle Archaic
29	Dart point	Expanding stem, convex base	White chert, red inclusions	Prehistoric	Archaic
30	Core	Multidirectional	Black hornfels	Prehistoric	
31	Scraper	Side and end	Hornfels	Prehistoric	
32	Biface	Crude, utilized edge	Cream chert	Prehistoric	
33	Five flakes		Hornfels	Prehistoric	
34	Two flakes	One trimmed, one primary	Both hornfels	Prehistoric	
35	Core and flake		Hornfels	Prehistoric	
36	Four flakes	All secondary	Hornfels	Prehistoric	
37	Core		Hornfels	Prehistoric	
38	Scraper	Side and end	Chert	Prehistoric	
39	Biface	Possible dart point fragment	Chert	Prehistoric	
40	Flake and scraper	Utilized flake, unfinished scraper	Both hornfels	Prehistoric	
41	Dart point	Contracting stem	Gray chert	Prehistoric	Middle Archaic
42	Core and flake	Possible chopper	Both hornfels	Prehistoric	
43	Biface	Crude, Thick	Hornfels	Prehistoric	
44	Chopper	Spokeshave bit	Hornfels	Prehistoric	
45	Core	Utilized edge	Hornfels	Prehistoric	
46	Spokeshave and four flakes		Hornfels	Prehistoric	
47	Spokeshave	Patinated blade	Gray hornfels	Prehistoric	
48	Four flakes	One trimmed, 3 with spokeshave bits	Hornfels	Prehistoric	
49	Spokeshave and flake		Hornfels	Prehistoric	
50	Biface and core	Spokeshave bits on both	Hornfels	Prehistoric	
51	Scraper	Side	Mottled chert	Prehistoric	
52	Horseshoe	6-Hole, possible muleshoe		Historic	
53	Biface	Heavy utilization, sub-circular	Gray chert	Prehistoric	

54	Spokeshave and two flakes		Hornfels and agate	Prehistoric	
55	Spokeshave and three flakes	Large spokeshave	Hornfels	Prehistoric	
56	Spokeshave and core	Bidirectional core	Hornfels	Prehistoric	
57	Spokeshave	Minimal use	Hornfels	Prehistoric	
58	Scraper		Hornfels	Prehistoric	
59	Two spokeshaves and three flakes	Patinated	Hornfels	Prehistoric	
60	Spokeshave and five flakes	Two bits on spokeshave	Rhyolite and hornfels flakes	Prehistoric	
61	Horseshoe	8-Hole		Historic	
62	Canteen	"Bear Brand" on cap		Historic	Patent 1918
63	Flake	Utilized	Silicified wood	Prehistoric	
64	Horseshoe	Large, 13.5 cm wide x 12 cm long		Historic	
65	Biface	Utilized on distal end	Hornfels	Prehistoric	
66	Biface	Distal end	White chert	Prehistoric	
67	Biface and flakes	Unfinished biface, one utilized flake	Chert and hornfels	Prehistoric	
68	Biface and flakes	Biface/chopper	Hornfels and chert	Prehistoric	
69	Core	Unidirectional	Hornfels	Prehistoric	
70	Biface	Possible dart point preform	Chert	Prehistoric	
71	Chain	24 Links	Metal	Historic	
72	Scraper	Side	Hornfels	Prehistoric	
73	Core	Bidirectional, utilized edges	Hornfels	Prehistoric	
74	Flake	Trimmed, utilized	Hornfels	Prehistoric	
75	Horseshoe	Well-worn		Historic	
76	Biface and flakes	Crude biface	Chert and hornfels	Prehistoric	
77	Spokeshave and four flakes	Spokeshave with steep bit	Schist-like and hornfels	Prehistoric	
78	Chopper	Unifacial	Hornfels	Prehistoric	
79	Spokeshave		Hornfels	Prehistoric	
80	Scraper and flake		Hornfels	Prehistoric	
81	Dart point	Expanding stem, fragment	Brown agate	Prehistoric	Archaic
82	Mano	2-Sided	Igneous	Prehistoric	
83	Biface and flakes	Spokeshave bit	Hornfels	Prehistoric	
84	Mano	1-Sided	Unknown	Prehistoric	
85	Flake	Heavily utilized	Silicified wood	Prehistoric	
86	Dart point	Contracting stem, fragment	Chert	Prehistoric	Archaic
87	Horseshoe	8-Hole		Historic	
88	Dart point	Contracting stem, fragment	Burro Mesa tuff	Prehistoric	Archaic

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
89	Dart point	Blade fragment	Maravillas chert	Prehistoric	Archaic
91	Dart point	Contracting stem, fragment	Chert	Prehistoric	Middle Archaic
92	Mano	2-Sided	Battered edges	Prehistoric	
93	Biface	Possible dart point, lanceolate	Chalcedony or silicified wood	Prehistoric	
94	Dart point	Parallel-sided stem	White chert	Prehistoric	Archaic
95	Arrow point	Contracting stem	Silicified wood	Prehistoric	Late Prehistoric
96	Horseshoe	Muleshoe		Historic	
97	Bottle	Complete Log Cabin Syrup	Screw cap	Historic	1940–1950
98	Bottle	Probable whiskey bottle	"WW" On base	Historic	
99	Scraper	Side	Banded chert	Prehistoric	
100	Biface and flakes	Lanceolate shaped biface	Chert biface, hornfels flakes	Prehistoric	
101	Mano	2-Sided	Unknown	Prehistoric	
102	Metate	Slab	Rhyolite	Prehistoric	
103	Biface and flakes	Possible Pandale dart point	Hornfels	Prehistoric	
115	Dart point	Irregular edges and barbs	Cream chert	Prehistoric	Archaic
116	Mano	2-Sided	Sandstone	Prehistoric	
117	Biface	Pointed	Hornfels	Prehistoric	
118	Dart point	Contracting stem, proximal end	Unknown	Prehistoric	Archaic
119	Dart point	Dart point proximal fragment	Chert	Prehistoric	Archaic
120	Scraper	End	Pink chert	Prehistoric	
121	Scraper	Two bit edges	Hornfels	Prehistoric	
122	Bottle	Screw top mouth, double loop ears on stem	"Half gallon" on front	Historic	
123	Shaft abrader	4 x 7 x 8 cm	Rhyolite	Prehistoric	
124	Cartridge casing	.30 caliber	"W.R.A. CO. 30 USG"	Historic	
125	Two hammerstones	Both rounded	Hornfels	Prehistoric	
126	Biface	Possible chopper	Hornfels	Prehistoric	
127	Fork	Rusted 3-tine		Historic	
128	Dart point	Fragment	Gray mottled chert	Prehistoric	Archaic
129	Clock face fragment	Roman numerals	Metal	Historic	
130	Dart point	Fragment	Mottled gray chert	Prehistoric	Archaic
131	Arrow point	Parallel-sided stem		Prehistoric	
139	Cartridge casing	16-Gauge shotgun shell	"WINCHESTER No. 16 Leader"	Historic	
140	Knife	Folding pocket knife		Historic	
141	Scraper		Gray chert	Prehistoric	
142	Scraper		Gray hornfels	Prehistoric	

143	Cartridge casing	12-Gauge shotgun shell	"REMINGTON UMC No.12 Arrow"	Historic	
144	Scraper	Fragment	Gray tan chert	Prehistoric	
145	Scraper	Fragment	Mottled pink white chert	Prehistoric	
146	Biface		Banded chert	Prehistoric	
147	Shell		Olivella shell (*Olivella biplicata*)	Prehistoric	
148	Drill	Missing tip	Hornfels	Prehistoric	
149	Biface	Fragment	Chert	Prehistoric	
150	Dart point	Fragment	Pink-red chert	Prehistoric	Archaic
151	Horseshoe	6-Hole		Historic	
152	Keg	Cylindrical with friction lid	Metal	Historic	
153	Scraper	Scraper	Brown agate	Prehistoric	
154	Horseshoe	Half 6-hole		Historic	
155	Horseshoe	Half 6-hole		Historic	
156	Bottle	Tequila bottle, clear glass	Screw cap, "Jal. Mexico"	Historic	
157	Cartridge casing	.44 caliber	"44 W.C.F. W.R.A. CO."	Historic	
158	Ceramic	White tea cup with green line	No makers mark	Historic	
159	Bowl	No makers mark	Whiteware	Historic	
160	Dart point	Fragment	Brown agate	Prehistoric	Early Archaic
161	Mano	Small, 1-sided	Well-ground	Prehistoric	
162	Tin can	Crimped end and side seams	Church key opened	Historic	
163	Tin can	Top, crimped end and side seams, "estab 396" on top		Historic	
164	Condensed milk can	Crimped side, lap end seams		Historic	
165	Scraper	Side and end	Mottled tan chert	Prehistoric	
166	Biface		Brown chert	Prehistoric	
167	Biface		Sub-rectangular	Prehistoric	
168	Cartridge casing	.30-06 caliber	"U.S.C. CO. 18"	Historic	1918
169	Bottle	Fragments, no makers mark	Clear to light green glass	Historic	
170	Tobacco tin	3-Hinge, round holes punched through both sides		Historic	
171	Cartridge casing	.30-06 caliber	"RA H 18"	Historic	1918
172	Lard pail		Tin	Historic	
173	Cartridge casing	.30-06 caliber	"U.S.C. CO. 18"	Historic	1918
174	Biface		Gray chert	Prehistoric	
175	Dart point		Patinated chert	Prehistoric	Archaic
176	Cartridge casing	Centerfire	Unstamped	Historic	Pre 1877
177	Tin can			Historic	
178	Tin can			Historic	
179	Handmade mug		Wire handle	Historic	
180	Cartridge casing	.44 caliber	"W.R.A. CO. 44 W.C.F."	Historic	

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
181	Mussel shell fragment			Prehistoric	
182	Cartridge casing	.30 caliber	"W.R.A. 30 W.C.F."	Historic	
183	Biface		White chert	Prehistoric	
184	Cartridge casing	Centerfire	Unstamped	Historic	
185	Lard pail		Tin	Historic	
186	Tin can			Historic	
187	Bottle		"Since 1836"	Historic	
188	Horseshoe			Historic	
189	Harmonica reed plate		Metal	Historic	
190	Marble		Ceramic	Historic	
191	Mussel shell fragment			Prehistoric	
192	Horseshoe			Historic	
193	Cartridge casing	.44 caliber	"UMC 44 W.C.F."	Historic	
194	Bottle		Clear glass	Historic	
195	Pail		Blue enameled metal	Historic	
196	Arrow point	Base missing		Prehistoric	Late Prehistoric
197	Condensed milk can			Historic	
198	Biface		Brown agate	Prehistoric	
199	Cartridge casing	.30 caliber	"W-W SUPER 30-30 WIN"	Historic	
200	Drag chain		For leg hold trap	Historic	
201	Cartridge casing	.303 caliber	"REM-UMC 303 SAV"	Historic	
202	Cartridge casing	Centerfire	Unstamped	Historic	
203	Bottle		Amber glass	Historic	
204	Condensed milk can			Historic	
205	Scraper		Hornfels	Prehistoric	
206	Horseshoe			Historic	
207	Metate	1-Sided, ground and pecked	Sandstone	Prehistoric	
209	Arrow point		Red chert	Prehistoric	
210	Dart point		Chalcedony	Prehistoric	Archaic
211	Biface		Brown agate	Prehistoric	
212	Biface		Burro Mesa tuff	Prehistoric	
213	Scraper		Chert	Prehistoric	
214	Cartridge casing	.250-3000 caliber	"250-3000 SAVAGE"	Historic	
215	Horseshoe			Historic	
216	Dart point fragment		Red tan tuff/mudstone	Prehistoric	Archaic
217	Tea cup		White enamel with blue handle	Historic	
218	Lid handle		Cast iron	Historic	
219	Chain		Metal	Historic	

220	Trap		Made by Triumph Trap Company Inc.	Historic	Ca.1910–1936
221	Plate		Ceramic	Historic	
222	Dart point	Shumla like dart point	Mottled pink chert	Prehistoric	Late Archaic
223	Rock hammer			Historic	
224	Cartridge casing	.30-06 caliber	"R.A.H. 18"	Historic	1918
225	Lid		Metal	Historic	
226	Mexican dime			Historic	1892
227	Tobacco tin	3-Hinge		Historic	
228	Horseshoe			Historic	
229	Cartridge casing	.45 caliber	"W.R.A. CO. COLT 45"	Historic	
230	Horseshoe			Historic	
231	Dart point		Patinated tan chert	Prehistoric	Archaic
232	Four cartridge casings	.30 caliber	"REM-UMC 30-30"	Historic	
233	Tobacco tin	3-Hinge		Historic	
234	Tobacco tin	3-Hinge		Historic	
235	Horseshoe			Historic	
236	Cartridge casing	.30-06 caliber	"F-A-35"	Historic	1935
237	Caster		Metal	Historic	
238	Tin can			Historic	
239	Three spool ends		Metal	Historic	
240	Lard pail		Metal	Historic	
241	Mano		Rhyolite	Prehistoric	
242	Horseshoe			Historic	
243	Cartridge casing	.30-06 caliber	"R-P 30-06 SPRG"	Historic	
244	Hammerstone		Gray rhyolite	Prehistoric	
245	Tobacco tin	3-Hinge		Historic	
246	Cartridge casing	Centerfire	Unstamped	Historic	
247	Mano		Very formal	Prehistoric	
248	Tin can		On top "pan oil xxx spout to end of can" and other writing	Historic	
249	Cartridge casing	.25-35 caliber	"W.R.A. CO. 25-35 W.C.F."	Historic	
250	Tin can		With "08095" on lid	Historic	
251	Cook pot		Blue and white speckled enamel	Historic	
252	Biface		Brown agate	Prehistoric	
253	Pendant		Kaolinite	Prehistoric	
254	Bottle		Solarized glass	Historic	
255	Tent stake?		Metal	Historic	
256	Cartridge casing	.30-06 caliber	"WCC 41"	Historic	1941

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
257	Tin can	Crimped side seam, stamped ends, shot 3-4 times		Historic	
258	Tobacco tin	3-Hinge		Historic	
259	Horseshoe	8-Hole fragment		Historic	
260	Mano	1-Sided	Unknown	Prehistoric	
261	Lard pail	With bail		Historic	
262	Cartridge casing	.30-06 caliber	REM-UMC 1906 30-06	Historic	1906
263	Three cartridge casings	.243 caliber	"R.P.243 WINCHESTER"	Historic	
264	Horseshoe	6-Hole		Historic	
265	Tobacco tin	Crushed		Historic	
266	Horseshoe			Historic	
267	Bottle		Amber glass	Historic	
268	Tin can	Stamped end seam	Church key opened	Historic	
269	Tobacco tin	Crushed		Historic	
270	Tin can			Historic	
271	Sheet metal	With rivets	Copper	Historic	
272	Tin can	"6179 8 hazt" stamped on base		Historic	
273	Bolt	2 Inches long		Historic	
274	Tin can	"7208" Stamped on base		Historic	
275	Tin can	"Estab 396" over "e20" stamped on lid		Historic	
276	Horseshoe			Historic	
277	Pan		Blue speckled enamel	Historic	
278	Beer can	Cone top, "zippered" side-seam		Historic	
279	Metal band	Cast		Historic	
280	Tin can	Crimped-seam		Historic	
281	Scraper		Gray rhyolite	Prehistoric	
282	Metal ring			Historic	
283	Mug	Faceted	Clear glass	Historic	
284	Muffler fragment			Historic	
285	Tire fragment			Historic	Ca. 1930s
286	Tin can	With bail lugs, crushed		Historic	
287	Cartridge casing	.30 caliber	"W.R.A. 30 WRC"	Historic	
288	Metal bar		Butt seam	Historic	
289	Knife		Broken blade, worn wooden handle	Historic	
290	Tin can		Sanitary	Historic	
291	Tobacco tin	3-Hinge		Historic	

292	Ceramic		Thick basal sherd	Historic	
293	Two cartridge casings	.44 caliber	"WRA CO. 44 WCF"	Historic	
294	Threaded cylindrical can	"Universal" on base		Historic	
295	Hub cap	Chevrolet	Chrome circle	Historic	1937–1938
296	Condensed milk can			Historic	
297	Cable	Braided grounding cable		Historic	
298	Lard pail			Historic	
299	Bottle		Clear glass	Historic	
300	Tin can	Lid with rolled lip		Historic	
301	Horseshoe	8-Hole, half		Historic	
302	Tobacco tin			Historic	
303	Tin can	Sanitary		Historic	
304	Sardine can			Historic	
305	Tin can	Sanitary, crimped seam		Historic	
306	Tin house mailbox	Fragment	Tin	Historic	
307	Beer or soda can	Crimped-seam	Church key opened	Historic	
308	Tin can	Sanitary	Rotary opened	Historic	
309	Ceramic sherd		Whiteware	Historic	
310	Folger's coffee can	"49956" on base		Historic	
311	Tin can		Church key opened	Historic	
312	Milled lumber	2 3/4 x 59 x 1/2"		Historic	
313	Tobacco tin and glass	1 Glass sherd	Aqua glass	Historic	
314	Juice can	Corroded		Historic	
315	Pipe	Iron		Historic	
316	Juice can		Church key opened	Historic	
317	Juice can		Church key opened	Historic	
318	Juice can		Church key opened	Historic	
319	Floral design		Brass	Historic	
320	Juice can		Church key opened	Historic	
321	Arrow point	Fragment	Tan chert	Prehistoric	
322	Sheet metal	Car part?		Historic	
323	Cartridge casing	.45 ACP caliber	"USC CO. 18"	Historic	1918
324	Pipe	Irrigation pipe segment, welded seams		Historic	
325	Cable	Twisted wire cable	6 wire cables twisted into 1 cable	Historic	
326	Pipe	Irrigation pipe	Ceramic	Historic	
327	Tin can	Lid	Key strip opened	Historic	
328	Horseshoe	Half 8-hole		Historic	
329	Meat tin		Key strip opened	Historic	
330	Horseshoe	8-Hole		Historic	

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
331	Tin can	Sanitary, crushed		Historic	
332	Wagon wheel wrench?	Hand-forged iron	Iron	Historic	
333	Tin can	Opened at base		Historic	
381	Tin can	Crushed, crimped		Historic	
382	Tin can	Stamped lid		Historic	
383	Tin can	Crimped-seam and soldered seam can		Historic	
384	Tin can	Crimped-seam		Historic	
385	Tin can, large bolt, and milled lumber	Crimped-seam	Key strip opened can	Historic	
386	Tin can	Crimped-seam	Church key opened	Historic	
387	Tin can	Crimped-seam	Key hole punch	Historic	
388	Core	Utilized edge	Large white sandstone	Prehistoric	
389	Horseshoe	Half 8-hole		Historic	
390	Tin can			Historic	
391	Tobacco tin	3-Hinge		Historic	
392	Condensed milk can			Historic	
393	Metal scoop	With rivets		Historic	
394	Horseshoe	6-Hole		Historic	
395	Metal bar	With cast iron attachment		Historic	
396	Possible hammerstone		Gray blue chert	Prehistoric	
397	Sheet metal	One end with drilled holes		Historic	
398	Dart point	Fragment; side-notched	Quartzite	Prehistoric	Archaic
399	Bowl shaped object		Metal	Historic	
400	Tin can lid			Historic	
401	Tin can	Stamped ends	Church key opened	Historic	
402	Condensed milk can			Historic	
403	Tobacco tin	3-Hinge		Historic	
404	Horseshoe	8-Hole		Historic	
405	Beer or soda can	Sanitary		Historic	
406	Beer or soda can		Knife-opened	Historic	
407	Tobacco tin	3-Hinge		Historic	
408	Telephone pole	Wooden pole with ceramic insulator	Wood, metal, ceramic	Historic	
409	Wire	Long thin piece of gray wire	Running underground and then out	Historic	
410	Motor oil can	Light medium S.A.E. 20	Bullet riddled	Historic	
411	Metal washer	1 Inch diameter, rusted		Historic	
412	Tin insulator	Possibly for telephone		Historic	
413	Beer or soda can			Historic	

414	Tin can	Crimped-seam, soldered side		Historic	
415	Tin can	Crimped-seam		Historic	
416	Tin can	Crimped-seam		Historic	
417	Ceramic mug	Mexican ware	Glazed earthenware	Historic	
418	Milled lumber	Cut lumber with 2 round nails	Wood, metal	Historic	
419	Tin can	Crushed, sanitary	Church key opened	Historic	
420	Tin can	Crimped-seam	Church key opened	Historic	
421	Tin can	Crimped-seam	Church key opened	Historic	
422	Tobacco tin	Prince Albert		Historic	
423	Cartridge casing	.30-06 caliber	"Super Speed 30 Army"	Historic	
424	Tin can	Hole-in-cap, stamped ends	Knife-opened	Historic	
425	Cartridge casing	.250-3000 caliber	"W.R.A. 250-3000"	Historic	
426	Square nut	About 1" long		Historic	
427	Tin can and possible oar handle			Historic	
428	Horseshoe	8-Hole		Historic	
429	Kerosene can	Rectangular		Historic	
430	Horseshoe	8-Hole		Historic	
431	Carriage bolt	Six inches long		Historic	
432	Bottle	Crown cap lip	Aqua glass	Historic	
433	Tin can	Stamped lid and crimped side seam		Historic	
434	Tin can	Crimped-seam	Knife-opened	Historic	
435	Horseshoe	8-Hole		Historic	
436	Tin can	Sanitary, crimped-seam		Historic	
437	Biface	Patinated biface, ground ventral side	Hornfels	Prehistoric	
438	Horseshoe	8-Hole		Historic	
439	Cartridge casing	.25-35 caliber	"W.R.A. CO. 25-35 W.C.F."	Historic	1935
440	Horseshoe	8-Hole		Historic	
441	Aluminum pull tab	Zippered seam		Historic	
442	Tin can	Crimped-seam		Historic	
443	Cartridge casing	.44 caliber	"W.R.A. CO 44 W.C.F."	Historic	
444	Biface	Fragment	White chert	Prehistoric	
445	Arrow point and scraper	End, fragment	Black chert point, mottled pink/red chert scraper	Prehistoric	Late Prehistoric
446	Horseshoe	6-Hole		Historic	
447	Horseshoe	8-Hole		Historic	
448	Shackle made out of leaf spring			Historic	
449	Tin can	Crimped-seam	Church key opened	Historic	
450	Cartridge casing	.35 caliber	"REM UMC 35 REM"	Historic	

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
451	Baking powder can	External friction lid	Base with g on bottom	Historic	
452	Tin can	Crimped-seam		Historic	
453	Biface	Fragmentary, utilized	Mottled red/white chert	Prehistoric	
454	Condensed milk can			Historic	
455	Coca-Cola sign	2 bullet holes		Historic	
456	Cartridge casing	.45 ACP caliber	"WCC 41"	Historic	
457	Flake	Utilized, possible drill	Hornfels	Prehistoric	
458	Tin can			Historic	
459	Milled lumber	Wire attached		Historic	
460	Horseshoe	8-Hole		Historic	
461	Tobacco tin	3-Hinge		Historic	
462	Metal pole wood on top			Historic	
463	Tin can	Hole-in-cap lid	Crushed	Historic	
464	Wire	12 Ga., 3 m long	Metal	Historic	
465	Tin can		Church key opened	Historic	
466	Milled lumber, glass, and wire		Aqua glass sherds, gray wire	Historic	
467	Biface	Late stage	Chert	Prehistoric	
468	Tin can		Church key opened	Historic	
469	Cone-top can	Crimped seam	Gold paint	Historic	
470	Beer or soda can		Opened with can opener	Historic	
471	Clear glass	Fragments, floral embossed design		Historic	
472	Tin can		Church key opened	Historic	
473	Beer or soda can		Church key opened	Historic	
474	Lard pail			Historic	
475	Tin can	Crimped-seam	Open with pocket knife	Historic	
476	Tin bucket	No handle		Historic	
477	Sheet metal	Two handmade punctures		Historic	
479	Tin can		Church key opened	Historic	
480	Bottle	Fragment, "9 47 11 Dura Glas 6x" and "130" on base	Amber glass	Historic	
481	Bottle	Flask shape, "D9 56 40 M 87-1-A" on base	Clear glass	Historic	
482	Oil can	"Gulf Lube Motor Oil S.A.E. 40" on base		Historic	
483	Horseshoe	8-Hole		Historic	
484	Tobacco tin	Crushed		Historic	
485	Cartridge casing	.22 caliber	"WESTERN 22 H.P."	Historic	1898–1932

486	Tin can	External friction lid, crimped side seam		Historic	
487	Beer or soda can		Church key opened	Historic	
488	Insulator	For telephone?	Green glass	Historic	
489	Biface		White chert	Prehistoric	
490	Beer or soda can	Crimped-seam	Church key opened	Historic	
491	Horseshoe	8-Hole		Historic	
492	Milled lumber	Tapered at one end		Historic	
493	Two oil cans	S.A.E. 40		Historic	
494	Tin can	Crimped-seam	Key strip opened	Historic	
495	Unidentified car part	Barstock with counter sunk screws		Historic	
496	Bottle	Neck and base: "7" on base	Amber glass	Historic	
497	Tobacco tin	3-Hinge		Historic	
498	Scraper		White, gray, tan agate	Prehistoric	
499	Tobacco tin	Crushed		Historic	
500	Tin can		Pivot opener opened	Historic	
501	Sheet metal			Historic	
502	Tin can	Internal friction lid		Historic	
503	Wire	4 m of galvanized wire		Historic	
504	Metal pipe	Sunk in ground		Historic	
505	Insulator		Agua glass	Historic	
506	Tin can		Key strip opened	Historic	
507	Metal pipe	Hole bored through pipe		Historic	
508	Unknown metal and tin can	Black and yellow paint on metal		Historic	
509	Tire remnant	Six tread		Historic	
510	Tin can	External friction lid		Historic	
511	Unknown metal	"Great Britain pat" stamped		Historic	
512	Tin can and metal	Conoco Motor Oil can		Historic	
513	Tobacco tin	3-Hinge		Historic	
514	Horseshoe	8-Hole		Historic	
515	Tobacco tin	3-Hinge		Historic	
516	Two tin cans	Crimped-seam	Church key open	Historic	
517	Scraper	End, formal	White pink agate	Prehistoric	
518	Tobacco tin	Crushed		Historic	
519	Tobacco tin			Historic	
520	Lard pail lid	Stamped: "use 1/3 less than butter"		Historic	
521	Tobacco tin			Historic	
522	Tin can	Sanitary	Cut or key strip opened	Historic	

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
523	Tin can	External friction lid		Historic	
524	Tin can	Hole-in-cap	Knife-opened	Historic	
525	Tin can	Crimped-seam, has "c" on top and "s" on bottom	Pivot style opening	Historic	
526	Tin can	Crimped-seam can		Historic	
527	Tin can	Crimped-seam can	Church key opened	Historic	
528	Tin can	Crimped-seam can	Can opener half way and then folded "osn aim" on base	Historic	
529	Tin can		Knife holes	Historic	
530	Pipe	One inch diameter rusty pipe in ground		Historic	
531	Milled lumber	.5 x 2 in x 1 ft long		Historic	
532	Cartridge casing	.30 caliber	"W.R.A. CO 30 W.C.F."	Historic	
533	Tin can	Hole-in-cap, crimped seam, crushed		Historic	
534	Horseshoe	8-Hole		Historic	
535	Tin can	Side tab pull, stamped "est. 396" and "sh8"		Historic	
536	Horseshoe	Half 8-hole		Historic	
537	Tin can	Crimped-seam can	Church key opened	Historic	
538	Tin can	Crimped-seam can	Rotary opened	Historic	
539	Wooden stake			Historic	
540	Bottle	Screw Top, "Federal Law Prohibits Sale or Reuse . ."	Clear glass	Historic	1930–1964
541	Lone Star beer can	Pull tab, painted label		Historic	
542	Condensed milk can	Crimped-seam		Historic	Ca. 1908–1930
543	Large needle	Hand-forged, for wool sack?	Iron	Historic	
544	Tin can	Sanitary	Knife-opened	Historic	
545	Cartridge casing	.30-06 caliber	"F-A-8-11"	Historic	1911
546	Tobacco tin	3-Hinge		Historic	
547	Hammerstone		Mottled/banded chert	Prehistoric	
548	Meat tin	Key strip on side	Pivot opened	Historic	
549	Biface	Fragmentary	White quartzite	Prehistoric	
550	Car part	Probable leaf spring fragment		Historic	
551	Cartridge casing	.44 caliber	"UMC 44 CFW"	Historic	1889–1920
552	Unknown metal	Thin piece of metal		Historic	
553	Car part	Metal hub with screw holes		Historic	
554	Tin can	Sanitary		Historic	
555	Tobacco tin	Crushed		Historic	

556	Milled lumber			Historic	
557	Metate	Slab	Reddish rhyolite	Prehistoric	
558	Tobacco tin	3-Hinge		Historic	
559	Unknown metal object		Aluminum	Historic	
560	Tin can	Metal can, aluminum pull tab		Historic	
561	Glass sherd		Brown glass	Historic	
562	Bottle fragment	Half of lip	Frosted, aqua glass	Historic	
563	Sardine can			Historic	
564	Bottle fragment	Base and mold seam over lip with "vm" on base	Clear glass	Historic	1909–1980
565	Tin can	Sanitary		Historic	
566	Milled lumber			Historic	
567	Oil can	Rusted, crushed		Historic	
568	Tobacco tin	3-Hinge		Historic	
569	Cartridge casing	.44 caliber	W.R.A. CO. 44 W.C.F.	Historic	
570	Tin can	Crimped-seam	Key strip opened	Historic	
571	Bottle fragment	Body fragment	Black glass	Historic	
572	Five bottle sherds		Aqua glass	Historic	
573	Flask	Half pint, screw top	Glass	Historic	
574	Horseshoe	Nails present		Historic	
575	Biface		Purple, blue, white, agate	Prehistoric	
576	Bottle sherds		Amber glass	Historic	
577	Tobacco tin	3-Hinge		Historic	
578	Biface	Fragment	White chert	Prehistoric	
579	Bottle	Screw top	Amber glass	Historic	1975
580	Mano	2-Sided	Basalt	Prehistoric	
581	Tobacco tin			Historic	
582	Juice can		Church key opened	Historic	
583	Tin can		Knife cut	Historic	
584	55-gallon drum	Corroded		Historic	
585	Stone ornament	Shaped	Kaolinite	Prehistoric	
586	Drill bit shaft		Metal	Historic	
587	Biface		Tan white chert	Prehistoric	
588	Bottle sherd	Base	Clear glass	Historic	
589	Tin can		Rotary opened	Historic	
590	Tin can		Rotary opened	Historic	
591	Tin can	Lid	Rotary opened	Historic	
592	Metate	Slab	Pink rhyolite	Prehistoric	
593	Tin can	External friction lid		Historic	
594	Tin can		Rotary opened	Historic	
595	Tin can	Sanitary	Rotary opened	Historic	

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
596	Tin can	Lid and base, crimped seam		Historic	
597	Biface		Brown chert	Prehistoric	
598	Horseshoe	6-Hole		Historic	
599	Horseshoe	8-Hole		Historic	
600	Metate		Vesicular basalt	Prehistoric	
601	Biface		Brown agate	Prehistoric	
602	Tin can	Crimped-seam	Rotary opened	Historic	
603	Bottle	Screw top, circle heart makers mark	Clear glass	Historic	
604	Biface	Crude, broken into 2 pieces	White mottled chert	Prehistoric	
606	Hammerstone		Black chert	Prehistoric	
607	Cartridge casing	.30 caliber	"W.R.A. CO. 30 W.C.F."	Historic	
608	Glass sherd	Painted	Amber glass	Historic	
609	Bottle fragment	Patinated base	Amber glass	Historic	
610	Biface and/or hammerstone		Brown chert	Prehistoric	
611	Barbed wire	Two small rolls		Historic	
612	Barbed wire	Four rolls		Historic	
613	Iron stake			Historic	
614	Metate	Convex ground face	Igneous	Prehistoric	
615	Dart point	Fragment	Tan chert	Prehistoric	Archaic
644	Bottle	Screw top	Clear glass	Historic	
645	Hammerstone		Black chert	Prehistoric	
646	Horseshoe	8-Hole		Historic	
647	Metate	Rectangular	Rhyolite	Prehistoric	
648	Tobacco tin	Prince Albert		Historic	
649	Tin can	Crimped-seam	Pivot style opening	Historic	
650	Tin can	External friction, crushed, "G" on base		Historic	
651	Bottle fragments	8 sherds including base embossed "pint"	Aqua glass	Historic	
652	Tin can	External friction lid		Historic	
653	Sardine can		Knife cut	Historic	
654	Milled lumber	Board with nails	Hand-sawn	Historic	
655	Bowl rimsherd		Brown glazed porcelain	Historic	
656	Metal hoop	Thick, forged seam		Historic	
657	Trace chains	U.S. military chains		Historic	
658	Metal bucket	"H" on base		Historic	
659	Small bucket	Crimped side seam,		Historic	
660	Metal banding	With beveled edges		Historic	

661	Tobacco tin			Historic	
662	Metal hoop	With forged seam		Historic	
663	Horseshoe	6-Hole		Historic	
664	Horseshoe	6-Hole		Historic	
665	Tin can	Crimped-seam		Historic	
666	Metate and metal bar		Basalt	Prehistoric	
667	Bottle fragment	"B1" on base	Aqua glass	Historic	
668	Scraper		Chert	Prehistoric	
669	Biface	Ovoid	Rhyolite	Prehistoric	
670	Metal plate	"Dummond" stamp		Historic	
671	Cartridge casing	.40-82 caliber	"W.R.A. CO. 40-82 W.C.F."	Historic	
672	Muleshoe	8-Hole		Historic	
673	Metal band			Historic	
674	Tin can	External friction		Historic	
675	Metate	Slighty basin shaped	Unknown	Prehistoric	
676	Ripper tooth	Hand-forged		Historic	
677	Mano	2-Sided	Rhyolite	Prehistoric	
678	Tobacco tin	Crushed		Historic	
679	Horseshoe	With caulks		Historic	
680	Cartridge casing	.30-06 caliber	"USC CO 30 GOV"	Historic	
681	Dart point	Contracting stem, missing base		Prehistoric	Archaic
682	Metal bucket	With handle		Historic	
683	Iron ring	From pack saddle?		Historic	
684	Biface		White stone	Prehistoric	
685	Horseshoe	Small, with heel caulks		Historic	
686	Modified tin can	Wire handle, made into mug		Historic	
687	Metate	Slightly basin shaped	Rhyolite	Prehistoric	
688	Biface		Agate	Prehistoric	
689	Horseshoe	8-Hole		Historic	
690	Tin can	External friction closure		Historic	
691	Horseshoe	8-Hole with caulks		Historic	
692	Horseshoe	Half of 8-hole, with caulks		Historic	
693	Sardine can	Crimped-seam		Historic	
694	Tobacco tin	3-Hinge		Historic	
695	Metate		Unknown material	Prehistoric	
696	Biface		Brown/white chert	Prehistoric	
697	Cartridge casing	.38 Special caliber	"REM UMC .38 SPL"	Historic	
698	Sardine can			Historic	
699	Bottle fragment	Lip with crown cap closure	Aqua glass	Historic	
700	Truck part			Historic	

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
701	Beer or soda can		Church key opened	Historic	
702	Tin can	Flat top		Historic	
703	Biface fragment	Possible knife	Mottled pink fossiliferous chert	Prehistoric	
704	Barbed wire spool			Historic	
705	Tin can	Sanitary, stamped "estab 316 open this end"		Historic	
706	Dart point	Contracting stem		Prehistoric	Late Archaic
707	Dart point	Notched blade, Van Horn-like		Prehistoric	Archaic
708	Milled lumber	Weathered		Historic	
709	Dart point fragment		Gray white chert	Prehistoric	Archaic
710	Horseshoe	6-Hole		Historic	
711	Mano	1-Sided	Sandstone	Prehistoric	
712	Tobacco tin	With striker plate		Historic	
713	Bottle	Clear glass		Historic	
714	Biface	Lanceolate	White chert	Prehistoric	
715	Metal bucket			Historic	
716	Tin can	Unopened, crimped seam		Historic	
717	Bottle glass	Square base	Clear glass	Historic	
718	Milled lumber			Historic	
719	Sardine can	Bent		Historic	
720	Bottle neck and base	"ab x s" on base	Aqua glass	Historic	1904–07
721	Tin can	Crimped seam	Knife cut	Historic	
722	Braided wire			Historic	
723	Tin can	Unopened, lap seam		Historic	
724	Two cartridge casings	.38 Long caliber	"REM UMC 38 LONG"	Historic	
725	Biface	Lanceolate	Brown chert	Prehistoric	
726	Jug fragment	Finger loop handle	Amber glass	Historic	
727	Biface		Silicified wood	Prehistoric	
728	Horseshoe	8-Hole		Historic	
729	Two wheat pennies			Historic	1930, 1937
730	Bottle neck	Aluminum twist cap	Aqua glass	Historic	
731	Mano fragment	2-Sided, ground and pecked		Prehistoric	
732	Two cartridge casings	.41 and .41 Long Colt calibers	"UMC 41" and "41 LC"	Historic	
733	Car part		Metal	Historic	1930s–1940s
734	Cartridge casing	.30-06 caliber	"SL 43"	Historic	1941–1945
735	Possible wagon hub	Thick metal band		Historic	
736	Spring and coupling	Car part		Historic	
737	Dart point	Midsection	Red mottled chert	Prehistoric	Archaic

738	Soda and tin cans	Aluminum beer or soda with handle and can	One knife-opened, one with two punched holes	Historic	
739	Horseshoe	Half 8-hole, with caulks		Historic	
740	Cartridge casing	.30 caliber	"W.R.A. CO. 30 W.C.F."	Historic	
741	Tobacco tin	3-Hinge		Historic	
742	Horseshoe	8-Hole		Historic	
743	Horseshoe	Half of 8-hole		Historic	
744	Cartridge casing	.45 caliber		Historic	
745	Cinch buckle	Flattened		Historic	
746	Bottle sherd and unknown metal	"ab" on base	Aqua glass	Historic	1904–1907
747	Cartridge casing	.30-06 caliber	"U.S.C. CO. 18"	Historic	1918
748	Biface	Late stage	White chert	Prehistoric	
749	Ceramic sherds	Partially glazed		Historic	
750	Metal hook			Historic	
751	Tobacco tin			Historic	
752	Horseshoe	Half of 8-hole with heel caulks		Historic	
753	Cartridge casing	Centerfire	Unstamped	Historic	
754	Horseshoe	8-Hole		Historic	
755	Cinch ring	Rusted		Historic	
756	Tobacco tin	3-Hinge		Historic	
757	Bottle fragment	"One pint" on side	Clear glass	Historic	
758	Mano	2-Sided	Quartzite	Prehistoric	
759	Tin can	Sanitary	Key-strip opened	Historic	
760	Horseshoe	8-Hole		Historic	
761	Rusted shallow metal pan			Historic	
762	Mano and shaft abrader			Prehistoric	
763	Cartridge casing	.30 caliber	"W.R.A. CO 30 W.C.F."	Historic	
764	Horseshoe	8-Hole with heel caulks		Historic	
765	Tobacco tin	3-Hinge		Historic	
766	Muleshoe	Half of 6-hole		Historic	
767	Bottle	Thick, with mold seam	Amber glass	Historic	
768	Chain links on fencepost			Historic	
769	Barbed wire spool	Flat barbs		Historic	
770	Pipe	Cut at one end		Historic	
771	Horseshoe	8-Hole with heel caulks		Historic	
772	Cartridge casing	.25-35 caliber	"REM UMC 25-35"	Historic	
773	Five pieces of milled lumber	With wire nails		Historic	
774	Horseshoe	6-Hole		Historic	

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
775	Tin can	Crimped-seam		Historic	
776	Tin can	"Pure aluminum made in USA" on base, external friction		Historic	
777	Bottle base	"K.E." on base	Black glass	Historic	
778	Horseshoe fragment	Hand forged?		Historic	
779	Tin can	Hole-in-cap		Historic	
780	Handle	Soldered onto metal scrap	Metal	Historic	
781	Cartridge casing	.45-70 caliber	"C-F-7-80"	Historic	1880
782	Tin can	Hole-in-cap		Historic	
783	Tin can	Hold-in-cap, machine soldered		Historic	
784	Cartridge casing	.45-70 caliber	"C-F-4-86"	Historic	1886
785	Horseshoe	8-Hole		Historic	
786	Ceramic sherd	White with blue bands	Porcelain	Historic	
787	Baking powder can	"Full Weight 1/2 Lb. Royal Baking Powder Absolutely Pure"		Historic	
788	Cartridge casing	.45-70 caliber	"C-F-2-85"	Historic	1885
789	Plate fragment	Two black horizontal lines on top	White stoneware	Historic	
790	Horseshoe	Half of 8-hole, small, no caulks		Historic	
791	Three tin cans	Stamped end seam, external closure lids		Historic	
792	Horseshoe and tin can	Half of 8-hole, hole-in-cap can		Historic	
793	Cartridge casing	.45-70 caliber	"C-F-3-88"	Historic	1888
794	Horseshoe	8-Hole with heel caulks		Historic	
795	Horseshoe	8-Hole, unusually thick and heavy		Historic	
796	Horseshoe	With heel caulks		Historic	
797	Metate		Igneous	Prehistoric	
798	Tin can			Historic	
799	Two cartridge casings	.45-70 caliber	"C-F-9-83"	Historic	1883
800	Metate	Partially buried		Prehistoric	
801	Cartridge casing	.45-70 caliber	"C-F-8-82"	Historic	1882
802	Horseshoe	8-Hole with nails		Historic	
803	Dart point		White chert	Prehistoric	Archaic
804	Oil can	SAE 30	Church key opened	Historic	
805	Bottle sherd	"27 n" on base	Green glass	Historic	
806	Two tin cans	Sanitary and juice cans	Church key opened	Historic	
807	Meat tin	Small		Historic	

808	Two manos	Ground and pecked, possible cache	Tan sandstone	Prehistoric	
809	Two tin cans	Sanitary and condensed milk	Rotary opened	Historic	
810	Lard pail	External friction, with lugs		Historic	
811	Tin can	Crushed	Rotary opened	Historic	
812	Lard pail	Small		Historic	
813	Biface fragment		Agate	Prehistoric	
814	Tin can		Knife-opened	Historic	
815	Horseshoe	8-Hole with heel caulks		Historic	
816	Tin can		Church key opened	Historic	
817	Condensed milk can			Historic	
818	Tin can lid	Flattened, words stamped on top and bottom		Historic	
819	Paint can	With bail lugs		Historic	
820	Dart point	Frio-like		Prehistoric	Archaic
821	Tin can	One gallon, stamped base	Key strip opened	Historic	
822	Dart point	Probable Pandale		Prehistoric	Early Archaic
823	Dart point fragment		White chert	Prehistoric	Archaic
824	Arrow point		White chert	Prehistoric	
825	Dart point			Prehistoric	Archaic
826	Two glass sherds		Cobalt blue glass	Historic	
827	Metate	Oval basin-shaped	Unknown	Prehistoric	
828	Dart point	Contracting stem	Pink/tan chert	Prehistoric	Archaic
829	Tobacco tin	3-Hinge w/horizontal cuts on side		Historic	
830	Dart point	Midsection	Mottled gray chert	Prehistoric	Archaic
831	Mano		Green Sandstone	Prehistoric	
832	Dart point		Purple chert	Prehistoric	Archaic
833	Dart point		Purple chert	Prehistoric	Archaic
834	Arrow point	Fresno-like		Prehistoric	Late Prehistoric
835	Mano	2-Sided	Igneous material	Prehistoric	
836	Cartridge casing	10-Gauge shotgun	"WINCHESTER No. 10 New Rival"	Historic	
837	Mano fragment		Unknown material	Prehistoric	
838	Mano	1-Sided	Igneous	Prehistoric	
839	Biface		White agate	Prehistoric	
840	Dart point		Gray/brown chert	Prehistoric	Archaic
841	Dart point fragment			Prehistoric	Archaic
842	Glass sherd		Purple glass	Historic	
843	Hoe fragment	Blade, shaft		Historic	

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
845	Two cores		White chert and black hornfels	Prehistoric	
846	Metate		Unknown	Prehistoric	
847	Metate		Unknown	Prehistoric	
848	Scraper		Siltstone	Prehistoric	
849	Live round	.45 caliber	"W.R.A. CO. COLT 45"	Historic	
850	Biface	Ovate	Unknown	Prehistoric	
853	Condensed milk can			Historic	
854	Horseshoe	8-Hole		Historic	
855	Scraper		Chert	Prehistoric	
856	Horseshoe	8-Hole		Historic	
857	Blade flake	Retouched	Unknown	Prehistoric	
858	Dart point	Base	Gray chert	Prehistoric	Archaic
859	Biface		Unknown	Prehistoric	
860	Arrow point	Toyah		Prehistoric	Late Prehistoric
861	Metate	Slab	Igneous	Prehistoric	
862	Beer can			Historic	
863	Biface and core		Unknown	Prehistoric	
864	Biface	Sickle-shaped	White chert	Prehistoric	
865	Biface		Chert	Prehistoric	
866	Bottle sherd	Neck and lip fragment	Aqua glass	Historic	
867	Cartridge casing	.30 caliber	"W.R.A. CO. 30 W.C.F."	Historic	
868	Biface	Late stage	Mottled purple/white chert	Prehistoric	
869	Mano fragment	2-Sided		Prehistoric	
870	Cartridge casing	20-Gauge shotgun	"F-10-86-NO. 20"	Historic	1886
871	Biface		Chert	Prehistoric	
872	Biface fragment		Mottled purple white chert	Prehistoric	
873	Horseshoe	8-Hole		Historic	
874	Metate	Formal, basin shaped	Rhyolite	Prehistoric	
875	Mano	2-Sided	Rhyolite	Prehistoric	
876	Cartridge casing	Centerfire	Unstamped	Historic	
877	Metal handle	Probably from bucket		Historic	
878	Scraper		Hornfels	Prehistoric	
879	Canteen		Metal	Historic	
880	Horseshoe	Half		Historic	
881	Twelve to fifteen ceramic sherds		Earthenware	Historic	
882	Biface		Gray chert	Prehistoric	
883	Horseshoe			Historic	

884	Gas can			Historic	
885	Mano fragment		Sandstone	Prehistoric	
886	Tin can	Friction top, "factory no 263,25,5th dist. N.J."		Historic	
887	Mason jar sherd		Clear glass	Historic	
888	Dart point	Side-notched		Prehistoric	Archaic
889	Container with handle	Stamped: "Contents guaranteed only when seal is intact."	Metal	Historic	
890	Cartridge casing	.30-06 caliber	"F-A-9-09"	Historic	1909
891	Metate fragment	Slab	Sandstone	Prehistoric	
892	Gas can	Square	Metal	Historic	
893	Dart point	Ellis-like	Brown chert	Prehistoric	Archaic
894	Mano fragment		Unknown	Prehistoric	
895	Metate		Rhyolite	Prehistoric	
896	Scraper		Chert	Prehistoric	
897	Arrow point		White chert	Prehistoric	Late Prehistoric
898	Cartridge casing	.45-70 caliber	"F-C-1-85"	Historic	1885
899	Possible woodstove part		Metal	Historic	
900	Two tin cans		1 Knife-opened, 1 church key opened	Historic	
901	Dart point	Complete, square stem	Brown chert	Prehistoric	Archaic
902	Dart point fragment		White chert	Prehistoric	Archaic
903	Dart point		Mottled pink/red chert	Prehistoric	Archaic
904	Discoidal bead		Kaolinite	Prehistoric	
905	Dart point fragment		Red agate	Prehistoric	Archaic
906	Biface fragment	Possible dart point tip	White chert	Prehistoric	
907	Scraper fragment		White chert	Prehistoric	
908	Tobacco tin	3-Hinge		Historic	
909	Horseshoe	Half 8-hole		Historic	
910	Tin can	Sanitary	Rotary opened	Historic	
911	Horseshoe	8-Hole		Historic	
912	Dart point fragment	Serrated blade	White chert	Prehistoric	Archaic
913	Tin can fragment	Sanitary	Pivot-opened	Historic	
914	Condensed milk can	Crushed		Historic	
915	Two tin cans	Standing, soldered seam		Historic	
916	Fifteen ceramic sherds		Glazed stoneware	Historic	
917	Cartridge casing	.30 caliber	"REM-UMC 30-30"	Historic	
918	Horseshoe	8-Hole		Historic	
919	Tin can	Hole-in-cap		Historic	
920	Tin can	Hole-in-cap	Pivot opened	Historic	

IF #	Object	Description	Material Type, Etc.	General Time Period	Archeological Period
921	Tire fragment and ceramic sherds		White/brown earthenware	Historic	
922	Salt shaker	Flower/leaf design	Ceramic	Historic	
923	Horseshoe	8-Hole		Historic	
924	Tailpipe and milled lumber	Wooden stake		Historic	
925	Cartridge casing	.30-06 caliber	"T-W-7-2"	Historic	1932
926	Mano	2-Sided	Unknown material	Prehistoric	
927	Wagon wheel and tin can	Crimped-seam		Historic	
928	Live round	.30-06 caliber	"F-A-11-4"	Historic	1904
929	Steel ring			Historic	
930	Cartridge casing	.30 caliber	"W.R.A. CO. 30 W.C.F."	Historic	
931	Tobacco tin	Crushed		Historic	
932	Horseshoe	8-Hole with heel caulks		Historic	
933	Tobacco tin	3-hinge		Historic	
934	Horseshoe	8-Hole with heel caulks		Historic	
935	Tin can	Hole-in-cap, complete		Historic	
936	Bullet	Smashed, unknown caliber		Historic	
937	Horseshoe	8-Hole		Historic	
938	Metate	Heavy use	Rhyolite	Prehistoric	
939	Dart point fragment	Pandale	Unknown	Prehistoric	Early Archaic
940	Horseshoe	Half 6-Hole		Historic	
941	Sauce bottle	Embossed label "Joseph Campbell Camden, N.J. U.S.A. Preserve Co."	Solarized glass	Historic	1892–96
942	Arrow point fragment	Perdiz	Tan/white chert	Prehistoric	
943	Tin can	Sanitary	Rotary-opened	Historic	
944	Ink bottle	Cork closure	Aqua glass	Historic	
945	Tobacco tin			Historic	
946	Horseshoe	Half 8-hole		Historic	
947	Cartridge casing	.44 caliber	"W.R.A. CO. 44 W.C.F."	Historic	
948	Juice can		Punctured on top	Historic	
949	Biface	Dart point preform?	Brown agate	Prehistoric	
950	Dart point	Midsection	White chert	Prehistoric	Archaic
951	Cartridge casing and horseshoe	.30 caliber, half 8-hole horseshoe	"RP 30-30 WINCHESTER"	Historic	
952	Horseshoe fragment	8-Hole		Historic	
953	Cartridge casing	.30 caliber	"W.R.A. CO. 30 W.C.F."	Historic	
954	Horseshoe	8-Hole		Historic	
955	Horseshoe	Half, 6- or 8-hole		Historic	

956	Metate fragment		Basalt	Prehistoric	
957	Dart point	Parallel-sided	White-tan chert	Prehistoric	Archaic

NOTE: Isolated Find (IF) numbers that are missing represent sequences used for other projects (n=93) or that were pulled from the list as a result of not meeting the IF criteria (n=6).

Appendix 3

Lithic Scatters

LS#	Maximum Dimension	# Pieces	Stage(s)	Material Type	Other Materials
1	ND	6	ND	ND	
2	ND	5	T	ND	
3	35 m	12	P	A, C	
4	ND	6	ND	H	
5	5 m	5	ND	H	CO, MA,
6	20 m	6	S	H, CH, C	
7	ND	9	ND	H	
8	3 m	15	ND	SW	
9	50 m	15	ND	H, SW	BF, SC,
10	160 m	80-100	ND	SW, H	SC, BF, SP
11	10 m	15	ND	H	CO
12	30 m	40-45	ND	H	CO
13	4 m	>30	ND	H	
14	ND	50-60	S, T	H	CO, SP
15	30 m	40	ND	H, SW	CO
16	2 m	15-20	ND	H	
17	3 m	15-20	ND	H	
18	4 m	15-20	ND	H	
19	3 m	50	ND	H	CO
20	4 m	25-30	ND	H	CO, CH
21	ND	15-20	ND	H	
22	ND	20-25	ND	H	CO, HS
23	15 m	25-35	ND	H	CO
24	4 m	25	ND	H	CO
25	3 m	30	ND	H	CO
26	4 m	>50	ND	H	CO, SP

LS#	Maximum Dimension	# Pieces	Stage(s)	Material Type	Other Materials
27	8 m	>50	ND	H	CO, HS
28	ND	15-20	NE	H	CO
29	ND	17	P, S	H	CO
30	0.5 m	25	P	H	CO
31	40 m	50	ND	H	
32	40 m	50	ND	H, SW	
33	5 m	13	ND	H	CO
34	15 m	18	ND	H, CH	
35	10 m	25	ND	H	CO
36	5 m	25	ND	H	CO
37	40 m	45	ND	H	CO
38	40 m	60	ND	H, SW, CH	CO
39	25 m	75	ND	SW	
40	ND	30	ND	H	CO
41	5 m	25	ND	H	CO
42	4 m	10	ND	H	CO
43	4 m	13	ND	H	CO
44	3 m	20	ND	H	CO
45	8 m	65	ND	H	CO
46	4 m	40	ND	H	CO
47	15 m	30	ND	H	CO
48	ND	20	ND	H	CO
49	5 m	200	ND	SW	
50	ND	30	ND	H	CO, HS
51	20 m	85	ND	H	CO
52	30 m	70	ND	SW, H	SC, BF
53	3 m	25	ND	H	CO
54	20 m	1,000s	P	H	CO
55	4 m	50	P, S	H	CO
56	12 m	50	P	H, SW	CO
57	15 m	80	P. S	H	CO
58	5 m	50	P	H	CO
59	20 m	65	ND	H	CO
60	12 m	55	P	H	
61	8 m	45	P	H	
62	8 m	65	P	H	
63	15 m	115	P	H	
64	5 m	40	P	H	
65	3 m	25	P	H	

66	2 m	35	P, S	H	
67	4 m	15	ND	H	
68	3 m	40	P	H	CO
69	6 m	85	P, S	H	CO
70	2 m	13	ND	H	CO
71	2 m	35	P	H	
72	1.5 m	100	P, S	H	
73	5 m	70	P	H	CO
74	2 m	15	ND	H	
75	15 m	25	ND	H	CO
76	10 m	35	ND	H	
77	50 m	100	ND	H, A	CO
78	60 m	150	ND	A, N	CO
79	3 m	80	ND	A	CO, BF
80	210 m	110	ND	C, A, H	CO, BF
81	2 m	34	P, S, T	A	CO
82	5 m	33	P, S	A	CO
83	20 m	>100	ND	MU	
84	5 m	3	ND	H	
85	30 m	5	ND	H, SW	BF
86	5 m	100	ND	MU	
87	23 m	20	ND	A, SW, H, MU	
88	17 m	25	ND	SW, C, H,	SC, SP
89	25 m	4	ND	H, C	
90	30 m	7	ND	H, C	PP, BF
91	20 m	4	ND	H, SW	SP
92	20 m	3	ND	H	SC
93	3 m	16	ND	MU	CO
94	30 m	>500	ND	MU	
95	20 m	4	ND	H, C	
96	25 m	>1,000	ND	ND	BF
97	25 m	20	ND	H, SW	BF
98	15 m	5	ND	H	SC
99	20 m	3	ND	C, H	HS/MA
100	25 m	20	ND	H, SW, C, A	SC
101	30 m	30	ND	H, A	
102	40 m	22	ND	A, C, H	BF
103	2 m	3	ND	H	
104	20 m	10	ND	H, A	BF
105	15 m	25	ND	H, A, C	BF

LS#	Maximum Dimension	# Pieces	Stage(s)	Material Type	Other Materials
107	15 m	20	ND	H	CO
108	15 m	20	ND	H	
109	35 m	250	ND	H	CO
110	30 m	60	ND	H	CO
111	20 m	55	ND	ND	CO
112	6 m	40	ND	H	CO
113	10 m	25	ND	H	CO
114	6 m	40	ND	H	CO
115	10 m	20	ND	H	CO
116	6 m	50	ND	H	CO
117	3 m	25	ND	H	CO
118	15 m	15	ND	H, C	CO
119	5 m	20	ND	H	
120	20 m	200	ND	H	CO, BF
121	35 m	60	ND	H	BF, UF
122	6 m	75	ND	H	
123	7 m	70	ND	H	CO
124	20 m	70	ND	H, A	BF, SP
125	35 m	30	ND	H	CO
126	5 m	50	ND	H	
127	15 m	25	ND	H	
128	20 m	25	ND	H	CO
129	20 m	90	ND	H	CO
130	15 m	100	ND	H	CO
131	5 m	40	ND	H	CO
132	50 m	>200	ND	H	CO, BF
133	15 m	50	ND	SW	
134	2 m	8	T, S	C	
135	15 m	13	S	H, C	PP
139	5 m	ND	ND	H, C, CH	PP, ME, BF
140	25 m	20-30	P,S	H, C	CO
141	10 m	<15	T	C	BF, PP
142	40 m	>10	P,S	C, A	BF, BF
143	35 m	8	ND	H	SC
144	25 m	6	ND	H	CO
145	65 m	28	ND	H	CO
146	65 m	>75	ND	H	UN, CO
147	2 m	60	P, S, T	H	CO, BF
148	15 m	ND	ND	H	

149	25 m	ND	P, S, T	H	CO
150	10 m	50	ND	H	CO
151	50 m	ND	ND	H, C	SC, BF
152	25 m	<25	ND	C, H	BF, SC
153	100 m	<70	ND	C, H, GL	BF, PP
154	30 m	12	ND	ND	CO
155	25 m	<50	P, S	H	CO, BF
156	10 m	12	T, S	H	
157	15 m	15	ND	H, C, A, CH	CO, BF
158	25 m	<30	ND	H	HS, SC
159	10 m	<40	ND	H	CO
160	20 m	30	P, S, T	C	HS, CO
161	65 m	130	P, S	H	
162	3 m	32	ND	ND	CO
163	3 m	<20	S, T	A	
164	50 m	112	ND	A, H	CO
165	30 m	<100	T	ND	PP
166	3 m	12	P, S	A	
167	< 1 m	<40	P, S	A, C, CH	CO
168	3 m	15	S, T	A	CO
169	< 1 m	8	ND	A, C	
170	2 m	10	ND	CH, C	
171	30 m	15	ND	CH, C, A	CO
172	1 m	<5	ND	A	
173	< 1 m	6	ND	A	CO
174	3 m	25	T, S	ND	CO
175	1.50 m	ND	ND	R	H
176	2 m	25	P, S	H	CO
177	ND	6	ND	H	CO
178	ND	10	ND	H	CO
179	4 m	12	ND	H	
180	4 m	12	ND	A	
181	1 m	8	ND	Q	CO
182	2 m	7	P, S	C	CO
183	2 m	22	P, S	A	CO
184	10 m	ND	P, S, T	A, Q, C, H	CO
185	3 m	> 5	S	C	
186	ND	12	ND	SW	CO
187	3 m	9	ND	A, C	HS
188	4 m	13	P, S	C	CO

LS#	Maximum Dimension	# Pieces	Stage(s)	Material Type	Other Materials
190	2 m	9	P, S	C	CO
191	< 1 m	ND	ND	A	
192	1m	12	S, T	H	CO
193	< 1 m	5	P, S	H	HS
194	3 m	40	ND	H	
195	< 1 m	>100	T	H	
196	1.5 m	15	ND	H	CO
197	5 m	15	S, T	Q	
198	1.2 m	10	P, S	R	CO
199	9 m	13	P, S	C	CO
200	1.5 m	8	P, S	C	CO
201	2m	9	P, S	CH	CO
202	50 m	24	T	A, CH, SW	
203	1.5 m	>100	P, S	A, CH, SW	
204	20 m	>200	P, S	A, SW, C	
205	3 m	100	P, S, T	CH	CO
206	8 m	100	S	A, C, SW	AN
207	3 m	21	ND	C	CO
208	4 m	13	P, S, T	C	CO
209	1.2 m	20	ND	C	
210	2 m	15	ND	C	
211	55 m	>24	P, S	C	CO, BF
212	5 m	>30	P, S	C	CO
213	45 m	ND	P, S	A	CO
214	2 m	20	P, S	A	CO
215	75 m	>1000	P, S, T	C, SW, A	CO
216	4 m	25	P, S, T	A	CO
217	4 m	20	P, S	C	
218	1 m	25	ND	A	
219	1.5m	20	T	C	
220	< 1 m	7	ND	A, C	
221	4 m	35	P, T	A	CO
222	ND	ND	P, S	SW, C , A	
223	1.7 m	15	ND	A	CO
224	10 m	50	ND	A	
225	20 m	ND	ND	A, C	
226	2 m	ND	P, S	C	
227	4 m	40	ND	A	
228	5 m	ND	T	C	

229	5 m	10	ND	A, C	CO
230	ND	10	P, S	C	CO
231	1.3 m	50	ND	A	
232	4 m	10	P, S	A	
233	2 m	ND	ND	ND	
234	4 m	10	P, S	A	
235	3 m	15	ND	SW, C, A	
236	1.6 m	16	P, S	C	
237	30 m	500	ND	ND	BF, CO, AN
238	3 m	12	S, T	C	CO
239	20 m	100	ND	SW	
240	6 m	ND	ND	C	CO

Key:

A Agate
AN Anvil
BF Biface
C Chert
CH Chalcedony
CO Core
H Hornfels
HS Hammerstone
MA Mano
ME Metate
MU Mudstone
N Novaculite
ND No Data
P Primary
PP Projectile Point
Q Quartzite
R Rhyolite
S Secondary
SC Scraper
SP Spokeshave
SW Silicified Wood
T Tertiary
TC Tested Cobble
UN Uniface

Appendix 4

Historic Scatters

HS#	Maximum Dimension	# of Items	Materials Present	Comments
01	NA	7	TT, TC, NA, WI	
02	5 m	10	CE	Makers Mark
03	10 m	4	4 Iron Pipe Segments	
04	3 m	25	Solarized GL Fragments	
05	10 m	6	GL, WI, Mason Jar, Pickle Jar, Dutch Oven Lid	
06	10 m	2	HSH, TT	
07	12 m	11	FC, MTL, Maintainer Blade, Threaded Metal Cap, Pipe, Woodstove Fragments	FC Collected
08	30 m	4	ML, GL	Among Boulder Concentration
09	10 m	3	TC Pull Tab, CP (Side Panel, Rear Panel)	
10	1 m	2	FC (.30-30) , HSH (8-Hole)	
11	12 m	4	CC, TT	
12	5 m	4	TC, WI, CC, OTH (Sandstone Slabs)	
13	3 m	7	ML	
14	13 m	3	CE, TC	
15	N/A	3	TC, GL, RC (35 cm Maximum Diameter)	
16	1 m	9	CE	
17	50 m	4	TC, GL	
18	12 m	5	TC	
19	3 m	25	FE, WI, 25 Posts Stacked	
20	7 m	7	GL, CE	
28	20 m	6	CE, TC, WI, ML	
29	20 m	6	CP, TC	
30	10 m	28	FC, 3 Stripper Clips	
31	N/A	21	TC	
32	12 m	15	FC	
33	10 m	10	FE, Cedar Posts	
34	50 m	6	TC	
35	20 m	3	TC, MTL	
36	10 m	4	TC, OTH	
37	35 m	12	TC, TT, Wood, Stove Pipe	
38	7 m	Ca. 20	TC, GL, CE, MTL, Brick, Concrete Fragments	
39	2 m	11	MTL, NA, Skillet Fragments	

NOTE: HS21-27 were recorded during the Lone Mountain Bike Trail project and are detailed in that report of investigations.

Key:

CE Ceramic
CP Car Part
FC Firearm Cartridge
FE Fence
GL Glass
HSH Horseshoe
MTL Metal
NA Nail
OTH Other
TC Tin Can
TT Tobacco Tin
WI Wire

Appendix 5

National Register Sites

A total of 561 sites recorded during the Big Bend National Park project were determined to be potentially eligible for listing on the National Register of Historic Places. They are listed individually under thematic groupings (historic contexts) for ease of future formal nominations (Tables 1–6). Note that some sites are potentially eligible under more than one historic context.

Due to time and budgetary constraints, individual nominations for these sites could not be accomplished. However, future nominations should be facilitated by the framework offered by the following historic contexts and associated sites presently assessed as eligible as well as the fully developed historic context relating to architectural remains as outlined in Appendix 19.

In addition to these potentially eligible sites, a total of 276 sites determined potentially ineligible (Table 7), and 834 sites of unknown eligibility (Table 8), are listed.

Appendix 5, Table 1 Archeological Sites Containing Data Important to Prehistory. (226 Sites)

BIBE00048	BIBE00537	BIBE01108	BIBE01150	BIBE01224	BIBE01326
BIBE00049	BIBE00546	BIBE01109	BIBE01152	BIBE01257	BIBE01338
BIBE00050	BIBE00548	BIBE01110	BIBE01156	BIBE01264	BIBE01380
BIBE00123	BIBE00604	BIBE01111	BIBE01157	BIBE01265	BIBE01381
BIBE00124	BIBE00755	BIBE01118	BIBE01163	BIBE01270	BIBE01434
BIBE00136	BIBE00760	BIBE01119	BIBE01175	BIBE01273	BIBE01520
BIBE00152	BIBE00761	BIBE01124	BIBE01182	BIBE01278	BIBE01554
BIBE00246	BIBE00775	BIBE01134	BIBE01188	BIBE01291	BIBE01594
BIBE00284	BIBE00817	BIBE01135	BIBE01203	BIBE01300	BIBE01628
BIBE00296	BIBE00970	BIBE01138	BIBE01205	BIBE01308	BIBE01636
BIBE00338	BIBE00978	BIBE01140	BIBE01211	BIBE01309	BIBE01637
BIBE00415	BIBE00987	BIBE01141	BIBE01214	BIBE01315	BIBE01638
BIBE00418	BIBE00988	BIBE01144	BIBE01215	BIBE01323	BIBE01647
BIBE00430	BIBE01100	BIBE01145	BIBE01216	BIBE01324	BIBE01648
BIBE00438	BIBE01105	BIBE01147	BIBE01218	BIBE01325	BIBE01653

Appendix 5, Table 1 Archeological Sites Containing Data Important to Prehistory. (226 Sites) *(continued)*

BIBE01654	BIBE01978	BIBE02487	BIBE02695	BIBE01110	BIBE01325
BIBE01655	BIBE01982	BIBE02490	BIBE02697	BIBE01111	BIBE01326
BIBE01657	BIBE01984	BIBE02491	BIBE02716	BIBE01118	BIBE01338
BIBE01667	BIBE01988	BIBE02492	BIBE02717	BIBE01119	BIBE01380
BIBE01668	BIBE02004	BIBE02495	BIBE02719	BIBE01124	BIBE01381
BIBE01671	BIBE02030	BIBE02497	BIBE02723	BIBE01134	BIBE01434
BIBE01672	BIBE02035	BIBE02498	BIBE02763	BIBE01135	BIBE01520
BIBE01676	BIBE02085	BIBE02502	BIBE02764	BIBE01138	BIBE01554
BIBE01681	BIBE02096	BIBE02506	BIBE02768	BIBE01140	BIBE01594
BIBE01682	BIBE02099	BIBE02509	BIBE02769	BIBE01141	BIBE01628
BIBE01684	BIBE02101	BIBE02516	BIBE00048	BIBE01144	BIBE01636
BIBE01688	BIBE02117	BIBE02519	BIBE00049	BIBE01145	BIBE01637
BIBE01690	BIBE02126	BIBE02523	BIBE00050	BIBE01147	BIBE01638
BIBE01694	BIBE02142	BIBE02526	BIBE00123	BIBE01150	BIBE01647
BIBE01700	BIBE02155	BIBE02527	BIBE00124	BIBE01152	BIBE01648
BIBE01702	BIBE02195	BIBE02531	BIBE00136	BIBE01156	BIBE01653
BIBE01713	BIBE02196	BIBE02551	BIBE00152	BIBE01157	BIBE01654
BIBE01724	BIBE02215	BIBE02562	BIBE00246	BIBE01163	BIBE01655
BIBE01734	BIBE02254	BIBE02567	BIBE00284	BIBE01175	BIBE01657
BIBE01738	BIBE02255	BIBE02568	BIBE00296	BIBE01182	BIBE01667
BIBE01749	BIBE02323	BIBE02572	BIBE00338	BIBE01188	BIBE01668
BIBE01752	BIBE02337	BIBE02575	BIBE00415	BIBE01203	BIBE01671
BIBE01753	BIBE02338	BIBE02588	BIBE00418	BIBE01205	BIBE01672
BIBE01796	BIBE02364	BIBE02604	BIBE00430	BIBE01211	BIBE01676
BIBE01815	BIBE02367	BIBE02624	BIBE00438	BIBE01214	BIBE01681
BIBE01816	BIBE02394	BIBE02628	BIBE00537	BIBE01215	BIBE01682
BIBE01825	BIBE02400	BIBE02629	BIBE00546	BIBE01216	BIBE01684
BIBE01829	BIBE02403	BIBE02632	BIBE00548	BIBE01218	BIBE01688
BIBE01844	BIBE02411	BIBE02633	BIBE00604	BIBE01224	BIBE01690
BIBE01849	BIBE02417	BIBE02636	BIBE00755	BIBE01257	BIBE01694
BIBE01850	BIBE02418	BIBE02640	BIBE00760	BIBE01264	BIBE01700
BIBE01853	BIBE02424	BIBE02645	BIBE00761	BIBE01265	BIBE01702
BIBE01859	BIBE02428	BIBE02648	BIBE00775	BIBE01270	BIBE01713
BIBE01882	BIBE02430	BIBE02652	BIBE00817	BIBE01273	BIBE01724
BIBE01898	BIBE02433	BIBE02654	BIBE00970	BIBE01278	BIBE01734
BIBE01902	BIBE02437	BIBE02656	BIBE00978	BIBE01291	BIBE01738
BIBE01910	BIBE02446	BIBE02662	BIBE00987	BIBE01300	BIBE01749
BIBE01913	BIBE02447	BIBE02664	BIBE00988	BIBE01308	BIBE01752
BIBE01942	BIBE02454	BIBE02665	BIBE01100	BIBE01309	BIBE01753
BIBE01959	BIBE02469	BIBE02668	BIBE01105	BIBE01315	BIBE01796
BIBE01975	BIBE02473	BIBE02670	BIBE01108	BIBE01323	BIBE01815
BIBE01976	BIBE02486	BIBE02687	BIBE01109	BIBE01324	BIBE01816

BIBE01825	BIBE01988	BIBE02338	BIBE02486	BIBE02567	BIBE02664
BIBE01829	BIBE02004	BIBE02364	BIBE02487	BIBE02568	BIBE02665
BIBE01844	BIBE02030	BIBE02367	BIBE02490	BIBE02572	BIBE02668
BIBE01849	BIBE02035	BIBE02394	BIBE02491	BIBE02575	BIBE02670
BIBE01850	BIBE02085	BIBE02400	BIBE02492	BIBE02588	BIBE02687
BIBE01853	BIBE02096	BIBE02403	BIBE02495	BIBE02604	BIBE02695
BIBE01859	BIBE02099	BIBE02411	BIBE02497	BIBE02624	BIBE02697
BIBE01882	BIBE02101	BIBE02417	BIBE02498	BIBE02628	BIBE02716
BIBE01898	BIBE02117	BIBE02418	BIBE02502	BIBE02629	BIBE02717
BIBE01902	BIBE02126	BIBE02424	BIBE02506	BIBE02632	BIBE02719
BIBE01910	BIBE02142	BIBE02428	BIBE02509	BIBE02633	BIBE02723
BIBE01913	BIBE02155	BIBE02430	BIBE02516	BIBE02636	BIBE02763
BIBE01942	BIBE02195	BIBE02433	BIBE02519	BIBE02640	BIBE02764
BIBE01959	BIBE02196	BIBE02437	BIBE02523	BIBE02645	BIBE02768
BIBE01975	BIBE02215	BIBE02446	BIBE02526	BIBE02648	BIBE02769
BIBE01976	BIBE02254	BIBE02447	BIBE02527	BIBE02652	
BIBE01978	BIBE02255	BIBE02454	BIBE02531	BIBE02654	
BIBE01982	BIBE02323	BIBE02469	BIBE02551	BIBE02656	
BIBE01984	BIBE02337	BIBE02473	BIBE02562	BIBE02662	

Appendix 5, Table 2 Prehistoric and Historic Rock Imagery and Other Ritualistic Features. (47 Sites)

BIBE00246	BIBE01427	BIBE01960	BIBE02256	BIBE02351	BIBE02472
BIBE00608	BIBE01428	BIBE01979	BIBE02266	BIBE02364	BIBE02479
BIBE00749	BIBE01693	BIBE01984	BIBE02294	BIBE02371	BIBE02524
BIBE00952	BIBE01829	BIBE01988	BIBE02299	BIBE02376	BIBE02623
BIBE00971	BIBE01853	BIBE02011	BIBE02310	BIBE02392	BIBE02655
BIBE00989	BIBE01908	BIBE02023	BIBE02341	BIBE02399	BIBE02700
BIBE01344	BIBE01917	BIBE02030	BIBE02342	BIBE02404	BIBE02708
BIBE01425	BIBE01935	BIBE02247	BIBE02343	BIBE02451	

Appendix 5, Table 3 Prehistoric Quarries, Procurement Areas, and Lithic Workshops. (67 Sites)

BIBE00438	BIBE01192	BIBE01213	BIBE01271	BIBE01636	BIBE02222
BIBE01106	BIBE01193	BIBE01222	BIBE01272	BIBE01655	BIBE02253
BIBE01108	BIBE01194	BIBE01227	BIBE01284	BIBE01659	BIBE02263
BIBE01110	BIBE01197	BIBE01228	BIBE01307	BIBE01665	BIBE02266
BIBE01120	BIBE01198	BIBE01230	BIBE01343	BIBE01690	BIBE02316
BIBE01173	BIBE01199	BIBE01242	BIBE01418	BIBE01718	BIBE02705
BIBE01185	BIBE01200	BIBE01244	BIBE01426	BIBE01862	BIBE02709
BIBE01186	BIBE01201	BIBE01247	BIBE01430	BIBE02058	
BIBE01187	BIBE01202	BIBE01249	BIBE01432	BIBE02062	
BIBE01189	BIBE01206	BIBE01250	BIBE01575	BIBE02068	
BIBE01190	BIBE01207	BIBE01261	BIBE01612	BIBE02131	
BIBE01191	BIBE01208	BIBE01269	BIBE01630	BIBE02181	

Appendix 5, Table 4 Historic Period Commerce. (60 Sites)

BIBE00185	BIBE01318	BIBE01623	BIBE01837	BIBE02043	BIBE02130
BIBE00415	BIBE01325	BIBE01625	BIBE01838	BIBE02044	BIBE02135
BIBE00775	BIBE01375	BIBE01626	BIBE01848	BIBE02048	BIBE02153
BIBE00856	BIBE01422	BIBE01642	BIBE01910	BIBE02061	BIBE02312
BIBE00859	BIBE01446	BIBE01645	BIBE01912	BIBE02063	BIBE02313
BIBE00990	BIBE01453	BIBE01675	BIBE01920	BIBE02066	BIBE02357
BIBE00991	BIBE01455	BIBE01708	BIBE01942	BIBE02067	BIBE02457
BIBE01003	BIBE01524	BIBE01709	BIBE01987	BIBE02069	BIBE02515
BIBE01082	BIBE01594	BIBE01726	BIBE02009	BIBE02097	BIBE02565
BIBE01083	BIBE01621	BIBE01747	BIBE02030	BIBE02102	BIBE02679

Appendix 5, Table 5 Military Sites and Outposts. (3 Sites)

BIBE00593	BIBE02379	BIBE02686

Appendix 5, Table 6 Prehistoric and Historic Vernacular Architecture. (158 Sites)

BIBE00185	BIBE01522	BIBE01848	BIBE02199	BIBE02460	BIBE02652
BIBE00284	BIBE01524	BIBE01910	BIBE02207	BIBE02464	BIBE02656
BIBE00338	BIBE01562	BIBE01912	BIBE02238	BIBE02479	BIBE02659
BIBE00415	BIBE01594	BIBE01920	BIBE02247	BIBE02491	BIBE02663
BIBE00462	BIBE01601	BIBE01942	BIBE02256	BIBE02497	BIBE02664
BIBE00593	BIBE01618	BIBE01976	BIBE02283	BIBE02501	BIBE02665
BIBE00607	BIBE01621	BIBE01980	BIBE02301	BIBE02508	BIBE02666
BIBE00749	BIBE01623	BIBE01987	BIBE02312	BIBE02515	BIBE02667
BIBE00760	BIBE01625	BIBE01988	BIBE02313	BIBE02524	BIBE02669
BIBE00761	BIBE01626	BIBE02009	BIBE02332	BIBE02527	BIBE02670
BIBE00856	BIBE01635	BIBE02018	BIBE02340	BIBE02528	BIBE02671
BIBE00859	BIBE01642	BIBE02023	BIBE02343	BIBE02531	BIBE02674
BIBE00970	BIBE01646	BIBE02030	BIBE02346	BIBE02533	BIBE02676
BIBE00971	BIBE01658	BIBE02034	BIBE02349	BIBE02534	BIBE02686
BIBE00972	BIBE01672	BIBE02043	BIBE02367	BIBE02535	BIBE02702
BIBE00989	BIBE01674	BIBE02044	BIBE02372	BIBE02536	BIBE02708
BIBE00990	BIBE01675	BIBE02048	BIBE02374	BIBE02537	BIBE02709
BIBE01003	BIBE01706	BIBE02061	BIBE02379	BIBE02542	BIBE02710
BIBE01082	BIBE01707	BIBE02063	BIBE02390	BIBE02551	BIBE02714
BIBE01083	BIBE01708	BIBE02066	BIBE02413	BIBE02588	BIBE02716
BIBE01254	BIBE01722	BIBE02067	BIBE02422	BIBE02591	BIBE02719
BIBE01324	BIBE01723	BIBE02071	BIBE02423	BIBE02604	BIBE02722
BIBE01325	BIBE01726	BIBE02085	BIBE02432	BIBE02606	BIBE02739
BIBE01429	BIBE01747	BIBE02112	BIBE02436	BIBE02619	
BIBE01445	BIBE01781	BIBE02153	BIBE02440	BIBE02624	
BIBE01448	BIBE01814	BIBE02196	BIBE02451	BIBE02634	
BIBE01455	BIBE01837	BIBE02198	BIBE02457	BIBE02637	

Appendix 5, Table 7 Potentially Ineligible Sites. (276 sites)

BIBE00044	BIBE01231	BIBE01353	BIBE01451	BIBE01791	BIBE02162
BIBE00046	BIBE01235	BIBE01355	BIBE01454	BIBE01793	BIBE02165
BIBE00047	BIBE01236	BIBE01356	BIBE01456	BIBE01794	BIBE02166
BIBE00297	BIBE01237	BIBE01359	BIBE01457	BIBE01798	BIBE02167
BIBE00448	BIBE01239	BIBE01361	BIBE01458	BIBE01811	BIBE02170
BIBE00449	BIBE01251	BIBE01362	BIBE01459	BIBE01817	BIBE02176
BIBE00450	BIBE01258	BIBE01363	BIBE01460	BIBE01819	BIBE02178
BIBE00497	BIBE01259	BIBE01364	BIBE01462	BIBE01840	BIBE02186
BIBE00498	BIBE01274	BIBE01370	BIBE01603	BIBE01842	BIBE02192
BIBE00503	BIBE01275	BIBE01374	BIBE01604	BIBE01843	BIBE02201
BIBE00536	BIBE01277	BIBE01376	BIBE01608	BIBE01855	BIBE02209

Appendix 5, Table 7 Potentially Ineligible Sites. (276 sites) *(continued)*

BIBE00609	BIBE01286	BIBE01377	BIBE01610	BIBE01866	BIBE02214
BIBE00747	BIBE01287	BIBE01378	BIBE01611	BIBE01887	BIBE02251
BIBE00908	BIBE01288	BIBE01382	BIBE01617	BIBE01901	BIBE02252
BIBE00920	BIBE01289	BIBE01388	BIBE01624	BIBE01905	BIBE02257
BIBE00921	BIBE01290	BIBE01390	BIBE01639	BIBE01906	BIBE02267
BIBE00951	BIBE01292	BIBE01392	BIBE01640	BIBE01930	BIBE02269
BIBE00953	BIBE01293	BIBE01397	BIBE01643	BIBE01934	BIBE02280
BIBE00986	BIBE01294	BIBE01398	BIBE01644	BIBE01936	BIBE02281
BIBE01040	BIBE01295	BIBE01399	BIBE01650	BIBE01977	BIBE02297
BIBE01101	BIBE01296	BIBE01403	BIBE01656	BIBE02015	BIBE02330
BIBE01102	BIBE01297	BIBE01404	BIBE01666	BIBE02027	BIBE02334
BIBE01103	BIBE01298	BIBE01406	BIBE01669	BIBE02037	BIBE02335
BIBE01104	BIBE01299	BIBE01408	BIBE01689	BIBE02045	BIBE02336
BIBE01112	BIBE01301	BIBE01409	BIBE01704	BIBE02049	BIBE02344
BIBE01121	BIBE01302	BIBE01410	BIBE01725	BIBE02056	BIBE02354
BIBE01128	BIBE01303	BIBE01411	BIBE01730	BIBE02057	BIBE02355
BIBE01136	BIBE01306	BIBE01412	BIBE01731	BIBE02086	BIBE02363
BIBE01137	BIBE01314	BIBE01414	BIBE01735	BIBE02098	BIBE02397
BIBE01139	BIBE01317	BIBE01420	BIBE01736	BIBE02103	BIBE02401
BIBE01143	BIBE01328	BIBE01423	BIBE01739	BIBE02107	BIBE02407
BIBE01149	BIBE01330	BIBE01424	BIBE01742	BIBE02109	BIBE02416
BIBE01151	BIBE01333	BIBE01436	BIBE01745	BIBE02110	BIBE02431
BIBE01155	BIBE01335	BIBE01438	BIBE01748	BIBE02115	BIBE02445
BIBE01162	BIBE01336	BIBE01440	BIBE01751	BIBE02119	BIBE02448
BIBE01167	BIBE01345	BIBE01441	BIBE01754	BIBE02121	BIBE02461
BIBE01183	BIBE01347	BIBE01442	BIBE01757	BIBE02124	BIBE02463
BIBE01195	BIBE01348	BIBE01443	BIBE01772	BIBE02136	BIBE02471
BIBE01204	BIBE01350	BIBE01444	BIBE01776	BIBE02138	BIBE02475
BIBE01212	BIBE01351	BIBE01447	BIBE01777	BIBE02152	BIBE02488
BIBE01229	BIBE01352	BIBE01450	BIBE01778	BIBE02158	BIBE02494
BIBE02503	BIBE02556	BIBE02577	BIBE02603	BIBE02644	BIBE02706
BIBE02520	BIBE02557	BIBE02578	BIBE02618	BIBE02673	BIBE02729
BIBE02540	BIBE02559	BIBE02579	BIBE02620	BIBE02694	BIBE02731
BIBE02549	BIBE02560	BIBE02582	BIBE02625	BIBE02696	BIBE02732
BIBE02553	BIBE02574	BIBE02584	BIBE02627	BIBE02704	BIBE02766

Appendix 5, Table 8 Sites of Unknown Eligibility. (834 sites)

BIBE00045	BIBE01132	BIBE01238	BIBE01337	BIBE01419	BIBE01664
BIBE00051	BIBE01133	BIBE01240	BIBE01339	BIBE01421	BIBE01670
BIBE00052	BIBE01142	BIBE01241	BIBE01340	BIBE01431	BIBE01673
BIBE00092	BIBE01146	BIBE01243	BIBE01341	BIBE01433	BIBE01677
BIBE00093	BIBE01148	BIBE01245	BIBE01342	BIBE01435	BIBE01678
BIBE00094	BIBE01153	BIBE01246	BIBE01346	BIBE01437	BIBE01679
BIBE00135	BIBE01154	BIBE01248	BIBE01349	BIBE01439	BIBE01680
BIBE00186	BIBE01158	BIBE01252	BIBE01354	BIBE01449	BIBE01683
BIBE00187	BIBE01159	BIBE01253	BIBE01357	BIBE01452	BIBE01685
BIBE00545	BIBE01160	BIBE01255	BIBE01358	BIBE01461	BIBE01686
BIBE00547	BIBE01161	BIBE01256	BIBE01360	BIBE01472	BIBE01687
BIBE00549	BIBE01164	BIBE01260	BIBE01365	BIBE01519	BIBE01691
BIBE00603	BIBE01165	BIBE01262	BIBE01366	BIBE01523	BIBE01692
BIBE00630	BIBE01166	BIBE01263	BIBE01367	BIBE01535	BIBE01695
BIBE00748	BIBE01168	BIBE01266	BIBE01368	BIBE01553	BIBE01696
BIBE00758	BIBE01169	BIBE01267	BIBE01369	BIBE01573	BIBE01697
BIBE00767	BIBE01170	BIBE01268	BIBE01371	BIBE01600	BIBE01698
BIBE00771	BIBE01171	BIBE01276	BIBE01372	BIBE01602	BIBE01699
BIBE00812	BIBE01172	BIBE01279	BIBE01373	BIBE01605	BIBE01701
BIBE00813	BIBE01174	BIBE01280	BIBE01379	BIBE01606	BIBE01703
BIBE00814	BIBE01176	BIBE01281	BIBE01383	BIBE01607	BIBE01705
BIBE00853	BIBE01177	BIBE01282	BIBE01384	BIBE01609	BIBE01710
BIBE00857	BIBE01178	BIBE01283	BIBE01385	BIBE01613	BIBE01711
BIBE00979	BIBE01179	BIBE01285	BIBE01386	BIBE01614	BIBE01712
BIBE00985	BIBE01180	BIBE01304	BIBE01387	BIBE01615	BIBE01714
BIBE01071	BIBE01181	BIBE01305	BIBE01389	BIBE01616	BIBE01715
BIBE01107	BIBE01184	BIBE01310	BIBE01391	BIBE01619	BIBE01716
BIBE01113	BIBE01196	BIBE01311	BIBE01393	BIBE01620	BIBE01717
BIBE01114	BIBE01209	BIBE01312	BIBE01394	BIBE01622	BIBE01719
BIBE01115	BIBE01210	BIBE01313	BIBE01395	BIBE01627	BIBE01720
BIBE01116	BIBE01217	BIBE01316	BIBE01396	BIBE01629	BIBE01721
BIBE01117	BIBE01219	BIBE01319	BIBE01400	BIBE01631	BIBE01727
BIBE01122	BIBE01220	BIBE01320	BIBE01401	BIBE01632	BIBE01728
BIBE01123	BIBE01221	BIBE01321	BIBE01402	BIBE01633	BIBE01729
BIBE01125	BIBE01223	BIBE01322	BIBE01405	BIBE01634	BIBE01732
BIBE01126	BIBE01225	BIBE01327	BIBE01407	BIBE01641	BIBE01733
BIBE01127	BIBE01226	BIBE01329	BIBE01413	BIBE01649	BIBE01737
BIBE01129	BIBE01232	BIBE01331	BIBE01415	BIBE01651	BIBE01740
BIBE01130	BIBE01233	BIBE01332	BIBE01416	BIBE01652	BIBE01741
BIBE01131	BIBE01234	BIBE01334	BIBE01417	BIBE01663	BIBE01743

Appendix 5, Table 8 Sites of Unknown Eligibility. (834 sites) *(continued)*

BIBE01744	BIBE01809	BIBE01871	BIBE01924	BIBE01998	BIBE02054
BIBE01746	BIBE01810	BIBE01872	BIBE01925	BIBE01999	BIBE02055
BIBE01750	BIBE01812	BIBE01873	BIBE01926	BIBE02000	BIBE02059
BIBE01755	BIBE01813	BIBE01874	BIBE01927	BIBE02001	BIBE02060
BIBE01756	BIBE01818	BIBE01875	BIBE01928	BIBE02002	BIBE02064
BIBE01758	BIBE01820	BIBE01876	BIBE01929	BIBE02003	BIBE02065
BIBE01759	BIBE01821	BIBE01877	BIBE01931	BIBE02005	BIBE02070
BIBE01760	BIBE01822	BIBE01878	BIBE01932	BIBE02006	BIBE02072
BIBE01761	BIBE01823	BIBE01879	BIBE01933	BIBE02007	BIBE02073
BIBE01762	BIBE01824	BIBE01880	BIBE01937	BIBE02008	BIBE02074
BIBE01763	BIBE01826	BIBE01881	BIBE01938	BIBE02010	BIBE02075
BIBE01764	BIBE01827	BIBE01883	BIBE01939	BIBE02012	BIBE02076
BIBE01765	BIBE01828	BIBE01884	BIBE01940	BIBE02013	BIBE02077
BIBE01766	BIBE01830	BIBE01885	BIBE01941	BIBE02014	BIBE02078
BIBE01767	BIBE01831	BIBE01886	BIBE01961	BIBE02016	BIBE02079
BIBE01768	BIBE01832	BIBE01888	BIBE01963	BIBE02017	BIBE02080
BIBE01769	BIBE01833	BIBE01889	BIBE01964	BIBE02019	BIBE02081
BIBE01770	BIBE01834	BIBE01890	BIBE01965	BIBE02020	BIBE02082
BIBE01771	BIBE01835	BIBE01891	BIBE01966	BIBE02021	BIBE02083
BIBE01773	BIBE01836	BIBE01892	BIBE01967	BIBE02022	BIBE02091
BIBE01774	BIBE01839	BIBE01893	BIBE01968	BIBE02024	BIBE02092
BIBE01775	BIBE01841	BIBE01894	BIBE01969	BIBE02025	BIBE02093
BIBE01779	BIBE01845	BIBE01895	BIBE01970	BIBE02026	BIBE02094
BIBE01780	BIBE01846	BIBE01896	BIBE01971	BIBE02028	BIBE02095
BIBE01782	BIBE01847	BIBE01897	BIBE01972	BIBE02029	BIBE02100
BIBE01783	BIBE01851	BIBE01899	BIBE01973	BIBE02031	BIBE02104
BIBE01784	BIBE01852	BIBE01900	BIBE01974	BIBE02032	BIBE02105
BIBE01785	BIBE01854	BIBE01903	BIBE01981	BIBE02033	BIBE02106
BIBE01786	BIBE01856	BIBE01904	BIBE01983	BIBE02036	BIBE02108
BIBE01787	BIBE01857	BIBE01907	BIBE01985	BIBE02038	BIBE02111
BIBE01788	BIBE01858	BIBE01909	BIBE01986	BIBE02039	BIBE02113
BIBE01789	BIBE01860	BIBE01911	BIBE01989	BIBE02040	BIBE02114
BIBE01790	BIBE01861	BIBE01914	BIBE01990	BIBE02041	BIBE02116
BIBE01792	BIBE01863	BIBE01915	BIBE01991	BIBE02042	BIBE02118
BIBE01795	BIBE01864	BIBE01916	BIBE01992	BIBE02046	BIBE02120
BIBE01797	BIBE01865	BIBE01918	BIBE01993	BIBE02047	BIBE02122
BIBE01805	BIBE01867	BIBE01919	BIBE01994	BIBE02050	BIBE02123
BIBE01806	BIBE01868	BIBE01921	BIBE01995	BIBE02051	BIBE02125
BIBE01807	BIBE01869	BIBE01922	BIBE01996	BIBE02052	BIBE02127
BIBE01808	BIBE01870	BIBE01923	BIBE01997	BIBE02053	BIBE02128

BIBE02129	BIBE02188	BIBE02241	BIBE02305	BIBE02373	BIBE02442
BIBE02132	BIBE02189	BIBE02242	BIBE02306	BIBE02375	BIBE02443
BIBE02133	BIBE02190	BIBE02243	BIBE02307	BIBE02377	BIBE02444
BIBE02134	BIBE02191	BIBE02244	BIBE02308	BIBE02378	BIBE02449
BIBE02137	BIBE02193	BIBE02245	BIBE02309	BIBE02380	BIBE02450
BIBE02139	BIBE02194	BIBE02246	BIBE02311	BIBE02381	BIBE02452
BIBE02140	BIBE02197	BIBE02248	BIBE02314	BIBE02382	BIBE02453
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BIBE02143	BIBE02202	BIBE02250	BIBE02317	BIBE02384	BIBE02456
BIBE02144	BIBE02203	BIBE02264	BIBE02318	BIBE02385	BIBE02458
BIBE02145	BIBE02204	BIBE02265	BIBE02319	BIBE02386	BIBE02459
BIBE02146	BIBE02205	BIBE02268	BIBE02320	BIBE02387	BIBE02462
BIBE02147	BIBE02206	BIBE02270	BIBE02321	BIBE02388	BIBE02465
BIBE02148	BIBE02208	BIBE02271	BIBE02322	BIBE02389	BIBE02466
BIBE02149	BIBE02210	BIBE02272	BIBE02324	BIBE02391	BIBE02467
BIBE02150	BIBE02211	BIBE02273	BIBE02325	BIBE02393	BIBE02468
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BIBE02154	BIBE02213	BIBE02275	BIBE02327	BIBE02396	BIBE02474
BIBE02156	BIBE02216	BIBE02276	BIBE02328	BIBE02398	BIBE02476
BIBE02157	BIBE02217	BIBE02277	BIBE02329	BIBE02402	BIBE02477
BIBE02159	BIBE02218	BIBE02278	BIBE02331	BIBE02405	BIBE02480
BIBE02160	BIBE02219	BIBE02279	BIBE02333	BIBE02406	BIBE02481
BIBE02161	BIBE02220	BIBE02282	BIBE02339	BIBE02408	BIBE02482
BIBE02163	BIBE02221	BIBE02284	BIBE02345	BIBE02409	BIBE02483
BIBE02164	BIBE02223	BIBE02285	BIBE02347	BIBE02410	BIBE02484
BIBE02168	BIBE02224	BIBE02286	BIBE02348	BIBE02412	BIBE02485
BIBE02169	BIBE02225	BIBE02287	BIBE02350	BIBE02414	BIBE02489
BIBE02171	BIBE02226	BIBE02288	BIBE02352	BIBE02415	BIBE02493
BIBE02172	BIBE02227	BIBE02289	BIBE02353	BIBE02419	BIBE02496
BIBE02173	BIBE02228	BIBE02290	BIBE02356	BIBE02420	BIBE02499
BIBE02174	BIBE02229	BIBE02291	BIBE02358	BIBE02421	BIBE02500
BIBE02175	BIBE02230	BIBE02292	BIBE02359	BIBE02425	BIBE02504
BIBE02177	BIBE02231	BIBE02293	BIBE02360	BIBE02426	BIBE02505
BIBE02179	BIBE02232	BIBE02295	BIBE02361	BIBE02427	BIBE02507
BIBE02180	BIBE02233	BIBE02296	BIBE02362	BIBE02429	BIBE02510
BIBE02182	BIBE02234	BIBE02298	BIBE02365	BIBE02434	BIBE02511
BIBE02183	BIBE02235	BIBE02300	BIBE02366	BIBE02435	BIBE02512
BIBE02184	BIBE02236	BIBE02302	BIBE02368	BIBE02438	BIBE02513
BIBE02185	BIBE02237	BIBE02303	BIBE02369	BIBE02439	BIBE02514
BIBE02187	BIBE02239	BIBE02304	BIBE02370	BIBE02441	BIBE02517

Appendix 5, Table 8 Sites of Unknown Eligibility. (834 sites) *(continued)*

BIBE02518	BIBE02561	BIBE02601	BIBE02635	BIBE02678	BIBE02715
BIBE02521	BIBE02563	BIBE02602	BIBE02638	BIBE02680	BIBE02718
BIBE02522	BIBE02564	BIBE02605	BIBE02639	BIBE02682	BIBE02720
BIBE02529	BIBE02566	BIBE02607	BIBE02641	BIBE02684	BIBE02721
BIBE02530	BIBE02569	BIBE02608	BIBE02642	BIBE02685	BIBE02724
BIBE02532	BIBE02570	BIBE02609	BIBE02643	BIBE02688	BIBE02725
BIBE02539	BIBE02571	BIBE02610	BIBE02646	BIBE02689	BIBE02726
BIBE02541	BIBE02573	BIBE02611	BIBE02647	BIBE02690	BIBE02727
BIBE02543	BIBE02576	BIBE02612	BIBE02649	BIBE02691	BIBE02728
BIBE02544	BIBE02580	BIBE02613	BIBE02650	BIBE02692	BIBE02733
BIBE02545	BIBE02581	BIBE02614	BIBE02651	BIBE02693	BIBE02734
BIBE02546	BIBE02583	BIBE02615	BIBE02653	BIBE02698	BIBE02735
BIBE02547	BIBE02585	BIBE02616	BIBE02657	BIBE02699	BIBE02736
BIBE02548	BIBE02586	BIBE02617	BIBE02658	BIBE02701	BIBE02737
BIBE02550	BIBE02587	BIBE02621	BIBE02660	BIBE02703	BIBE02738
BIBE02552	BIBE02589	BIBE02622	BIBE02661	BIBE02707	BIBE02740
BIBE02554	BIBE02590	BIBE02626	BIBE02672	BIBE02711	BIBE02741
BIBE02555	BIBE02592	BIBE02630	BIBE02675	BIBE02712	BIBE02765
BIBE02558	BIBE02600	BIBE02631	BIBE02677	BIBE02713	BIBE02767

Appendix 6

National Park Service Archeological Project Data

The following archeological projects were completed in Big Bend National Park between 1982 and 2011, both as in-house and contracted projects. Where the survey type is indicated as "Intensive §106," reports were generated that were reviewed by THC for §106 compliance. Other projects not indicated as "Intensive §106" were generally carried out for in-house park management purposes only and may or may not be complete recordings.

Categorization separates surveyed areas by whether the survey was linear or wide area. Linear surveys can to a degree be considered as transects across park terrain whereas wide area surveys can be considered as sampling blocks.

Finally, two separate categories herein are for non-§106 projects done by volunteers who were enlisted to take the 1970 T.N. Campbell report and revisit areas where his sites were clustered and record a current condition. The other non-§106 projects were done by the park archeologist and/or his wife during personal time.

Appendix 6, Table 1 NPS Archeological Project Data.

Project	Date	Survey Type	Area Surveyed (Ha)	# of Sites	Site Type	Time Period	Recorder
Surveys For NHPA §106 Purposes							
Boundary and Land Surveys							
Boundary Segment A	1984	Intensive §106	73.8	6	CAMP	Prehistoric	Thomas Alex
				1	LISC	Prehistoric	Thomas Alex
Boundary Segment B	1984	Intensive §106	23.4	1	CAMP	Prehistoric	Thomas Alex
				1	LISC	Prehistoric	Thomas Alex
Boundary Segment C	1984	Intensive §106	15.4	1	CAMP/ RANC	Prehistoric and Historic	Thomas Alex
Boundary Segment D	1984	Intensive §106	21.9	1	CAMP	Prehistoric	Thomas Alex
Boundary Segment E	1984	Intensive §106	20.4	1	CAMP	Prehistoric	Thomas Alex

Appendix 6, Table 1 NPS Archeological Project Data. *(continued)*

Project	Date	Survey Type	Area Surveyed (Ha)	# of Sites	Site Type	Time Period	Recorder
Surveys For NHPA §106 Purposes *(continued)*							
Boundary and Land Surveys *(continued)*							
Boundary Segment F	1984	Intensive §106	23.0	1	CAMP	Prehistoric	Thomas Alex
Boundary Segment G	1984	Intensive §106	9.0	1	CAMP	Prehistoric	Thomas Alex
Boundary Segment H	1984	Intensive §106	30.1	2	CAMP	Prehistoric	Thomas Alex
Boundary Segment J	1984	Intensive §106	35.8	2	CAMP	Prehistoric	Thomas Alex
Boundary Segment K	1984	Intensive §106	54.7	4	CAMP	Prehistoric	Thomas Alex
Boundary Segment L	1984	Intensive §106	20.4	2	CAMP	Prehistoric	Thomas Alex
Boundary Segment M	1984	Intensive §106	33.2	NR	NR		Thomas Alex
Boundary Segment N	1984	Intensive §106	9.0	NR	NR		Thomas Alex
Road and Trail Surveys							
Boquillas Canyon Road	1995	Intensive	96.2	1	CAMP	Prehistoric	Originally recorded by T. N. Campbell
Reed Camp Reroute	1984	Intensive §106	42.6	4	CAMP	Prehistoric	Thomas Alex
Route 11	1984	Intensive §106	287.8	1	LSSU	Prehistoric	Thomas Alex
				6	CAMP	Prehistoric	Thomas Alex
Route 12	1995	Intensive §106	235.2	7	CAMP	Prehistoric	Thomas Alex
				1	FARM	Historic	3 Originally recorded by T. N. Campbell
Route 13 (1)	1986	Intensive §106	224.6	25	CAMP	Prehistoric	Thomas Alex
				2	LISC	Prehistoric	Thomas Alex
Route 14 North End	1989	Intensive §106	38.5	1	CAMP	Prehistoric	Thomas Alex
Route 15	1990	Intensive §106	323.8	6	LISC	Prehistoric	Donald Corrick, Frank Garcia, Karl Kibler
				18	CAMP	Prehistoric	Donald Corrick, Frank Garcia, Karl Kibler
				1	CAMP/ RANC	Prehistoric and Historic	Donald Corrick, Frank Garcia, Karl Kibler
				1	SHRO	Prehistoric	Originally recorded by T. N. Campbell
				1	FARM	Historic	Donald Corrick, Frank Garcia, Karl Kibler
Route 16	1997	Intensive §106	100.1	7	CAMP	Prehistoric	1 Originally recorded by T. N. Campbell
				4	CAMP/ FARM	Prehistoric and Historic	Thomas Alex, Donald Corrick, Tracy Stone, James Cheatham
				2	FARM	Historic	Thomas Alex, Donald Corrick, Tracy Stone, James Cheatham
				1	LSSU	Prehistoric	Thomas Alex, Donald Corrick, Tracy Stone, James Cheatham
				1	CAMP/ RANC	Prehistoric and Historic	Originally recorded by T. N. Campbell
Emory Peak Trail	1993	Intensive §106	9.2	1	CAMP	Prehistoric	Thomas Alex, Frank Garcia
				1	SHRO	Prehistoric	Thomas Alex, Frank Garcia

Intermountain Bicycling Association Phase 1	2007	Intensive §106	44.1	5	CAMP	Prehistoric	Thomas Alex
Intermountain Bicycling Association Phase 2	2007	Intensive §106	47.5	1	CAMP	Prehistoric	Thomas Alex
				1	DAM	Historic	Thomas Alex
Intermountain Bicycling Association Phase 3	2007	Intensive §106	14.3	NR	NR		Thomas Alex
Laguna Meadow Trail	1989	Intensive §106	32.7	2	LISC	Prehistoric	Thomas Alex
				2	CAMP	Prehistoric	Thomas Alex
Lost Mine Trail	1994	Intensive §106	11.2	NR	NR		Donald Corrick
Blue Creek	1993	Intensive §106	30.2	3	CAMP	Prehistoric	Originally recorded by T. N. Campbell
				4	SHRO/ PICT	Prehistoric	Originally recorded by T. N. Campbell
				2	SHRO	Prehistoric	Frank Garcia
Lower Marufo Vega	1993	Intensive §106	26.0	4	LISC	Prehistoric	Donald Corrick, Frank Garcia
Marufo Vega Loop	1993	Intensive §106	26.2	4	LISC	Prehistoric	Donald Corrick, Frank Garcia
				1	SHRO	Prehistoric	Donald Corrick, Frank Garcia
				1	SHCL	Prehistoric	Donald Corrick, Frank Garcia
				1	CAMP	Prehistoric	Donald Corrick, Frank Garcia
West End Dodson	1993	Intensive §106	27.6	1	CAMP	Prehistoric	Originally recorded by T. N. Campbell
Middle and East Dodson	1993	Intensive §106	95.6	1	LISC	Prehistoric	
				5	CAMP	Prehistoric	Donald Corrick
				1	CAMP/ RANC	Prehistoric and Historic	Donald Corrick
Smoky Creek Trail	1993	Intensive §106	53.5	1	CAMP	Prehistoric	Frank Garcia
							Frank Garcia
Mule Ears Trail	1993	Intensive §106	70.4	4	CAMP	Prehistoric	Originally recorded by T. N. Campbell
				2	CAMP/ RANC	Prehistoric and Historic	Originally recorded by T. N. Campbell
Upper Blue Creek	1993	Intensive §106	17.4	5	CAMP	Prehistoric	Frank Garcia
Upper Juniper Canyon	1993	Intensive §106	25.1	1	CAMP/ SHRO	Prehistoric	Frank Garcia
				4	CAMP	Prehistoric	Frank Garcia
				1	LITH	Prehistoric	Frank Garcia
				1	RANC	Historic	Frank Garcia
				1	ISOL	Middle Archaic (Langtry)	Frank Garcia
Upper Pinnacles	1995	Intensive §106	2.7	NR	NR		Donald Corrick
Upper to Lower Basin		Intensive §106	3.3	1	DAM	Historic	

Appendix 6, Table 1 NPS Archeological Project Data. *(continued)*

Project	Date	Survey Type	Area Surveyed (Ha)	# of Sites	Site Type	Time Period	Recorder
Surveys For NHPA §106 Purposes *(continued)*							
Road and Trail Surveys *(continued)*							
Window Trail	1989	Intensive §106	26.5	1	CAMP	Prehistoric	Originally recorded by Erik Reed 1936; T.N. Campbell 1966; Andy Cloud 1989
				1	SHBO	Prehistoric	Excavated 6/1936 J.C. Kelley & Pearce
				1	CAMP/ LSSU	Prehistoric	Originally recorded by Erik Reed 1936
Ore Terminal Trail	1993	Intensive §106	67.3	1	LSSU	Prehistoric	Donald Corrick, Frank Garcia
Santa Elena Canyon	1995	Intensive §106	2.3	1	CAMP	Prehistoric	Donald Corrick, Frank Garcia
				NR	NR		Donald Corrick
Hot Springs to Rio Grande Village	1993	Intensive §106	32.9	1	CAMP	Prehistoric	Originally recorded by T. N. Campbell
				1	SHCL/ PICT	Prehistoric	Donald Corrick
Amphitheater to Window View Trail		Intensive §106	6.8	2	CAMP	Prehistoric	Donald Corrick, Thomas Alex
Campground to Remuda Trail		Intensive §106	0.5	NR	NR		Thomas Alex
North Rosillos/Tornillo Flat Disturbed Land Surveys							
North Rosillos Disturbed Land	2008	Intensive	33.0	1	CAMP	Prehistoric	Thomas Alex
				1	CAMP/ RANC	Prehistoric and Historic	Thomas Alex
Grasslands Restoration	2011	Intensive §106	25.6	2	LSSU	Prehistoric	Thomas Alex
Developed Area Surveys							
Rio Grande Village Water System	2006	Intensive §106	4.2	NR	NR		Thomas Alex
Basin Water Tank		Intensive §106	0.8	3	CAMP	Prehistoric	Originally recorded by T. N. Campbell
Fossil Bone Exhibit	2003	Intensive	5.8	1	LISC	Prehistoric	Thomas Alex
Powerline/Utilities Surveys							
Powerline Phases 1-3	1983	Intensive §106	696.1	64	CAMP	Prehistoric	5 Originally recorded by T. N. Campbell; 59 by Thomas Alex
				1	RANC	Historic	Thomas Alex
				1	SHRO	Prehistoric	1 Originally recorded by T. N. Campbell
				2	HIST	Historic	Thomas Alex
Powerline 4 and 5 and buried telephone cable	1986	Intensive §106	307.0	12	LISC	Prehistoric	Thomas Alex
				35	CAMP	Prehistoric	Thomas Alex
				1	SHRO	Prehistoric	Thomas Alex

Powerline 6	1984	Intensive §106	183.0	12	CAMP	Prehistoric	Thomas Alex
				2	LISC	Prehistoric	Thomas Alex
				1	RANC	Historic	Thomas Alex
				1	SHRO/ PICT	Prehistoric	Thomas Alex
				1	CAMP/ RANC	Prehistoric and Historic	Thomas Alex
				1	FARM	Historic	Thomas Alex
Rio Grande Electric Coop Project 320	1997	Intensive §106	92.0	4	CAMP	Prehistoric	Espey Huston & Associates; Contracted by Rio Grande Electric Coop
				1	LISC	Prehistoric	Espey Huston & Associates; Contracted by Rio Grande Electric Coop
Green Gulch Powerline	1999	Intensive	18.4	NR	NR		Thomas Alex
Pitcock Telephone Cable	2006	Intensive §106	12.6	1	CAMP	Prehistoric	Originally recorded by T. N. Campbell
Prescribed Fire Surveys							
Panther Junction Developed Area Burn Block	1998	Intensive §106	112.6	1	CAMP	Prehistoric	Thomas Alex
Santa Elena Canyon Sublett Farm	2005	Intensive §106	166.0	2	CAMP	Prehistoric	CBBS Survey
				1	RANC	Historic	CBBS Survey
South Rim Prescribed Burn	1999	Intensive §106	146.9	2	SHRO	Prehistoric	CBBS Survey
				1	LSSU	Prehistoric	CBBS Survey
				5	CAMP	Prehistoric	CBBS Survey
Lone Mountain Rx Burn Block	1998	Intensive §106	176.0	1	LISC	Prehistoric	Thomas Alex
				2	CAMP	Prehistoric	Thomas Alex
Southwest Rim Prescribed Burn	2004	Intensive §106	62.3	3	CAMP	Prehistoric	CBBS Survey
				1	SHRO	Prehistoric	CBBS Survey
Hannold Draw Rx Burn	2008	Intensive §106	403.0	4	CAMP	Prehistoric	CBBS Survey
				1	HIST	Historic	
Rt 13/Rt 14 Rx Burn	1999	Intensive §106	232.1	6	CAMP	Prehistoric	CBBS Survey

Non §106 Projects

Thomas C. Alex, Independent Surveys

Chilicotal North	1992	Reconnaissance	20.4	1	CAMP/ RANC	Prehistoric and Historic	Originally recorded by T. N. Campbell
				2	CAMP	Prehistoric	Thomas Alex
Kit Mountain	1993	Reconnaissance	4.8	1	CAMP	Prehistoric	Thomas Alex
				1	SHRO	Prehistoric	Thomas Alex
Mule Ear Spring	1984	Intensive	1.0	1	CAMP	Late PaleoIndian	Thomas Alex
Mesa de Anguila	1984	Reconnaissance	25.1	3	SHRO	Prehistoric	Thomas Alex
				11	CAMP	Prehistoric	Thomas Alex
				4	WAX	Historic	Thomas Alex

Appendix 6, Table 1 NPS Archeological Project Data. *(continued)*

Project	Date	Survey Type	Area Surveyed (Ha)	# of Sites	Site Type	Time Period	Recorder
Non §106 Projects *(continued)*							
Thomas C. Alex, Independent Surveys *(continued)*							
Mesa de Anguila	1984	Reconnaissance	24.3	4	CAMP	Prehistoric	Thomas Alex
				2	SHRO	Prehistoric	Thomas Alex
Mesa de Anguila west cliff	1986	Reconnaissance	20.5	2	CAMP	Prehistoric	Thomas Alex
				1	SHRO/ PICT	Prehistoric	Thomas Alex
				2	SHRO	Prehistoric	Thomas Alex
				1	WAX	Historic	Thomas Alex
Gano Spring area	1982	Reconnaissance	19.1	1	CAMP	Prehistoric	Originally recorded by T. N. Campbell
				1	CAMP/ RANC	Prehistoric and Historic	Originally recorded by T. N. Campbell
Gano Spring area	1982	Reconnaissance	22.5	1	SHBO/ CAMP	Prehistoric	Thomas Alex
				1	SHRO	Prehistoric	Thomas Alex
				1	CAMP	Prehistoric	Originally recorded by T. N. Campbell
Carlota Tinaja	1983	Intensive	3.5	1	CAMP	Prehistoric	Thomas Alex
Black Willow	1985	Intensive	79.2	1	CAMP/ MILI	Prehistoric and Historic	Thomas Alex
				1	CAMP/ GRAV	Prehistoric	Thomas Alex
				1	GRAV	Prehistoric	Thomas Alex
Alta Site	1988	Intensive	8.5	1	SHRO	Middle Archaic	Thomas Alex
Smoky Spring	1988	Reconnaissance	13.4	1	CAMP/ RANC	Prehistoric and Historic	Thomas Alex
Gano Creek	1990	Reconnaissance	18.3	3	CAMP	Prehistoric	Thomas Alex
				1	CAMP/ SHRO	Prehistoric	Thomas Alex
North Rosillos	1990	Intensive	12.1	3	CAMP	Prehistoric	Thomas Alex
Burro Mesa North	1995	Reconnaissance	22.1	1	LSQU	Prehistoric	Thomas Alex
				1	SPEC	Prehistoric	Thomas Alex
North Rosillos	2004	Intensive	19.0	1	CAMP	Prehistoric	Thomas Alex
North Rosillos	2004	Intensive	3.0	1	CAMP	Prehistoric	Thomas Alex
North Rosillos	1990	Intensive	19.6	2	CAMP	Prehistoric	Thomas Alex
Sierra Quemada Elephant Tusk	1986	Reconnaissance	36.2	2	CAMP	Prehistoric	Thomas Alex

Sierra Quemada	1990	Reconnaissance	16.7	2	CAMP/ RANC	Prehistoric and Historic	Thomas Alex
				1	DAM	Historic	Thomas Alex
				6	CAMP	Prehistoric	Thomas Alex
				1	SHRO	Prehistoric	Thomas Alex
				1	SHRO/ PICT	Prehistoric	Thomas Alex
Sierra Quemada	1990	Reconnaissance	19.0	2	CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1990	Reconnaissance	27.9	4	CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1990	Reconnaissance	99.6	4	CAMP	Prehistoric	Thomas Alex
				1	CAMP/ RANC	Prehistoric and Historic	Thomas Alex
				1	DAM	Historic	Thomas Alex
Sierra Quemada	1991	Intensive	12.0	1	CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1991	Intensive	13.3	4	CAMP	Prehistoric	Thomas Alex
				1	SHBO/ CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1992	Reconnaissance	41.9	1	CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1992	Intensive	5.5	NR	NR		Thomas Alex
Sierra Quemada	1995	Reconnaissance	7.2	NR	NR		Thomas Alex
Sierra Quemada	1995	Reconnaissance	15.6	1	SHRO	Prehistoric	Thomas Alex
				1	CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1995	Reconnaissance	2.3	NR	NR		Thomas Alex
Sierra Quemada	1995	Intensive	1.8	1	CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1995	Intensive	5.4	1	CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1995	Reconnaissance	13.6	1	CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1995	Intensive	8.3	NR	NR		Thomas Alex
Sierra Quemada	1997	Reconnaissance	4.0	NR	NR		Thomas Alex
Sierra Quemada	1997	Reconnaissance	11.9	NR	NR		Thomas Alex
Sierra Quemada	1997	Reconnaissance	9.4	1	CAMP	Prehistoric	Thomas Alex
Sierra Quemada	1997	Reconnaissance	15.7	2	CAMP	Prehistoric	Thomas Alex
				1	SHBO/ CAMP	Prehistoric	Thomas Alex
Telephone Canyon	1989	Reconnaissance	15.7	4	SHRO	Prehistoric	Thomas Alex
				2	CAMP	Prehistoric	Thomas Alex
				1	SHRO/ PETR	Prehistoric	Thomas Alex
Tortuga	1986	Reconnaissance	19.1	2	CAMP	Prehistoric	Thomas Alex
Volunteer Surveys							
Howard Newman	1991 – 1994	Intensive	61.1	9	CAMP	Prehistoric	4 Originally recorded by T. N. Campbell
				1	CAMP/ RANC	Prehistoric and Historic	Originally recorded by T. N. Campbell
Steven Harper	2003	Reconnaissance	25.5	2	CAMP	Prehistoric	Steven Harper

Appendix 6, Table 1 NPS Archeological Project Data. *(continued)*

Project	Date	Survey Type	Area Surveyed (Ha)	# of Sites	Site Type	Time Period	Recorder
Non §106 Projects *(continued)*							
Volunteer Surveys *(continued)*							
Steven Harper Croton Spring	2006	Reconnaissance	99.9	25	CAMP	Prehistoric	12 Originally recorded by T. N. Campbell
				1	SHBO/ PICT/ PETR	Prehistoric	Steven Harper
				1	SHRO	Prehistoric	Originally recorded by T. N. Campbell
				1	CAMP/ MINE	Prehistoric and Historic	Steven Harper
Steven Harper Maverick Road	2003	Intensive	477.9	12	CAMP	Prehistoric	3 Originally recorded by T. N. Campbell
				1	CAIRN	UNK	Steven Harper
				1	FARM	Historic	Originally recorded by T. N. Campbell
Steven Harper Persimmon Gap	2001	Intensive	206.3	20	CAMP	Prehistoric	9 Originally recorded by T. N. Campbell
				1	STORE	Historic	Steven Harper
Steven Harper River Road	2004	Intensive	575.7	18	CAMP	Prehistoric	Steven Harper
				1	CAMP/ LSQU		Steven Harper
				1	CEME	Historic	Steven Harper
				1	CAMP/ RANC	Prehistoric and Historic	Steven Harper
				1	CAMP/ SHSE	Prehistoric	Steven Harper
				3	RANC	Historic	Steven Harper
Steven Harper Terlingua Abajo	2003	Reconnaissance	318.9	3	RANC	Historic	Steven Harper
				14	CAMP	Prehistoric	Steven Harper
				2	RANC	Historic	Steven Harper
				1	KILN	Historic	Steven Harper
Steven Wick Campbell Resurvey	2003	Intensive	1479.5	83	CAMP	Prehistoric	63 Originally recorded by T. N. Campbell
				3	CAMP/ LSSU	Prehistoric	Originally recorded by T. N. Campbell
				1	LSSU	Prehistoric	Originally recorded by T. N. Campbell
				1	SHRO/ PICT	Prehistoric	Originally recorded by T. N. Campbell
Zena Lyons	1992	Reconnaissance	46.3	1	RANC	Historic	Zena Lyons

Other Project Surveys

BurroMesaNRDist	1984	Intensive	183.2	1	LISQ	Prehistoric	Originally recorded by T. N. Campbell; NR District survey by Tim Seaman, Virginia Wulfkuhle, and Thomas Alex
				1	CAMP/ RANC	Prehistoric and Historic	NR District survey by Tim Seaman, Virginia Wulfkuhle, and Thomas Alex
				1	SHCL/ PICT	Prehistoric	Originally recorded by T. N. Campbell; NR District survey by Tim Seaman, Virginia Wulfkuhle, and Thomas Alex
				1	CAMP	Prehistoric	NR District survey by Tim Seaman, Virginia Wulfkuhle, and Thomas Alex
Yanagi Quarry	2002	Intensive	13.3	1	LSSU/ RANC	Prehistoric and Historic	Thomas Alex

Key To Abbreviations

CAMP Campsite
CEME Cemetery
GRAV Gravesite
HIST Historic
ISOL Isolate
LITH Lithic
LSQU Lithic Scatter, Quarry
LSSU Lithic Scatter, Surface
MILI Military
NR Not Recorded
PETR Petroglyph
PICT Pictograph
RANC Ranch
SHBO Boulder Shelter
SHCL Cliff Shelter
SHRO Rock Shelter

Appendix 7

Center for Big Bend Studies Cultural Resource Management Projects in Big Bend National Park

The results from six Cultural Resource Management (CRM) projects conducted within Big Bend National Park (BBNP) were included in the Geographic Information System (GIS) analysis to create the predictive model. Five of these projects were undertaken prior to prescribed burns and one was conducted prior to developing a mountain bike trail. As these projects have been fully reported elsewhere, they are not part of the present report. The table below provides summary information of the results of these studies followed by a list of the available reports.

Taken together, these projects add an additional 1,116 hectares (ha) that were intensively surveyed within BBNP, resulting in the documentation of 44 sites—24 of which were new sites and 20 of which had been previously recorded. A total of 26 artifacts were collected during these projects.

Appendix 7, Table 1 CBBS Cultural Resource Management Projects in BBNP.

Project	Hectares Surveyed	# of New Sites	# of Previously Recorded Sites	Total Sites	# of Isolates	# of Collected Artifacts
Southeast Rim	147	3	3	6	0	1
Route 13/14	232	6	3	9	5	11
Southwest Rim	62	2	3	5	6	4
Sublett Farm/Santa Elena	166	3	7	10	7	0
Hannold Draw	403	5	0	5	28	2
Lone Mountain Bike Trail	106	5	4	9	47	8
Totals	1,116	24	20	44	93	26

CRM Report Citations

Cloud, William A.

1999 Archeological Survey of the Southeast Rim Prescribed Project, Big Bend National Park, Brewster County, Texas. Unpublished report on file, National Park Service, Big Bend National Park, Texas.

2000 Archeological Survey of the Route 13/Route 14 Prescribed Project, Big Bend National Park, Brewster County, Texas. Unpublished report on file, National Park Service, Big Bend National Park, Texas.

Cloud, William A., and Richard W. Walter

2006 An Archaeological Survey for a Proposed Prescribed Burn on the Southwest Rim of the Chisos Mountains, Big Bend National Park, Brewster County, Texas. Reports in Contract Archeology 16. Center for Big Bend Studies, Sul Ross State University, Alpine, Texas.

Keller, David W., and William A. Cloud

2007 Intensive Archaeological Survey of the Sublett Farm and Santa Elena Canyon Overlook Burn Blocks, Big Bend National Park, Brewster County, Texas. Reports in Contract Archaeology 19, Big Bend National Park and Center for Big Bend Studies, Sul Ross State University, Alpine, Texas.

2008 Intensive Archaeological Survey of the Proposed Lone Mountain Bike Trail, Big Bend National Park, Brewster County, Texas. Reports in Contract Archaeology 20, Big Bend National Park and Center for Big Bend Studies, Sul Ross State University, Alpine, Texas.

Kent, Floyd D., William A. Cloud, Dwight R. Cropper, and David W. Keller

2008 Archaeological Survey of the Hannold Draw Prescribed Burn Unit, Big Bend National Park, Brewster County, Texas. Reports in Contract Archaeology 21, Big Bend National Park and Center for Big Bend Studies, Sul Ross State University, Alpine, Texas.

Appendix 8

Project Special Studies

During the course of the project, a limited number of special studies were conducted consisting of radiocarbon dating, obsidian sourcing, ceramic analysis, and analysis of corn cobs. Soil humate and charcoal samples were collected from a number of sites over the course of the project, most often from archeological deposits in buried contexts, or from features with unique morphology or exceptional integrity. A total of 13 samples were submitted for radiocarbon analyses (including 2 corn cobs) from 9 sites (Table 1).

It is notable that the majority of radiocarbon dates in the dataset (n=8) are relatively late—overlapping the Protohistoric, early Historic, or late Historic periods. Of these samples with late dates, two maize cobs date to between A.D. 1680 and A.D. 1930, and charcoal from a possible lime kiln dated to the historic period as well (see Appendices 9 and 10 for the Radiocarbon reports and Appendix 12 for the maize cob analysis). Eight of the samples were derived from other thermal features, typically hearths, including five samples that fall within the Late Archaic period. These samples, along with radiocarbon dates from other projects form the foundation of a Big Bend National Park (BBNP) chronological database.

In addition to the radiocarbon dates, two obsidian samples were submitted for energy-dispersive X-ray fluorescence (Table 2). Both samples were collected from the same location within BIBE 2085, a very large prehistoric and historic open campsite occupying the first silt terrace adjacent to the Rio Grande floodplain with artifacts suggesting a predominance of Late Prehistoric occupation. Although found together, the results of the analysis indicate these two obsidian flakes originated from sources 756 km (470 mi) apart—one from the Jemez Mountains of northern New Mexico about 837 km (520 mi) northwest of BBNP and the other from Los Jagueyes, Chihuahua about 380 km (236 mi) due west of BBNP.

Ceramics collected during the project served as the foundation for the first ceramic analysis conducted in BBNP by David V. Hill (see Appendix 13). Summary descriptions of the analysis are also provided in the Survey Results chapter, parts II and III. Samples of corn cobs from two different sites also allowed a comparative description of corn cob morphology by J. Phil Dering utilizing a limited sample from the greater Big Bend region (see Appendix 12). This is the first step in developing a baseline for future studies that address regional and temporal variation of corn varieties in the early Historic period before the advent of modern farming and ranching in the region.

Appendix 8, Table 1 Radiocarbon Dates Procured During the Survey Project.

BIBE No.	Trinomial	Feature No.	Type	Sample No.	Conventional Radiocarbon Age	Calibrated Date A.D. (2-Sigma) - Probability Distribution (.95) as Reported	13C ratio (o/oo)	Sample Description	Bibliographic Reference
418	41BS0758	20	Soil humate	NA	1990±80 Before the Present (B.P.)	B.C. 197– A.D. 180; A.D. 185–214	NR	Soil humate sample from partially buried context.	1997 CBBS BBNP Status Report; The University of Texas Radiocarbon Dating Laboratory
999	Not Assigned	NR	Charcoal from thermal feature	TX-9011	1525±42 B.P.	A.D. 424 - 614	NR	Charcoal sample from hearth 1.4 mbs.	1997 CBBS BBNP Status Report; The University of Texas Radiocarbon Dating Laboratory
1030	Not Assigned	NR	Charcoal from thermal feature	TX-9012	1727±40 B.P.	A.D. 225 - 405	NR	Charcoal sample from hearth 1 meter below surface (mbs).	1997 CBBS BBNP Status Report; The University of Texas Radiocarbon Dating Laboratory
1032	Not Assigned	NR	Charcoal from thermal feature	TX-9251	1130±50 B.P.	A.D. 773 - 1011	NR	Charcoal sample from hearth 30-37 centimeters below surface (cmbs).	1998 CBBS BBNP Status Report; The University of Texas Radiocarbon Dating Laboratory
1232	41BS1165	NR	Charcoal from thermal feature	TX-9250	150±30 B.P.	A.D. 1770-1830	NR	Charcoal from large burned rock feature 1.8 m diameter	1998 CBBS BBNP Status Report; The University of Texas Radiocarbon Dating Laboratory
1841	41BS1767	4	Charcoal from thermal feature	Beta-281282	410±40 B.P.	A.D. 1430– 1520; A.D. 1580–1630	-24.1	Pavement hearth eroding from cutbank, 110 cmbs.	Tamers and Hood 2010
1859	41BS1785	6	Charcoal from thermal feature	PRI-10-95-1859-F6	285±20 B.P.	A.D. 1520-1600; A.D. 1610-1660	-21.5	Charcoal from fill of a robust, pavement-style hearth measuring 210 cm maximum diameter and containing over 100 limestone rocks that average 15–20 cm in size.	Puseman 2010
1891	41BS1817	2	Charcoal from thermal feature	Beta-281283	116 for 0±40 B.P.	A.D. 770 to 980	-24.2	Lens of FCR roughly 65 cmbs with charcoal and partially burnt wood.	Tamers and Hood 2010
1910	41BS1836	12	Corn cob from basin hearth	PRI-10-95-1910-F12	95±20 B.P.	A.D. 1690-1730; A.D. 1810-1930	-12.5	Charred Zea mays cob fragments representing an 18-rowed ear of corn from a small, basin-shaped hearth exposed in a cutbank that measures 13 cm in depth and 32 cm in diameter.	Puseman 2010
1910	41BS1836	14	Charcoal from thermal feature	PRI-10-95-1910-F14	110±20 B.P.	A.D. 1680-1740; A.D. 1800-1930	-23.4	Prosopis charcoal from fill of a thermal feature rectilinear in planview, measuring 52 cm max diameter, and containing entire intact branches. Exposed just below the terrace near historic debris.	Puseman 2010

1910	41BS1836	15	Historic lime kiln	PRI-10-95-1910-F15	115±20 B.P.	A.D. 1680-1740; A.D. 1800-1940	-22.8	Prosopis charcoal from the fill of a concentration of burned limestone pebbles intermixed with charcoal believed to represent a historic lime kiln. Feature measures 5.8 m max diameter.	Puseman 2010
1942	41BS1868	7	Corn cob from archeological deposit	PRI-10-95-1942-F7	85±20 B.P.	A.D. 1690-1730; A.D. 1810-1920	-10.8	One of the burned Zea mays cob fragments representing a 14-rowed ear of corn from a loose, discontinuous concentration of charcoal and charred corn cobs, with a small amount of burned daub, found eroding out of a slope along the edge of a silt terrace above the Rio Grande floodplain.	Puseman 2010
1942	41BS1868	20	Charcoal from thermal feature	PRI-10-95-1942-F20	1805±20 B.P.	A.D. 130-260; A.D. 300-320	-26.4	Charcoal from fill of feature consisting of a well-defined, circular, cobble-lined hearth measuring about 60 cm in diameter.	Puseman 2010

Appendix 8, Table 2 Obsidian Sourcing of Artifacts Collected During the Project.

BIBE No.	Trinomial	Artifact No.	Type	Specimen No.	Source	Lab Reference
2085	41BS1971	A4	Obsidian Flake	CBBS-14	Valles Rhy (Cerro Toledo) Jemez Mountains, NM	Dr. Steven Shackley Geoarchaeological XRF Laboratory Albuquerque, NM
2085	41BS1817	A4	Obsidian Flake	CBBS-15	Los Jagueyes NW Chihuahua, Mexico	Dr. Steven Shackley Geoarchaeological XRF Laboratory Albuquerque, NM

Appendix 9

Identification and AMS Radiocarbon Dating of Samples from Sites BIBE1859, BIBE1910, and BIBE1942 in Big Bend National Park, Texas

Kathryn Puseman
With Assistance from
Peter Ková…ik
PaleoResearch Institute
Golden, Colorado

PaleoResearch Institute Technical Report 10-95

Prepared For

Center for Big Bend Studies
Sul Ross State University
Alpine, Texas

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Introduction

Charcoal and charred corn cobs from sites BIBE 1859, BIBE 1910, and BIBE 1942 in Big Bend National Park, Texas, were submitted for identification and AMS radiocarbon dating. Site BIBE 1859 is a prehistoric open campsite, while sites BIBE 1910 and BIBE 1942 are prehistoric sites with historic components. AMS radiocarbon dates were obtained on four charcoal samples and two charred corn cobs.

Methods

Identification

Charcoal fragments were broken to expose fresh cross, radial, and tangential sections, then examined under a binocular microscope at a magnification of 70x and under a Nikon Optiphot 66 microscope at magnifications of 320–800x. The weights of each charcoal type also were recorded. Charcoal was identified using manuals (Carlquist 2001; Core, et al. 1976; Hoadley 1990; Panshin and de Zeeuw 1980; Petrides and Petrides 1992) and by comparison with modern and archaeological references. Corn cobs were examined under a binocular microscope at a magnification of 10x. The row number was determined by counting the number of cupule rows and multiplying by two. Because charcoal and charred corn cobs were to be submitted for radiocarbon dating, clean laboratory conditions were used during screening and identification to avoid contamination. All instruments were washed between samples, and samples were protected from contact with modern charcoal.

AMS Radiocarbon Dating–Charcoal and Wood

Charcoal and wood samples submitted for radiocarbon dating were identified and weighed prior to selecting subsamples for pre-treatment. The remainder of each subsample that proceeds to pre-treatment, if any, is permanently curated at PaleoResearch. The subsample selected for pre-treatment first was freeze-dried using a vacuum system, which freezes out all moisture at -107°C. Samples then were subjected to hot (at least 110°C), 6N hydrochloric acid (HCl), with rinses to neutral between each HCl treatment, until the supernatant was clear. This step removes iron compounds and calcium carbonates that hamper removal of humate compounds. Next, the samples were subjected to 5% potassium hydroxide (KOH) to remove humates. Once again, the samples were rinsed to neutral and re-acidified with pH 2 HCl between each KOH step. This step was repeated until the supernatant was clear, signaling removal of all humates. After humate removal, each sample was made slightly acidic. Charcoal samples (but not wood or other uncharred organic samples) then were subjected to a concentrated, hot nitric acid bath, which removes all modern and recent organics. This treatment is not used on unburned or partially burned samples because it oxidizes unburned material. Each sample again was freeze-dried, then combined with cupric oxide (CuO) and elemental silver (Ag^{O}) in a quartz tube and flame sealed under vacuum.

Standards and laboratory background wood samples were simultaneously treated to the same acid and base processing as the wood and charcoal samples of unknown age, with the exception that they were not subjected to the concentrated, hot nitric acid bath because it oxidizes unburned material. A radiocarbon "dead" EUA wood blank from Alaska that is more than 70,000 years old (currently beyond the detection capabilities of AMS) was used to calibrate the laboratory correction factor. Standards of known age, such as Two Creeks wood that dates to 11,400 RCYBP and others from the Third International Radiocarbon Intercomparison (TIRI), also were used to establish the laboratory correction factor. Each wood standard was run in a quantity similar to the submitted samples of unknown age and sealed in a quartz tube after the requisite pre-treatment. Once all the wood standards, blanks, and submitted samples of unknown age were prepared and sealed in their individual quartz tubes, they were combusted at 820°C, soaked for an extended period of time at that temperature, and then slowly allowed to cool to enable the chemical reaction that extracts carbon dioxide ($C0_2$) gas.

Following this last step, all samples of unknown age, the wood standards, and the laboratory backgrounds were sent to the Keck Carbon Cycle AMS Facility at the University of California, Irvine, where the $C0_2$ gas was processed into graphite. The graphite in these samples was then placed in the target and run through the accelerator, which produces the numbers that are converted into the radiocarbon date presented in the data section. Dates are presented as conventional radiocarbon ages, as well as calibrated ages using Intcalc04 curves on Oxcal version 3.10 (Bronk Ramsey 2005; Reimer et al. 2009). This is a probability-based method for determining conventional ages and is preferred over the intercept-based alternative because it provides a calibrated date that reflects the probability of its occurrence within a given distribution (reflected by the amplitude [height] of the curve), as opposed to individual point estimates. As a result, the probability-based method offers more stability to the calibrated values than those derived from intercept-based methods that are subject to adjustments in the calibration curve (Telford et al. 2004).

Radiocarbon Review

When interpreting radiocarbon dates from non-annuals such as trees and shrubs, it is important to understand that a radiocarbon date reflects the age of that portion of the tree/shrub when it stopped exchanging carbon with the atmosphere, not necessarily the date that the tree/shrub died or was burned. Trees and shrubs grow bigger each year from the cambium, where a new layer or ring of cells is added each year. During photosynthesis, new cells take in atmospheric carbon dioxide, which includes radiocarbon. The radiocarbon taken in will reflect the radiocarbon present in the atmosphere during that season of growth. Once the sapwood in a tree has been converted into heartwood, the metabolic process stops for that inner wood. Once this happens, no new carbon atoms are acquired, and the radiocarbon that is present starts to decay. Studies have shown that there is little to no movement of carbon-bearing material from one ring to another. As a result, wood from different parts of the tree will yield different radiocarbon dates. The outer rings exhibit an age close to the cutting or death date of the tree, while the inner rings will reflect the age of the tree. Because the younger, outer rings burn off first when a log or branch is burned, it is the older, inner rings that typically are what is left remaining in a charcoal assemblage (Puseman 2009; Taylor 1987).

Discussion

Sites BIBE 1859, BIBE 1910, and BIBE 1942 are located just north of the Rio Grande River and west of Mariscal Mountain in Big Bend National Park, Texas. Local vegetation in this area is sparse and includes mesquite (*Prosopis*), creosotebush (*Larrea tridentata*), condalia (*Condalia*), cactus including prickly pear (*Opuntia*) and pitaya (*Echinocereus enneacanthus*), and sparse annual forbs. A total of four charcoal samples and two charred corn cobs were submitted for identification and AMS radiocarbon dating.

BIBE1859

Site BIBE 1859 is an eroded open campsite located on a dissected, denuded silt terrace remnant above the Rio Grande floodplain. This site contains unusually large, robust hearths made from limestone cobbles measuring 15–35 cm in maximum diameter. These cobbles are found in clusters measuring 3–5 meters in diameter. Two corner-notched projectile points are believed to represent a Late Archaic occupation.

Feature 6 is a robust, pavement-style hearth measuring 210 cm north-south by 180 cm east-west and containing over 100 limestone rocks that average 15–20 cm in size. Sample 1 represents charcoal from the fill of Feature 6 (Table 1). This sample consists of Prosopis, indicating that local mesquite wood was burned as fuel (Table 2, Table 3). A portion of Prosopis charcoal was submitted for AMS radiocarbon dating, resulting in a date of 285±20 RCYBP (PRI-10-95-1859-F6). At the two-sigma level, this date calibrates to an age range of 430–350

CAL yr. B.P. (56.3%) and 340–290 (39.1%) CAL yr. B.P. (Table 4, Figure 1) or A.D. 1520–1600 (56.3%) and A.D. 1610–1660 (39.1%) (Figure 2). This date suggests occupation late in the Late Prehistoric period.

BIBE1910

Site BIBE 1910 is situated along the terminal edge of the second silt terrace above the Rio Grande floodplain. The site consists of a large prehistoric open campsite with an historic homestead and a U.S. military component. Samples were submitted from three features.

Feature 12

Feature 12 is a small, basin-shaped hearth exposed in a cutbank that measures 13 cm in depth and 32 cm in diameter. The feature contained a piece of fire-cracked rock, abundant charcoal, and charred corn (*Zea mays*) cobs. Sample 2 consists of one of the charred *Zea mays* cob fragments. This cob represents an 18-rowed ear of corn. It yielded an AMS radiocarbon date of 95±20 RCYBP (PRI-10-95-1910-F12), with a two-sigma calibrated age range of 260–220 (26.7%) and 140–20 (68.7%) CAL yr. B.P. (Figure 3) or A.D. 1690–1730 (26.7%) and A.D. 1810–1930 (68.7%) (Figure 4). This charred *Zea mays* cob appears to be associated with the historic occupation of the site.

Feature 14

Charcoal sample 3 was collected from the fill of Feature 14, a thermal feature containing charcoal with entire intact branches exposed along the top of a small bench just below the terrace near historic debris. An oxidized layer of sediment surrounded the outer edge. This feature was rectilinear in plan view and measured 52 cm north-south by 42 cm east–west. Sample 3 contained *Prosopis* charcoal, again representing mesquite wood that was burned. A radiocarbon date of 110±20 RCYBP (PRI-10-95-1910-F14) was returned for the *Prosopis* charcoal, which calibrates to an age range of 270–210 (27.4%) and 150–20 (68%) CAL yr. B.P. (Figure 5) or A.D. 1680–1740 (27.4%) and A.D. 1800–1930 (68%) (Figure 6), suggesting that this feature is associated with the historic occupation (Figure 3).

Feature 15

Feature 15 is a concentration of burned limestone pebbles intermixed with charcoal believed to represent a historic lime kiln. This feature measures 4.5 meters east-west and 5.8 meters north–south. Charcoal sample 4 consists of *Prosopis* charcoal from the fill of Feature 15, reflecting use of mesquite wood as fuel in the kiln. This charcoal yielded a date of 115±20 RCYBP (PRI-10-95-1910-F15) and a two-sigma calibrated age range of 270–210 (27.7%) CAL yr. B.P. and 150–10 (67.7%) CAL yr. B.P. (Figure 7) or A.D. 1680–1740 (27.7%) and A.D. 1800–1940 (67.7%) (Figure 8), reflecting the historic occupation.

BIBE1942

Site BIBE 1942 is a large prehistoric open campsite consisting of thermal and/or midden deposits containing projectile points and point fragments dating from the Middle Archaic to the Late Prehistoric. The prehistoric component is overlaid by an early historic homestead/community consisting of at least 12 structural remains made primarily of adobe and jacal that are believed to have been utilized from the late 19th Century to about the 1930s.

Feature 7

Feature 7 is a loose, discontinuous concentration of charcoal and charred corn cobs, with a small amount of burned daub, found eroding out of a slope along the edge of a silt terrace above the Rio Grande floodplain. Sample 5 is one of the burned Zea mays cob fragments. This sample represents a 14-rowed ear of corn that yielded an AMS radiocarbon date of 85±20 RCYBP (PRI-10-95-1942-F7). At the two-sigma level, this date calibrates to an age range of 260–220 (26%) CAL yr. B.P. and 140–30 (69.4%) CAL yr. B.P. (Figure 9) or A.D. 1690–1730 (26%) and A.D. 1810–1920 (69.4%) (Figure 10) and reflects the historic occupation of the site.

Feature 20

Feature 20 consists of a well-defined, circular, cobble-lined hearth measuring about 60 cm in diameter. Many of the cobbles were thermally-altered. Charcoal sample 6 was taken from fill of Feature 20 and consists of Prosopis charcoal, again reflecting use of mesquite wood as fuel. This charcoal yielded a radiocarbon date of 1805±20 RCYBP (PRI-10-95-1942-F20), with a two-sigma calibrated age range of 1820–1690 (93.2%) CAL yr. B.P. and 1650–1630 (2.2%) CAL yr. B.P. (Figure 11) or A.D. 130–260 (93.2%) and A.D. 300–320 (2.2%) (Figure 12). This date reflects a Late Archaic occupation of the area.

Summary and Conclusions

Identification of charcoal from features at sites BIBE 1859, BIBE 1910, and BIBE 1942 in Big Bend National Park, Texas, indicate that the various occupants of these sites utilized local mesquite wood as fuel. A date of 1805±20 B.P. from Feature 20 at BIBE 1942, a date of 285±20 B.P. from Feature 6 at BIBE 1859, and dates of 110±20 B.P. and 115±20 B.P. for Features 14 and 15 at BIBE 1910 reflect Late Archaic, Late Prehistoric, and Historic occupations of the area (Figures 13 and 14). Mesquite appears to have been a common component of the landscape throughout the time periods represented. Charred corn cob fragments from sites BIBE 1910 and BIBE 1942 yielded dates of 95±20 B.P. and 85±20 B.P., respectively, indicating that this resource was utilized by the historic occupants of the area.

Appendix 9, Table 1 Provenience Data for Samples from Sites BIBE1859, BIBE1910, and BIBE1942 in Big Bend National Park, Texas.

Site No.	Sample No.	Feature No.	SampleDescription	Analysis
BIBE 1859	1	6	Charcoal from fill of robust, pavement-style hearth	Charcoal ID, AMS 14C Date
BIBE 1910	2	12	Charred corn cob from fill of small, basin- shaped hearth exposed in a cutbank	AMS 14C Date
	3	14	Charcoal from fill of rectilinear thermal feature	Charcoal ID, AMS 14C Date
	4	15	Charcoal from fill of possible historic lime kiln	Charcoal ID, AMS 14C Date
BIBE 1942	5	7	Charred corn cob from loose concentration of charcoal, charred corncobs, and burned daub	AMS 14C Date
	6	20	Charcoal from fill of circular, cobble-lined hearth	Charcoal ID, AMS 14C Date

Appendix 9, Table 2 Macrofloral Remains from Sites BIBE1859, BIBE1910, and BIBE1942 in Big Bend National Park, Texas.

Sample No.	Identification	Part	Charred		Uncharred		Weights/ Comments
			W	F	W	F	
		Site BIBE 1859					
1 Feature 6	**Charcoal/Wood:**						
	Prosopis**	Charcoal		1			0.758 g
		Site BIBE 1910					
2 Feature 12	**Floral Remains:**						
	Zea mays - 18-row**	Cob		1			0.997 g
3 Feature 14	**Charcoal/Wood:**						
	Prosopis**	Charcoal		1			0.631 g
4 Feature 15	**Charcoal/Wood:**						
	Prosopis**	Charcoal		2			1.172 g
		Site BIBE 1942					
5 Feature 7	**Floral Remains:**						
	Zea mays - 14-row**	Cob		1			0.928 g
6 Feature 20	**Charcoal/Wood:**						
	Prosopis**	Charcoal		15			0.605 g

**= Submitted for AMS Radiocarbon Dating F = Fragment g = grams W = Whole

Appendix 9, Table 3 Index of Macrofloral Remains Recovered from Sites BIBE1859, BIBE1910, and BIBE1942 in Big Bend National Park, Texas.

Scientific Name	Common Name
Cultigens:	
Zea mays	Maize, Corn
Charcoal/Wood:	
Prosopis	Mesquite

Appendix 9, Table 4 Radiocarbon Results for Samples from Sites BIBE1859, BIBE1910, and BIBE1942 in Big Bend National Park, Texas.

Sample No.	Sample Identification	AMS ^{14}C Date*	1-sigma Calibrated Date (68.2%)	2-sigma Calibrated Date (95.4%)	*^{13}C** (°/) oo
PRI-10-95-1859-F6	*Prosopis* charcoal	285±20 RCYBP	430–390; 320–300 CAL yr. B.P. A.D. 1520–1560; A.D.1630–1650	430–350; 340–290 CAL yr. B.P. A.D. 1520–1600; A.D. 1610–1660	-21.5
PRI-10-95-1910-F12	*Zea mays* cob - charred	95±20 RCYBP	260–220; 140–110; 80–30 CAL yr. B.P. A.D. 1690–1730; A.D. 1810–1840; A.D. 1870–1920	260–220; 140–20 CAL yr. B.P. A.D. 1690–1730; A.D. 1810–1930	-12.5
PRI-10-95-1910-F14	*Prosopis* charcoal	110±20 RCYBP	260–220; 140–60; 50–30 CAL yr. B.P. A.D. 1690–1730; A.D. 1810–1890; A.D. 1900–1920	270–210; 150–20 CAL yr. B.P. A.D. 1680–1740; A.D. 1800–1930	-23.4

Appendix 9, Table 4 Radiocarbon Results for Samples from Sites BIBE1859, BIBE1910, and BIBE1942 in Big Bend National Park, Texas. *(continued)*

Sample No.	Sample Identification	AMS ^{14}C Date*	1-sigma Calibrated Date (68.2%)	2-sigma Calibrated Date (95.4%)	*^{13}C** (°/) oo
PRI-10-95-1910-F15	*Prosopis* charcoal	115±20 RCYBP	260–220; 140–160; 40–20 CAL yr. B.P. A.D. 1690–1730; A.D. 1810–1890; A.D. 1910–1930	270–210; 150–10 CAL yr. B.P. A.D. 1680–1740; A.D. 1800–1940	-22.8
PRI-10-95-1942-F7	*Zea mays* cob - charred	85±20 RCYBP	260–230; 140–110;80–30 CAL yr. B.P. A.D. 1690–1720; A.D. 1810–1840; A.D. 1870–1920	260–220; 140–30 CAL yr. B.P. A.D. 1690–1730; A.D. 1810–1920	-10.8
PRI-10-95-1942-F20	Prosopis charcoal	1805±20 RCYBP	1820–1700 CAL yr. B.P. A.D. 130–250	1820–1690; 1650–1630 CAL yr. B.P. A.D. 130–260; A.D. 300–320	-26.4

* Reported in radiocarbon years at 1 standard deviation measurement precision (68.2%), corrected for *^{13}C

^{13}C values are measured by AMS during the ^{14}C measurement. The AMS-^{13}C values are used for the ^{14}C calculation and should not be used for dietary or paleoenvironmental interpretations.

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Appendix 10

Additional Project Radiocarbon Data

This appendix contains the radiocarbon reports from Beta Analytic Inc. (Tamers and Hood 2010) for BIBE1841 and BIBE1891 as well as excerpts from the 1997 and 1998 Status Reports containing the results of The University of Texas Radiocarbon Dating Laboratory for BIBE418, BIBE1030, BIBE999, BIBE1032, and BIBE1232 since the original laboratory reports were not relocated.

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REPORT OF RADIOCARBON DATING ANALYSES

Mr. David Keller — Report Date: 7/20/2010

Sul Ross State University — Material Received: 6/29/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 281282	390 +/- 40 BP	-24.1 o/oo	410 +/- 40 BP

SAMPLE : BBNP1841F4
ANALYSIS : Radiometric-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1430 to 1520 (Cal BP 520 to 430) AND Cal AD 1580 to 1630 (Cal BP 370 to 320)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 281283	1150 +/- 40 BP	-24.2 o/oo	1160 +/- 40 BP

SAMPLE : BBNP1891F2
ANALYSIS : Radiometric-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 770 to 980 (Cal BP 1180 to 970)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

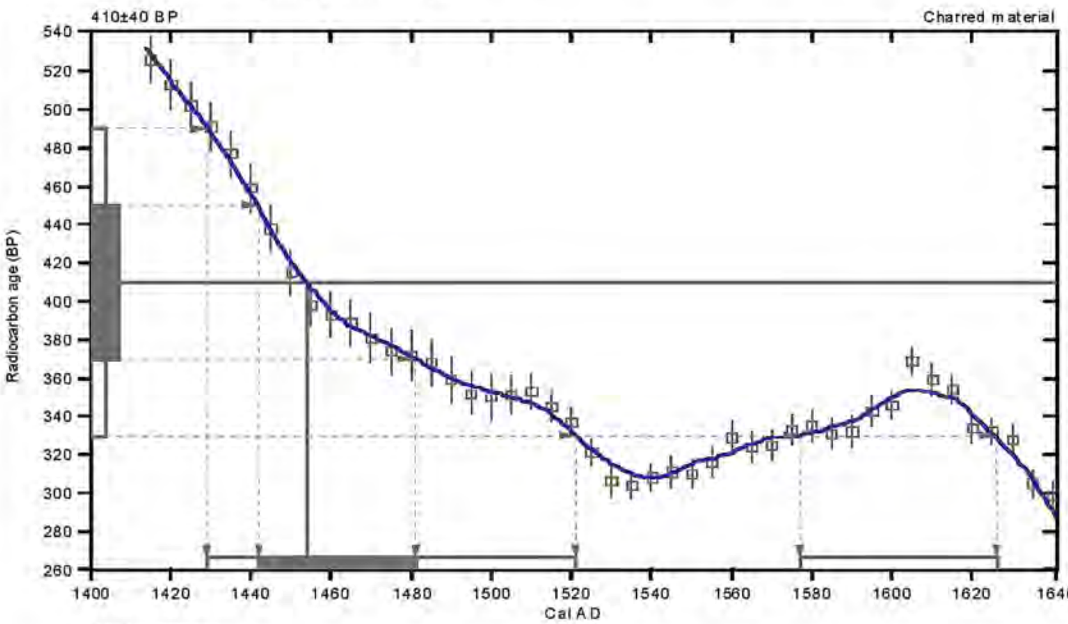
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.1:lab. mult=1)

Laboratory number:	**Beta-281282**
Conventional radiocarbon age:	**410±40 BP**
2 Sigma calibrated results: (95% probability)	**Cal AD 1430 to 1520 (Cal BP 520 to 430) and Cal AD 1580 to 1630 (Cal BP 370 to 320)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 1450 (Cal BP 500)
1 Sigma calibrated result: (68% probability)	Cal AD 1440 to 1480 (Cal BP 510 to 470)



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Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.2:lab. mult=1)

Laboratory number: Beta-281283

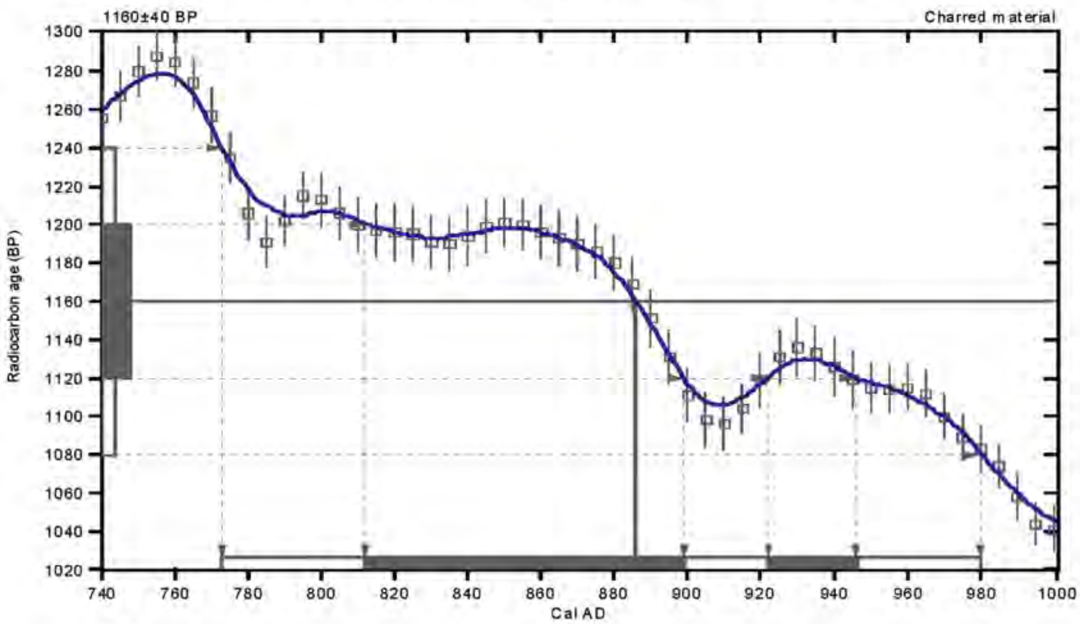
Conventional radiocarbon age: 1160±40 BP

2 Sigma calibrated result: Cal AD 770 to 980 (Cal BP 1180 to 970)
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 890 (Cal BP 1060)

1 Sigma calibrated results: Cal AD 810 to 900 (Cal BP 1140 to 1050) and
(68% probability) Cal AD 920 to 950 (Cal BP 1030 to 1000)



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A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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The University of Texas Radiocarbon Laboratory Data Reporting

Excerpt from 1997 Status Report

Nine of the soil humate and charcoal samples have been submitted to the Radiocarbon Laboratory at the University of Texas at Austin for analysis, and to date, 3 of these samples have been analyzed. The only date secured thus far from surveyed areas is from site BIBE-418 (41 BS758), located in Control Quadrat A. A soil humate sample from a slightly buried context at this dune site yielded a corrected date of 1990±80 B.P. (Stuiver and Pearson 1993). Another sample was secured from site BIBE-1030 just east of Control Quadrat B along Tornillo Creek. This charcoal sample, obtained from a hearth ca. 1 m helow the surface, yielded a corrected date of 1727±40 B.P. (Stuiver and Pearson 1993). The last sample was obtained from site BIBE-999 on an alluvial terrace of the Rio Grande. This charcoal sample, collected from a hearth buried ca. 1.4 m below the surface, yielded a corrected date of 1525±42 B.P. (Stuiver and Pearson 1993). As might have been expected, these features yielded dates from the Late Archaic period, a time that is well represented in archeological assemblages of the Big Bend. The 6 pending samples will provide further chronological data on terrace formations and human use of the Tornillo Creek drainage system in Control Quadrat B.

Excerpt from 1998 Status Report

Dates from 2 sites have been received from the Radiocarbon Laboratory at the University of Texas at Austin since the last status report. One of these sites (Turkey Hen Site) is located along Tornillo Creek just outside the eastern boundary of Control Block B. The charcoal sample from this site, collected from a hearth buried from 30-37 cm (11.8-14.6 in) below the surface, yielded a corrected date of 1130+50 B.P. (Struiver and Pearson 1993). The other site, 41BS1165 (Leaf Cutter Site), is located in Control Block B along a tributary arroyo of Tornillo Creek. Charcoal from a large hearth on the surface of this site yielded a corrected date of 150+30 B.P. (Struiver and Pearson 1993). The buried hearth from the Turkey Hen Site dates to the approximate transition between the Late Archaic and Late Prehistoric periods. This date increases our understanding of terrace formations and human use along Tornillo Creek. The large (ca. 1.8 x 1.8 m/5.9 x 5.9 ft in diameter) surficial hearth from the Leaf Cutter Site dates to the Historic period and this marks the first time that this distinctive feature type has been dated.

The additional soil humate and charcoal samples collected this spring were obtained from several buried hearths at site 41BS1220 (Squawking Raven Site) in Control Block B and from 2 surficial hearths at 2 separate sites (site 41BS1323/Sea of Tranquility Site and site 41BS1325/Basin Outfall Site) in Control Block C. The samples from the Squawking Raven Site should provide further chronological data on terrace formation and human use of the Tornillo Creek drainage system in Control Block B. The samples from Control Block C will help establish when aboriginals used the basin in the southwest corner of the quadrat.

Appendix 11

Non-Project Radiocarbon Data–National Park Service Projects

Since the National Park Service (NPS) hired its first archeologist at Big Bend National Park in 1983, several projects have resulted in radiometric dating of cultural materials, including documentation prior to construction and development and one project associated with the recovery of human remains. A total of 29 radiometric and accelerator mass spectrometry (AMS) dates were secured from 3 different radiocarbon laboratories (Beta Analytic Inc., The University of Texas at Austin, and PaleoResearch Institute) during these projects. These data are provided in Table 1.

Of particular note is the time range of a set of seven dates associated with data recovery on a stratified campsite in the Chisos Basin at site BIBE908 (41BS908), the J. Charles Kelley site. Dates range from A.D. 1640–1950 near the ground surface to 8030–7730 B.C. at a depth of about 1.4 m below ground surface. This latter date represented the earliest date associated with humans in the region at the time of the analysis (Alex 1999).

Eleven radiocarbon dates from site BIBE878 (41BS611) are associated with the construction of additional operations infrastructure at Panther Junction. The site originally contained more than 30 thermal features consisting of hearths, fire-cracked rock (FCR) scatters, and one midden. One surficial pavement hearth investigated in 1998 yielded a Protohistoric/Historic date. A subsequent data recovery project contracted to Four Corners Research, Inc. excavated 21 features and yielded 10 radiocarbon dates, most of which fall rather late, between A.D. 1420 and A.D. 1950 although one date falls between A.D. 780 and A.D. 1000 (Greenwald 2010).

Five radiocarbon dates are associated with a burned rock midden at site BIBE2240, the Gnarly Root site, located in the Chisos Basin. A single 1 x 1 m test unit was placed into the midden and excavated to a depth of about 70 cm below ground surface where a calcareous zone marked the contact of the midden with culturally sterile sediment. The range of dates indicate that the midden matrix is stratigraphically mixed but the age for this Late Prehistoric site falls within a range between A.D. 1010 and A.D. 1280, which correlates with the two arrow point fragments recovered during excavation.

The remaining 6 radiocarbon dates are from four different sites. All but one lack a calibrated date and will be reported here using IntCal 20 (Reimer et al. 2020). An A.D. 1395 to A.D. 1638 date was returned for charcoal in association with the Rough Run Burial at BIBE80 (41BS844) (Cloud 2002). In addition, three dates were returned from a single thermal feature at

BIBE371 (41BS188) where charcoal in association with Toyah arrowpoints was collected from an endangered hearth. The dates ranged from A.D. 1050 to A.D. 1415 although two of the dates were nearly identical and ranged from A.D. 1270 to A.D. 1415. At BIBE381 (41BS861), charcoal was collected from a pavement hearth below a rockshelter that returned a date range of A.D. 1362 to A.D. 1623. Finally, a charcoal sample was collected from a thermal feature in another rockshelter at BIBE481 that returned a reported calibrated date of A.D. 1260 to A.D. 1300 (Puseman 2013).

Appendix 11, Table 1 Radiocarbon Data from NPS Projects.

BIBE Number	Feature or TU Number	Sample Type	Laboratory and Sample Number	Conventional Radiocarbon Age	Calibrated Date A.D. / B.C. (2-Sigma)–Probability Distribution (.95) *as Reported*	13C Ratio (o/oo)	Context	Bibliographic Reference
80	1	Charcoal from burial association	Beta-56189; CAMS-3829	440±70 B.P.	Not Reported	NR	Small charcoal fragments recovered in association with burial.	Beta Analytic Inc. 1992 Report of Radiocarbon Dating Analysis 10.20.1992; CS#7
371	14	Charcoal from hearth	Beta-46208	790±60 B.P.	Not Reported	-25	Basin-shaped hearth at ground surface. Large sample retrieved was split and run as three separate samples.	Beta Analytic Inc. 1991 Report of Radiocarbon Dating Analysis 8.14.1991; PRA–BIBE 15–538(2) Split #1
371	14	Charcoal from hearth	Beta-46209	650±60 B.P.	Not Reported	-25.5	Basin-shaped hearth at ground surface. Large sample retrieved was split and run as three separate samples.	Beta Analytic Inc. 1991 Report of Radiocarbon Dating Analysis 8.14.1991; PRA–BIBE 15–538(2) Split #2
371	14	Charcoal from hearth	Beta-46210	630±60 B.P.	Not Reported	-24.3	Basin-shaped hearth at ground surface. Large sample retrieved was split and run as three separate samples.	Beta Analytic Inc. 1991 Report of Radiocarbon Dating Analysis 8.14.1991; PRA–BIBE 15–538(2) Split #3
381	5	Charcoal from hearth	UT Austin 711.4 Run # II-109	480±60 B.P.	Not Reported	-23.4	Stone-paved hearth, circular, pavement style.	University of Texas at Austin Radiocarbon Laboratory results 12.3.1990; PRA–BIBE 15–537
481	1	Charcoal from midden	PRI-13-045-F1.01	712±21 RCYBP	Cal A.D. 1260–1300	-11.67	Cylindropuntia charcoal sample from center of F1 Ring Midden. Cylindropuntia was selected over hardwoods due to shorter lifespan of from 20-50 years.	PaleoResearch Institute. 2013, Identification and AMS Radiocarbon Dating of Charcoal From Site BIBE00481, Big Bend National Park, Texas
878	16	Charcoal from pavement hearth	Beta-118308	170±50 B.P.	A.D. 1650–1950	-23.6	Hearth with in situ imbedded carbon fragments recovered from the floor of the feature at <10cm below ground surface.	Beta Analytic Inc. 1998 Report of Radiocarbon Dating Analysis 6.18.1998; 611–1640
878	1	Charred material from hearth	Beta-278101	360±40 B.P.	Cal A.D. 1440–1640	-25	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F1
878	2	Charred material from hearth	Beta-278102	320±40 B.P.	Cal A.D. 1460–1660	-23.7	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F2
878	3	Charred material from hearth	Beta-278103	350±40 B.P.	Cal A.D. 1450–1650	-23.2	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F3
878	5	Charred material from hearth	Beta-278104	310±40 B.P.	Cal A.D. 1460–1660	-24	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F5

Appendix 11, Table 1 Radiocarbon Data from NPS Projects. *(continued)*

BIBE Number	Feature or TU Number	Sample Type	Laboratory and Sample Number	Conventional Radiocarbon Age	Calibrated Date A.D. / B.C. (2-Sigma)–Probability Distribution (.95) *as Reported*	13C Ratio (o/oo)	Context	Bibliographic Reference
878	13A	Charred material from hearth	Beta-278105	260±40 B.P.	Cal A.D. 1520–1590 and cal A.D. 1620–1670 and cal A.D. 1770–1800 and cal A.D. 1940–1950	-24.8	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F13A
878	17	Charred material from hearth	Beta-278106	310±40 B.P.	Cal A.D. 1460–1660	-23.6	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F17
878	18	Charred material from hearth	Beta-278107	330±40 B.P.	Cal A.D. 1450–1650	-22.8	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F18
878	20	Charred material from hearth	Beta-2781-8	250±40 B.P.	Cal A.D. 1520–1580 and cal A.D. 1630–1680 and cal A.D. 1770–1800 and cal A.D. 1940–1950	-25.4	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F20
878	21	Charred material from hearth	Beta-278109	430±40 B.P.	Cal A.D. 1420–1500 and cal A.D. 1600–1610	-27.5	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F21
878	31A	Charred material from hearth	Beta-278110	1130 ±40 B.P.	Cal A.D. 780–1000	-22.3	Mostly charcoal fragments recovered during excavation of hearth.	Beta Analytic Inc. 2010 Report of Radiocarbon Dating Analysis 4.26.2010; 41BS611–F31A
908	1	Charred material from hearth	Beta-70859; CAMS-12212	8890±90 B.P.	Cal B.C. 8080–7700	-26.2	F1 was located in the bottom of a drainage pipe ditch at approximately the same stratigraphic depth as F8.Charcoal collected from central core in the lower matrix.	Beta Analytic Inc. 1998 Report of Radiocarbon Dating Analysis 3.23.1994; 908–785
908	2	Charcoal from hearth	Beta-70860	350±50 B.P.	A.D. 1440–1660	-26.4	Stone paved hearth; charcoal collected from central core in the lower matrix.	Beta Analytic Inc. 1998 Report of Radiocarbon Dating Analysis 3.23.1994; 908–795
908	4	Charcoal from hearth	Beta-70862	4990±60 B.P.	Cal B.C. 3950–3660	-25.4	Stone paved hearth; charcoal collected from central core in the lower matrix.	Beta Analytic Inc. 1998 Report of Radiocarbon Dating Analysis 3.23.1994; 908–800
908	5	Charcoal from hearth	Beta-70863	160±70 B.P.	Cal A.D. 1640–1950	-25.7	Stone paved hearth; charcoal collected from central core in the lower matrix.	Beta Analytic Inc. 1998 Report of Radiocarbon Dating Analysis 3.23.1994; 908–801
908	3	Charred material from hearth	Beta-70861;CAMS-12213	6120±60 B.P.	Cal B.C. 5220–4910	-22.6	Stone paved hearth; charcoal collected from outer perimeter in the lower matrix. 3x3m unit, Level 5.	Beta Analytic Inc. 1998 Report of Radiocarbon Dating Analysis 3.23.1994; 908–799

908	6	Charred material from hearth	Beta-79864; CAMS-12214	1040±50 B.P.	Cal A.D. 900–1050 and Cal A.D. 1100–1110	-22.9	Stone paved hearth; charcoal collected from central core in the lower matrix. 3x3m unit, Level 3.	Beta Analytic Inc. 1998 Report of Radiocarbon Dating Analysis 3.23.1994; 908–803
908	8	Charred material from hearth	Beta-70865; CAMS-12215	8880±50 B.P.	Cal B.C. 8030–7730	-25.5	Stone paved hearth; charcoal collected from central core in the lower matrix. 3x3m unit, Level 14.	Beta Analytic Inc. 1998 Report of Radiocarbon Dating Analysis 3.23.1994; 908–804
2240	TU1	Charred material from midden	Beta-253357	840±40 B.P.	Cal A.D. 1060–1080 and A.D. 1150–1270	-23.8	Mostly charcoal fragments recovered during excavation in Test Unit 1, Level 2 from midden with mixed stratification.	Beta Analytic Inc. 2009 Report of Radiocarbon Dating Analysis 1.13.2009; BIBE2240–1784
2240	TU1	Charred material from midden	Beta-253358	830±40 B.P.	Cal A.D. 1160–1270	-23	Mostly charcoal fragments recovered during excavation in Test Unit 1, Level 3 from midden with mixed stratification.	Beta Analytic Inc. 2009 Report of Radiocarbon Dating Analysis 1.13.2009; BIBE2240–1785
2240	TU1	Charred material from midden	Beta-253359	960±40 B.P.	Cal A.D. 1010–1170	-25	Mostly charcoal fragments recovered during excavation in Test Unit 1, Level 4 from midden with mixed stratification.	Beta Analytic Inc. 2009 Report of Radiocarbon Dating Analysis 1.13.2009; BIBE2240–1791
2240	TU1	Charred material from midden	Beta-253360	810±40 B.P.	Cal A.D. 1160–1280	-23.8	Mostly charcoal fragments recovered during excavation in Test Unit 1, Level 5 from midden with mixed stratification.	Beta Analytic Inc. 2009 Report of Radiocarbon Dating Analysis 1.13.2009; BIBE2240–1792
2240	TU1	Charred material from midden	Beta-253361	800±40 B.P.	Cal A.D. 1170–1280	-21.3	Mostly charcoal fragments recovered during excavation in Test Unit 1, Level 6 from midden with mixed stratification.	Beta Analytic Inc. 2009 Report of Radiocarbon Dating Analysis 1.13.2009; BIBE2240–1793

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Appendix 12

Maize Cob Fragments from Archeological Sites in the Big Bend

J. Phil Dering

Introduction and Methods

This study provides measurements from 10 maize cob samples recovered from archeological sites in the Big Bend region of Texas. These measurements may be utilized for two main purposes. This first is to determine if the measurements fall within the range of prehistoric or early historic maize, and the second is to provide comparative data for future studies. Most of these cob fragments came from the Fulcher site (41BS1495) located along Terlingua Creek about 5 km west of Big Bend National Park (BBNP). None of the specimens had kernels remaining on the cob.

The cob fragments were examined using an 8-45 X stereo zoom microscope. Measurements were recorded to the nearest 0.1 mm using electronic readout calipers. I did not adjust the measurements to account for changes in size caused by charring.

Four or five characters are repeatedly utilized for the comparison of maize cobs. These are row number, cupule width and length, cupule depth, and kernel thickness. Other characteristics are useful for comparing specimens, but apparently aren't very diagnostic for identifying races of maize. These include pith, rachis, and cob diameter. Cupules and kernels are the cob fragments most commonly encountered in archeological contexts, and the measurements most often recorded are row number, cupule width, cupule length, cupule thickness, and kernel thickness (Diehl 2005; Wagner 1986).

Therefore, the recorded observations and measurements in the current study include cob row number, cupule width, cupule length, and cupule depth. Also included for some specimens are cob diameter, cob fragment length, and pith diameter. Measurements were taken as described by Bird (1994), as allowed by the condition of each specimen. No measurements were taken from tapered, distal ends as the cupules in that part of a cob are much smaller and not representative of the cob as a whole.

Cob diameter measures the size of the entire cob perpendicular to its long axis. Although the cobs in the current study were not whole, cob length is provided to give an idea of the specimen size. Row number refers to the number of kernels arranged around the circumference of the cob. In the current study the cobs are straight-rowed, and all row numbers are even. Row number is determined by counting the number of cupules around the circumference of a medial section of the cob, and multiplying by two.

The cupule is a depression on the surface of the corn cob that holds two kernels side-by-side. Cupules often separate from the rachis, or shaft, and when separated they have boat-shaped appearances. Three measurements of the cupule can be utilized to compare maize attributes, cupule width, cupule length, and cupule depth. Cupule width is a measurement of the cupule along the axis that is tangential to the long axis of the cob. This is usually the longest measurement of the cupule. Cupule length is the measurement of the cupule along the long axis of the cob, that is, from the proximal end to the distal end. This is usually a smaller figure than cupule width. Cupule depth is a measurement from the point that the hard base of the cupule attaches to the inner pith of the maize cob, to its upper (or outer) edge (Adams 1994; Bird 1994; Nickerson 1953; Wagner 1986).

Results

Results of the measurements are provided in Table 1. All of the specimens are cob fragments from which the kernels have been removed, so each specimen does not comprise an entire cob from the proximal to the distal points. Most of the specimens are medial fragments, but one comprises the proximal end of a cob. One sample, BS-3, consists of three refitted fragments and row number is estimated.

The single cob from BIBE1910 in BBNP is the most complete of the specimens. It consists of a proximal cob section with glumes and pedicels in most of the cupules, but with no remaining kernels. It is a 12-row specimen with an average cupule width of 6.11 mm. The cob pith measured 8.2 mm in diameter and overall cob diameter is 20.5 mm. This is a fairly large cob, certainly larger than the other two specimens from BBNP.

Two cobs from BIBE1942 are composed of multiple fragments. Specimen BS-3 has an intact medial fragment from which pith and overall diameter could be determined, along with three rachis fragments consisting of vertical rows of cupules. It is a 14-row medial cob fragment with a pith diameter of 6.0 mm and an overall diameter of 14.3 mm. The cupules average 3.76 mm wide and 1.83 mm long. The cob has several remaining lower glumes that measured an average width of 2.6 mm.

Appendix 12, Table 1 Measurements of Maize Cob Fragments from the Big Bend Region.

Site	Sample	Row #	Average Cupule Length (mm)	Average Cupule Width (mm)	Average Cupule Depth (mm)	Cob Diameter (mm)	Cob Fragment Length* (mm)
Fulcher	A	14	1.3	5.15	1.8	18.0	29
Fulcher	B	14	1.1	5.15	2.0	17.1	34
Fulcher	C	18	0.8	2.0	1.5	10.6	28
Fulcher	D	14	0.6	5.5	--	14.0	21
Fulcher	E	14	1.7	5.6	--	13.0	30
Fulcher	F	14	1.75	4.7	--	15.0	28
Fulcher	G	18	1.6	3.2	--	14.0	22
BIBE1910	BS-1	12	1.32	6.11	1.74	20.5	--
BIBE1942	BS-3	14	1.83	3.76	1.68	14.3	--
BIBE1942	BS-4	14 or 16	1.0	5.14	1.73	--	--
Average		14.67	1.30	4.63	1.74	--	--

* Cob fragment length is approximate to nearest mm.

BS-4 from BIBE1942 is actually three cob fragments consisting of vertical rows of cupules that can be refitted to form a specimen with which row count, pith diameter, and overall diameter can be estimated. It is considerably larger than its counterpart from the same site (BS-3). As noted in the table, these are estimates. BS-4 is either a 14 or 16 row cob, with an average cupule width of 5.14 mm and a cupule length of 1.0 mm. Pith diameter is about 5 mm.

Seven specimens from the Fulcher site were measured in a previous study. These are labeled specimens A–G. Where the condition of each specimen made measurements possible, row number, cupule width, cupule length, and cupule depth are provided.

Discussion

The inferences that can be drawn from morphometric studies of maize in the greater Southwest is a hotly debated topic. We certainly cannot determine maize variety from a few charred cob fragments, cupules, or kernels and as a result, studies of prehistoric races of maize have been conducted on entire, mostly uncharred remains recovered from caves and sheltered pueblo contexts (e.g., Adams 1994). However, there are some trends in the archeological record that have been noticed, and these trends may be tied into maize productivity. Varieties with larger kernels either were introduced or developed (or both) in the region during the middle of the first millennium (Upham et al. 1989). Diehl (2005) and others have demonstrated that this trend toward larger kernel size continued into the Late Prehistoric period. The larger kernel size is manifested in wider and longer cupules, and it is apparent that cupule width increased through time regardless of the row number of the cob (Adams 1994; Diehl 2005). Cob size has also increased through time. There is, however, a need to measure large samples because cob size and the metrics of the individual parts of a cob are affected by both local field conditions (such as soil moisture) and by general climatic conditions, insect pests, and other environmental factors. A large sample tends to compensate for the variability inherent in any maize collection.

Although the exact nature of the races of maize in the Big Bend remains murky, there are some statements that may be made regarding the specimens at hand. Table 2 presents available measurements from archeological and modern maize races from the Southwest. These are compared to the measurements of the specimens in the current study.

First, most, but not all of the measurements of the Big Bend cobs fall within the range of comparative archeological material presented in Table 2. However, the average row number and cupule width of the Big Bend material differs from the other areas of the Southwest. The average row count in the current study of Big Bend maize is 14.67, much higher than other collections. In specimens from Hohokam sites the row number ranges from 8-16 and the average row number varies from 11.7 to 12.7, depending on the site. Row counts are also lower in the Jornada Mogollon specimens from the Hot Well site—18 percent of the cobs are 8-row, 43 percent are 10-row, 37 percent are 12-row, and 2 percent are 14-row cobs. The average row count for the 92 specimens from Hot Well is 10.48, lower than the Hohokam material and much lower than the Big Bend cobs.

Following the pattern set by row counts, the cupule width of Big Bend maize cobs appears to differ from other areas in the Southwest. A comparison of cupule widths from the other late period archeological sites demonstrates that while the Big Bend specimens fall into the range of archeological material, the average cupule width is smaller than the other regions. The only exception is the Early Agricultural (EA) period sites in Southeastern Arizona which predate the Big Bend material by 1,000 years. The EA material has smaller cupule widths than the later Hohokam, Jornada Mogollon, or Big Bend material; the cupule width of the Big Bend specimens varies from 3.76–6.11 mm and the average is 4.63 mm. The average cupule width for the Hohokam sites ranges from 5.0–8.2 mm, and the average width of the Hot Well cupules is 6.91 mm. Therefore, the cupule width is significantly narrower in the Big Bend specimens.

Appendix 12, Table 2 Maize Cob Measurements from Modern and Archeological Collections in the Greater Southwest.

Collection/Site	Average Row #[2]	Average Cupule Width (mm)	Average Cupule length (mm)	Average Cupule Depth (mm)	Source
Modern Papago[2]					Micsicek 1979
White Flour (n=14)	10–16	6.9	--	--	
Red Flour (n=1)	8	9.4	--	--	
Pink Flour (n=1)	10	7	--	--	
Yellow Flint (n=2)	12	6.9	--	--	
Blue Flint (n=1)	12	9.4	--	--	
Early Agricultural Period					
Donaldson	12–14	2.56 (n=102)	--	1.72 (n=101)	Huckell 1995
Los Ojitos	12–14	2.93 (n=338)	--	1.67 (n=336)	Huckell 1995
Milagro	10.8	2.86 (n=28)	--	1.73 (n=28)	Huckell 1995
Clearwater (Early Cienega Phase)	NA	3.1 (n=8)	1.5 (n=8)	--	Diehl 2005
Los Pozos (Late Cienega Phase) (n=8)	NA	3.8 (n=88)	1.9 (n=98)	--	
Las Capas (San Pedro)	11.58 (n=29)	3.2 (n=272)	2.2 (n=266)	--	
Hohokam					
Gatlin (n=18)	11.7	5.0	--	--	Micsicek 1979
AZ T:14:12 (n=13)	11.7	6.4	--	--	Micsicek 1979
Reeve Ruin (n=6)	12	6.1	--	--	Micsicek 1979
Alder Wash (n=85)	12.7	8.2	--	--	Micsicek 1979
Jornada Mogollon					
Hot Well (n=92)	10.48	5.4	--[3]	--	O'Laughlin 2005
Big Bend					
BBNP and Fulcher	14.67	4.63	1.74		Current study

Footnotes

1 Average row number is given where available, and the range of row numbers is given where an average was not reported.

2 Measurements of modern specimens are reduced by 20 percent to account for charring (Micsicek 1979)

Summary and Conclusions

During the course of this investigation, it became clear that there is not very much metric information available for comparative studies of maize, especially in the Trans-Pecos region of Texas. This is probably due to the fact that few measurements are taken on extremely fragmented maize recovered from open archeological sites. However, Diehl (2005) and Huckell (1995) have demonstrated the utility of recording these measurements. Given the embryonic state of the maize studies in the Trans-Pecos, this small study of 10 cob fragments represents a first step toward the comparison of maize to other regions.

The measurements of 10 partial maize cobs from the Big Bend region were compared to others from archeological and modern maize in the Southwest. Although the measurements of the material from the Big Bend overlap the Hohokam and Jornada Mogollon (Hot Well) material, the averages are different. This may be due to the fact that no 8-row cobs were noted in the specimens from the Big Bend, and the collection contained two 18-row cobs. These are higher row counts that are not often observed in late sites; however, 18-row cobs have been recorded from Early Agricultural period sites in southern Arizona. The average cupule width for the Big Bend specimens is smaller than those for either the Jornada or the Hohokam material, even though some of the Big Bend specimens fall with the range of both regions.

The comparison of the material from Big Bend to other Southwestern maize measurements raises several intriguing possibilities. First, do the data show that the inhabitants were growing a different type, or at least a different suite of corn types, in the Big Bend? If this is the case, are we looking at regional variation, or at temporal variation due to the very late dates associated with these specimens? Or is it a little bit of both?

Before addressing these possibilities we must make the disclaimer that 10 maize cobs from a poorly understood archeological context is only a start toward a comprehensive regional description of maize types from the region. Although the maize from the Fulcher site is thought to be perhaps of early Historic origin, it has been dated to a somewhat difficult area of the radiocarbon calibration curve, and the 2-sigma calibrated date falls between 1550 and 1950. However, this is certainly within the range of other Historic period radiocarbon assays, and matches reasonably well with dates on wood charcoal from the Fulcher site. We can cautiously say that this probably is maize that was grown before European settler and ranching operations moved into the area. Assuming that the 10 cobs are representative of maize grown in the region around 200–400 years ago, then there is the possibility that these specimens demonstrate both temporal and regional differences between the Big Bend maize and the comparative archeological and modern material from other areas of the greater Southwest. These cobs have higher row numbers, smaller cupule widths, and by inference, slightly smaller kernels than the other archeological material. Whether the Big Bend maize data are an anomaly, or the entire region differs from maize growing areas to the west, can only be determined by measuring more cobs from other Big Bend sites.

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Appendix 13

Ceramics Recovered from Big Bend National Park

David V. Hill

Introduction

Five-hundred-and-nineteen ceramic sherds and ceramic artifacts recovered from 28 archeological sites and one isolated find were examined during the current project. These included 373 ceramics recovered from 24 sites and one isolated find during the recent survey of Big Bend National Park (BBNP). One-hundred-forty-six ceramic sherds collected from four additional sites within the park that were not part of the present survey project were also examined. Analysis of this collection is oriented towards typological classification, temporal placement, and identification of potential areas where the ceramics were produced. Following the methodology, the analysis results are presented by class of ceramic, followed by ceramic type. Tables present the data by site as an aid to site interpretation.

Methodology

The ceramics that form the corpus of the current study appear to represent production by local peoples from the prehistoric and historic periods as well as historic pottery produced in Mexico, the United States, Europe, and Asia. Given the great variability in the kinds of ceramics represented in the collection from BBNP, distinct approaches were applied to different types of pottery. Whereas historic Mexican and Euro-American pottery was classified through comparison with previously published examples of these types, a non-typological, attribute-based approach was taken when classifying earthenwares believed to have been produced in the La Junta and Big Bend areas. All of the probable locally made earthenwares were examined using a combination of a 20X hand-lens and binocular microscope to identify the mineral grains and rock fragments present in the paste of this class of sherds. Identification of these components was conducted in an attempt to place these objects in space and time—as an aid in determining possible origins for the source material of these sherds as well as cultural and temporal affiliation. Colors of the earthenwares were assigned using the Munsell Soil Color chart. Because only a preliminary typological classification of indigenous ceramics has been completed—along with very limited Instrumental Neutron Activation Analysis (INAA) and petrographic analysis—formal classification of these ceramics should await further independent studies (Cloud 2004; Hill 2008:180).

The following narrative is organized by class of ceramic. In the tables that follow, data are presented by site: general collections from the current survey of the park are presented first, followed by more detailed descriptions of the ceramics from sites where larger collections were made. Presenting data for these sites individually allows for a more refined interpretation of temporal and cultural affiliation. As there were many sherds in the BBNP collection belonging to the same vessel, to avoid skewing the data, percentages given indicate vessels rather than sherd count to more accurately reflect the range of the ceramic collection.

Results of the Analysis

Given the variation in origins of pottery recovered from BBNP, the results of the analysis will be divided into four groups: Unglazed Earthenwares, Mexican Glazed Ceramics, Euro-American Ceramics, and Unclassified Ceramics.

Unglazed Earthenwares

This class of pottery consists of low-fired prehistoric and historic ceramics, the majority of which were probably produced by native peoples or by historic Mexicans and Mexican-Americans. With the exception of known exotic types (such as the Rockport Black-on-Gray, Chupadero, the El Paso types, and Tonala burnished), most in this category are also presumed to have been locally produced. Temporal affiliation of these ceramics is derived from their archeological contexts and comparisons with published sources.

Plainware

Eighteen undecorated earthenware sherds were collected from three sites: BIBE859-I, BIBE1681, and BIBE1942. These sites produced sherds of handmade pottery characterized by a red or reddish yellow (5YR7/5, 5YR7/6) colored paste with a smooth unpolished surface. The paste of the vessels was tempered using quartz-rich sands that contain abundant dark-colored volcanic rock fragments.

The exception to this description is the fourteen sherds recovered from BIBE1942. While these sherds resemble the other plainwares in this group in terms of the reddish color of the paste and fragments of dark volcanic rock, the sherds from this site—representing at least two different vessels—also contain fragments of white limestone. The presence of limestone in the paste of the plainware sherds indicates that they were produced using different ceramic resources than the other pottery in this class of artifacts. One of the sherds recovered from BIBE1942 was a rim sherd. The rim of this sherd had been notched or pinched to create serrated appearance. This sherd had a reddish yellow (5YR7/5) paste that contained sands which included fragments of black basalt.

Polished Plainware

Eight sherds from at least one vessel of polished plainware were recovered from BIBE1910. This vessel was a jar form with an everted rim and rounded lip. The polished area begins on the vessel at the shoulder about 3 cm below the rim. The paste of this sherd is highly variable due to uneven firing conditions. Its color ranges from dark brown (7.5YR4/4) to red (2.5YR4/6) and it was tempered using sands that contain sparse amounts of dark-colored volcanic rock fragments.

Red-on-Brown

This type is a variant of plainware that includes the addition of lines in red iron-based paint to the exterior of jars and the interior of bowls. None of the sherds were large enough to identify a particular design layout. Six Red-on-Brown sherds were collected from two different sites: BIBE2030 (areas G, J, and K), and BIBE2085. The Red-on-Brown ceramics are characterized by having a red to reddish yellow or light reddish brown colored paste that contains sand with dark-colored volcanic rock fragments. Because one of these sites (BIBE2030) also produced plainware, it is possible that some of the undecorated sherds are unpainted portions of red-painted vessels. In any case, the similarity in color of the ceramics paste and the types of minerals and volcanic rocks present in the Red-on-Brown sherds suggest a common origin with plainware in the present analysis.

Red-on-Brown ceramics have been reported from prehistoric and historic contexts along the Rio Grande from as far north as El Paso nearly to its mouth (Galindo 2003; Hill 2002b, 2008; Perttula et al. 1999; Wright 1996). The wide lines and apparently simple design layouts of the Red-on-Brown ceramics recovered from the current survey appear most similar to the historic Native American decorated ceramics that have been recovered around La Junta (classified by J. Charles Kelley as Chinati, Capote and Conchos Red-on-Brown) and the El Paso area (Hill 2002b, Kelley 2004; Perttula et al. 1999; Wright 1996:153).

El Paso Brownware

Test excavations at BIBE149 recovered a single sherd of El Paso Brownware. This sherd is distinguished by a polished red (2.5YR4/6) exterior and a black interior and core. The paste is tempered using distinctive coarse-grained granite that originated in the Franklin Mountains outside El Paso, Texas. El Paso Brownwares were being produced by at least A.D. 300 until approximately A.D. 1450 and are characteristic of the Jornada Mogollon culture of southeastern New Mexico and western Texas (Burgett 2006; Miller 1995). Ceramics from the El Paso area including the decorated types El Paso Bichrome and El Paso Polychrome have been recovered previously from Big Bend Ranch State Park and figured prominently in assemblages during the La Junta phase in the La Junta district (around present-day Presidio, Texas) (Wright 1996:153; Kelley 1986).

Chupadero Black-on-White

Two sherds of Chupadero Black-on-White were collected from the surface of BIBE1676. Based on the presence of deep striations in the paste on the concave surfaces of the two sherds, both sherds are derived from one or more jar-forms.

Chupadero Black-on-White is distinguished by a hard gray colored ceramic paste, geometric designs that are executed in black mineral-based paint, and the presence of deep striations in the clay on the interior of jars. The striations most likely result from the smoothing of vessels' interiors using bunches of grass. Chupadero Black-on-White was produced between A.D. 1050/1100 until about A.D. 1544 (Wiseman 1982, 1986).

Recent studies of Chupadero Black-on-White using INAA and thin-section petrography have identified five major sources for the production of this type (Capone 2002; Clark 2006; Creel et al. 2002). Chupadero Black-on-White was produced in the Sierra Blanca and Capitan Mountains and in the Chupadera Mesa/Gran Quivera area of southeastern New Mexico (Creel et al. 2002, Kelly 1979; Wiseman 1982). It has, however, been suggested that some Chupadero Black-on-White pottery was also produced in the upper portions of the Pecos River and its western tributaries (Clark 2006).

Chupadero Black-on-White was widely traded across the southwest and southern Great Plains and is found throughout southeastern New Mexico, with lesser quantities in the eastern Trans-Pecos (Mera 1931; Wiseman 1982, 1986). This distinctive type has also been documented from sites in the La Junta district (Kelley et al. 1940:34; Cloud et al. 1994:88-89). A single sherd of Chupadero Black-on-White was recovered previously from Big Bend Ranch State Park (Wright 1996:153).

Rockport Black-on-Gray Type II

A single sherd of Rockport Black-on-Gray was recovered from BIBE1702. Rockport Black-on-Gray is characterized by the presence of crushed bone as a ceramic temper. The sherd is from a jar-form. The interior surface and paste are black and the paste tempered using crushed gray-colored burned bone. A trace amount of rounded grains of quartz sand are also present in the paste of this sherd. The exterior is white with two parallel lines executed in natural black asphaltum. The presence of parallel lines on the body of the vessel indicates that this sherd is classifiable as Rockport Black-on-Gray II (Ricklis 1995:199).

Rockport pottery was produced along a narrow strip of the Texas Gulf Coast between Baffin Bay on the south to the Colorado River delta on the north (Ricklis 1995:196). Rockport Black-on-Gray was produced between A.D. 1250/1300 until the early nineteenth century by Karankawa Indians living along the Texas Gulf Coast (Ricklis 1995, 1999; Perttula 2002). Prior to the current study no sherds of Rockport Black-on-Gray have been recovered from West Texas.

Red-Slipped Earthenware

Three sites produced sherds of red-slipped pottery: BIBE859-I, BIBE1738, and BIBE1910. Based on the similarity of the paste of these sherds to that observed in the hand-made plainwares it is likely that the red-slipped sherds represent locally produced pottery. However, the appearance of the red slip on the red-slipped sherds differs between these sites.

A sherd recovered from BIBE859-I has a fugitive red slip—one that tends to preserve poorly as a result of low firing temperatures. This sherd has a fine sandy temper with dark volcanic inclusions. One or more red-slipped vessels are represented in the collection of 23 sherds from the Rio Grande Dune site (BIBE1738). These red-slipped sherds are characterized by a thick maroon-colored exterior slip that had been applied to the exterior of a jar. The paste of the jar was tempered using sands with abundant fragments of dark volcanic rock. The red slip was well polished. A rim sherd recovered from BIBE1910 was coated on its exterior with a sandy-textured red wash that presents a dull matte finish. Like the other (probably native-made) earthenwares recovered from this site, the sherd was tempered using sands that contained abundant fragments of dark-colored volcanic rock.

It is likely that the red-slipped sherds in the collection are prehistoric in age. Red-slipped pottery is common in the American Southwest and has been documented in ceramic assemblages from the Loma Alta and Polvo sites in the Big Bend (Cloud et al. 1994; Hill 2008:182). Red-slipped ceramics with the earliest temporal placement is San Francisco Red dating between A.D. 200 to 650 (Blake et al. 1986). San Francisco Red was produced across southwestern New Mexico and eastern Arizona.

Red slipped ceramics are also present in Viejo and Medio Periods (ca. A.D. 200–1150/1200 and 1200–1450, respectively) ceramic assemblages from the Casas Grandes cultural area (Di Peso et al. 1974; Whalen and Minnis 2004). Several undescribed local varieties of red slipped brownwares have also been reported from southeastern New Mexico (Jelinek 1967). Red-slipped ceramics have also been recovered in low numbers from late eighteenth and nineteenth century sites located along the lower Rio Grande Valley (Galindo 2003:236).

Apache Plainware

One hundred and forty-three sherds from one or more vessels were recovered from the surface of BIBE516. The vessel or vessels were made using clay that contains abundant sediments from a volcanic source. Fragments of black basalt, alkali feldspar, and rarely quartz are present in the paste of the sherds. It is likely that the basalt and mineral grains were natural inclusions in the clay used to form the vessel. The interior and exterior surfaces of the sherds are uneven and rough. The rough surfaces are the result of smoothing of the vessels with a ridged tool that caught the mineral grains and rock fragments, pulling the grains across the surface and creating parallel striations (Ferg 2004, Figures 36 and 37; Hill 1996, 2012; Seymour 2008). The striations created by the tool-smoothing are less visible on the exterior surfaces due to the handling of the vessel while the clay was still moist. The surface color of the vessel ranges from reddish gray (5YR5/2) to light reddish brown (5YR6/4) as a result of the vessel being unevenly fired, most likely in an open "bonfire" kiln.

No evidence of construction such as coil breaks or anvil depressions were observed on the interior or exterior surface of the sherds. It may be that the vessel was formed using the "section method" in which vessels are made using overlapping patches or short segments of coils molded together (Vandiver 1987). The vessel appears to be globular and has a direct slightly everted rim with a smooth rounded lip. No basal or lower body sherds were identified in the collections from this location.

The sherds from BIBE516 most closely resemble Apache vessels and sherds that have been recovered from southern New Mexico and the Big Bend area within the boundaries of what was Mescalero Apache territory during the nineteenth century (Opler 1983). Apache vessels from southern New Mexico and West Texas vary in shape, but were consistently made using sandy untempered clays (Hill 1996, 2002a, 2012; Seymour 2008).

Roof Tiles

BIBE908 produced three fragments of curved earthenware roof tiles from a shovel test (20–40 cmbs). The tiles are red (2.5YR5/8) in color and the interior and exterior surface of the fragments display very fine parallel lines, evidence of the tiles having been formed in a mold. Clay roofing developed in China some 12,000 years ago and the Middle East a short time later. The tradition soon spread throughout Asia and Europe, and was imported to Mexico and the southwest by the Spanish. Clay tiles were first manufactured in the southwest around 1780 by Indians in California under the direction of missionaries (Grimmer and Williams 1992). However, roofing tiles do not seem to appear in the regional archeological record until the nineteenth century. Based on the context of this site (adjacent to the developed area in the Chisos Basin), these fragments are almost certainly associated with the Chisos Mountain Lodge or associated park infrastructure that are roofed in these tiles.

Tonala Burnished

Tonala Burnished is characterized by a tan to buff colored silty-textured paste and smooth surface. Tonala vessels are decorated in black, red, and rust-colored paints (Fox and Ulrich 2008:60). Tonala Burnished was produced beginning in the late eighteenth century in Tonala, located near Guadalajara, in the state of Jalisco, and continues to be produced today (Barnes 1980:101-102; Fox and Ulrich 2008:60). A common form found in sites of the nineteenth and twentieth centuries (notably those in El Paso) are water containers (Hill 2002b).

Three examples of Tonala Burnished ceramics were recovered during the survey of BBNP. One sherd is from BIBE1910 while another red-slipped variety from BIBE1942 is the neck of a water-jar. Another possible Tonala sherd from BIBE2030 is a mold-made basket that was part of a larger sculptured object and is addressed in Unclassified Ceramics.

"Massiveware"

Site BIBE1942 produced an unusual earthenware pottery referred to informally as "Massiveware." Originally a field term used to describe this unusually thick type of ceramic, Massiveware is characterized by sherds that are often as much as 2.5 cm in thickness. Massiveware appears to have been assembled in sections rather than being made in a mold or thrown on a wheel (Vandiver 1987). The clay used to make Massiveware contains sands with fragments of dark colored volcanic rock and is tempered using angular fragments of crushed ceramics. Given the preponderance of this type of inclusion in earthenware pottery from BBNP it is likely that Massiveware is a local product. The function of this type of pottery is unknown, but may have been used as a household or community water storage vessel of a type documented in the La Junta district (Oscar Rodriguez, personal communication, 2012).

Mexican Glazed Ceramics

Ceramics recovered during the BBNP survey that were produced in Mexico fall into two distinct classes: earthenwares (discussed above) and Mexican glazed ceramics. Until the arrival of the Southern Pacific Railroad in northern Brewster County in 1882, Mexico served as the nearest source of mass-produced pottery available to the residents of the Big Bend region. Such vessels served as the major types of cooking, serving, and storage wares used in local households. The following sections will describe in greater detail the types and potential sources of Mexican pottery recovered during the survey of BBNP and vicinity.

Majolica

The most common type of glazed Mexican pottery is majolica, a white, tin-opacified, lead-based glaze. The technology of majolica was brought to Mexico during the early sixteenth century and continues to be produced today at two locations: the city of Puebla and at several craft shops located in Ciudad Guanajuato (Fournier 2003; Goggin 1968; Lister and Lister 1976; McKinzie1989; Whitaker and Whitaker 1978).

With this class of ceramics, paste color is indicative of origins. Majolica with a reddish-brown colored paste was probably produced in the state of Guanajuato (Fournier 1997; McKinzie 1989). Majolica with a whitish or pinkish paste was produced in Puebla, Mexico (Goggin 1968).

Four sites within BBNP produced sherds of majolica: BIBE246, BIBE859, BIBE2030 and BIBE2085. The majolica sherds recovered from BIBE2085, two proveniences at BIBE2030 (F and J), and BIBE859-D were produced in the nineteenth century based on the presence of rust-colored pigments (Fournier 1997). The majolica sherds from BIBE246, BIBE859-D, BIBE859-G, BIBE2030, and BIBE2085 had pale reddish or pink colored pastes indicative of their origins in Puebla. Another sherd from BIBE859-G has a much darker reddish brown colored paste indicating its origin in Guanajuato (Fournier 2003). The Puebla-made majolica sherd from BIBE2085 is classified as Aranama Polychrome. Aranama Polychrome had a production span of 1800–1900 and possibly into the nineteenth century (Fournier 1997:214).

The sherd from BIBE246 is from a bowl with floral designs executed in a dark cobalt-blue glaze. This sherd is classified as Puebla Blue-on-White, a type first described by John Goggin (1968:190–195). Puebla Blue-on-White was produced between roughly 1650 and 1830, making this sherd one of the earliest examples of Euro-American material culture documented in BBNP. The majolica sherd has been ground along one edge to produce a sub-circular disk. Similar ground disks made from majolica dating to the late eighteenth century have been recovered from the El Paso area (Miller and O'Leary 1992). The ground majolica disks could have served as spindle weights, gorgets, or gaming pieces.

Green-Glazed Ceramics

Two types of lead-based green glazed pottery were recovered during the survey. The more common type, Guanajuato Green-Glaze is characterized by a reddish brown or dark-brown paste and frequently has a sandy texture (Gerald 1968:53; Fournier 1997). Three sites produced one or more green-glazed sherds that most likely originated in Guanajuato: BIBE1695, BIBE1942, and BIBE2030. In addition, BIBE1848 produced a polychrome sherd also originating in Guanajuato. Guanajuato Green-Glaze was produced beginning around 1750 and continues to be produced in the Mexican state of Guanajuato today (Barnes 1980; Fournier 1997).

The second green-glaze type is Presidios Green-Glaze. Three sites, BIBE859, BIBE2030 and BIBE2085 produced sherds of Presidios Green. Presidios Green-Glaze is distinguished by a light gray to light pink colored ceramic paste and green-colored glaze (Fournier 1997). Presidios Green-Glaze is believed to have been produced between the sixteenth into the nineteenth century and was defined based on ceramics recovered from Presidio Carrizal, Chihuahua (Brown and Fournier 1998).

Given the variation in the colors of the pastes of green-glazed ceramics classified as Presidios and Guanajuato green-glazed, it is likely that they were produced at more than one location. Limited INAA studies of green-glazed pottery from mission sites in Texas suggest that some green-glazed pottery may have been made in Texas (Carlson and James 1995). Future studies of green-glazed pottery and other lead-glazed ceramics presumably from Mexico from well-dated contexts should include petrographic, lead isotopic, and neutron activation analyses to determine their origins.

The state of Guanajuato is also the source of majolica pottery (Fournier 1997; 2003). The paste of Guanajuato majolica ranges in color from dark brown to reddish brown (Fournier 1997). A majolica sherd collected from BIBE1942 likely was derived from this source and probably dates to the nineteenth century (Fournier 1997). Ceramics from Guanajuato, both green-colored glazes and majolica appear in ceramic assemblages from late Colonial and Mexican Republican period sites in Central Texas as early as 1750 and continues to be produced today (Fournier 1997; Fox and Ulrich 2008; Galendo 2003).

Galera Tradition Glazeware

Nine sites, BIBE859, BIBE1594, BIBE1674, BIBE1747, BIBE1842, BIBE1910, BIBE1920, BIBE1942, and BIBE2030 produced one or more sherds attributable to the Galera ceramic tradition. Galera ceramics are characterized by a fine textured light reddish brown to orange colored ceramic paste. Glazewares are characterized by a wide variety of decorative designs executed primarily in black, white, and yellow paint. White dots occasionally outline black-painted designs. The paint was then covered with a clear or slightly greenish-colored lead-based glaze. Galera ceramics were produced near Guadalajara beginning in 1780 and continue to the present day (Barnes 1980; Fournier 1997:239; Gerald 1968:53; Perttula et al. 1999; Galindo 2003:242). Because of the lack of overall design-work on some Galera vessels, undecorated sherds of this type were attributed to the "Galera Tradition" based on the presence of clear glazes on a light reddish brown paste.

Stamped Lead Glaze

Nine sherds from a single jar were recovered as an isolated find (IF 749). The sherds have a fine reddish yellow (7.5YR 6/8) paste and the exterior of the original vessel was decorated with two types of stamped designs. One stamped design consists of a series of stylized floral patterns and isolated dots. The other stamped design consists of a series of angled parallel lines. These designs were applied to the exterior of the vessel just below the rim. The vessel was coated on the interior and the decorated portion of the exterior using clear lead-based glaze. A single stamped sherd with a paste similar in appearance to the one recovered from Big Bend was excavated from San Elizario, Texas (Fournier 2003:243). Ceramics made with a reddish yellow paste and clear lead-glaze date from the early nineteenth century, but continue to be produced in Mexico today (Barnes 1980:110; Fournier 2003:241).

Three sites also produced ceramics that are likely attributable to the Mexican glazeware tradition, but lacked one or more diagnostic features. One sherd from BIBE859-C and two sherds from BIBE2030 have a reddish yellow paste that resembles examples of ceramics from the Galera tradition. The three sherds however, lack decoration or a clear lead glaze. One sherd from BIBE1942 was highly overfired resulting in the melting of the glaze. Another sherd had only spots of green glaze, again possibly from burning.

Post-Firing Decoration

Two earthenware sherds—probably originating from Mexico—recovered from BIBE859-G were decorated using bright blue tempra paint on an orange and black fired vessel. The blue color was added to the vessel after it had been fired. The two sherds possibly came from the same object. The light buff-colored paste of these two sherds is similar enough to the painted Tonala specimens that they may share a common origin.

Euro-American Ceramics

Euro-American ceramics represent a class of pottery made either within the United States or Europe. As is commonly observed in the archeological record of West Texas, Euro-American ceramics generally do not appear in domestic archeological contexts until after the arrival of the railroad (Hill 2002b, 2008). The Euro-American ceramic assemblages from the archeological survey of BBNP also reflect this pattern. No examples of Euro-American pottery dating before the late nineteenth century were observed in the collections from the present survey.

Ironstone and Transfer-Print Ceramics

The most common variety of Euro-American pottery that was recovered during the survey is white ironstone. White ironstone is also the ceramic body that underlies transfer-printed ceramics—a decorative technique developed in England in the late eighteenth century, although clear images were not produced until around 1825 (Gross 1996; Blake and Freeman 1998). British potteries that produced white earthenware, referred to as ironstone in this report, were much more productive and popular than similar American products. The British potteries, predominately located around Straffordshire, produced abundant transfer-printed ceramics for export. It took the passage of the McKinley Tariff Act in 1890 to limit the amount of British pottery imported into the United States (Majewski and O'Brien 1984:20). Interestingly, the majority of the maker's marks on the ironstone sherds are of British origin, suggesting that these vessels may have been brought to the Big Bend area prior to 1890.

Eight sites, BIBE593, BIBE859, BIBE1675, BIBE1707, BIBE1910, BIBE1920, BIBE1942 and BIBE2030 produced sherds of white ironstone. Three of these sites—BIBE1910, BIBE1920, and BIBE1942—also produced sherds of transfer printed ceramics.

Decalware, which allowed more complex designs with multiple colors to be transferred to ceramics, was developed in 1860 (Berg 1980:200). The multi-colored images of decalware allowed manufacturers to cheaply produce a type of ceramic that resembled more expensive hand-painted ceramics. Six sherds from the same vessel with a swan design below the rim— probably a teacup—were recovered from BIBE1920 and three sherds from three different decalware vessels were collected from BIBE1942.

Stoneware

Five sites, BIBE859, BIBE1910, BIBE1920, BIBE2025, BIBE2030, produced stoneware sherds—a type of pottery that is impermeable and partly vitrified but opaque and is usually grey or brownish in color due to impurities in the clay. Frequently salt glazed, it was the predominant houseware of the nineteenth century in the U.S.

BIBE859, BIBE1910, and BIBE1920 produced brown-glazed stoneware also known as Albany Slipped stoneware (Stelle 2011). Albany Slipped stoneware was manufactured during the late nineteenth century until just prior to World War II.

Fragments of stoneware from BIBE859-B display the characteristic gray color and uneven texture of salt-glaze. Salt-glazed ceramics present an orange peel-like texture and a light grayish color that result from the addition of salt to the kiln while the vessels were fired. This glaze was popular throughout the nineteenth century but became less common after the 1860s (Stelle 2011).

One Stoneware sherd lacking a glaze was recovered from BIBE2025. This sherd is a fragment from a bottle.

Ceramic Crucibles?

Sherds of white stoneware believed to have functioned as crucibles were recovered from BIBE859 and BIBE2030. A fragment of the base of a small wheel-thrown vessel was collected from the surface of BIBE895-I, and a fragmentary base from a similar vessel was recovered from BIBE2030-F. The term "refractory-clay" is used in this case to designate a type of fired vessel made from clay that can be heated to temperatures that are great enough to melt ore samples. The paste of these objects is white. The interior surfaces of the sherds display abundant tiny red spots. The function of these vessels is unknown but since the vessels appear to have been subjected to temperatures high enough to oxidize inclusions in their interior, these objects may be assay crucibles. Such crucibles were used to melt metallic ore samples to determine if the ore contained valuable metals. Based on the presence of a reddish residue (probably mercury) inside the sherd from BIBE859 and the history of quicksilver mining in the region, it is likely these vessels were used in conjunction with area prospects.

Rockingham or Bennington Ware

BIBE1942 produced the upper portion of a brown-glazed earthenware lid of Rockingham or Bennington ware. Without a makers' mark, Rockingham has become a generic term for mid-nineteenth to early twentieth century brown-glazed pottery (Brown 1982; Clancy 2004).

Yellowware or Creamware

The ring base of a yellowware vessel was recovered from the surface of BIBE859-B and sherds from a single yellowware bowl with a white glazed band on its exterior were recovered from BIBE1910. Yellowware was produced from 1827 to 1922 (Berg 1980:171; Brown 1982:15). Similar yellowware ceramics have been recovered from Big Bend Ranch State Park (Wright 1996: 162).

Porcelain

Three sites, BIBE1910, BIBE1920 and BIBE1942 produced sherds of high-fired porcelain. Porcelain ceramic bodies are white and present a vitreous appearance. All of the sherds are small and lack maker's marks or other temporally distinctive features. One sherd of porcelain luster-painted pottery was recovered from BIBE1942. Luster-painting is a process that requires ceramic vessels to be fired twice, once to fire on the colored glazes, the second time at a much lower temperature to set the metallic "luster" paint. Luster-painted pottery was invented in Basra, Iraq, around A.D. 800 and continues to be produced around the world today. Locally, luster-painted pottery would be expected in post-railroad ceramic assemblages.

Ceramic Figurines

Fragments of two ceramic figurines were recovered from BIBE1842 and BIBE1942. The figurine fragment from BIBE1842 consists of a round base from which the figure had been broken away. Made of a white porcelain clay body, the base had red and green parallel bands encircling it. The other figurine is represented by a male torso. This piece was made from unglazed white porcelain.

Unclassified Ceramics

This class of ceramics represents pottery that could not be classified due to the lack of comparative published material or experience of the analyst. Some of this material is likely prehistoric or protohistoric in age. However, due to the limited analysis of undecorated ceramics in West Texas or northeastern Mexico, no comparative material is available. Some of the undecorated sherds, specifically the wheel-thrown and mold-made ceramics, probably originated from small craft shops in Mexico and were brought to the Big Bend area during the nineteenth or early twentieth century. Descriptions of these sherds are provided to create a database for future researchers working with historic materials from sites in the border region of the United States and Mexico.

Mold-Made Ceramics

Mold-Made Earthenware

Sherds from BIBE856, BIBE859-B, and BIBE2063 were made by pressing clay into prefabricated molds. The production of mold-made earthenware in Mexico was practiced during the prehistoric period and continues today (Druc 2000).

Mold-Made-Incised

One mold-made sherd from BIBE2030-I is incised. Except for a large square calcareous inclusion exposed when a portion of the exterior surface exfoliated during firing, the paste of the sherd is reddish yellow (5YR/7/8) and outside of the exposed inclusion, the texture is homogeneous. The interior of the sherd displays the smoothed-over impressions of finger-prints. The exterior of the sherd is smooth and decorated with three curvilinear lines that were incised into the surface before the vessel was fired.

Mold-Made Basket Design

A single mold-made sherd with a basket design on its exterior surface was recovered from BIBE2030-I. The paste of this sherd is pinkish gray (7.5YR 6/2). Its low-fired paste superficially resembles the examples of earthenware pottery from Tonala, Jalisco, and may have come from that location. The exterior of the sherd, which has a finely textured surface made to represent a woven basket, has a light reddish wash or perhaps fired light red (10R 6/6) color. The interior of the vessel shows fingernail and fingerprint impressions where it was pressed into the mold.

Wheel-Thrown Ceramics

Wheel-Thrown Plainware

Plainware sherds recovered from BIBE859-C, BIBE859-D, BIBE859-E, and BIBE2030-F were thrown on a potter's wheel. The pastes are pink in color and the clays lack visible inclusions. The sherds display the parallel lines in the clay surface characteristic of wheel-thrown vessels. These low-fired earthenware vessels were probably produced in small craft-shops in Mexico and transported to the locations where they were recovered.

Wheel-Thrown Slipped Plainware

A single sherd from a wheel-thrown vessel with a thick matte-textured yellow slip on the interior was recovered from BIBE859-D. The paste of this earthenware sherd is light brown (7.5YR 6/4) and lacks inclusions. No origin for this sherd could be found.

Wheel-Thrown Decorated

Three wheel-thrown sherds from BIBE2030-H were decorated. The paste of these sherds is a strong brown color (7.5YR5/6) and they have a gray core. The sherds have faint green or white pigments on their interiors and exteriors and probably came from the same vessel. The green and white colors might be the result of weathering of the original glazes or as the result of the original vessel being under-fired.

Unclassified Plainware

Two sherds from BIBE2030-F share a common smooth uneven surface and surface color. Specimen A9 has a floated surface on the interior of the sherd whereas specimen A10F—a rim sherd—has an interior surface which tapers sharply, almost to a point at the lip of the vessel, resulting in a wedge-shaped profile. Fine particles of clay coat the interiors of the two sherds and resemble a light colored slip. The floated surface is pale yellow brown (10YR7/4). Both sherds have been overheated causing the sherds to be exfoliated on the exterior and interior of the body and to be oxidized to a light red (2.5YR6/8) color.

The sherds also contain sands that include white limestone or caliche, probably as an added tempering agent. Unmixed fragments of clay are also present in the paste of these sherds, which appear to have come from bowls that were constructed using coils. Whether these sherds represent historic or prehistoric pottery cannot be determined without further work.

Another sherd of this type from BIBE2030-F is characterized by a red (2.5YR 5/8) exterior and a very dark gray core. The paste is tempered using sands derived from a plutonic source containing white, gray, and pink alkali feldspar and quartz. The exterior of the surface of this sherd displays the striations and compaction from being stone-polished. The presence of stone-polishing, a technological trait not observed on the historic Red-on-Brown sherds, but present on red-slipped and polished plainware sherds, indicates this sherd is prehistoric although its origin of manufacture is unknown.

A sherd collected from BIBE1684 may be from the same source as the sherd from BIBE2030-F. This sherd has an exterior surface color of weak red (10R5/2) and an interior surface color of red (10R5/8). Its core is very dark gray and the interior surface has been stone-polished. The inclusions in the sherd are derived from a plutonic source including quartz in conjunction with white, gray, and pink feldspar.

One plainware sherd from BIBE1842 contains very sparse rounded quartz sand mixed with grains of brown chert. It is likely that the clay used to make this vessel was levigated to remove the coarser sediments present before being used. The paste of this sherd is pink 5YR7/3. The method of manufacture could not be determined.

Hand-molded Ceramics

Hand-molded fired and unfired clay objects were recovered from four sites: BIBE146, BIBE859-D, BIBE1920, and BIBE2030-A. Fired miniature "pinch pots" were recovered from BIBE1920 and BIBE2030-A. The sparse fragments of dark-colored volcanic rock in the sandy paste of the two vessels somewhat resembles that of the plainwares recovered from both sites. BIBE1920 also produced a small fired amorphous lump of clay. These fired miniature objects are unique in the archeology of the Big Bend region. Whether they represent test-firing of clays by historic potters, the production of toy dishes for children, or some other purpose is unknown.

A molded, unfired clay object was recovered at level #5 (40–50 cm) from test excavations at BIBE146. The object is a lump of clay that contains a mix of fragments of dark-colored volcanic rock, limestone, quartz and feldspar sands, and charcoal. The presence of unfired grasses mixed with charcoal in the piece indicated that the clay object was molded but not fired. It measures 4.1 cm in length, 3.3 cm in maximum width, and 1.2 cm in thickness. One side is flat, while the opposite side is indented and coated with grayish white ash. A 2.5 cm section of one of the flattened edges has broken off and presents a wedge-shaped appearance as the two flat faces converge, but do not meet. The formation processes or function of this object is unknown.

Stoneware

A single sherd of unclassified stoneware was recovered from BIBE2030-F. The sherd is characterized by a smooth very dark gray glazed exterior and a thick black glazed interior. The paste of this sherd is also very dark gray in color and contains small black inclusions. Stonewares were produced across Western Europe in the sixteenth century and continue to be produced there today. In the United States stoneware pottery was produced primarily between the eighteenth and early twentieth centuries (Brown 1982).

Vitrified Sherds

Two sherds from BIBE859-E, probably from the same vessel, were heated to the point of vitrification (melting) of the glaze and ceramic body. The clay of the ceramic body is bloated and pores have formed. The surface has formed a glassy coat that may or may not be the result of vitrification on the original pottery glaze. The temperature reached by whatever process that caused the vitrification and bloating observed on the two sherds cannot be estimated without experimental means, but was well above the firing temperature of the original vessel. Such extreme overheating would have only occurred under unusual circumstances such as being in a burning building.

Tables

The following tables present the ceramic data by site, followed by ceramic type. The first two tables address ceramics from non-project sites (Table 1) and ceramics from project sites (Table 2). The remaining tables (Tables 3–12) address ceramic assemblages of BIBE859, BIBE1910, BIBE1920, BIBE1942, BIBE2030, and BIBE2085.

Appendix 13, Table 1 Ceramics from Non-Project Sites in Big Bend National Park, by Site.

Ceramic Type	Catalog Number	Total Sherds	Comments
BIBE146 (41BS0706) Lo Bue			
Unclassified Ceramics			
Unfired Molded Clay	5315	1	Contains burned and unburned plant material
BIBE149 (41BS0707) Takeout			
Unglazed Earthenware			
El Paso Brownware	20124	1	
BIBE246 (41BS2277) Remolino			
Mexican Glazed Ceramics			
Puebla Blue-on-White Majolica (Puebla origin)	21151	1	Sherd is ground along one edge
BIBE516 Pot Drop Site			
Unglazed Earthenware			
Apache Plainware	46290 46291 46292 46293	143	One or more vessels represented

Appendix 13, Table 2 Ceramics from Project Sites in Big Bend National Park, by Site.

Ceramic Type	Catalog Number	Total Sherds	Comments
BIBE593 (41BS2491) Neville's Spring			
Euro-American Ceramics			
White Ironstone	27058	1	Fragmentary Maker's Mark "3 MAR"
BIBE856 (41BS0388) La Clocha			
Unclassified Ceramics			
Mold Made Plainware	26636	1	Paste: Pink (7.5YR7/4) with very fine quartz sand naturally present
BIBE908 (41BS908) Abajo Del Pico			
Historic Earthenware			
Historic Roofing Tile	27332	3	

BIBE1594 Woodson's #2			
Mexican Glazed Ceramics			
Galera Tradition	25524	5	Undecorated clear glaze on light brown paste
BIBE1674 (41BS1607) Canyon Sentinel			
Mexican Glazed Ceramics			
Galera Tradition	25431	2	Undecorated clear glaze on light brown paste
BIBE1675 (41BS1608) Canyon Mouth Campsite			
Euro-American Ceramics			
White Ironstone	25432	1	Maker's mark "LIVERPOOL"
BIBE1676 (41BS1609) Chupadero			
Unglazed Earthenware			
Chupadero Black-on-White	25434 25435	2	Jar
BIBE1681 (41BS1614) Big Dartpoint			
Unglazed Earthenware			
Plainware	25443	2	Exterior: yellowish brown (10YR5/4); Interior: yellowish red (5YR5/8); Core: reddish yellow sands with dark volcanic rock fragments
BIBE1684 (41BS1617) Redslip Sherd			
Unclassified Ceramics			
Plainware	25461	1	Exterior: weak red (10R5/2); Interior: red (10R5/8); coarse sand temper from plutonic source; red color results from oxidation during firing, not a slip
BIBE1695 (41BS1628) Green Pot Drop			
Mexican Glazed Ceramics			
Guanajuato Green Glaze	25475	39	Sherds from single glazed jar
BIBE1702 (41BS1635)			
Unglazed Earthenware			
Rockport Black-on-Gray Type II	25505	1	
BIBE1707 (41BS1640) Terrace Top Camp			
Euro-American Ceramics			
White Ironstone	25512 25513 25514	3	Same vessel, mixed transfer-print and hand-painted
BIBE1738 Rio Grande Dunes			
Unglazed Earthenware			
Red Slipped	25879 25880 25881 25882 25883	21	Exterior: well polished red slip (10R6/8); Interior: yellowish brown (10YR5/4) Fine igneous temper-Prehistoric; same vessel?
BIBE1747 (41BS1679) Sandstone Homesite			
Mexican Glazed Ceramics			
Galera Tradition	25889	1	Clear and thin green lead glaze

Appendix 13, Table 2 Ceramics from Project Sites in Big Bend National Park, by Site. *(continued)*

Ceramic Type	Catalog Number	Total Sherds	Comments
BIBE1842 (41BS1768) Wound Wire Ring			
Unclassified Ceramics			
Plainware	25951	1	Sparse rounded quartz and red chert sands; historic?
Mexican Glazed Ceramics			
Galera Tradition	25950 25957	2	Clear glaze
Galera Tradition	25955 25959	2	Black line; clear glaze
Euro-American Glazed Ceramics			
Porcelain Figurine	25956	1	Figurine base
BIBE1848 (41BS1774) Woodstove			
Mexican Glazed Ceramics			
Guanajuato Polychrome	25968	3	Black lines surrounding white slip painted spots
BIBE2025 (41BS2242) San Vicente School			
Euro-American Earthenware			
Stoneware	26531	1	Wheel-thrown stoneware crock basal fragment
BIBE2063 (41BS1950) Celayo			
Unclassified Ceramics			
Plainware	26711	1	Mold made; historic
IF 749			
Mexican Glazed Ceramics			
Stamped-Lead Glaze	26877	9	Sherds from the same jar

Ceramic Assemblages

More substantial ceramic collections were recovered at six sites—BIBE859, BIBE1910, BIBE1920, BIBE1942¸ BIBE2030, and BIBE2085—during the survey of BBNP. Separate analyses of the ceramic assemblages from these sites allow for a more detailed look at such issues as the occupation history of a site and clues about the residents of that location.

BIBE859 (41BS391) Upper San Vicente

BIBE859 is the upper (northern) portion of the former townsite of San Vicente, Texas. Based on the presence of Red-on-Brown and plainware in subsite I along with green-colored Mexican glazewares that date possibly from the late eighteenth century to the twentieth century, this site may have been affiliated with Presidio San Vicente, or the later Mexican community that developed near it (Table 3). The presence of decorated majolicas in subsite G also indicates a possible late eighteenth century occupation. The limited amount and diversity of Euro-American ceramics in the assemblage from this site reflects either a limited twentieth century occupation or stronger economic ties and access to manufactured goods from Mexico.

Appendix 13, Table 3 Ceramic Assemblage from BIBE859 in Big Bend National Park, by Subsite.

Ceramic Type	Catalog Number	Total Sherds	Comments
BIBE859-B Corn Cob			
Mexican Glazed Ceramics			
Galera Tradition	26649 26652 26656 26657	4	Clear lead glazes on red to buff bodies
Galera Tradition	26658	1	Unglazed Galera paste body sherd
Euro-American Ceramics			
Brown Albany Slip Stoneware	26654 26667	2	2 different vessels, distinct pastes
Salt-Glazed Stoneware-Brown Albany Slip	26653	1	
Yellowware	26650	1	Wheel-thrown ring base
White Ironstone	26651 26655	2	One sherd with tiny fragment of maker's mark
Unclassified Ceramics			
Earthenware	26664	1	Mold-made
BIBE859-C Sandstone Stem Wall			
Mexican Glazed Ceramics			
Presidios Green	26668 26670	4	
Unclassified Ceramics			
Wheel-Thrown Plainware	26671	1	Unglazed Galera Tradition?
BIBE859-D Upper San Vicente			
Mexican Glazed Ceramics			
Green/Rust Majolica	26677	1	Puebla origin
Unclassified Ceramics			
Wheel-Thrown Plainware	26678	1	Pink (5YR7/6); silty paste
Hand-Molded Plainware	26674	1	Pink (5YR8/4); silty paste with dark volcanic rock fragments, uneven surface, coil breaks; Prehistoric?
Hand-Molded Plainware	26673	1	Pale yellow brown (10YR6/4); quartz sand and dark volcanic temper; Prehistoric ?
Wheel-Thrown Slipped Plainware	26675	1	Light brown (7.5YR6/4); no inclusions in paste; matte-yellow slip on interior
BIBE859-E Deep Midden			
Unclassified Ceramics			
Vitrified Sherds	26541	2	Sherds overheated until clay vitrified, body bloated
Wheel-Thrown Plainware	26537	1	

Appendix 13, Table 3 Ceramic Assemblage from BIBE859 in Big Bend National Park, by Subsite. *(continued)*

Ceramic Type	Catalog Number	Total Sherds	Comments
BIBE859-G Tom Millers Neighborhood			
Mexican Glazed Ceramics			
Green-on-white Majolica	26691	1	Guanajuato tradition
Brown-on-white Majolica	26688	1	Puebla origin
Blue and black post-firing painting on orange paste	26686 26692	2	Probably of Mexican origin
BIBE859-I Chiveteros			
Unglazed Earthenware			
Plainware	26697	1	Fine sandy temper with dark volcanic inclusions
Red Slip	26693	1	Fugitive red slip; fine sandy temper with dark volcanic inclusions
Mexican Glazed Ceramics			
Presidios Green Glaze	26695	3	
Euro-American Ceramics			
White Stoneware	26698	1	Crucible?

BIBE1910 (41BS1836) The Longue Duree

Ceramics recovered from BIBE1910 suggest at least two separate occupations (Tables 4 and 5). Based on the presence of 1 red-slipped and 13 polished plainwares, the first occupation of the site dates to a generalized prehistoric period sometime between A.D. 300 and 1450. The second occupation of the site dates to the latter part of the nineteenth century. The presence of three sherds with Johnson Brothers maker's marks suggests that these pieces were probably purchased before 1890, but after the arrival of the railroad to West Texas. The presence of the Meakin maker's mark also indicates a post 1890s occupation of this site that continued into the twentieth century. Ceramics imported from Mexico were procured and used alongside Euro-American pottery throughout the second occupation of this site.

Appendix 13, Table 4 Ceramic Assemblage from BIBE1910 in Big Bend National Park.

Ceramic Type	Catalog Number	Total Sherds	Comments
Unglazed Earthenware			
Polished Plainware	26112 26120 26125 26126 26127 26142 26145 26147	13	Volcanic-rich sediments used as temper; possibly from the same vessel; Prehistoric
Red Slipped	26146	1	Hematite slip/wash on exterior surface of jar rim; sands containing dark volcanic inclusions; Prehistoric

Mexican Glazed Ceramics			
Galera Polychrome	26113 26116 25117	4	Slip-painted
Galera Tradition	26084 26096 26109 26121 26129	21	Undecorated lead-glaze
Tonala Burnished Ware	26114	1	
Mexican Brown Lead Glaze	26043	1	
Euro-American Ceramics			
White Ironstone	26054 26058 26067 26088 26099 26101 26102	7	
Albany Slip Stoneware	26086 26087 26103 26138	8	
Transfer-Print	26085 26091 26106	3	2 Blue; 1 green transfer
Yellowware	26097	13	White glaze rim; same vessel
Porcelain	26093 26110 26095	5	Specimen 26095 has overglaze painting

Appendix 13, Table 5 Maker's Marks from BIBE1910 in Big Bend National Park.

Ceramic Type	Catalog Number	Span of Production	Reference
Johnson Brothers Royal Ironstone	26054	1883-Present	Sussman, Lynne (1985:75)
Johnson Brothers Royal Ironstone	26058	1883-Present	Sussman, Lynne (1985:75)
Johnson Brothers Royal Ironstone	26067	1883-Present	Sussman, Lynne (1985:75)
J.G. Meakin White Ironstone	26085	After 1891	Kovel and Kovel (1995:202)
Stubenville Pottery Company White Ironstone	26099	1879-1959	Lehner (1988:447)

BIBE1920 (41BS1846) Shootist's Jacal

This site is a homestead. Like the unglazed earthenwares recovered at other sites, the presence of dark colored volcanic rock fragments in the sediments of the miniature bowl and unidentified fired lump suggest both types of vessels came from geologically similar clay sources as the prehistoric and historic plainware from the collection (Table 6). The hand molded miniature ceramic vessel made from local clay and the unidentified fired clay lump recovered from the site suggest the presence of children at this location. The presence of Johnson Brothers and J.G. Meakin maker's marks indicate that the site may have been first occupied during the later nineteenth century (Table 7). The Stubenville maker's mark suggests that the site's occupation continued until the early twentieth century.

Appendix 13, Table 6 Ceramic Assemblage from BIBE1920 in Big Bend National Park.

Type	Catalog Number	Total Sherds	Comments
Mexican Glazed Ceramics			
Galera Tradition	26206 26250	4	
Euro-American Ceramics			
White Ironstone	26164 26181 26220 26249 26166 26243	6	
Albany Slip Stoneware	26248 26252	2	
Glaze-Decorated Ironstone	26257	1	Plate rim
Transfer-Print	26198 26255	3	
Decalware	26221 26222 26253	3	26253 Angel decal
Porcelain	26237 26251 26254 26258	5	26251 over-glaze decorated; 26254 and 26258 from same small bowl (toy?)
Unclassified Earthenware			
Miniature fired bowl	26216	3	Pinch-pot (three fragments)
Unidentified fired clay object	26229	1	Hand-molded object

Appendix 13, Table 7 Maker's Marks from BIBE1920 in Big Bend National Park.

Ceramic type	Catalog Number	Span of Production	Reference
Johnson Brothers Royal Ironstone	26164	1883-Present	Sussman, Lynne (1985:75)
Johnson Brothers Royal Ironstone	26220	1883-Present	Sussman, Lynne (1985:75)
J. G. Meakin White Ironstone	26181	After 1891	Kovel and Kovel (1995:202)
J. G. Meakin White Ironstone	26249	After 1891	Kovel and Kovel (1995:202)
Stubenville Pottery Company Ironstone	26166	1879–1959	Lehner (1988:447)

BIBE1942 (41BS1868) Pantera

This site represents the abandoned village of Pantera. The presence of 10 undecorated plainware sherds suggests a possible prehistoric or historic indigenous occupation of the site or contact with native peoples (Table 8). Based on the abundance and types of Mexican and Euro-American ceramics recovered from this site, the major portion of the occupation dates to the late nineteenth or early twentieth century. The presence of the "Noritake" maker's mark suggests the site was occupied until just prior to the establishment of BBNP (Table 9).

Appendix 13, Table 8 Ceramic Assemblage from BIBE1942 in Big Bend National Park.

Type	Catalog Number	Total Sherds	Comments
Unglazed Earthenware			
Plainware	26408 26411 26416 26419 26421 26424 26434	15	Light reddish brown (5YR6/4); temper: limestone, sands, and dark volcanic fragments; 26416 a rim sherd with a scalloped lip; 26421 a rim sherd from a small jar
Mexican Glazed Ceramics			
Galera Polychrome	26417 26431 26433	3	26417 brown exterior slip, weathered white decoration, clear lead glaze interior
Galera Tradition	26400 26410 26423 26425 26432 26435 26426 26429	17	26426 and 26429 fragments from two different molcajetes with characteristic interior incisions inside a bowl form; 26423 stamped exterior design
Guanajuato Green Glaze	26409 26436	3	
Unclassified Green Glaze	26407	2	Overfired or burned, coil-constructed
Tonala Tradition Red-slipped	26415	1	Red paint on white earthenware rim sherd, water-jar neck?
"Massiveware"	26403 26420 26422 26438	17	Local clays tempered with sherds and sands containing dark volcanic rock fragments and unmixed clay fragments
Euro-American Ceramics			
Brown Rockingham Ware	26412	1	Teapot lid
Decalware	26402 26427	6	Sherds from same cup or setting
Luster-Painted	26461	1	Porcelain body, glaze-paint and luster paint
Ironstone	26401 26406 26440	3	
Porcelain	26399 26404 26405 26413 26414	5	Same vessel; swan design band below lip on exterior of vessel
White Porcelain Doll fragment	26418	1	
Unidentified	26428 26430 26437 26439	5	

Appendix 13, Table 9 Maker's Marks from BIBE1942 in Big Bend National Park.

Ceramic Type	Catalog Number	Span of Production	Reference
Owen China White Ironstone	26401	1902–1932	Lehner (1988:333)
Colonial Pottery Company Ironstone	26440	1903–1929	Lehner (1988:100)
Unidentified	26428	NA	
J. G. Meakin White Ironstone	26406	After 1891	Kovel (1995:202)
Unidentified "Made in Germany"	26437 26439		
Noritake Porcelain	26414	1921–1953	Fisher (n.d.)
Unidentified "Germany"	26430		

BIBE2030 (41BS2247) Lower San Vicente

This site is the lower (southern) portion of the town of San Vicente that lies nearest the present channel of the Rio Grande. Although probably settled somewhat later, parts of this site are contemporaneous with portions of the original, upper San Vicente townsite, sometime during the late nineteenth century probably prior to the arrival of the railroad. The presence of the possible prehistoric plainware sherd at BIBE2030-F is suggestive of a prehistoric occupation (Table 10). The presence of decorated earthenware at this site, which was also present at the upper San Vicente townsite, indicates that this craft tradition persisted into the nineteenth century. That some of the Red-on-Brown and plainware ceramics recovered from this site were also produced locally is indicated by the presence of the fired miniature vessel.

Occupation of the lower portion of San Vicente may have continued after the abandonment of the original townsite as evidenced by the Limoge maker's mark which suggests that the occupation of this site may have continued until the founding of BBNP (Table 11).

Appendix 13, Table 10 Ceramic Assemblage from BIBE2030 in Big Bend National Park.

Type	Catalog Number	Total Sherds	Comments
BIBE2030-A Crossing Campsite			
Unclassified Ceramics			
Fired hand-molded miniature bowl	26548	1	Sand with dark volcanic rock fragments in clay
Mexican Glazed Ceramics			
Presidios Green	26547 26550	3	One sherd burned, glaze melted
BIBE2030-F Kitchen Midden			
Mexican Glazed Ceramics			
Presidios Green	26569 26571 26584 26585	4	Coverage and thickness of green glaze variable
Guanajuato Green Glaze	26577	1	
Majolica (Puebla origin)	26574	1	Blue/rust rim
Galera Tradition	26568 26575 26578 26579 26581	7	Black lines on light brown paste with clear glaze or clear glazes only
Galera Paste	26567	2	Undecorated Galera paste

Euro-American Ceramics			
White Ironstone	26583	1	Maker's Mark indecipherable
Blue Transfer-Print	26580	1	Handle
White Stoneware	26576	1	Crucible?
Unclassified Ceramics			
Plainware	26570	1	Paste: interior and exterior dark red (2.5YR3/6); exterior surface: polished; black core; temper sands with dark volcanic rock; Prehistoric
Plainware	26572 26573	3	Paste: interior and exterior: pink (7.5YR7/6); exterior of two sherds are heat spalled; one sherd with pores where organic matter was burned out; temper: sand with dark volcanic inclusions; Prehistoric
Stoneware	26582	1	Unidentified form; black interior glaze
Wheel-thrown Earthenware	26566	2	Bowl
BIBE2030-G Twin Lime Kilns			
Unglazed Earthenware			
Red-on-Brown	26591	1	Paste: reddish yellow (5YR7/6); temper: sands with dark volcanic rock fragments
BIBE2030-H Cobble Pavement			
Mexican Glazed Ceramics			
Presidios Green	26595	2	Refit
Presidios Green (?)	26596	1	Spotty green glaze; burned after firing?
Unclassified Ceramics			
Wheel-thrown Decorated	26597 26594	2	White and green pigments/glazes weathered from the surface
Wheel-thrown Earthenware	26598	1	
BIBE2030-I Stanley Elliott's Grandfather's			
Unclassified Ceramics			
Mold-Made Incised Earthenware	26614	1	Base of vessel? fine paste; one large white calcareous grain in surface
Molded Basket form from sculpture	26615	1	Tonala-like gray paste; Jalisco origin?
BIBE2030-J Purple Crown Stobber			
Unglazed Earthenware			
Red-on-Brown	26608	1	Large bowl sherd, Paste Light reddish brown (5YR6/4) Temper: Sand with dark volcanic rock
Mexican Glazed Ceramics			
Guanajuato Green Glaze	26607	1	
Galera Tradition	26605	1	Light yellow floral designs; fine line-work with raised spots of white glaze
Majolica (Puebla origin)	26609	1	Light and dark rust paint with black lines
BIBE2030-K Elliot's Frame House			
Unglazed Earthenware			
Red-on-Brown	26625	2	Large bowl sherd (1.2 cm. thick) and jar sherd; paste: light reddish brown (5YR6/4); temper: sand with dark volcanic rock
BIBE2030-L Lower San Vicente/Elliot Jacal			
Euro-American Ceramics			
White Ironstone	26631	1	Limoges China Company

Appendix 13, Table 11 Maker's Marks from BIBE2030 in Big Bend National Park.

Ceramic Type	Catalog Number	Span of production	Reference
Limoges China Company White Ironstone	26631	1900-1955	Lehner (1988:262–264)
White Ironstone	26583		

BIBE2085 (41BS1971) Crescent Silt Terrace

BIBE2085 produced a ceramic assemblage that includes Red-on-Brown earthenwares as well as ceramics produced in Mexico (Table 12). A few Euro-American pottery sherds were also noted on the site, but not collected. The single majolica sherd of Aranama Polychrome has a production span of 1800–1900 or possibly into the nineteenth century (Fournier 1997:214). The co-occurrence of this majolica type and the sherd of Presidios Green with local indigenous ceramics suggest that the historic component at this site may date as far back as the eighteenth or early nineteenth centuries.

Appendix 13, Table 12 Ceramic Assemblage from BIBE2085 in Big Bend National Park.

Type	Catalog Number	Total Sherds	Comments
Unglazed Earthenware			
Red-on-Brown	26733 26734 26737	3	Sherds possibly from the same jar
Mexican Glazed Ceramics			
Presidios Green	26735	1	
Aranama Polychrome Majolica (Puebla origin)	26736	1	Yellow/black/rust

Conclusion

This analysis of the ceramic collection from BBNP adds to our understanding of regional lifeways during a particularly complex and poorly understood period spanning the Late Prehistoric to the Historic periods. Ceramics in archeological contexts have been virtually ignored in past work conducted in the park. With the exception of the La Junta area, this has also been true across the Big Bend region. This is partly the result of the predominance of largely aceramic hunter-gatherers in the region throughout prehistory. It has also been the result of researcher bias towards prehistoric sites at the expense of early historic sites from which the bulk of the present collection is derived. Because the current BBNP project sought to partially address this deficiency, the current analysis represents the first ceramic study conducted for the park and is the largest ceramic study yet conducted in the region outside of La Junta.

Unglazed earthenwares make up the third largest category of ceramics represented, accounting for approximately 21 percent of the analyzed specimens (excluding redundant sherds from the same vessel). Of these, the majority (51 percent) are believed to represent locally made ceramics dating to the early historic period. Most tend to have similar colored pastes and tempers containing abundant volcanic rock fragments believed to be locally derived. These plainwares are poorly understood and present the most persistent research questions dealing with regional ceramics.

A small minority of earthenware sherds analyzed represent known prehistoric ceramic types from outside the region. Only three such types were identified: El Paso Brownware, Chupadero Black-on-White, and Rockport Black-on-Gray. These sherds provide limited evidence of mobility and/or exchange during the Late Prehistoric period across a vast area extending from coastal Texas westward to far West Texas and southern New Mexico. This extensive trade pattern was later documented for the La Junta area by seventeenth century Spanish explorers (Wade 2003:72).

Both El Paso Brownware and Chupadero Black-on-White have been reported previously in the La Junta area as well as from Big Bend Ranch State Park (Wright 1996). These vessels likely arrived in the area through trade with groups living in southeastern New Mexico and Far West Texas (Hill 2009). Chupadero Black-on-White has been traced to origins in east-central and southeastern New Mexico, but was widely traded across a much broader area extending eastward to Central Texas and westward to Arizona.

The El Paso area is believed to have been the major source of prehistoric ceramics recovered from the La Junta area, based on their abundance in the ceramic collections from excavations at the Millington and Polvo site (Cloud et al. 1994; Shackleford 1951, 1955; Kelly et al. 1940). However, re-examination of the collections from the Polvo site by the author found that the high incidence of El Paso Polychrome in the ceramic assemblage was due to the presence of a single very large vessel that, when broken, produced a much higher quantity of sherds than were represented by local types.

The Rockport Black-on-Gray Type II sherd, a well-documented type produced along the Texas Gulf Coast by Karankawa Indians from ca. A.D. 1250–1825, represents the greatest range of trade and mobility evidenced in the current collection. It also represents the first such sherd identified in West Texas. While there is no documented link between coastal Texas Indians and those of the Big Bend region, such a connection is plausible through the far-traveling and trading Jumanos, who were known to attend large trade fairs in Central or South Texas. In fact, indirect contact between the Bravo Valley aspect peoples of the La Junta area and the Karankawa has been previously hypothesized (Kelley 1955, 1986:139).

In the late 1930s and 1940s, J. Charles Kelley devised the only ceramic typology that has been developed within the Big Bend region. Although specific to the La Junta district located some 26 miles upstream from BBNP (and which contained the only known prehistoric agricultural village sites in the region), his typology is potentially applicable to a wider area, including BBNP. As Mexican and Mexican-American settlement in the region expanded beyond the La Junta area (and local Spanish Presidios) in the early historic period, it is likely that local ceramic traditions attended such settlement.

Although Kelley's typology was only preliminary, and still needs to be formalized and verified through additional work, it has been supported by independent INAA and petrography (Robinson 2004; Rodriguez-Alegría et al. 2004). Kelley believed that many of the plainwares and Red-on-Brown wares were locally produced from around A.D. 1450 to at least 1800, although it is clear the ceramic tradition persisted well into the historic period.

Local ceramic production apparently carried forward, if only sporadically, to present times. As noted by archeologist Donald Lehmer, ceramics were still being produced locally by two Mexican families in Ojinaga during his research in 1939 (Lehmer 1939:186). More recently, a local potter was documented working as late as 1994 in Redford, although apparently for personal or local use (William A. Cloud, personal communication 2012). Generally, however, these earthenware sherds are most commonly found in relatively early Mexican-American sites, with later sites and Anglo-American sites typically containing more stoneware, white ironstone, and other Euro-American types. Consequently, a tentative date range of ca. 1450–1950 for local made unglazed earthenwares in archeological contexts is proposed, although it is likely the tradition continues in an abbreviated fashion even today in rural areas in Mexico.

Plainware specimens believed to represent locally made prehistoric pottery include sherds from BIBE859, BIBE1684 and BIBE2030. The polished plainware sherds recovered from BIBE1910 and the red-slipped sherds recovered from BIBE859, BIBE1910 and BIBE1738 may also represent locally made prehistoric ceramics. Both polished plainware and red-slipped ceramics have been recovered from the La Junta area as well as Big Bend Ranch State Park (Wright 1996:154; Kelley 1986; Hoyt 1994; Hill 2008). The presence of these locally produced plainware and two types of red-slipped ceramics recovered during the Big Bend survey demonstrate the variability of locally-produced probable prehistoric ceramics from western Texas.

The presence of historic Native Americans in BBNP was also represented in the ceramic assemblage. The most outstanding example of this is the broken, nearly complete probable Apache vessel from BIBE516. As the Big Bend area falls within the traditional range of the Mescalero Apache, the presence of Apache ceramics should not be surprising. In fact, it seems odd that more of these vessels have not been recovered from BBNP and the region.

The most common types of probable historic locally crafted ceramics recovered from BBNP are plainware and Red-on-Brown earthenwares that together make up 33 percent of the unglazed earthenwares. These types are characterized by ceramic pastes that fire to a reddish yellow or light reddish brown and contain sands that include dark colored fragments of volcanic rock. Both the Red-on-Brown sherds and plainwares are believed to represent local or regional ceramic production during the eighteenth and nineteenth centuries.

The consistent association of plainware and Red-on-Brown ceramics with locations known to have been occupied during the nineteenth century or that were associated with nineteenth century Mexican and Euro-American ceramics supports the historic dating of this type of pottery. Red-on-Brown ceramics with decorations similar to those recovered from BBNP were produced by the Tigua of Socorro and Ysleta, Texas, well into the nineteenth century (Brown et al. 2003; Hill 2002b, 2005). However, the two types are distinct. Tigua ceramics are a darker brown color than the historic native-made pottery of the Big Bend area and contain much coarser sized sands that occasionally include granite from the nearby Franklin Mountains (Hill 1991, 2002a, 2002b). Although no systematic comparison between the decorative style of El Paso area Red-on-Brown ceramics and those of the Big Bend region has been conducted, the similarity of the protohistoric and historic Red-on-Brown decorated Tigua, La Junta, and Big Bend ceramics suggests contact between these areas (Kelley 1986; Wade 2003:69).

These types of ceramics have also been reported from Big Bend Ranch State Park and the La Junta area (Wright 1996:153; Kelley 1986; Hoyt 1994). Historic decorated and plainware ceramics in the La Junta area have been referred to as Conchos Plain and Conchos Red-on-Brown, types proposed by Kelley that have not been formally described (Kelley 2004:213–124; Wright 1996:153).

Additional sherds collected from San Vicente display throwing marks suggesting they were wheel-thrown while another displays finger impressions from being pressed into a mold. These wares were probably produced regionally (in Mexico) if not locally in the village of San Vicente. The hand-molded clay objects in the collection, including miniature pinch pots recovered from BIBE1920 and BIBE2030 make a case for both locally made ceramics (literally on-site) as well as the presence of children. The so called "massiveware" recovered from BIBE1942, is also believed to have been locally produced and probably was used either for water storage or may have had small-scale industrial applications.

Mexican Glazed Ceramics account for approximately 33 percent of the analyzed specimens. Of these, the majority (47 percent) are considered to be from the Galera tradition. The second in abundance (16 percent) are typed as Presidios Green. Guanajuato Green Glaze and Galera Polychrome each account for around 8 percent of the Mexican collection. The remainder is spread across the various identified types. Prior to the arrival of the Southern Pacific Railroad in 1882, Mexico served as the primary source for mass-produced pottery for residents of the Big Bend. These vessels were used extensively in local households for both cooking and storage.

With one notable exception (BIBE246), all the glazed Mexican ceramics were recovered from sites along the Rio Grande, which is indicative of earlier settlement in this part of BBNP. The larger sites, especially San Vicente (BIBE859 and BIBE2030) and BIBE1942, produced multiple types. Galera tradition glazeware was recovered from nine sites including BIBE859, BIBE1594, BIBE1674, BIBE1747, BIBE1842, BIBE1910, BIBE1920, BIBE1942, and BIBE2030. In addition, multiple sherds of Galera Polychrome were recovered from BIBE1910 and BIBE1942. Presidios Green Glaze was recovered three sites, BIBE859, BIBE2030 and BIBE2085. Commonly found at presidios and mission sites, these ceramics serve as good temporal diagnostics believed to date from the sixteenth to the nineteenth centuries. Guanajuato Green Glaze was recovered from three sites, BIBE1695, BIBE1942, and BIBE2030.

Mexican glazed ceramics recovered from BIBE2085, including Presidios Green and Aranama Polychrome, probably date from the time of the Mexican Republican period or early Texas Statehood. Along with the presence of decorated earthenwares these majolica sherds may suggest an affiliation with the nearby Presidio San Vicente, particularly considering that the site is only 1 kilometer due west of the presidio, and was probably the nearest site along the Rio Grande that was suitable for habitation.

The modified Puebla Blue-on-White sherd recovered from BIBE246 (the only site containing majolica located away from the Rio Grande) likely represents a Spanish vessel that was traded for or stolen, and is thus indicative of historic Indian presence, possibly the Mescalero Apache. The possible intended re-use of the sherd as a gorget or spindle weight has been documented in assemblages of the Tigua at Ysleta, Texas, and elsewhere.

Euro-American ceramics account for approximately 33 percent of the collection, the same proportion as Mexican glazed ceramics. The most common variety of Euro-American pottery that was recovered during the survey is white ironstone. Including decorated (transfer-print) and undecorated forms, this type makes up approximately 46 percent of this class of ceramics. This was followed in abundance by porcelain, Albany Slip stoneware, and decalware. The remaining types occurred infrequently.

Made either within the United States or Europe, these ceramics generally do not appear in domestic archeological contexts until after the arrival of the railroad in the northern part of the Big Bend in 1882. Significantly, the majority of the maker's marks on the ironstone sherds are of British origin, suggesting that these vessels were likely brought to the Big Bend area prior to the McKinley Tariff Act of 1890.

Although a large variety of Euro-American ceramics are still produced today (such as porcelain and ironstone), some, such as yellowware (1827–1922) and Albany slip stoneware (ca. 1870–1940) have bracketed manufacturing dates, making them useful temporal diagnostics. In addition to the sherds lending temporal information, some also supply functional information such as the possible assay crucibles from BIBE859 and BIBE2030-F as well as the ceramic figurine from BIBE1942—the former two suggestive of mineral prospecting, the latter suggestive of families and domestic habitation.

This ceramic analysis has addressed a subset of the material culture of the Big Bend that has received scant attention outside of the La Junta district, and virtually none within BBNP. Of the entire ceramic collection, relatively few are known or suspected to date to the prehistoric period suggesting a very limited or nonexistent prehistoric agricultural-sedentary adaptation in BBNP. Rather, the vast majority come from later periods reflecting increasing settlement during the protohistoric and historic periods.

Almost all of the collected ceramics were recovered from sites along the Rio Grande. This partially reflects survey and collection bias that had several components. For one, some of the largest survey blocks were along the river, and the sites found there were more complex. But there were also many more ceramics found in sites along the river, and collections made there reflect greater ceramic abundance. Also, the ceramics found along the river sites tended to be more diverse, and included many more sherds that appeared to represent earlier time periods and/or appeared to be locally made. Consequently, collections targeted ceramics that had more import in interpreting these potentially early sites. Sites in BBNP further from the river tended to be later and many were dominated by Euro-American wares that were easier to identify in the field, and thus were not collected.

Although the present study is groundbreaking in many ways, it is also preliminary and should be seen only as the starting point for future research. It is hoped these data will supplement other artifactual analyses and special studies in reconstructing the lifeways of prehistoric and historic people of the region. Future research on BBNP ceramics should focus on a number of different avenues. The largest gaps are those relating to the local ceramic tradition that appears to extend from prehistory nearly to the present-day. Testing for local production of ceramics should be conducted through INAA, petrographic analysis, and resource surveys to locate potential sources of pottery clay. Also, direct dating of sherds using optically stimulated luminescence (OSL) should be conducted to construct a more refined chronology for this poorly documented period. Taken together, these analytical criteria can serve as the foundation for a much needed ceramic chronology and typology based on absolute dating and compositional attributes.

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Appendix 14

Management Considerations at Big Bend National Park

Thomas C. Alex

Background on Cultural Resource Management

Big Bend National Park was established in 1944 for its natural and scenic qualities and for public recreation. Little recognition was given to the significance of cultural resources until the passage of the National Historic Preservation Act of 1966. Between 1944 and 1966, many of the old abandoned ranching, farming, and mining structures had begun suffering from deterioration. The loss of structural integrity led to the subsequent collapse of roof systems and walls and many of these structures became safety hazards. By the mid-1950s, park staff began a systematic dismantling project and razed many to the ground. Other more remotely isolated structures that received little public visitation were left to natural processes of deterioration.

The National Historic Preservation Act (NHPA) of 1966 and subsequent amendments declared a national policy of historic preservation, and encouraged preservation at the state and private levels; authorized the Secretary of the Interior to expand and maintain a National Register of Historic Places including properties of state and local as well as national significance; authorized matching federal grants to the states and the National Trust for Historic Preservation for surveys and planning and for acquiring and developing National Register properties; established the Advisory Council on Historic Preservation; required federal agencies to consider the effects of their undertakings on National Register properties and provide the Advisory Council opportunities to comment (Section 106). The act was amended in 1976 (Public law [P.L.] 94-422) to expand Section 106 to properties eligible for as well as those listed in the National Register. It was amended in 1980 (P.L. 96-515) to incorporate Executive Order (E.O.) 11593 requirements (see below), to give national historic landmarks extra protection in federal project planning, and to permit federal agencies to lease historic properties and apply the proceeds to any National Register properties under their administration. The act was amended again in 1992 to, among other things, redefine federal undertakings, address "anticipatory demolition," and emphasize the interests and involvement of Native Americans and Native Hawaiians.

Executive Order 11593, *Protection and Enhancement of the Cultural Environment,* of May 13, 1971 (36 Federal Register [FR] 8921) instructed all federal agencies to support the preservation of cultural properties; directed them to identify and nominate to the National Register cultural properties under their jurisdiction and to "exercise caution . . . to assure that any federally owned property that might qualify for nomination is not inadvertently transferred, sold, demolished, or substantially altered."

Beginning in 1968 and continuing into the 1970s, the National Park Service (NPS) contracted for a series of historic resource studies in Big Bend National Park (BBNP) that identified sites having historical significance and good integrity. These sites and districts were then evaluated and listed in the National Register of Historic Places. The listed sites consisted of Castolon and Old Castolon, Homer Wilson Blue Creek Ranch, Hot Springs, Sublett Farm/Rancho Estelle, Mariscal Mine, and the Luna Jacal.

In 1973, the NPS Regional Office contracted Southern Methodist University to conduct a literature review and field survey assessment of five national parks and monuments, including BBNP. The *Archaeological Assessment of Big Bend National Park* (Bousman and Rohrt 1974) provided a summary of the current knowledge of archeological research at the park and abstracts of extant writings pertinent to park resources.

By 1980, the park's first permanent resource management specialist, Carl M. Fleming, initiated a system of data collection for cultural resources. Casual archeological and historical site observations by park rangers and staff were noted on 5 x 7 index cards and locations were plotted on a United States Geological Survey (USGS) base map having a scale of 1:100,000.

In 1981, Fleming hired a second resource management specialist, Vidal Davila, who was tasked with an informal inventory of historic structures and ruins. Although Davila was untrained in standard documentation methods, he nevertheless recorded about 400 historic structures scattered over the park's landscape. The study revealed the extent of historic properties within the park and the significant need for formal documentation and evaluation.

Archeologist Thomas Alex arrived at Big Bend National Park in July 1982 and served as a volunteer to begin relocating the sites documented by T.N. Campbell in the 1966-67 survey (Campbell, 1970). Alex continued as a volunteer archeologist until June 1983 when Fleming hired him as the park's first staff archeologist to conduct a survey of powerlines that were scheduled for rehabilitation and reconstruction. Alex worked as a seasonal technician on this project and also worked alone or with volunteer assistance conducting occasional surveys for NHPA Section 106 compliance on various maintenance and construction projects.

Although NPS as a whole experienced funding reductions during the 1980s, the park received funds for a variety of construction and maintenance projects, all of which required a level of Section 106 compliance. These projects occurred simultaneously and the day-to-day operation of survey, monitoring, and mitigative actions was ad-hoc and uncontrollably spontaneous in nature. It was common to move from survey work on the park boundary in the morning to monitoring bulldozer work on the powerline in the afternoon and then jump to an underground utility installation the next day. The work load was such that fieldwork was scheduled by the needs of the day and even to the hour. There remained little time to complete comprehensive records, analyze artifacts, and coordinate curation with the collateral duty curator, and certainly little time for writing reports to professional standards in a timely manner. Most reporting consisted of short reports for compliance correspondence. Until the 1980s, all NHPA Section 106 compliance was conducted by the regional office. The 36 CFR Part 800 and NPS-28 Handbook (1980) guided park level Section 106 compliance and, Alex, as the new park archeologist, also became the Section 106 coordinator for NHPA compliance.

In 1982, there was no centralized file of cultural resource data. Historical publications, some archeological reports on the Lower Pecos area, and a few technical reports on rockshelter excavations east of the park, all resided in the library of the Interpretive Division. In the Resource Management office, scanty archeological data was limited to only 42 sites which were noted on 5 x 7 index cards with very limited information and no locational data. Alex began acquiring literature on previous archeological work in the Big Bend and greater Trans-Pecos Texas region and in the park files, found a manuscript copy of T.N. Campbell's Archeological Survey of the Big Bend National Park, 1966–67 (Campbell 1970) which proved a most invaluable asset as a synthesis of archeological information specific to the park. Alex also found typed manuscript reports from the work done in 1936–37 by Erik Reed and Ruel Cook during the Civilian Conservation Corps (CCC) era of park history (Reed 1936; Cook 1937). Campbell's report indicated that some information was available for at least 277 sites recorded during the 1936–37 surveys and Campbell had recorded an additional 351 sites in the park.

Alex also made the accidental discovery while inspecting a drawer of old correspondence files dating back to the tenure of the park's first superintendent, Ross A. Maxwell, of a small spiral notebook that had fallen into the back of the drawer. This turned out to be the original field notes of Erik Reed's 1936–37 survey that had been presumed destroyed in BBNP's CCC Museum fire of December 1941. This document included sketch drawings and other miscellaneous notes that were not included in their typed manuscript and these additional notations aided in locating a number of sites. Thus, the acquisition of archeological data specific to the park was a top priority. There was an urgent need to establish an archeological database and determine baseline site condition information.

During 1982, Alex visited data repositories at the Texas Historical Commission, Office of the State Archeologist, and Texas Archeological Research Laboratory at the University of Texas Balcones Research Center in Austin, Texas. Site locations plotted on maps at these repositories were hand-copied to a set of 1:24,000 7.5 minute USGS topographic maps for use at the park. The site locations plotted on these maps were derived primarily from the Campbell survey and the 1973 archeological assessment by Southern Methodist University. Interestingly, three reference sets of maps at the repositories in Austin had discrepancies in location plotting. In some instances, a site may have been plotted at three different locations on 7.5 minute topographic maps. All plottings were transferred to the park set of base maps and a program was initiated to revisit these sites and determine which plotting, if any, was the correct location. The relocation and confirmation of Campbell's sites has been an ongoing project since 1982.

Alex continued working as a seasonal employee until May, 1985 when ranger Davila transferred to another park, at which time Alex was hired as a permanent staff archeologist and cultural resource specialist. Although the accumulation of responsibilities dealing with historic preservation as well as historical, ethnographic, and cultural landscape resource management diverted attention away from archeological resources, the primary focus remained on archeology. Much effort went toward obtaining funding for inventories to fulfill NHPA and EO 11593 requirements and funding requests were made annually that listed a comprehensive survey of the park as a high priority.

In the late 1980s, Alex began collaborating with then-State Archeologist Robert J. Mallouf on several field investigations in the park. This eventually led to a proposal by the office of the state archeologist and BBNP to conduct a sampling survey of the park's cultural resources (Mallouf et al. 1990). The document was instrumental in bringing attention to the need for NPS funding for this important research. By the time NPS funding actually became available, Mallouf had moved to assume the directorship of the Center for Big Bend Studies (CBBS) at Sul Ross State University (SRSU) in Alpine, Texas.

The NPS funding acquisition process has been, and still is, biased toward nationally significant resources, parks that were established for historic and archeological significance, and national historic landmarks. National Park Service funding allocations typically are distributed to the "cultural" parks before "natural" areas such as Big Bend, whose resources are considered significant under National Register criteria at the local and state level only. It was not until the mid-1990s that Big Bend received its first infusion of funds specifically designated for a park-wide comprehensive archeological sampling. This funding allocation, from the Cultural Resource Preservation Program Base, provided only for the first three years of a multi-year project. Initiated in 1995, the project ran successfully until 1998 when it experienced a funding hiatus. In 2004, additional funds became available from the Servicewide Archeological Inventory Program. The project resumed in the spring of 2005 under a cooperative agreement between the NPS and SRSU and was completed in the spring of 2010. This report details the results of that project.

Management Needs

Among the most pressing of management needs is the accumulation of baseline data in accordance with EO11593 and the NHPA. The database must contain sufficient information to allow evaluation of the significance of a resource, and to determine the current condition of the resource before the particular preservation needs and methodologies can be planned. Simply stated, management is unable to design preservation strategies for unknown or poorly understood resources.

The evaluation of "significance" of BBNP's archeological resources has been hampered by a longstanding lack of data about prehistoric lifeways in the region and how local resources related in the broader cultural context. Scanty research has left many gaps in the archeological record. The long-term research by Mallouf into the archeology of TransPecos Texas and the interior of the Big Bend, specifically, clarified many questions regarding what constitutes significant archeological remains. Thus, the partnership with Mallouf instilled in the project a solid foundation for interpreting the park's cultural resources.

Significance of the resource is largely determined by factors of value to the scientific community, the state of preservation of archeological features, gaps in the park's database, and the value of particular site data in answering various questions regarding the region's history.

Data Management

Until the late 1980s, all data management was done manually with typewriters, Xerox machines, carbon and thermal based copies, and paper-based file keeping. The transition to digital data management occurred around 1988. With the acquisition of Geographic Information System (GIS) computer technology in 1991 and improvements in data collection technology, a gradual shift in site recording phased out instrument mapping in favor of a Differential Global Positioning System (DGPS) to improve accuracy and because software advances, primarily by *Environmental Systems Research Institute* (ESRI), allowed direct conversion of field data to the desktop computer platform. Even so, the increased accuracy of instrument mapping continues to be used for intrasite data collection (transit or total station and AutoCAD). General survey and reconnaissance data collection requiring less accuracy (2–5 meters) is done with GPS units equipped with Wide Area Augmentation System (WAAS) satellite differential positioning.

Data collection in the twenty-first century is routinely done using WAAS DGPS data collectors with ESRI GIS software. The addition of the Global Navigation Satellite System (GLONASS) and new handheld DGPS data collectors capable of using it has greatly improved field data collection and cultural site mapping. DGPS equipment used by park management consistently has accuracy to within 2 meters, which is acceptable for general site documentation and current NPS data management standards. As GPS equipment and satellite technology evolve and GIS data management improves, the NPS must stay abreast with these changes.

Obtaining baseline data and maintaining current information on the condition of resources are paramount among management issues. Without these scientifically based data, management decisions are ill founded and subject to the capriciousness of park managers. The fact that only about 10 percent of the park has been surveyed means that about 90 percent of the park's archeological and historical resources remain undocumented. The data recorded during recent decades have established a viable baseline by which to make assumptions about high probability areas for significant sites. Future funding requests should target high probability locales for inventory and condition assessments that will complement the existing dataset.

This massive dataset can only be managed by an adequately staffed GIS with a data manager and technicians to maintain the constantly growing databases. Additionally, the park needs to continue hiring a full time staff archeologist to manage these complex datasets.

Curation

In 2008, construction was completed on the current Science and Resource Management curatorial facility. A full time curator position was established although funding and staff time was shared between Fort Davis National Historic Site and BBNP. The park collection requires monitoring, conservation and protection, and proper catalog management. The work load is such that a curator is needed year-round to manage and insure protection of the increasing collection of cultural and natural resource specimens. However, in 2013 the park curator moved to another agency and the position has not been refilled. The park has since gone into default on its responsibility for accounting for and maintaining collections according to NPS Museum Standards. Until the NPS fills the curator position, an agreement must be in place to house collections from this archeological survey project at the CBBS.

Visitor Interpretation and Historic Contexts

Because BBNP was established for its scenic value and recreational opportunities, interpretive visitor services have suffered in much the same way that archeological research has suffered. To date, very little effort has been made towards interpreting past human occupation aside from National Register historic sites and districts that receive the major interpretive focus. To address this deficiency, the park needs to develop a range of historic contexts for use in interpretation and public education. Such historic contexts will aid the park in a number of ways, notably for use in general park planning documents as well as in preservation planning for the stabilization, repair, and maintenance of historic and, potentially, prehistoric structural remains.

Historic contexts will also be useful when developing interpretative displays of cultural objects as new exhibits are created. Geology and, particularly, paleontology are heavily interpreted in the park and in 2015–2016 an elaborate paleontological exhibit was constructed. However, the park lacks any comparable displays for historic and prehistoric museum objects and a representative selection of these artifacts should be displayed when such exhibits are designed and built.

It is also strongly suggested that one or more prehistoric and/or historic sites should be fully developed with trails and interpretive signage bearing a strong preservation message. As it stands, the park discourages visitors from accessing most archeological sites. One of the consequences of this policy, however, is a missed opportunity to educate the public and to instill a much-needed preservation ethic in keeping with NPS policy and federal mandates.

Threats, Disturbances, and Impacts to Scientific Values

Natural deterioration, erosion, gravity, and exposure to weathering threaten sites and structures throughout the park. Climate change may have more devastating consequences than we currently understand and the park must prepare by promoting research into climate change effects within BBNP.

The Rio Grande corridor has proven to contain the highest density of prehistoric and historic sites, many of which are among the most scientifically and historically important in the park. However, changes in the river flow regime has increased the frequency of catastrophic flooding on the Rio Grande. Such flooding, along with the unpredictability of river flow rates and timing (much of which is decided by Mexico) threatens riparian corridor sites. Incidents of trespass livestock from Mexico along the Rio Grande have also increased and it is well documented that these impacts to riparian corridor sites are significant and irreversibly destructive. Consequently, there is a pressing need for an intensive survey of the entire Rio Grande corridor to document sites and impacts to sites as well as establish a baseline from which to measure future change. Priority should also be given to inventories and condition assessments of locales that experience high visitation ranked on the degree of visitation each locale receives.

Rock art fades in sunlight and increased solar intensity and UV radiation will hasten the loss of significant imagery, while increased rainfall and sheetwash erosion are most responsible for degradation of sites, buildings, and structures. Ground dwelling mammals provide additional disturbances to buried archeological deposits and undermine structural foundations, destabilizing architectural features.

Historic and prehistoric architecture is extremely vulnerable to impacts from visitors and from trespass livestock. The more popular sites and those most frequently visited should receive priority for protection, stabilization, and preservation. Trash piles around historic buildings contain intact bottles and other objects that have commercial value. Looters and artifact hunters have learned where archeological sites are typically located and target those locations. Unfortunately, archeologically valuable sites such as rockshelters and caves are highly visible and consequently more vulnerable.

Threats or disturbances that are internal, that is, they come from NPS management choices, are more controllable. A classic example of poorly considered decisions occurred in the late 1970s and early 1980s when the park created a policy of controlling camping by park visitors. The park established a system of permitting for backcountry camping only at designated roadside campsites. At the time, numerous unimproved backcountry roads lead to locations where old homesteads had existed and it was thought that these already disturbed areas would make good designated campsites. There was no need to create new access roads and there were areas such as old corrals and such where visitor camping impacts could be more or less contained.

There was a failure to view these sites as important resources for understanding and interpreting the park's history. For three decades visitors have driven over sites, cleared tent pads, dug latrines, carted off artifacts by the bucket load, and otherwise manipulated and progressively hastened the destruction of prehistoric features and historic ruins in the park. Baseline surveys and impact assessments are needed in these areas to document the nature of these sites and the impacts affecting them. In some cases, NPS campsites should be closed or relocated to reduce such impacts.

Were sites to retain their full complement of intact features and artifacts, the archeological record would be more reliable and more easily interpreted. The present study clearly demonstrates that some significant sites and resources are in peril from natural processes but, more importantly, from human-induced impacts. Throughout the park, but most commonly near developed campgrounds and backcountry roadside sites, there has been a significant loss of cultural materials through theft, vandalism, and uncontrolled visitor activities. Even near historic ranching and farming sites, relic hunting has been a favorite pastime throughout the historic period and the steady loss of artifacts over the past 130 years has severely skewed the surficial expression that would otherwise contribute to sound scientific interpretation of the archeological record.

Even prehistoric occupants acquired, curated, and reused objects from previously occupied sites and thus the presence of Archaic-age materials on a Late Prehistoric site can skew its archeological interpretation. Consequently, surface artifacts alone cannot be trusted to produce consistently reliable data, especially within an area such as a national park where pre-park occupants and park visitors regularly contribute to the rearrangement of surficial data.

Thus, surface artifact distributions cannot serve as definitive temporal markers or as indicators of site use and function without significant qualifications (as is the case in the present report). To arrive at a more complete and accurate archeological interpretation is dependent upon excavations of undisturbed buried deposits from which more reliable temporal and functional data can be recovered. Future study should draw upon the current databases to identify potentially significant research avenues and their pursuit should incorporate systematic subsurface excavation and analysis.

Cross-Border Issues

The past decade has seen a revitalization of communication and cooperation between the U.S. and Mexico. Recognition of common land management issues has been a major driver and several meetings are held annually to devise strategies for cooperative management of the national and state parks and Mexican protected areas. Unfortunately, *Instituto Nacional de Antropología e Historia* (INAH) has not been significantly involved in these meetings—a factor that should be addressed in the future. The following is a basic list of resources and action items of common interest to both countries.

Presidio San Vicente

- Damage assessment from the post-2008 flood housing development on the presidio site
- Remapping, feature identification, and integrity assessment
- Site protection strategy
- Public education on heritage conservation and stewardship building

Presidio San Carlos

- Site integrity assessment
- Damage assessment from road construction and site visitation
- Remapping, feature identification, and integrity assessment
- Site protection strategy
- Public education on heritage conservation and stewardship building

Comanche Trail

- Aerial reconnaissance
- Ground feature identification/evaluation
- Campsite identification and integrity assessment

Riparian Corridor Reconnaissance/Survey

- Comparative study U.S./Mexico site density and distribution
- Prehistoric/Contact Period agricultural site identification
- Inventory and monitoring of impacts from trespass livestock to riparian corridor sites
- Geomorphic correlations with site occurrence
- Hydrologic and climatologic impacts to archeological sites

Rock Imagery

- Site identification and inventory
- Site recording and integrity assessment
- Imagery categorization
- Intrasite imagery characterization
- Protection strategy
- Public education on heritage conservation and stewardship building

- Public education on heritage conservation and stewardship building

Rockshelters

- Reconnaissance and inventory
- Integrity and damage assessment
- Protection strategy

Conclusion

Although BBNP was established for its natural and scenic qualities, the passage of NHPA in 1966 brought recognition of the significance of its cultural resources. Preliminary assessments of the park's resources were modest efforts, but after the park hired its first full time archeologist in 1983, significant strides have been made. In addition to centralizing the existing site data and overseeing numerous Section 106 projects, park archeologist Tom Alex helped develop and secure funding for Big Bend's first park-wide sampling project which dramatically increased the park's archeological database. Even so, many challenges persist and much work remains to be done. Among the most critical are archeological inventory and assessment in areas of high site density and/or that are subject to visitor impacts, a more robust program for interpretation of cultural resources, the employment of a full time curator, and engagement with Mexico to address cross-border concerns. As a result of these pressing needs, it is critical that BBNP also retain a full time staff archeologist to oversee these important tasks.

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Appendix 15

Geographic Information System Model for Predicting Archeological Site Presence in Big Bend National Park

Betty L. Alex

Developing an Environmental Zonation

Background

In the late 1980s, Big Bend National Park (BBNP) began using Geographic Information System (GIS) software and created a GIS Specialist position in 1991. Shortly thereafter, the two original principal investigators for the present archeological sampling project (Mallouf et al. 1990) began discussions with the GIS Specialist about the possibility of creating a "Predictive Model" for the park based on both existing site information and site data to be collected during the project.

The Center for Big Bend Studies (CBBS) of Sul Ross State University (SRSU) under cooperative agreement with BBNP began the project in 1995. Intensive survey of around 13 percent of the park's approximately 800,000 acres was the original goal. A major product of the survey analysis was to develop predictive capabilities for prehistoric and proto-historic cultural resources within the entire park. Geographic Information System analysis was to predict site presence in the unsurveyed 87 percent of the park, based upon the results from the surveyed 13 percent. The first phase of the GIS analysis was to produce a quantifiable system for defining an Environmental Zonation (EZ) within the park area.

Environmental zonation strategies had been used in similar research studies elsewhere in Texas by Robert J. Mallouf, one of the principal investigators (Mallouf et al. 1977), but since the zonation was based on the intuitive denotation of the field archeologist and not on the basis of mappable data, it was deemed of limited use for this project. There are two basic criteria for a GIS system to generate information that can be used for both fieldwork and predictive analysis: the EZ should be quantifiable using mappable data and, given the complexity and depth of the park's environmental data, should contain as few categories as possible to simplify use in the field

Determining Basic Parameters for Environmental Zonation

To define the EZ we first needed to decide which of the data available for the park could yield useful information for the purposes of the project. Johnston and Graham (2012) identified the following as important in determining a significant layer for a model:

- "The phenomena you are modeling must be understood
- What influences the phenomena must be identified
- How the significant layers influence the phenomena must be determined
- Irrelevant information must be eliminated
- Simplify the model
- Complex enough to capture the essence
- Needs to identify enough to address the question"

While Johnston and Graham wrote their paper long after the analysis was completed, this list succinctly elucidates issues that had to be addressed during the creation of the model.

The GIS inventory for BBNP contained most of the basic environmental data available for the area at the time. Vegetative communities, soils, geology, hydrology, elevation, slope, and aspect were the basic datasets considered to have potential to yield meaningful data from analyses. Because several recent natural resource studies had used a digital vegetation map completed in 1987 to define environmental stratifications (Plumb 1987), the initial inclination was to define environmental zones based upon that vegetation map.

However, the climate, vegetation, and details of the landscape have changed drastically during the approximately 10,000 years that humans have inhabited the Big Bend area. Van Devender (1986) reported pinyon-juniper-oak woodlands growing within 0.5 miles of the Rio Grande in BBNP more recently than 11,000 years before present (B.P.), and oak-juniper woodlands remained well developed at the same location until around 8,000 B.P. He estimated that a middle Holocene desert grassland developed near the Rio Grande after 8,000 B.P. and finally gave way to Chihuahuan desert scrub by about 4,000 B.P. Even modern vegetation formations have been altered substantially during the previous 60 years (Ross Maxwell, personal communication, 1992; Roland Wauer, personal communication, 1995), and the author had seen substantial, if localized, vegetation changes in portions of the study area just within the past 30 years. Examples of these more recent changes include:

- the general desertification of the area characterized by the depletion of grasslands and increased erosion due to overgrazing and drought prior to acquisition by the National Park Service;
- the denuding of streams and slopes by lumbering to supply wood to the local mercury mines during the first half of this century; and
- a partial recovery of some grasslands and wooded streams during the tenure of the National Park Service.

These changes are not fully quantifiable because most of the information is anecdotal. Therefore, the use of vegetation for determining environmental stratification for archeological investigations was eliminated in search for more temporally stable datasets.

Looking for more enduring components of the landscape led directly to the geology—perhaps the most persistent component of all. During the Holocene period, the Big Bend has changed from a regime of deposition to one of erosion (Plumb 1987). Initially, a geomorphologist was part of the project staff and his studies, to be conducted during the project, were to clearly define the extent, timing, and duration of these changes. However, the basic geological formations have remained relatively unchanged throughout the prehistoric period.

The mountain ranges of the Big Bend are part of the southernmost extension of the Basin and Range physiographic province of the western United States. Composed of Cretaceous-age limestone that has been uplifted and block-faulted into mountains, and Tertiary intrusive and extrusive igneous rock that originally formed mountains or has resisted erosion to become mountains, the Big Bend landscape is rugged and open, stark and subtle, simple and enigmatic.

The basin and range characteristics of the landscape, regardless of climate, would have tangibly influenced the environment during any period of human history. The high, rugged igneous mountains have always been cooler than the surrounding basins or the lower, temperate slopes of the limestone ranges. Through simple morphological differences, the gravel slopes that form a skirt around the mountains have almost certainly sustained a different flora and fauna than the steeper, rockier mountains, regardless of climatic conditions. The major watercourses, particularly the Rio Grande and Terlingua and Tornillo Creeks, have existed in some form during the entire era of human history in the Big Bend. Regardless of the actual climatic conditions, the geology has influenced land use by plants, animals, and ultimately, by humans more than any other single factor.

However, the geology alone does not define the Big Bend. Other factors such as elevation and slope strongly influence the environment. A strategy was needed to include important data in the model without using the multitude of categories that are generated based off geological factors (i.e., elevation, slope, aspect, terrain diversity, water availability, etc.) The basic EZ that was developed was an attempt to describe a highly diverse environment while maintaining a level of simplicity and interpretability.

The First General Environmental Zonation Design Using Soils and Geology (1995)

The initial environmental stratification scheme was determined with input from the two principal investigators, two junior authors of the Research Design, and a contract geomorphologist. After several discussions addressing the data that was available, the geomorphologist used basic geomorphic divisions to create the initial stratification (Mallouf et al. 1998).

The diverse components of the desert and mountain landscape contribute to the complexity of even the simplest zonation design. Mountainous terrain provides temperature and moisture regimes distinct from those in the basins. Rougher terrain creates barriers to travel, but also provides habitat not available in areas with little relief. These components influence vegetation patterns, soils, availability of game and many other natural factors. The natural factors, in turn, affect and impel patterns of human use. The two major environmental categories, Basins and Mountains, were subdivided into zones that generally describe the natural world using a landscape-based geomorphic approach. oject was shelved indefinitely. ey data was lost; needs clarificationwater availability and other factors. It became clear that

A final zonation design involved describing the environments within the study area to allow analysis of relationships between humans and the different environmental zones. This final design was to be determined through repeated analyses during the survey, and had the potential to become very complex. However, the initial stratification was intended to be simple enough to define the components in the field and allow field checking of the original computer-generated zonation map. Table 1 illustrates the initial geomorphology scheme developed by geomorphologist Rolf Mandell. Mandell defined the categories as follows:

Appendix 15, Table 1 Original Geomorphic Breakdown.

Mountains	Basins
Plateau	Alluvial Fans/Colluvial Aprons (include Footslopes)
Igneous	
Limestone	Alluvial Terraces
Sideslope	Alluvial Plains
Igneous	Badlands
Limestone	
Footslope (see Basins/Aprons)	

Mountains, Plateau: Relatively level areas in upland settings; includes summits, the highest position on a mountain or ridgetop, or a bench or saddle that has little or no net erosion or net sedimentation.

Mountains, Sideslope: The sideslope descends from plateaus and is a zone of net erosion. It is the least stable upland setting.

Mountains, Footslope: The footslope is a zone of net sedimentation (sediment accumulation) at the base of a sideslope. In this geomorphic setting, episodes of sedimentation may be punctuated with episodes of landscape stability. Two types of landform-sediment assemblages have developed in footslope positions: alluvial fans and colluvial aprons. For the beginning categorization, footslopes, while geomorphically part of the Mountain EZ, are functionally parts of the Basin Zone and were originally to be treated as such (see Basins, Alluvial Fans/Colluvial Aprons below).

Basins, Alluvial Fans/Colluvial Aprons: An alluvial fan is a fluvial deposit whose surface forms a segment of a cone that radiates downslope from an apex where the depositing stream or arroyo leaves its upland source area. In Big Bend, the source area is usually a mountain and the deposition area is at the foot of the mountain. Alluvial fans grade upward into steeper debris cones (see colluvial apron discussion, below) and downward into erosional pediments which are cut across the edge of an upland. Pediments nearly always have lower slope angles than fans, and their deposits form a thin veneer across a cut surface while fans are thick depositional features. The lateral coalescence of two or more alluvial fans along a mountain front is a "bajada."

Colluvial aprons have developed immediately downslope of and parallel to the side slopes of the mountains. The aprons consist of clastic sediment shed from the sideslopes, including boulders that form debris or talus cones. Colluvial deposition that produces the aprons is similar to processes that form alluvial fans, except that gravity is the primary agent of sediment transport, and running water is secondary. Colluvial aprons have gently to steeply sloping surfaces and may be deeply dissected by gullies.

Because these sedimentary structures routinely grade into each other, it is often impossible to differentiate, even in the field, the dividing line between a single alluvial fan, coalescing alluvial fans (bajadas), true pediments, and colluvial aprons. The broad alluvial/colluvial structures that devolve from the mountainous areas form the majority of the level terrain that, for human occupation and use, would be functionally part of the Basin Zone. Therefore, for the beginning categorization, alluvial fans and colluvial aprons were considered part of the Basin Zone and will be analyzed accordingly.

Basins, Alluvial Terraces: Alluvial terraces are benches, approximately parallel to the channel or valley walls, which represent former levels of floodplains or valley floors. Terraces may be discontinuous or continuous down the valley. It is typical for the lowest terrace in a sequence to be more continuous than terraces at higher elevations, which are older, more eroded, and more dissected. Terraces are separated from floodplains and each other by steep risers (terrace scarps). Terraces may be cut across bedrock so that they are essentially rock-cut surfaces with a veneer of fluvial sediment.

Basins, Alluvial Plains: Alluvial plains include (1) floodplains and (2) broad plains formed where intermittent drainage elements flow into low areas and deposit their sediment load. Floodplains occur alongside the channel of streams and arroyos; they are relatively flat surfaces and are periodically flooded. Other alluvial plains occur at the base of mountains and in closed basins; these two forms are rare in the Big Bend.

Basins, Badlands: Badlands is a general term for deeply dissected landscapes. In Big Bend, badlands often occur at the distal ends of pediments and bajadas. Badlands are especially common where tuff beds or the Aguja Formation are exposed.

The First Analysis Method

Using the analytical capabilities of GRASS (Geographic Resource Analysis Support System) on a UNIX platform (an early computer operating system) and relying heavily on 16 years of field experience in BBNP, the GIS Specialist began attempting to correlate the desired categories with the GIS data available at that time. Several initial courses of action were explored:

- using slope to differentiate ridges on alluvial fans from slopes;
- using slope to differentiate mountains from foothills;
- using terrain diversity (a number of different slope values within a defined distance) to delineate mountain slopes and badlands;
- defining the EZ based upon geology (Maxwell et al. 1967), then adding in slope values or soils to better describe certain landforms such as alluvial plains and alluvial terraces;
- defining the EZ based upon soils (Cochran and Rives 1985), then adding in selected slope values or geologic formations; and through numerous other methods.

Each of these approaches had positive results in some areas and inaccurate or unacceptably complex results in others.

Through these aborted analysis attempts, two conclusions were reached: first, the EZ's can only be partially described using geology; second, it became clear that soils are a powerful analytical component to use in combination with the geology. Because the formation of soils is dependent not only upon the parent rock but also on other factors such as rainfall, slope, and depositional/erosional processes, it was determined that an analytical combination of the soils and geology might reasonably provide a basis for the development of EZ's as delineated by Mandel.

The first step was to run a coincidence table to see if the number of categories was manageable and if the actual category combinations were, in fact, reasonable and could more closely define the nature of the area landforms (Table 2). The coincidence table indicated a large (n=337) but manageable number of combinations, and most were obviously compatible, such as geologic gravel beds coinciding with soils of obvious alluvial origin. The coincidence table also identified areas where only soils information or only geology information was currently available.

The second step was to run a GRASS module that generated a map showing the 337 combinations created by overlaying the soils and geology maps. Again, there were an additional 35 categories where only soils or only geology information was currently available, and these areas were mapped individually.

After studying the overall map, it appeared likely that the combination of geology and soils could be used to produce a map that would define six distinct environmental areas: Igneous Mountains, Limestone Mountains, Alluvial Fans/Colluvial Aprons, Alluvial Terraces, Alluvial Plains, and Badlands. Future analysis using slope would be necessary to differentiate Plateaus and Sideslopes within the two geologically different mountain subzones.

Using aerial photographs and extensive field experience along with occasional short trips to field check ambiguous areas, it was determined which of the six EZ classes best conformed to each of the 337 combinations. This bivariate analysis took several weeks, since each class had to be addressed individually.

Complexities of the Analysis and Some Solutions

Various complexities of data existed in the newly created zonation map. Some combinations of soils and geology were obvious candidates for specific environmental zones. The Chamberino and Chilicotal soils were generally described as occurring on piedmont or upland slopes and consisting of variously sized gravels. When combined with the Quaternary alluvial geologic formations, these corresponded to the Alluvial Fan/ Colluvial Apron EZ. Areas of Chamberino and Chilicotal soils combined with non-Quaternary geologic formations form Badlands or Alluvial Terraces.

Some geologic categories seemed to easily fall within a certain EZ. However, upon closer examination of the geology/soils relationship and the level of accuracy of the geologic map, it became clear that the relationships were not quite so definitively drawn. For instance, the geologic category Tertiary intrusives (Ti), defined as stocks, laccoliths, sills, and dikes, would always be part of the Mountains, Igneous EZ, and this was generally true. The soils map, however, showed areas of the Glendale-Harkey Association (GHA)—which are exclusively floodplain soils—where the geology was defined as Ti. Close examination of the areas where the two categories overlapped showed that either: 1) the Ti category was indeed the actual bedrock but was overlaid by floodplain soils, or 2) the geologic map was in error.

The same situation existed with the Pantera (PNA), Solis-Chamberino (SCB), Tornillo loam (TOA), and Vieja-Badland complex (VBD) soils (see Appendix B). Often where a stream had eroded a channel across an igneous bedrock outcrop, the overlying soils were either Alluvial Terraces or Alluvial Plains. The SCB forms badland topography. There were almost 700 acres of Ti geology included within the SCB soils. The areas were initially analyzed as Mountains, Igneous, but field examination showed that while the Tertiary intrusives are, in fact, present upon the surface of the ground, they do not form "mountain" topography. Instead they enhance the roughness and erosional features of the non-igneous, usually clay badlands surrounding them.

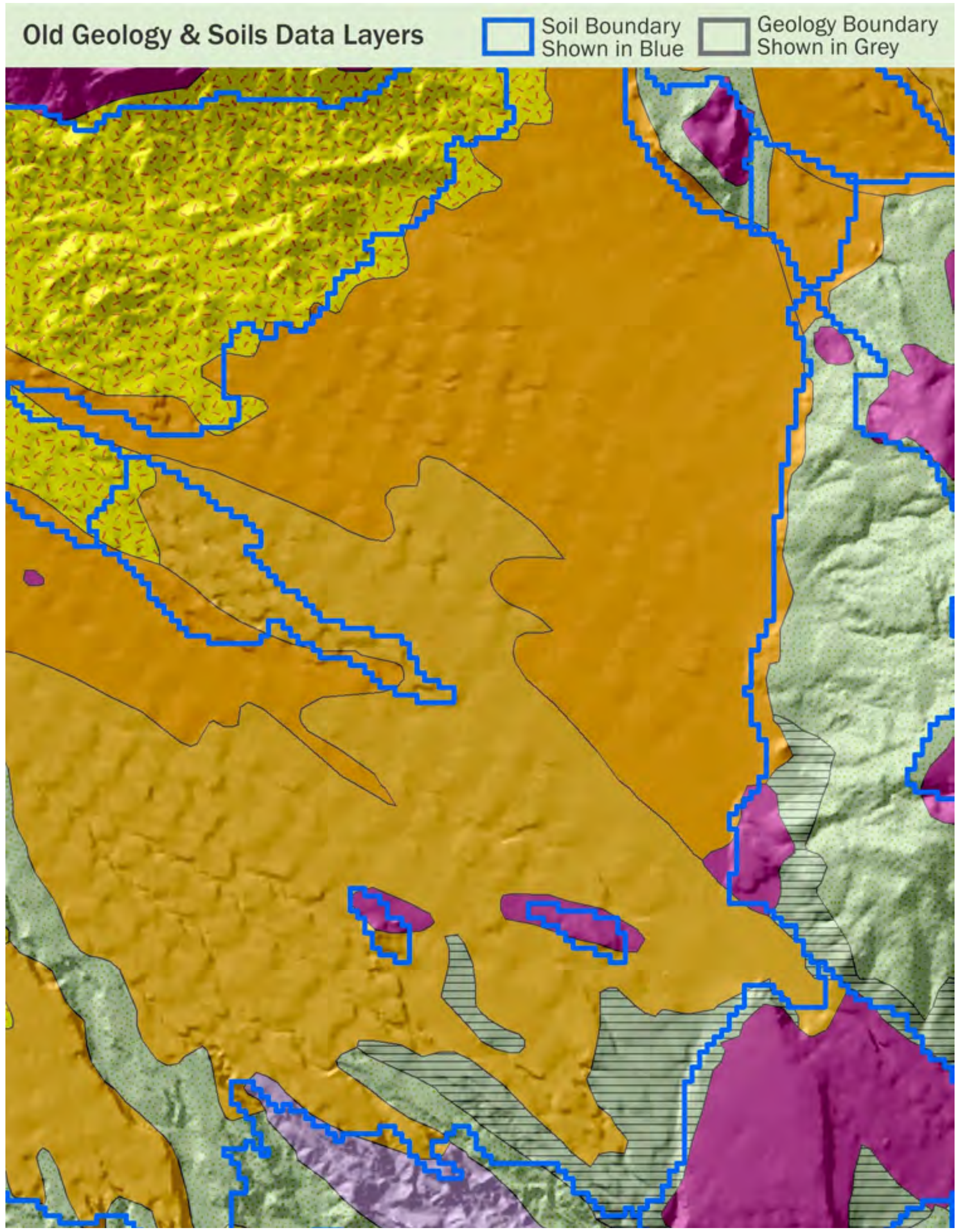
A few of the soil units are defined to the same level and by the same basic criteria as the EZ categories and it was reasonably easy to determine affiliation for those soils. Vieja Badland complex clearly belonged in the Badlands EZ, and GHA conformed to the Alluvial Plain EZ. Tornillo Loam was originally placed in the Alluvial Plain EZ, but upon close examination, areas where this soil was concurrent with Thh (Hannold Hill Formation), the area more closely resembled the Badlands EZ.

Similarly, while many soils would appear to automatically fall within a particular environmental zone, there were numerous exceptions when considering the effect of geology. The Ector Rock Outcrop complex, steep, is described as "soils on limestone hills and mountains" (Cochran and Rives 1985), but upon closer examination it became clear that there were small areas where igneous intrusions into and through the limestone were mapped as Ector soils. Therefore, the combination of Ector soils and Ti geology was placed in the Mountains, Igneous EZ rather than the Mountains, Limestone EZ.

The Brewster-Rock Outcrop complex is described as "soils on summits, shoulders, and back slopes of igneous hills and mountains." However, there are areas that are mapped as limestone on the geologic map—and are in fact limestone—that are mapped on the soils as Brewster-Rock Outcrop complex. Again, the geologic considerations outweighed the soils, and these areas were placed in the Mountains, Limestone EZ.

The next step in improving the accuracy of the EZ categories and the precision in delineating the edges of those categories required refining the data used for the initial analysis. The soils map, while the most accurate of the data layers used, had some minor omissions, such as a few pixels of missing data at the edges of 7.5 minute quadrangle maps and along the park boundary. Additionally, the soils map was a raster map causing the edges of mapped areas to be very "blocky." This lack of precision was to be rectified by matching the geologic boundaries to the soils boundaries after the problems with the geologic map were resolved.

Figure 1 demonstrates several of the issues with the original two datasets. Boundaries that logically should have been concurrent between the two data layers were substantially different due to the scale issue and to the blocky nature of the soils polygons.



Appendix 15, Figure 1 *Map showing original geology and soils data.*

The geology map had several accuracy errors. This map was digitized from a 1:250,000-scale map (by Army Corps of Engineers, Dallas) and some errors resulted from using such a small scale map. Other errors occurred during digitizing: some areas were mislabeled while others were incorrectly digitized. The mapping across the area varied on the original map because some data sources were detailed and others were more grossly mapped. In some areas of the map, similar geologic formations were aggregated into single categories and, in other areas, those same formations were mapped separately. These difficulties were to be remedied by: 1) doing some carefully controlled redigitizing of selected areas of the original 1:250,000-scale geology map; 2) digitizing the 1:62,500-scale map of the geology of BBNP (Ross Maxwell et al. 1967). Digitizing Maxwell's map would also have allowed some finer resolution of certain EZ's in areas where they are intricately intertwined.

Following the correction of the original data and the addition of Maxwell's geologic data, the original analysis was to be rerun. Then, using slope data from the Digital Elevation Model (DEM), the plateau and sideslope categories would be included within the mountainous regions.

A Hiatus in Sampling–Hardware, Software, and Conceptual Changes

However, at this point several unforeseen events occurred. First, it became clear that the Maxwell geology map did not conform to any georeferenced datum. The GIS office at the Southwest Region National Park Service (NPS) Headquarters in Santa Fe, New Mexico digitized the surface geology from the map, but repeated and intensive attempts to match the geologic boundaries to georeferenced data failed. Apparently, during the creation of the map, considerable "artistic license" occurred and no amount of georeferencing or "rubber sheeting" that was possible with the technology of the time could produce an accurate map. The entire map would need to be redrawn on a georeferenced set of maps and those then digitized or scanned to produce a usable data layer.

Secondly, the NPS decided GRASS software and UNIX platform would be abandoned and all data converted to Windows / Environmental Systems Research Incorporated (ESRI) software, specifically ArcView. The information and data on which this analysis was based is archived in the GIS files, but the final product of the analysis, the original EZ layer, was lost through an unfortunate series of events at the time of the software conversion. The data had to be converted using software and hardware not available at BBNP, so the entire computer system was shipped to the Intermountain Region (IMR) Denver GIS office of the NPS. That was at the time of the "Y2K scare" and computer systems in the IMR office and from parks around the IMR Region were being surplused and destroyed. The person responsible for accepting the hardware and software from BBNP and for doing the conversion suddenly became severely ill and was not in the office for several months just at the point when the computer system arrived in those offices. The entire system, including all data backups, was caught up in the Y2K surplus project and destroyed before any data conversion occurred. This was a loss not only of the already digitized archeological survey data and the analysis accomplished to date, but also of around six years of GIS data development for BBNP.

Thirdly, in 1998, funding for the archeological survey was withdrawn and the project was shelved indefinitely. There was a significant six-year hiatus before work resumed. During this hiatus, the GIS system was migrated to ESRI products (ArcView and then ArcGIS) on a Windows platform. During those intervening years, the GIS Specialist attempted to both recreate and improve upon the initial analysis using the Windows platform and software. Using the original soils and geology data produced various products that were only marginally better than the original analysis completed in 1996 using GRASS software. To better define the different areas of the Basin EZ, an entirely different analysis method was attempted, including a complex multivariate analysis (Fuzzy K), using the DEMs and geology layer. Although this produced a better product, each analysis took up to two weeks to set up and up to 72 hours to run, with the computer system only able to analyze about 10,000 acres at a time. At that rate, the 800,000 acres of the park would have required three to five or more years to complete, with no guarantee that the results would integrate into the kind of information needed for the EZ.

The GIS Specialist turned her attention to developing other environmental variable datasets for the park hoping that technology would improve to a level that a usable EZ could be created. When funding and fieldwork resumed on the archeological survey project in 2004, the GIS Specialist was involved in an intensive multi-year biology project and was unable to devote appreciable time to the archeological analysis until the end of that biology project in 2007. Meanwhile, the new digital soils map was in progress, and work on an improved EZ map was delayed until that data became available. The GIS Specialist worked on developing other data layers during that time (see "Environmental Data Used for Site Location Analysis", below).

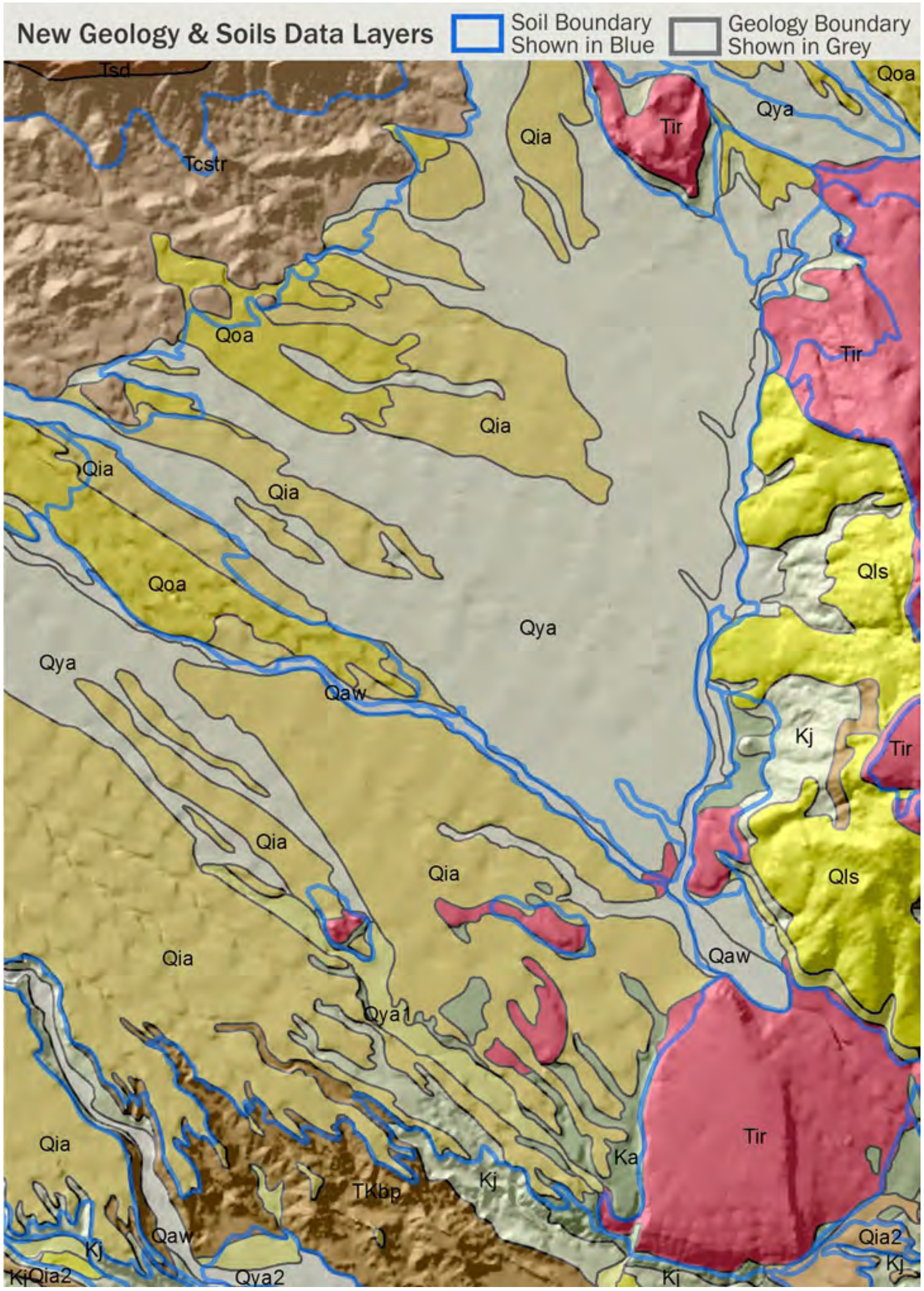
The Second General Environmental Zonation Design Using Soils

When the draft Natural Resources Conservation Service (NRCS) soils data layer became available in 2009, it presented an opportunity to revamp the EZ analysis based on an updated and highly detailed data layer. The older digital soils layer (Cochran and Rives 1985) was originally drawn on USGS 7.5 minute quadrangle maps in paper form, digitized some years later at another NPS facility, and finalized in raster format creating a blocky, "stairstep" edge for all areas. Based on recent, extensive fieldwork, the new NRCS soils data layer used high-resolution USGS 7.5 minute quadrangle digital raster graphic (DRG) photographs. This produced a highly detailed and far more precise map than the original soils data. The edges of the new soils polygons were clean and very detailed. Field checks of some previously problematic areas revealed that the soils polygons very closely matched the geomorphic boundaries that we had previously been attempting to define using the much less precise data layers.

The first goal was to divide the park into its three most basic physiographic subdivisions: Basin, Igneous Mountains, and Limestone Mountains. This basic division was termed EZ1. By the time the second EZ breakdown was complete, the project directors decided to change the project's focus from sampling each major environmental zone (in both mountains and basins) to sampling just those in the basin. Consequently, the issues most significantly affecting the Basin area were used to determine the final definitions of the three EZ's. A direct merge or union of the soils and geology data layers was not practical because of the different scales and mismatched edges. Using only the digital soils layer and the documentation accompanying it, the soils were divided into the three EZ1 zones of Basin, Igneous Mountains, and Limestone Mountains (Soil Survey Geographic [SSURGO] 2012). Differentiation of ambiguous igneous and limestone was accomplished based on the geology map and through field checks (Maxwell et al. 1967). Everything that was not determined to be Igneous or Limestone Mountains would become the Basin EZ1. Later in the project, when we received the new United States Geological Survey (USGS) geologic map (Turner et al. 2011) it became clear that this was a good decision, because the newer geology map boundaries much more closely matched the soils layer than did the previous map (Figure 2). Although the soils formed the components of each of the EZ1s, some soils occurred within more than one of the basic EZ1 zones. To address this, these soils were individually analyzed and categorized.

The following are most of the issues and solutions for defining the Basin area and dealing with anomalous soil areas. All soil data are derived from Turner et al. 2011.

1. The Rock outcrop-Terlingua complex, 10 to 30 percent slopes (RTE) occurred mostly as low igneous hills that some would refer to as "foothills" within the more alluvial Basin Zone. In the soil description, the landform type is defined as "knobs on hillslopes" and the parent material as basalt. They are generally small, low rises in the terrain that are neither greatly elevated nor large in extent. These areas are definitely not Igneous Mountains. However, two small areas of the RTE soils presented a problem that prevents the entire RTE soils from being included within the Basin. One of the anomalous locations is an apparently uplifted area of trachytic lava that occurs on the top of Bee Mountain, and the other is an area of undivided, basaltic rock that occurs within the Dead Horse Mountains. Bee Mountain is composed of various lava flows, most notably Bee Mountain Basalt, and is large enough (ca. 600 acres) and steep enough to be defined as Igneous Mountains surrounded by Basin. To have the very top of the mountain defined as "Basin" based on the soil was not logical or practical. The area within the Dead Horse Mountains that is RTE soil and would otherwise be considered Basin is one of several areas within those mountains where the geology is defined as "undivided basaltic" rock, but all other areas are small enough that, in the soils mapping, they were subsumed into the soil description of the surrounding limestone rock. Only the largest area of the basaltic rock was mapped as RTE. Because these areas were part of the mountains, both were manually placed in the appropriate "mountain" category rather than categorized as Basin.



Appendix 15, Figure 2 Revised geology and soils data layers.

2. The Rock outcrop-Terlingua complex, 20 to 70 percent slopes (RTG) soil generally forms small hills or rises within the Basin Zone, but it also forms the steep slope of Bee Mountain that is composed of basalts and lavas. Only that outcrop of RTG was included in the Igneous Mountains EZ because of the steepness and elevation of Bee Mountain above the surrounding Basin Zone (more than 600 feet).

3. Leyva-Rock outcrop complex, 10 to 30 percent slopes (LEE) and Lingua-Rock outcrop complex, 20 to 60 percent slopes (LGG) soils are rhyolite or trachyte rock outcrops and most of these soils occur in the Igneous Mountains. However, there are small areas of these outcrops that are neither large enough nor high enough (above the surrounding landscape) to be called Igneous Mountains. There are 36,800 acres of LEE soil within the park, but only 516 acres occur within the Basin Zone and the largest area is only 164 acres in extent; all others are less than 70 acres in size. There are 75,800 acres of LGG, but only 1,250 acres occur within the Basin as small hills; the largest is a 250-acre hill that rises slightly above the bajada. These areas were included in the Basin area because they were surrounded by Basin soils and were quite small.

4. Chilicotal very gravelly fine sandy loam, 1 to 8 percent slopes (CIC) occurs almost exclusively on the Fan Remnants on Piedmont Slopes (EZ2) also described as Upper Bajada (EZ3). However, on the top of Burro Mesa there is an alluvial valley that is classified as CIC.

The valley surrounds and is surrounded by igneous rocks and hills that make up a high area that is otherwise classified as Igneous Mountains. That small (233 acres) area was included in the Igneous Mountains EZ. Similarly, the top of the plateau that is formed by the structure of Burro Mesa is classified as Chilicotal-Paisano association, 5 to 30 percent slopes (CLE). This soil is also Fan Remnants on Piedmont Slopes (EZ2) also described as Upper Bajada (EZ3). However, the highland nature of the entire Burro Mesa structure led us to categorize only that area of CLE as Igneous Mountains.

5. The two Geefour Soils were complicated to classify. Both are described as "Clayey residuum weathered from mudstone." However, when comparing certain areas of that soil to the geologic map, and to the physical structure of Igneous Mountains, it is evident that those areas are igneous in nature. Both the Geefour silty clay, 3 to 20 percent slopes (GEE) and Geefour silty clay, 10 to 45 percent slopes (GEF) occur on the flanks of mountains where they have been raised and somewhat metamorphosed by igneous activity. Because those few areas are steep, rocky, mountainous, and surrounded by igneous soils, they were classified as Igneous Mountains while the majority of those soils were classified as Basin because they are erodible and unmodified mudstones.

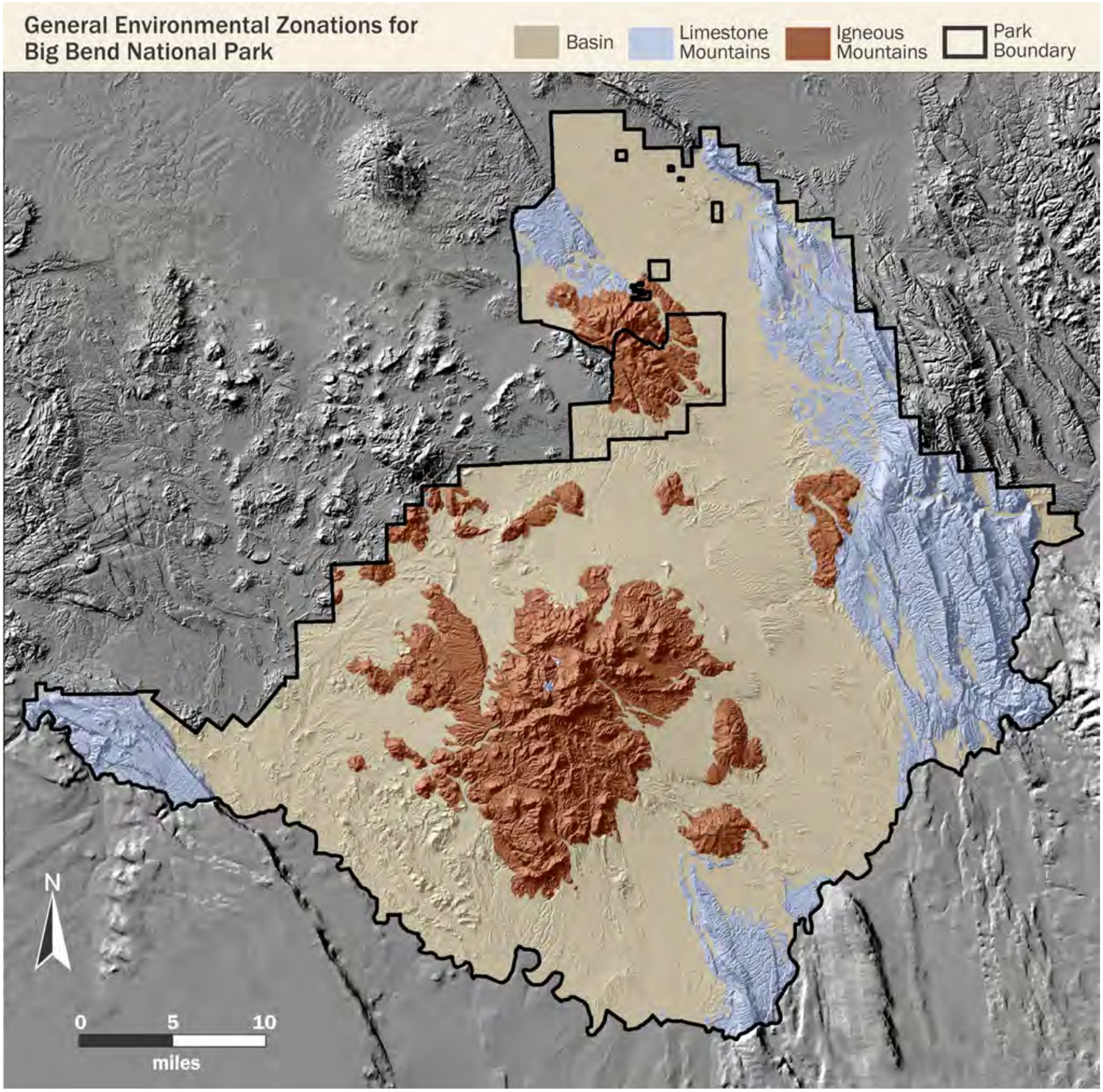
6. There is a similar discrepancy with the Solis-Rock outcrop complex, 1 to 20 percent slopes (SKE). Characterized as "Loamy residuum weathered from sandstone" most of this soil is distinctly Basin in character. However, two steep, rocky areas that were uplifted and metamorphosed by intrusive rocks were associated with large igneous intrusions and were classed as Igneous Mountains.

7. Mariscal very channery loam, 1 to 8 percent slopes (MCC) and Mariscal-Terlingua complex, 10 to 30 percent slopes (MNE), are major components of the Limestone Mountains EZ, but three small (each less than 30 acres), low-lying outcrops occur within typical alluvial fan areas and were included within the Basin EZ.

8. Riverwash and Pantera soils, 0 to 2 percent slopes, frequently flooded (RIA) is a typical arroyo soil and forms almost 11,000 acres of the Basin EZ. One 45-acre area of this soil is captured within an uplifted area of limestone soils and was included in the Limestone Mountains EZ.

During delineation of the three EZ1 categories, various adjustments potentially useful to the analysis were considered. The original desire to categorize the park based on geomorphology led to analyzing the soils data for geomorphologic categories concurrent with the definitions for EZ1. As discussed above, there were some problems defining small montane areas, but most of the mountainous terrain was easily placed in the EZ1 categories. Because the Basin Zone is highly diverse, containing alluvial, clay, limestone and igneous components, it was more problematic; dividing it into subcategories required some trial and error. For example, what constitutes a hill within the basin versus an igneous mountain surrounded by basin? There are numerous igneous intrusions within the area that was generally construed as the Basin Zone, and was not obviously part of the Igneous or Limestone Mountains. There are also some areas, disjunct from the masses of the Chisos and Rosillos Mountains, that are called and appear to be mountains, such as the Bee Mountain example discussed above regarding the RTE and RTG soils.

This issue had to be addressed based on contiguity within the soils layer, on the relationship to the geology data, and on the general "lay of the land." The transition areas between the Mountain and Basin zones were problematic; no definitive combination of factors placed all areas grouped by soils in appropriate categories. Grouped one way, areas that should be categorized



Appendix 15, Figure 3 General EZ's for the park.

as Igneous Mountains became part of the Basin, and grouped differently, flat Basin pediments would have been included in the Igneous Mountains.

Considerable time and energy was devoted to differentiating these areas and making this distinction. Originally, some specific definition of size, slope, and geologic composition was attempted, but the geomorphic variability proved elusive to characterize. Finally, each area was individually evaluated. Areas that were categorized as Igneous Mountains surrounded by Basin had these general characteristics:

- are primarily composed of igneous rock, either intrusive or extrusive;
- are distinctly (visually) raised above the surrounding terrain;

- have an extent of approximately 1 square mile or more; or
- are fulfilling the first two conditions listed above AND are contiguous with a larger area that is already within the Igneous Mountains.

However, some of the soils geomorphic descriptions are very broad; 15 of the 45 soil types occur in two of the EZ1 areas; a sixteenth soil type occurs in all three zones. These soils were manually sorted into geomorphic categories. Although the mountain areas were not analyzed during this project, the data are available for additional work in the future.

To capture the different levels of diversity in the park, three breakdowns were developed: EZ1 is the Basin, Igneous Mountains, Limestone Mountains grouping based primarily on the geology map (Maxwell et al. 1967) and further divided based on individual soils. EZ2 and EZ3 were conceptualized as descriptive subcategories, with EZ2 based on geomorphic groupings and EZ3 based on geologic and/or locational groupings. EZ3 was intended to be either a location (like High Chisos or Rio Grande) that is in itself definitive, or a geologic or structural term that better defines the area like Santa Elena Limestone. However, the creation of an EZ3 category was stymied by repeated delays in the release of the new geologic map for BBNP. Because the geologic map was published long after much of the other analyses were finalized, the EZ3 category was never revisited, leaving the categories based on older data (see Appendices A, B, and C).

The EZ2 breakdown, originally based on the soils' "Ecological Site Descriptions," offers a delineation of landforms that occur in certain soil types. For instance, Pantak-Rock outcrop complex, 10 to 30 percent slopes (PKE) occurs in both the Basin and Igneous Mountains zones and includes both Pantak and similar soils (60 percent) and Rock Outcrop (25 percent), with Dissimilar minor components (15 percent). PKE soils in the Igneous Mountains are distinctively grouped into Side and Lower Slopes and Summit and Side Slopes. The soils description refers to the landform as "hills," but some are quite large, high hills like Paint Gap Hills and Croton Peak, while others are low relief areas along alluvial/colluvial ridgelines. Within the Basin zone, the EZ2 was used to differentiate these two groups by naming the first group High Hills and the second group just Hills, so that these two groups could be analyzed together, separately or grouped with other soils that fit into the High Hills in Basin or Hills in Basin description.

After dealing with each soil type individually and trying to categorize the geomorphology, a few of the original groupings were found to be far too detailed for landscape level analysis. In some cases, subcategories had very little spatial extent. To address this, small acreage subcategories were either adjusted through descriptive changes or were combined with adjacent and larger EZ's. Because the data and information was mostly descriptive and because of the nature of the soils data, some subjective decisions had to be made; the final product was strongly based on the soil descriptions and the original subcategories intended at the beginning of the project.

Environmental Zone 2 categories typically coincide with descriptions used in the soils documentation if the terminology was appropriate (see SSURGO database for BBNP, Texas—2012" to understand the terminology issue). These are generally geomorphic terms and, in cases where they did not originate from the soils documentation, they were derived from geomorphic terminology first developed in the 1990s.

There are several variations on certain landform types: Hills versus High Hills, Dissected Bajada versus Bajada versus Upper Bajada, Dissected Clay versus Dissected Clay Hills, etc. These descriptions were an attempt to retain the original descriptions from the soils layer or to differentiate between different landforms. During analysis, all Bajada descriptive groups could be combined for analytical purposes, if necessary, as it is easier to start with more groups—with the option of lumping them later—than to start with fewer groups that may lack the necessary explanatory power.

This EZ structure originally formed the basis for the planned comparative analysis between the three broadest EZ's: Basin, Igneous Mountains, and Limestone Mountains. Each EZ1 could contain any of the EZ2 and comparison was to be based on those similarly defined. With the focus changed to only surveying and analyzing the Basin Zone, the analysis strategy had to be reinvented. Soils became the basis for the zonation within the Basin, with EZ2 values becoming secondary since they would not be compared to the same EZ2 values in the montane areas. As discussed below, other problems in using the EZ2 breakdown also became apparent.

Conceptualizing the Model

With the EZ developed, the next step was incorporating multiple criteria into a model. During the hiatus in fieldwork, several changes occurred in the modeling concept for the project. It began during what Verhagen (2007) called the "boom" period of archeological GIS applications. During the development of the original EZ, the concept of a predictive model was one that would indicate *specific locations* where sites would be expected to occur.

The idea was to design a sampling scheme that would randomly sample each major EZ, making it a "stratified" sample. However, there were several problems with this idea. First, it quickly became evident that doing a *random* stratified park-wide sampling was highly impractical for financial, logistical, and safety reasons. There simply was not enough money allocated for the project to adequately cover the more rugged areas of the park that would be included in a random sampling. Logistics would have been far more complicated. Moreover, surveying the more rugged and remote portions of the park would put the archeological crew at risk. There were simply too many complications to such an approach.

As a result, the decision was made to abandon random sampling in favor of judgmental sampling where survey block locations would be determined by the project managers. The decision was also made to restrict the remaining fieldwork to the Basin Zone. This area is more accessible and easier to traverse even if on long backpacking trips. Additionally, the Basin comprises the majority of the park (60 percent), and is the area in which most construction occurs and park infrastructure resides (such as new roads, trails, campsites, and other development).

Another reason for abandoning the stratified random sampling was pragmatic as well as financial: there was no money to hire a statistician for the duration of the project, and there was no money to train the GIS Specialist (or anyone else) to the level that such an analysis would require. The idea of creating a model to identify individual sites was abandoned primarily because archeological site records were very inconsistent. Numerous archeological projects had occurred over a 40-year time span and the quality and detail of recording was highly variable, ranging from amateur to professional, from complete site surveys to map dots and a site number, from recording techniques of the 1960s to the GPS era of the twenty-first century. Recording techniques and expertise varied due to changes in technology and personnel even during the present project.

The goal for the new modeling approach was twofold: first, to identify areas within the Basin Zone that had a higher likelihood of site occurrence and, second, in the case of construction projects or other activities with the potential to impact archeological sites, to reduce the area that must be intensively surveyed by archeologists. Thus, a predictive model that would attempt to locate individual sites was replaced by the concept of a "suitability model," one that—instead of attempting to predict the *exact* location of archeological sites—would indicate areas "suitable" for archeological sites of specified types.

Most suitability models are based on the perceptions and preferences of those designing the model rather than direct indications of important values derived from existing data. Suitability models usually predict nothing; they simply identify locations having specific environmental characteristics, indicating the compatibility of an area with specific uses. Most such models indicate areas suitable for a specific project such as a school or a landfill. Often several areas will be determined to be equally suitable, and other non-environmental factors will be used to make the final decision for locating the project.

In this project, the criteria used to develop the suitability model would be based on existing data. A method of determining site classes (discussed later in this section) was to be developed and those classes would be analyzed for environmental criteria occurring within each site class. Environmental zones would be weighted based on the results of the survey data. In practice, then, the model would designate areas having a high likelihood of site occurrence (and that should be targeted for archeological survey) rather than attempting to predict actual individual site occurrences.

With the acquisition of the more powerful ArcGIS 10.x, several possible options were examined for expanding or changing the suitability model for the final analysis. However, after investigating several types of analysis and consulting with the principle investigators on the project, the weighted overlay analysis appeared to be the most straightforward, understandable, and versatile option. This is an analytical method that a non-statistician/mathematician can understand and use, only requiring an understanding of basic relationships and straightforward index values. In a weighted overlay analysis, many data layers with highly diverse values and value ranges can be combined in a single analysis. Each value (or a range of values) in each data layer is reclassified into a common preference scale, with the highest value being the most favorable. Preference values are on a relative scale. In this analysis, the scale used was 1 to 5 (Environmental Systems Research Institute 2014).

Environmental and Archeological Data Used for Site Location Analysis

This section describes the data used for the suitability analysis, construction of the analysis layers, and delineation of campsite classes. The first section covers GIS environmental data and, the second, the archeological data.

GIS-Based Environmental Data Development

Data used for this project was provided by the NRCS (Soils), USGS (Geology and Digital Elevation Models [DEMs]), or was developed in BBNP by the Division of Science and Resource Management. All data layers were projected in North American Datum 1983 (NAD83), Universal Transverse Mercator (UTM) Zone 13 North, the projection used by park staff and the standard of the NPS for in-park (local) data. Early in the project, the raster data (DEMs, soils) was at 30-meter resolution (each pixel covering a 30 x 30 m area). However, the final model used 10-meter resolution (each pixel covering a 10 x 10 m area). All final data layers were constructed using ArcGIS 10.0 Service Pack 3. Grid size for the DEMs and all derivations was 11,945 rows x 10,736 columns, covering the entire park and several miles beyond its boundaries. Due to the rectangular nature of the data and the shape of the park, the entire park could not be included without a significant buffer. Analysis data layers were developed for all areas within this boundary, but the actual modeling was restricted to areas within the federally-owned park boundary.

The newer soils and geology layers were acquired as polygon files (shapefiles in ESRI ArcGIS format). All site boundaries were recorded as polygons (shapefile) data. Modeling results are in raster format (10 m resolution) and polygon (shapefile) format.

The following files were used to create data layers:

Layer	Type	Source
DEMs (Raster)	Elevation values	from USGS
Soils (Vector)	Polygon file	from NRCS
Archeological Site data	Polygon file	from BBNP Archeology and CBBS
Boundary File (Vector)	Polygon file	from BBNP GIS
Springs Value (Vector)	Point file	from BBNP GIS
Streams (Vector)	Line file	From USGS National Hydrography Dataset

Over several months, the two principal investigators, the project archeologist, and the GIS specialist discussed the environmental criteria that should be examined relative to site locations. The already developed EZ2 was the first data layer developed to associate with site location. Several other environmental attributes were also discussed. Slope, access, proximity to water, and aspect were obvious choices. Additional layers to be developed included solar radiation as a way to define preferences for rockshelters, ridgelines, and saddles since preliminary data indicated a prehistoric preference for these features.

Slope

When the sampling strategy changed to judgmental blocks, the principal investigators also made the decision to focus only on campsites within the Basin. Because camping activity usually requires level ground, slope would probably be a definitive attribute. The DEMs were used to define the slope by degrees. Slope was then reclassified into seven categories: 0–2 degrees, 2–4 degrees, 4–6 degrees, 6–10 degrees, 10–22.5 degrees, 22.5–45 degrees and >45 degrees.

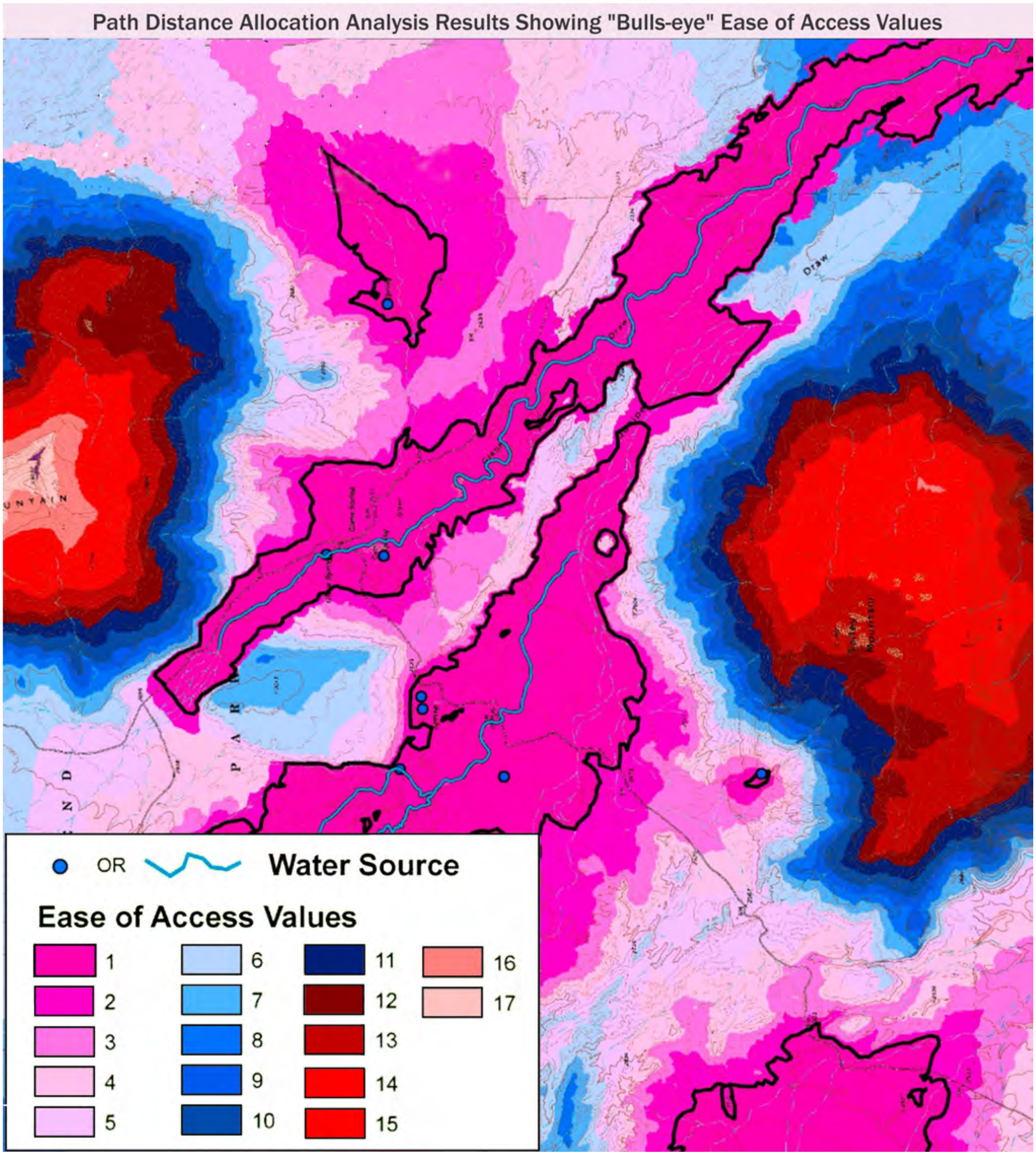
Water Source Analysis

Considerable water source information had been gathered throughout the park's history and a spring database was established in 1976. All known springs within the park were surveyed for water presence, flow rate, wildlife and visitor use, and general vegetative characteristics. The survey was repeated in the mid-1980s and at approximately five-year intervals thereafter. However, no water or other samples were taken, the spring recording forms changed with each survey, and much of the information recorded was anecdotal. The data resided in 40 three-inch-wide, three-ring binders and, beyond simple locational information, the data had never been digitized.

In 2008, the GIS Specialist researched and compiled over 32 years of data about all naturally occurring water sources within the park—a total of 335 springs, seeps, waterholes, and tinajas. The park's spring information was analyzed (see B. Alex 2008). Using a series of evaluation criteria, each water source was assigned a numeric "value." This value, used as an index for water availability, was incorporated into the water source data layer. The water sources were valued on a scale of 1 to 16 with one being a seep or ephemeral water source and 16 being a highly reliable perennial spring with a high flow rate.

A path distance allocation (PDA) analysis determines the minimum accumulative travel cost from a source to each location on a surface and can accommodate for the actual surface distance as well as other horizontal and vertical factors. The DEMs, slope and aspect files were used to derive a PDA analysis using these water source values and the spring point locations. Several areas around springs where there was flat and non-brushy terrain were chosen to determine the values returned in the analysis. Assuming that it is easy access to walk one mile across flat and open terrain, values of several areas were chosen where that kind of terrain extended out from a spring. The values in the PDA analysis for those locations exactly one mile from water sources were averaged and that value was used to define the difficulty of access to a water source. The one-mile easy access value was assigned a value of one as a baseline, a value of two being twice the difficulty of one, and so on. This produced a "bulls eye" type analysis that very graphically demonstrated the ease or difficulty of access to individual water sources and to groups of water sources (Figure 4).

Springs and tinajas are not the only water sources within the park, however. There are several stretches of perennial water in drainages, most notably Terlingua



Appendix 15, Figure 4 Map showing ease of access values.

and Tornillo creeks. But during the past 10,000 years, the wetter regime that existed—especially during the Archaic period—led us to consider incorporating areas where there probably were perennial streams at that time. Several days were spent perusing maps and trying to develop informed guesses about which stretches of streams to classify as perennial. Because this data qualified only as educated guessing, considerable restraint was used in adding locations to the dataset. The GIS Specialist and Park Archeologist have over 60 years of combined backcountry experience in the park and witnessed both the very wet 1980s and the drought of the 1990s. Using that knowledge, stretches of several streams were chosen and a perennial streams layer was created. The PDA analysis was run on this layer using the streams as line files rather than points. A similar analysis was completed on the Rio Grande using the line of the river.

The three layers were merged so that the highest value from whatever water source was most accessible would be included in the final file. The PDA also produced a file that contained polygons showing areas around each water source that provided the best access. These polygons were assigned the water source value previously determined in the water source matrix analysis (Figure 5).

Terrain Analysis for the Mountain Areas

The terrain analyses for the Mountain Zone were completed prior to the change in project focus to the Basin Zone alone. Considerable time and energy was dedicated to the ridgeline and hilltop analysis since it would be a major part of the survey's focus within the two mountainous EZ's (Limestone and Igneous mountains) because those areas, along with drainage edges, comprise the majority of level topography within the montane zones. The DEM file was inverted so that the ridgelines became drainages. A hydrology analysis (an analysis that determines flow direction from DEM's) was run on the inverted DEM creating an inverted flow direction file to define the ridges. Slope then defined the areas along ridges that would be appropriate for campsites. An attempt was also made to define saddles since those areas appear to be preferred for campsites, but no adequate method could be found to differentiate saddles from other flat areas along ridges.

A sink analysis (a hydrologic analysis that identifies low spots) was run on the inverted DEM to locate the peaks. Peaks tops were classified by slope. A method was also developed to define the relief above the closely surrounding terrain so that slight rises were differentiated from moderately high or very high peaks. A hydrological drop analysis (a hydrologic analysis that identifies vertical drops in the DEM's) was run on the inverted DEM producing a layer defining vertical cliffs in the mountains to be used to locate rockshelters.

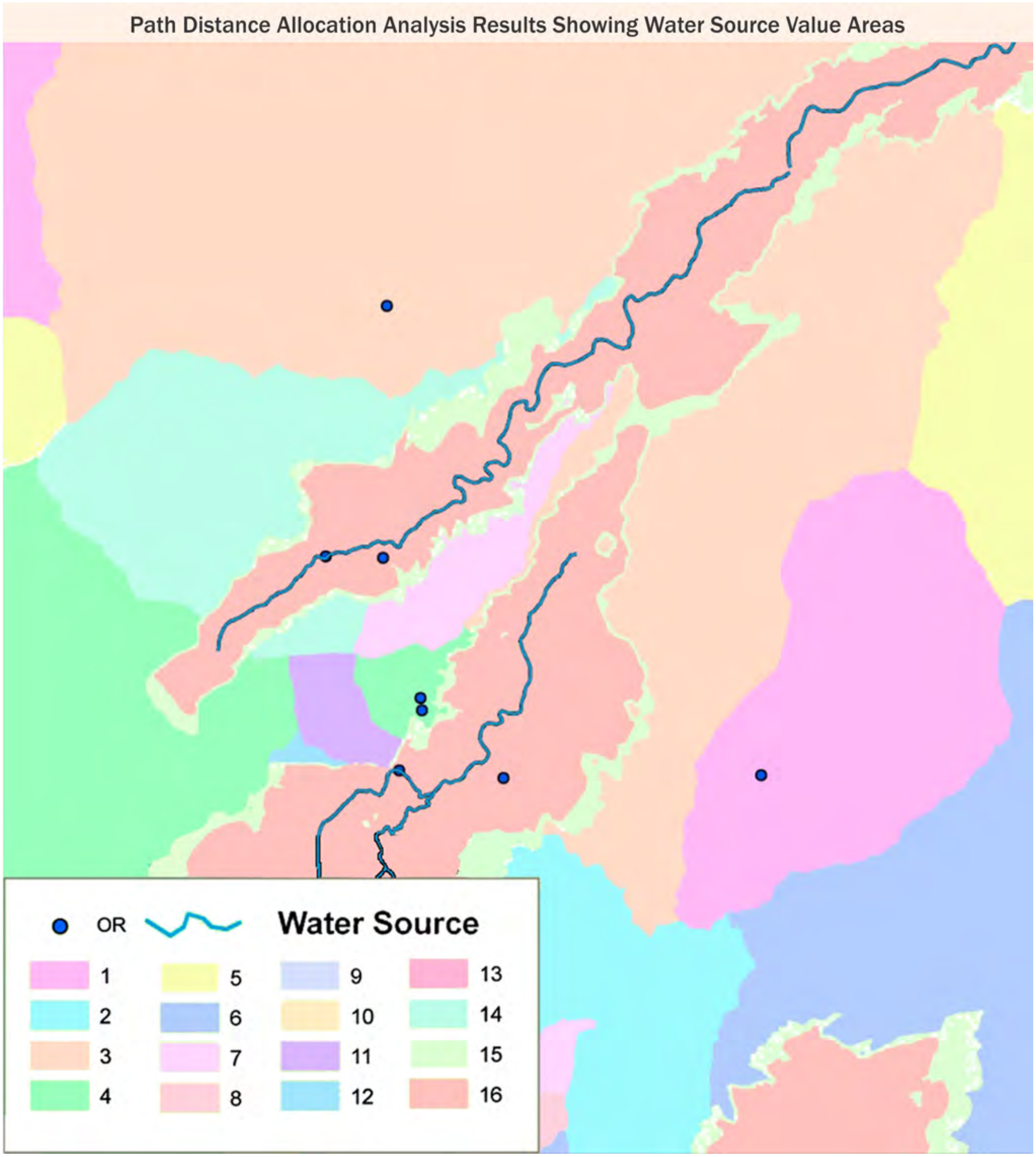
Area solar radiation defines the available solar radiation at the equinox and summer and winter solstices as well as the total solar radiation for a year. Solar radiation analysis was attempted but was ultimately discarded because of the lack of a suitable computer system. A ridges and cliff layer was developed, but was scrapped due to the change in focus on the Basin Zone.

Terrain Analysis for the Basin Area

With the analysis now restricted to the Basin Zone, an analysis area file was created that included only that zone.

At the beginning of the campsite data analysis, the peaks layer was investigated and found to be too complex and not specific enough within the Basin Zone. Similarly, the aspect layer was considered but the vast majority of open campsites occur on relatively flat ground, so aspect was dismissed as a major factor in site location. That left only soils, EZ2, EZ3, slope, ease of access to water and water source value as potential analytical layers. These layers had been developed on a park-wide basis and no additional data layers were planned to be developed for the Basin area.

In March of 2010, a preliminary weighted overlay analysis was run as a test to cover the final field season.



Appendix 15, Figure 5 Map showing water source value areas.

It was hoped that the test and the accuracy of the analysis would illuminate additional potential environmental layers or other analytical approaches. A new, high-powered computer had just been acquired and the entire modeling was going to be rerun on the new computer with ArcGIS 10.x. The draft environmental layers that had been previously developed were used for the test. A general, evenly-weighted analysis was run using the four environmental data layers listed above for the Basin area. Upon looking at the results of that analysis, it became immediately apparent that there was some relationship not previously recognized between site location and elevated areas. Some of these represented sites that bounded the areas of the Igneous and Limestone Mountains, and some were elevated areas within the Basin EZ.

Therefore, another environmental layer was developed and tested against general site location. From the final EZ1 and EZ2 data layers, Igneous Mountains, Limestone Mountains, and all hills in the Basin area (Igneous Hills in Basin, Scarps, Edge of Igneous Hills or Limestone/Shale Hills in Basin) were selected, creating three shapefiles that were merged into a single layer and dissolved to eliminate data overlap. A buffer file with both 0.25-mile and 0.5-mile buffer areas was created. A quick overlay of known site locations showed little or no difference in the two buffer areas for site occurrence overall, so the buffer was rerun using only 0.5-mile distance creating a highlands buffer file. Any areas occurring in either of the two montane EZ's were removed so that areas contained within the Basin but actually occurring on highlands were also included in the analysis layer. This created a highlands file for just the Basin Zone. The preliminary analysis was rerun and the highlands file appeared to add considerable accuracy.

Archeological Data Development

There have been multiple stages of archeological recording in BBNP ranging from casual, amateur records to intensive professional recording. Many projects and recording methods have occurred. Many of those projects included intensive survey resulting in data showing not just site presence, but also site absence. There were numerous "linear surveys" that had been conducted along segments of roads, power lines, trails, and the park boundary. Several projects had overlapping survey areas. All areas that had been intensively surveyed in the park were amassed into a single data layer and overlapping survey areas were merged into single, contiguous blocks. By the time fieldwork for the current project was complete, there were nearly 3,000 sites with reliable locational records and site boundaries. Figure 6 shows a few of the different types of survey areas covered by park projects.

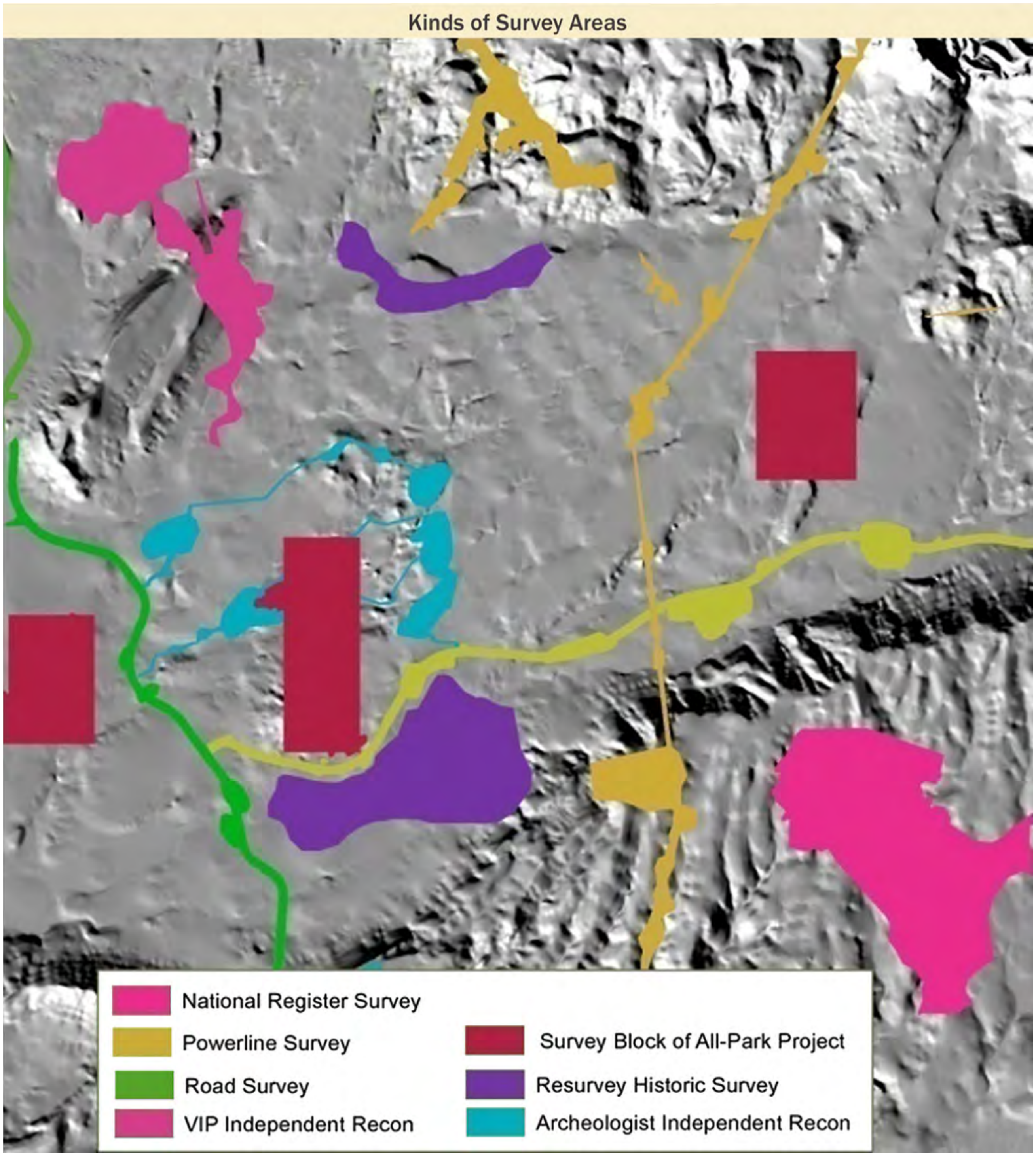
There was also varying levels of "confidence" in the surveys due to the differing levels of expertise of the recorders. Some were done by avocational volunteers, others by professional archeologists. Some were "windshield" surveys along roads, others quick reconnaissance surveys, and still others intensive surveys covering 100 percent of the survey area. As a result, confidence levels of 1–3 were assigned to each different survey, with 3 representing the highest confidence. Only surveys having the highest confidence level were included in the analysis.

As can be seen in Figure 6, several types of surveys were linear in nature. While most of those surveys were intensive and professionally done, the linear nature of the survey tended to skew the data. For instance, a single large site encountered along a linear transect—with the survey area expanded to encompass it—could potentially account for 80–90 percent of the total surveyed area.

To assure that the highest quality survey data was being used to determine environmental variable weights, linear survey areas were extracted from the total surveyed area and reserved as test areas after the weighted overlay analysis was completed. Non-linear survey areas completed prior to the present project and having a confidence level of 1 or 2 were also set aside for data testing. This left only larger contiguous areas that had been intensively surveyed by professional archeologists to be used in the analysis.

The survey blocks for the present project were automatically included in the area that would be used to analyze environmental data, and a few other survey areas were added, especially those that were contiguous with the project survey blocks. Several survey area files were created:

- all surveyed areas within the park;
- surveyed areas within the Basin EZ;
- surveyed areas within the Basin EZ to be used to define the environmental variable weights; and



Appendix 15, Figure 6 Types of survey areas in BBNP.

- surveyed areas within the Basin EZ to be used to test the environmental variable weighted analysis.

Surveyed areas within the Basin EZ to be used to define the environmental variable weights was called the "Model Area" data layer, an area of 60,000 acres within the Basin EZ, or approximately 12.5 percent of the 481,000 Basin acres.

Campsite Data Differentiation

Although a range of prehistoric site types were discovered during the project (such as lithic scatters, procurement areas, and special-use sites), modeling was limited to habitation sites, or open campsites, under the assumption that certain, quantifiable factors went into deciding their location, thus allowing better predictive capabilities. Campsites generally occur on level, open terrain (i.e., not primarily associated with rockshelters, boulder shelters, or other natural shelters although shelters may be minor components of open campsites), and they generally contain such domestic features as hearths, ring middens, and habitation structures. While quarry, rock art, boulder shelters and rockshelters, food processing and other site types may occur within a campsite, any of those site types that had no "campsite" component were excluded from the sites to be analyzed. The "Confirmed Sites" file as of October 2010 (following the completion of project fieldwork) was the data used for the analysis.

All archeological sites for which the park has accurate locational information are contained in a Confirmed Sites data layer that is routinely updated as new sites are discovered or unconfirmed sites (those whose location or level of recording are in question) are given a confirmed location. The Confirmed Sites file was used by the CBBS archeological crew to create a spreadsheet containing 40 fields as listed below:

ASMIS ID	Sheet Midden
Site name	Wikiup Ring
Confirmed location	Cielo
Site Type	Tipi Ring
Secondary Use	Stone Alignments
Tertiary Use	Stone Pavements
Paleoindian	Petroform
Early Archaic	Petroglyph
Middle Archaic	Pictograph
Late Archaic	# of Collections
Late Prehistoric	Collected Point Type
Prehistoric Undifferentiated	# Tools
	Bifaces & Preforms
Historic Undifferentiated	Scrapers
Modern	Hammerstone
# of Amerindian Features	Other Materials Collected
Hearth style	
Hearths	# Other Materials
Hearth Remnants	Manos
Hearth Remnants	Metates
Ring Midden	Mortars

The spreadsheet information was populated directly from CBBS/BBNP project-specific site forms as well as Texas State Archeological Site data forms already on file. Considerable thought and discussion went into a strategy to break sites out in such a way that it might improve the accuracy of the model such as site temporal affiliation or complexity. For our purposes, however a simple "site class" method was chosen based on site content, but criteria had to be devised to parse out the sites. The following set of feature and artifact types was determined by the principal investigators to be among the most significant, and were used in assigning site classes:

Architecture
- Wikiup Ring
- Cielo Structure
- Tipi Ring

Thermal Features
- Hearth
- Hearth Remnant
- Ring Midden
- Sheet Midden

Non-Thermal Feature
- Stone Alignment
- Stone Pavement
- Petroform
- Petroglyph
- Pictograph

Formal Tool Types
- Biface
- Preform
- Scraper
- Hammerstone

Groundstone
- Mano
- Metate
- Morter

To keep the analysis relatively simple, a four-class system was used, with Class I being simple sites with few features and Class 4 being complex sites with evidence of architecture or long-term habitation. The principal investigators and project archeologist met with the GIS specialist and decided the criteria for defining the four classes of open campsites. Because sites containing architecture and/or evidence of long-term habitation often have a higher potential to yield scientific data, those sites were defined as Class 4.

Class 4 sites were defined as:
- Having architectural features OR
  - Having one non-thermal feature
    AND two or more thermal feature types
    AND ground stone artifacts or features
    AND two or more formal tool types

Class 3 sites were defined as:
- Having no non-thermal features
- Having two or more thermal feature types
- AND ground stone artifacts or features
- AND two or more formal tool types

Dividing the remainder of the sites into classes was done by parsing out the simplest sites—sites that are the most common and have few features or artifacts—as Class 1 sites.

Class 1 sites were defined as:
- Having three or fewer hearths or hearth remnants (of only one type)
  AND no other thermal feature types or non-thermal features

All sites not fitting within these categories would fall into **Class 2**.

To define these categories, the GIS specialist created formulas that defined all project campsites by class. These formulas were run on the project master spreadsheet (Microsoft Excel) which extracted all campsites within the Basin Zone. The excel file containing only open campsite information was converted to a dBase database (DBF) file and "joined" to the Confirmed Sites file. Four data files, one for each site class, were created from the basin-only campsites file.

Site Location versus Environmental Data Layers

This section explains assigning Environmental Variable values (EV's) for each analysis layer (EZ's, EOA, Water Value, Slope, and Highlands) to each site, discusses the various statistical approaches that were investigated, and describes the final EV/site data analysis for assigning Weights.

Assigning Environmental Variable Values to Each Site

The areas involved in the environmental variable values ranged from less than 75 acres to over 100,000 acres, and site sizes range from less than 0.002 acres to over 440 acres. Although the original plan was to use points (site centroids) to represent site locations, looking at the EV and site size differences and the many odd site shapes, using points for the sites made little sense. If the centroid of a site was used, it could easily fall outside the EV that was most representative of that site. Some other method of defining the EV value of a site needed to be developed.

After several unsuccessful attempts, the following method was developed and run on each environmental variable. A GIS intersect was performed between campsites and each EV layer (EZ's, EOA, Water Value, Slope, and Highlands). This produced a file of campsites with multiple EV values for each site. Figure 7 illustrates the considerable variation of EV values within sites. The left illustration shows the different soil types and the right shows the differing slope types within a single site boundary. Some small sites were completely within a single soil or slope value, but most contained several EV values for each data layer. Summary statistics was run on each set of site data layers containing the various EV values to determine which value covered the largest area (acreage) of each site, and that maximum acreage value was assigned to the entire site. Figure 8 demonstrates this change.

This assured that each site had a single value for each EV. Most areas eliminated by this selection were small slivers on the edges of sites or areas of different soils within sites that were surrounded by the main EV value. However, there was a possibility that some sites could be assigned values that were inappropriate for their locations. There simply was not enough time to evaluate the nearly 1,800 sites being used for the modeling to determine the most appropriate EV component for each site for each data layer. Comparison tables of acreages before and after the EV value reassignment revealed that most sites were correctly classified, with the acreage changes accounted for by minor area components within the site.

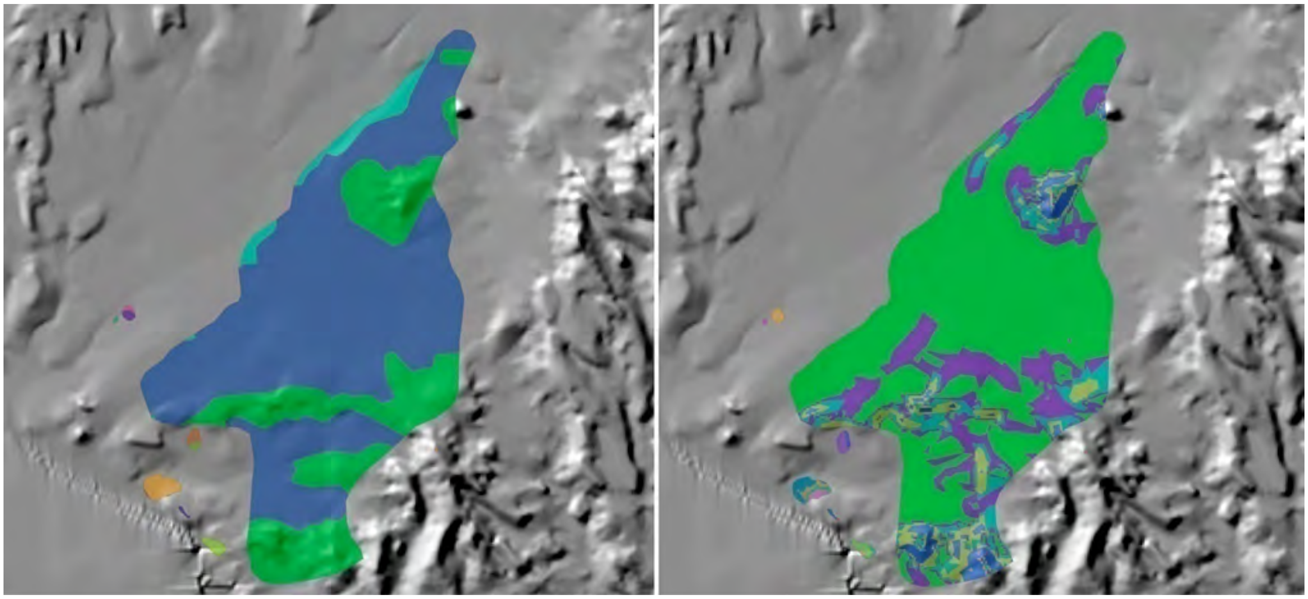
Calculating Environmental Variable Areas

The total acreage for each EV value was calculated using summary statistics in ArcGIS for both the entire Model Area and for each site class. That data was exported as excel spreadsheets to calculate the expected acreage of each EV value category, based on the percentage of total acres within each EV. Actual acres and percentages were entered and a simple ratio calculation was done to begin to determine if the relationship was random or selective. See Table 3 under "Determining the Weights to use in the Weighted Overlay Analysis" for an example of the tables.

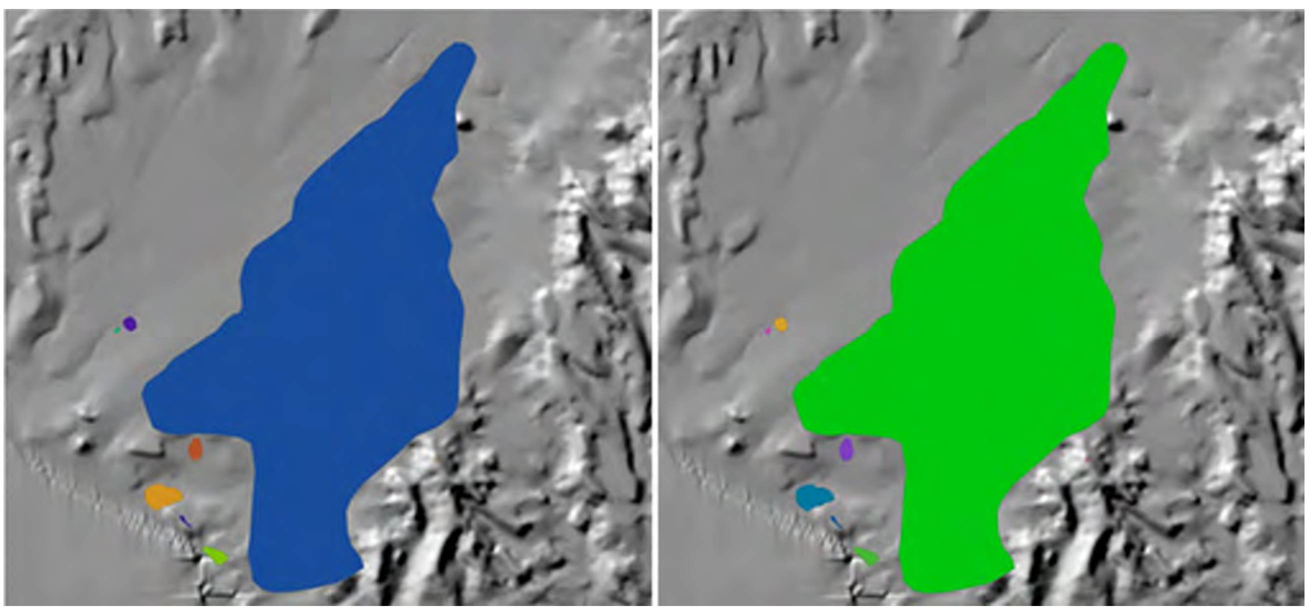
A Modified Approach to Determining the Weights to Use in a Simple Weighted Overlay Analysis

Several directions were considered for determining the weights to use in a weighted overlay analysis. Chi-Square tests were considered but this observation in Rohe (2003) led to a much simpler and more straightforward approach:

> The Simple Weighting Method used in this study focuses on the use of environmental layers that may be created using GIS software . . . Archaeological site locations are compared to the overall background environments to determine uniqueness within specific environmental zones, i.e., 0–5 degrees of slope covers 20 percent of the study area, but contain 55 percent of the known sites. Such a test is similar to Chi-Square tests, but does not test for significance. This method uses the difference between the environmental class percentage (expected) and the site class percentage (observed) to assign weights to each class range and variable. The assumption is made that if archaeological



Appendix 15, Figure 7 Variation of EV values within sites. Colored areas represent sites with different coloration representing soil types on the left and slope types on the right.



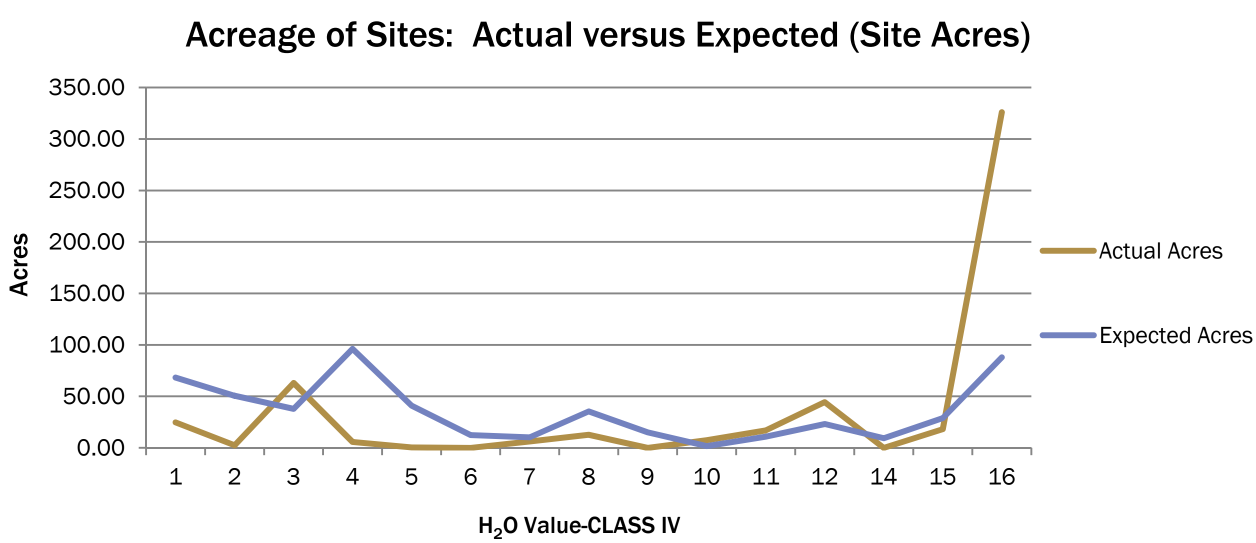
Appendix 15, Figure 8 Same sites as Figure 7 but showing values adjusted to represent the dominant soil type (left) or slope type (right) within the site.

sites are located without concern to specific environments, and if the sample is reasonably large (n=>25), then their locations should mirror the overall background environment, i.e., if 0–5 degrees of slope cover 20 percent of the study area then ~20 percent of the archaeological sites should be located in that class. If there are higher percentages observed than what is expected then there is a positive correlation, and if there are lower percentages then the correlation is negative (Rohe 2003).

Appendix 15, Table 2 Example of Calculations for Water Source Value for Class 4 Sites.

H2OValue-Model Area, Class 4 Sites								
Water Source Value	MA Total Acres	Expected Site Percent	Expected Site Acres	Observed Site Acres	Observed Site Percent	O - E	O - E Acres	Simple Ratio
1	7,612.82	12.91	68.20	24.76	4.69	-8.22	-43.44	0.36
2	5,642.50	9.57	50.55	2.49	0.47	-9.10	-48.06	0.05
3	4,220.80	7.16	37.81	63.07	11.94	4.78	25.26	1.67
4	10,729.77	18.20	96.12	5.73	1.08	-17.12	-90.39	0.06
5	4,579.40	7.77	41.02	0.42	0.08	-7.69	-40.60	0.01
6	1,378.05	2.34	12.34	0.00	0.00	-2.34	-12.34	0.00
7	1,130.01	1.92	10.12	6.09	1.15	-0.76	-4.03	0.60
8	3,939.90	6.68	35.29	12.65	2.40	-4.29	-22.64	0.36
9	1,677.55	2.85	15.03	0.00	0.00	-2.85	-15.03	0.00
10	179.04	0.30	1.60	7.35	1.39	1.09	5.75	4.58
11	1,213.71	2.06	10.87	16.87	3.19	1.14	6.00	1.55
12	2,571.04	4.36	23.03	44.44	8.41	4.05	21.41	1.93
14	1,039.10	1.76	9.31	0.00	0.00	-1.76	-9.31	0.00
15	3,224.42	5.47	28.89	18.15	3.44	-2.03	-10.74	0.63
16	9,815.67	16.65	87.93	326.10	61.75	45.10	238.17	3.71
Total Acres	58,953.78		528.12	528.12				

The principle investigators repeatedly requested that the analysis be made as simple as possible so that archeologists with little or no statistical expertise could redo the analysis and add data layers as they became available. To that end, Rohe's simple ratio analysis of "expected" versus "actual" values was used. Rohe used the number of sites occurring within an environmental variable value. This analysis used site acres occurring within each EV category. Using acreage rather than a simple point location bestowed more importance to large, complex sites than to smaller sites. Table 2 shows an example of calculations for water source value for Class 4 sites. Figure 9 graphically shows the difference in the raw data acreages between expected acres



Appendix 15, Figure 9 Actual versus expected values of site size.

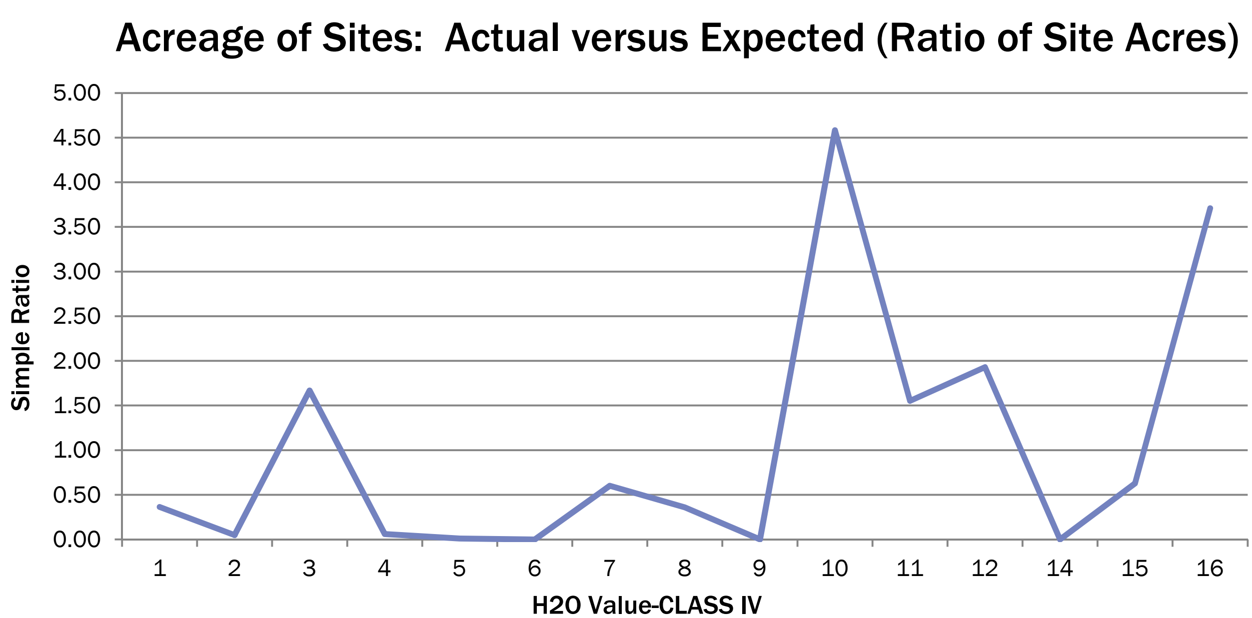
and actual site acres within the survey area. Figure 10 graphically shows the ratio of the actual versus expected site acres. This set of calculations was run for every data layer and every site class. A score of 0.5 means that there are 50 percent fewer sites than expected, a score of 1.5 means there are 50 percent more sites than expected, and a score of 1 indicates the observed value is the same as the expected value.

Both the graphs and simple ratio calculations strongly indicated that campsites were not randomly distributed; rather, it indicated correlations—some stronger than others—suggesting behavioral explanations related to environmental factors. Toward the end of these calculations, Bayesian probability analysis was suggested as a possible improvement on the calculations. Bayesian analysis is a statistical method that assigns probabilities to events or parameters based on experience or best guesses before experimentation and then applies Bayes' theorem to revise the probabilities and distributions after obtaining experimental data (Merriam-Webster 2014). Bayesian methods detailed in Bonham-Carter (1994), allowed use of the acreage data for the sites rather than just point locations.

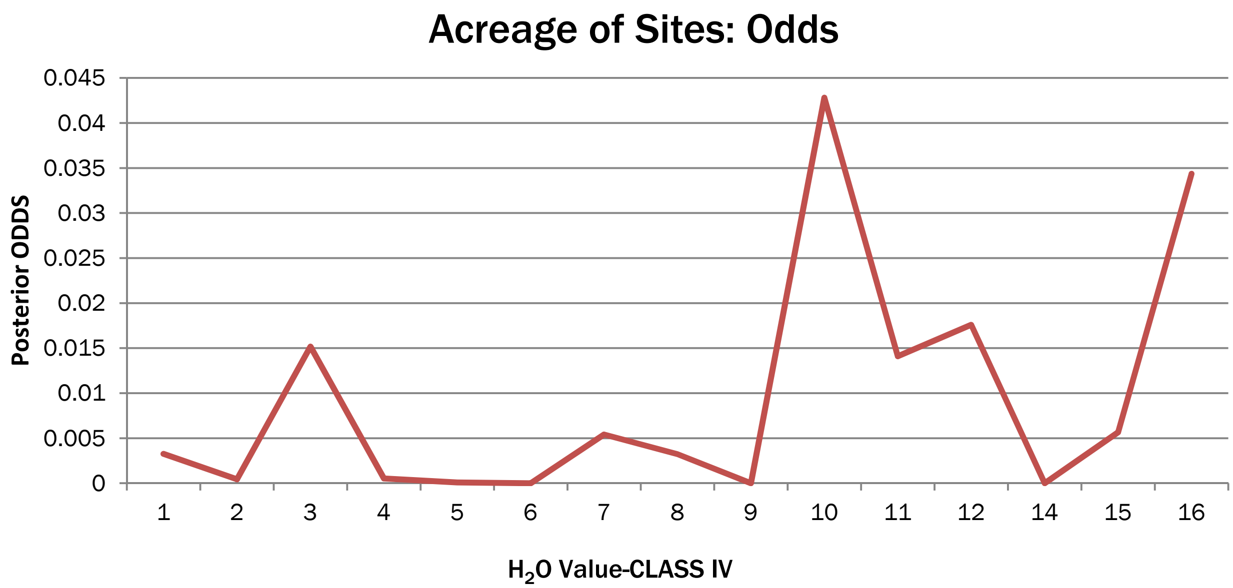
The area data was analyzed and a complex spreadsheet was created following Bonham-Carter's examples and each set of data was entered. Odds, the ratio of events to non-events, were calculated using Bayesian formulas. Figure 11 shows the results for the data whose simple ratio is shown in Figure 10. While the scale between the two results is different, the relationships within the site classes are identical.

At this point, analysis returned to the simple ratio method because the analysis needed to be kept as straightforward as possible. The next step was to determine the weight of each category in each dataset. Some simple ratio values ranged from zero to as high as 34, while other values had ratios that barely reached 2.

The method used by Rohe (2003) which was simply the difference between the percentage observed and percentage expected, yielded extremely wide ranges of values. The calculation would have worked, but the negative values involved made conceptualizing the range and differences somewhat difficult, especially when comparing two or more analyses. A more easily conceptualized and easily graphed method of calculating the weights, using positive values only was desired. Rohe's



Appendix 15, Figure 10 Actual versus expected values of site size as ratio.



Appendix 15, Figure 11 Acreage of sites (odds) using simple ratio data from Figure 10.

(2003) method of defining values was used (observed – expected) with an adjustment to eliminate negative values. This was performed simply by adding the lowest value scored to the highest value scored. Those results for each environmental variable for each site class were then normalized to a set of values between zero and one by dividing each value by the highest value in each set (normalized value; see Table 3). This simple rescaling 'normalization' resulted in a set of values that could be more easily visualized.

The observed minus expected value closest to zero (but that still was a negative number) in each dataset (e.g., Water Source Value 7 in Table 3) was chosen as

Appendix 15, Table 3 Normalized Values of Water Source Values.

Water Source Value	O - E Acres	Simple Ratio	Negative Values	Normalized Value
1	43.80	0.36	46.95	0.14
2	48.11	0.05	42.33	0.13
3	-23.59	1.67	115.65	0.35
4	90.45	0.06	0.00	0.00
5	40.61	0.01	49.79	0.15
6	12.34	0.00	78.04	0.24
7	**4.63**	**0.60**	**86.36**	**0.26**
8	23.00	0.36	67.75	0.21
9	15.03	0.00	75.36	0.23
10	-1.16	4.58	96.14	0.29
11	-4.45	1.55	96.39	0.29
12	-19.48	1.93	111.80	0.34
14	9.31	0.00	81.08	0.25
15	11.36	0.63	79.65	0.24
16	-234.46	3.71	328.56	1.00

the “zero point” for the weight. All normalized values equal to that or less were given zero value in the weighted overlay analysis. The evaluation scale in the weighted overlay was “0 to 5 by 1,” so the positive values were divided into five categories, assigned values 1–5, with each weight representing an equal range of values. Weights were assigned as shown in Table 4. This approach “skews” all weights that are lower than the expected value in to the same category: zero. The goal was for the analysis to locate high value areas that should contain high value sites. Giving any value to areas that are lower than expected would confuse and complicate interpretation of the results.

In evaluating the ratios and observed minus expected values, it became clear that the two EZ schemes that aggregated some of the soils values (EZ2 and EZ3) were not producing the robust results that were appearing with some other data layers. In several instances, the soils data showed distinct and rather dramatic differences in site presence between two or more soils that

Appendix 15, Table 4 Value Ranges for Weighting.

Value Range	Weight
<0.2628	0
0.2627 to 0.4103	1
0.4104 to 0.5577	2
0.5577 to 0.7051	3
0.7052 to 0.8526	4
0.8527 to 1.0	5

had been combined into a single EZ2 or EZ3 category. Examination of the data showed that either:

1) a soil with many site occurrences caused the entire EZ2 or EZ3 category to have a high value that was not reflected in the site occurrences of the other soils in that category, or

2) a soil with a very high site occurrence BUT limited spatial coverage relative to other soils in that EZ cause that data to be diluted such that correlations were no longer evident.

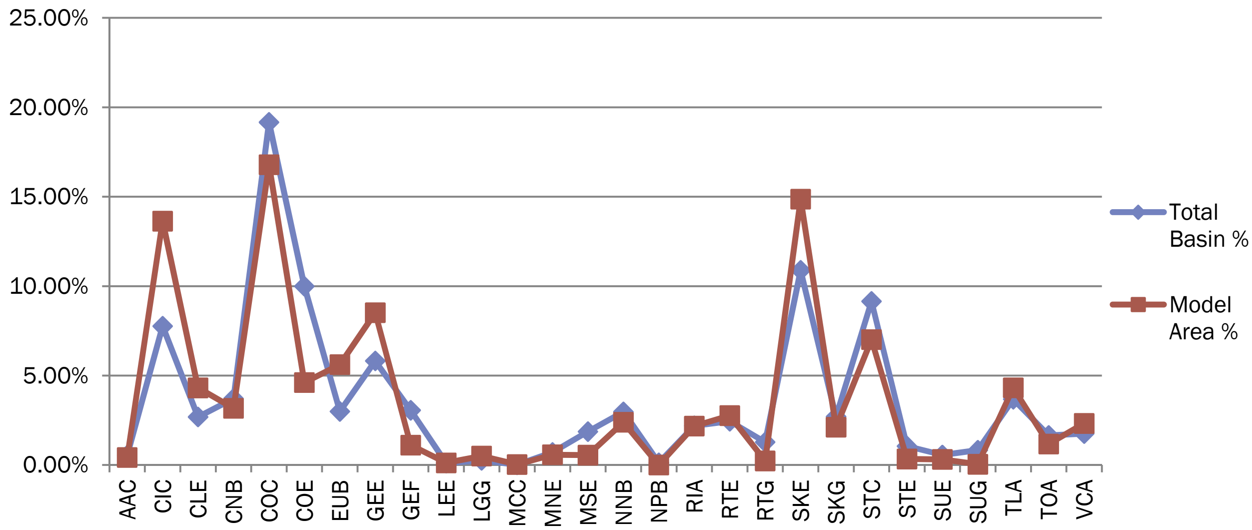
Examination of Weighted Analysis

Problems Encountered in Sampling Survey Area

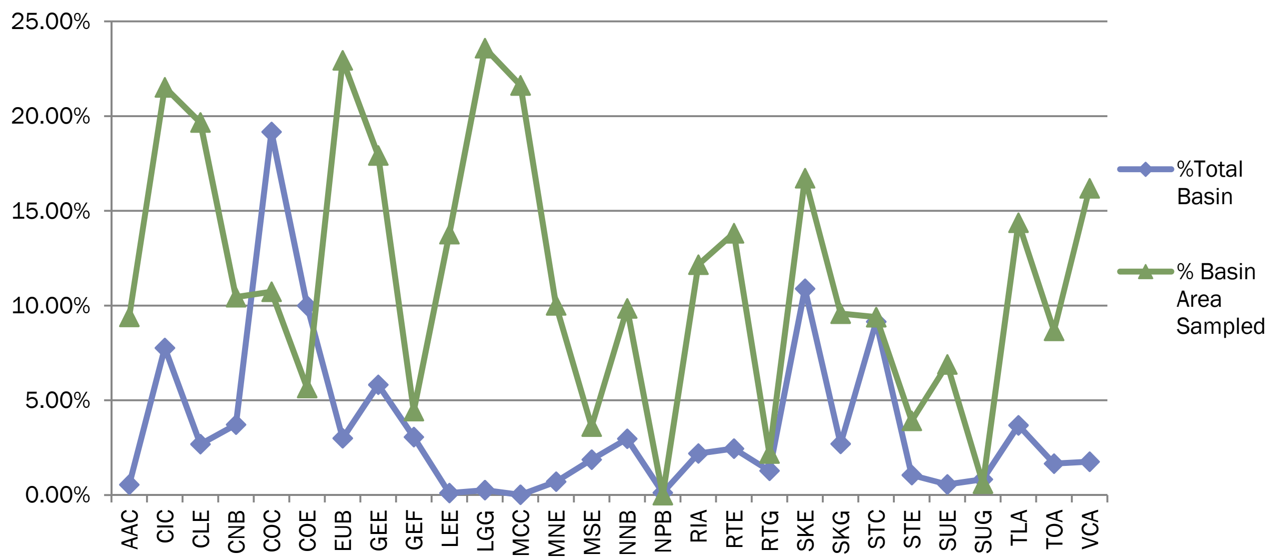
The initial sampling strategy was to have been a stratified random sampling based on the EZ. This strategy would have assured that a chosen percentage of each soil type was sampled. But the sampling strategy had changed. The majority of the sampling was now concentrated in the Basin Zone, although some Igneous and Limestone Mountain areas were sampled along the edge of the Basin. In addition, the sampling strategy was now judgmental. However, because of the knowledge and understanding of the primary investigators and project archeologist deciding the survey block locations, the percentage of each soil type surveyed (of the total area surveyed) within the Basin Zone generally follows the percentage of that soil type that occurs within the Model Area. Figure 12 graphically demonstrates this. However, there were some potentially significant variations in this relationship, especially within some of the minor Basin Zone soils. A sampling percentage of +/- 5 percent from the “ideal” 13 percent (statistically viable) sampling coverage per soil type would not raise a serious red flag, but thirteen of the 28 soils were either over or under this range.

Had the sampling been stratified, the goal would have been to sample approximately 13 percent of each soil type in the entire Basin Zone. However, under the judgmental sampling design, sampled percentages of soil types ranged from 0 percent to 24 percent as illustrated in Figure 13—the variance in percentage of total Basin soils sampled. It suggested that the undersampled soils were those that occurred least and the oversampled soils were those that occurred most. This proved not to be the case.

Figure 13 illustrates that several very infrequently occurring soils, LEE, LGG, MCC, MNE and VCA soils



Appendix 15, Figure 12 Percentages of soils in Basin Zone versus percentage of soils in Model Area.



Appendix 15, Figure 13 Percentages of soils in basin versus soils sampled.

in particular, were heavily sampled. The initial reaction was that those were areas where archeologists intuitively expected to find sites, but if that was the case, the archeologists were mostly wrong. Many of those soils were later shown to have a low site density. The oversampled and undersampled soils were individually evaluated to determine if some "adjustment" needed to be made in the analysis method.

Undersampled Soils

The Ninepoint Complex (NPB) soil was not sampled at all because no stratified sampling was done, and the soil was completely missed. There are only 589 acres of NPB soil within the park and it all occurs within the Tornillo Flat area. This soil is primarily an area of Tornillo Flat that was seriously manipulated by the Soil Conservation Service and the NPS during the 1950s in an unsuccessful attempt to stop erosion and create (or re-create) a grassland. Because of the small area involved and the intensive damage to the surface, it is probably not a critical soil to sample, unless the erosion has exposed very old living surfaces, which we do not believe is the case. Those soil areas have been looked at by archeologists (not formally surveyed) and no sites have been recorded in that soil.

This undersampling problem also occurs in other soils: Corazones very gravelly sandy loam, 1 to 30 percent slopes (COE), (GEF), Musgrave silty clay, 1 to 20 percent slopes (MSE), (RTG), Strawhouse-Stillwell complex, 1 to 30 percent slopes (STE), and Studybutte-Rock outcrop complex, 20 to 60 percent slopes (SUG). The descriptions of these soils portray areas of steep slope and significant bedrock outcrops that are not generally considered conducive to human habitation. This is probably why more of these areas were not chosen for survey. However, seven of the 87 Class 4 sites (8 percent) occur on these soils, and at least three of those Class 4 sites are long-term occupation sites that have potential to yield significant scientific information. There are several other sites, including one Class 3 long-term use site and several Class 2 long-term use and/or food processing sites that are in these soils. Because of the bedrock forming the soil substrate, food processing uses are common on Class 2–4 sites in these soils; mortars and metates abound on around half of the sites and there are stone alignments and substantial rock constructions on several others.

Oversampled Soils

Chilicotal very gravelly fine sandy loam, 1 to 8 percent slopes (CIC), Corazones very gravelly sandy loam, 1 to 8 percent slopes (COC), Equipaje-Agust complex, 1 to 3 percent slopes (EUB), GEE, and LGG soils comprise the mid-elevation "Sotol Grassland" area surrounding the Chisos and Rosillos Mountains. This is an extremely easy area to access via road and an area with significant, well-known water sources with locations that intuitively appear inviting for camping. Additionally, the soils stretch radially from the Chisos and Rosillos Mountains to the park boundary, the Rio Grande, or the Limestone Mountains. Because of the ubiquitous nature of the soils, all but four of the judgmental survey areas contained some of one or more of these soils. Avoiding over-surveying these soils would have been logistically complicated.

Mariscal very channery loam, 1 to 8 percent slopes (MCC) was also over sampled for a totally different reason. These soils primarily occur outside the park in limestone areas, but there are 5,855 acres of it within the Limestone Mountains EZ. Within the Basin EZ, there are only 3 tiny areas totaling 71 acres that are surrounded by distinctly "Basin" soils and these 3 areas were included in the Basin EZ. One of these areas occurred within a judgmentally placed survey area and 15 acres of MCC was surveyed. That constitutes 21 percent of the MCC acreage within the Basin EZ, meaning that the MCC soil was "over sampled." This was a completely coincidental choice of location.

Simple Weighted Overlay

In the simple weighted overlay analysis in ArcGIS, the value of each category in each data layer is reclassed to the same scale. Then each data layer is given a relative value on a scale of 0–100 percent; one layer may have 20 percent value in the analysis, and another layer 25 percent, while a third has 50 percent value and a fourth data layer is valued at 5 percent. These layer values must total to 100 percent. The value of each category in each data layer is multiplied by the scaled value of the layer and the resulting values for all data layers are added together, resulting in a single data layer that reflects the combined values of all data layers across the total analysis area. "Weighted overlay assumes that more favorable factors result in the higher values in the output raster, therefore identifying these locations as being the best" (Environmental Systems Research Institute 2012). In the resulting analysis, categories with higher number values are identified as being the most suitable locations for the purpose being analyzed.

To determine which environmental variables exerted the most influence over site location, several different combinations of percentage values were used in multiple weighted overlay analyses. The initial combination used the environmental variables of slope, soils, ease of access to water (EOA) and water source value (H_2O Value) with each EV categorized according to the method used by Rohe (2003). Each EV was initially allocated the same percentage value: 25 percent. Upon examining the results, the Highlands (HLND) layer was added to the analysis (See Section "Terrain Analysis for the Basin"). Table 5 shows all values used for the six Weighted Analyses. Weights were varied in an attempt to increase the number of sites located within the resulting high value areas, while minimizing the total area of the high value areas. The best analysis combination would be the one that contains the most sites in the smallest area.

The analysis combinations will be referred to as Combo 1, Combo 2, etc. The percentages were varied to determine what apparent effect the various environmental variables had on the model's accuracy in locating sites. The criterion for the "best" result was the lowest number of acres in the high value areas coupled with the highest number of sites and site acreage located.

The Highlands Value column reflects the weights given to the two Highlands areas. A "trial and error" analysis was run where the Highlands weight was varied: zero or one; zero or five; or one or five. This was done to determine if the Highlands proximity was of substantive value in the analysis and which value combination best reflected known sites. Several variations of Combos 3–6 were run changing the Highlands values, but only the "best" results of each set were retained and analyzed.

Weighted Analysis, Class 4 Sites:

The original datasets of that were assigned weights were Slope, EOA, Soils (EZ), and Water Source Value (H_2O Value) – see Table 5. Valuing each criterion as 25 percent, a Weighted Overlay analysis (Combo 1) was run using the values derived from the "Modified Approach to

Determining Weights for a Simple Weighted Overlay Analysis" (see section). The analysis produced values covering the Basin area of 0-5. The three highest valued categories in this analysis (values 3–5) "found" 82

Appendix 15, Table 5 Values Used for Weighted Analysis.

	Weighted Analysis – Percentage Used for Value (Combinations)					
Environmental Variable	Combo 1	Combo 2	Combo 3	Combo 4	Combo 5	Combo 6
Slope %	25	20	25	25	23	20
Soils (EZ1) %	25	20	25	25	23	20
H_2O Val %	25	20	0	0	0	0
EOA %	25	20	25	25	23	20
HLND %	0	20	25	25	30	40
Highlands Value (Yes/No)	NA 20	0/1	0/1	0/5	1/5	1/5

Appendix 15, Table 6 Comparison of Results of Multiple Weighted Analyses of Class 4 Sites.

Class 4 Sites	Combo 1	Combo 2	Combo 3	Combo 4	Combo 5	Combo 6
High Value Acres in Model	64,621	35,808	37,172	123,033	122,664	126,603
Percent of Acres in High Value Categories	13.43	7.44	7.69	25.56	25.49	26.31
Acres in Class 4 Sites	660	660	660	660	660	660
Class 4 Site Acres in High Value Areas	545.5	297.2	544.3	645.6	645.6	648.3
Percent of Class 4 Acres “Found” by Model	82.63	45.02	82.46	97.80	97.80	98.2
Number of Class 4 Sites	87	87	87	87	87	87
Number of Class 4 Sites “Found” in High Value Area	45	27	39	70	70	72
Percent of Class 4 Sites “Found” by Model	51.72	31.03	44.83	80.46	80.46	82.76

percent of the Class 4 acres but only slightly over 50 percent of the individual Class 4 sites using the top 3 Value Categories as the indicator of Suitability.

A second Weighted Overlay analysis (Combo 2) was run using the same four criteria but adding the Highlands layer, so that each layer had an equal weight of 20 percent. In this run, the Highlands criterion had either a zero or one value: zero for “not in highlands” and one for “in highlands.” The resulting three highest valued analysis categories (again 3–5) produced by this second analysis “found” only 45 percent of the acreage and only 31 percent of the Class 4 sites.

Critical examination indicated conflicting results related to the H_2O Value layer. The Water Source Value (H_2O Val) is missing several areas where there are clusters of probable Middle Archaic sites that are relatively high value sites, because of either their site class or their spatial extent. These sites are clustered along now-dry arroyos or near areas that may have been springs several millennia ago. The H_2O Val layer should be revisited and amended to include other “ancient” water sources and compared to older site locations, but time did not allow this additional analysis. Because of this, the H_2O Val was dropped from subsequent analyses which significantly improved overall results. The H_2O Val layer remains valuable for assisting with recent water availability, such as historic uses and Late Prehistoric site location, and can give insight into potential areas for future archeological work. Areas with high H_2O values are often the most heavily used by visitors and focusing on those areas could assist management in mitigating visitor impact to cultural resources. Examination also of the sites that were not “found” indicated that many of the sites that occurred in low-value areas of the analysis were, in fact, within the Highlands or highland buffer area.

A third weighted analysis was completed using only the Slope, EOA, Soils (EZ) and Highlands layers (Combo 3). All layers were given equal weight (25 percent each). The analysis “found” 82 percent of Class 4 site acreage and 45 percent of sites. The percentage found using the 4 highest value categories (2–5) was 82 percent–10 percent higher than the first analysis. Cursory evaluation of the differences between analysis Value 2 and Value 3 sites suggested that the Highlands area was more important to site location than previously thought.

The weight of the Highlands area was increased from 1 to 5 (with areas outside the Highlands maintaining a value of 0) and a fourth weighted analysis (Combo 4) was run. Combo 4 “found” 81 percent of the sites—the number of found sites in the three highest analysis value categories increased from a previous maximum of 45 to 70. Unfortunately, the total “high value” area also increased from 37,000 acres to 123,000 acres—over a three-fold increase.

Combo 5 was run using percentages of 23 percent for Slope, EOA, and Soils, and 30 percent weight for Highlands. The total high value area decreased by around 500 acres, but the number of sites within the three highest value categories (3–5) remained the same. However, the number of sites within analysis Value 2 increased by 6 sites.

Combo 6 was run using 20 percent value for Slope, EOA, and Soil, and 40 percent for Highlands. The total high value area increased by about 3,000 acres over the first equal-valued run, but the total number of "found" sites increased by 2 within the high value categories of the weighted overlay analysis results.

Analysis of sites that did not occur within the Highland area revealed several explanations and possibilities. Two of the 3 combos failed to "find" 19 sites. Of those 19 sites, only 6 occurred outside the Highlands. Of those six, two sites would have been valued higher had the minimum slope value been used to define the site rather than the slope value with the highest area. One site would have had a higher EOA value because of proximity to the Rio Grande had the Rio Grande proximity values been incorporated *slightly* differently into the EOA data layer. Three sites may have been misclassified based on data in the spreadsheet. One had only a single "tipi" ring that was described as "not typical," and the structures on two other sites may be of historic origin. It is also possible that those three sites are simply anomalous enough that they do not properly "fit" into the weighted overlay analysis criteria.

Several explanations exist for the analysis' failure to find 13 sites that occur in the Highlands. Two occur in LEE soils, an Igneous Mountains soil that outcrops only in small pockets within the Basin area and was under-sampled during the survey. Only 71 acres of LEE soils were surveyed within the Basin area and 41 of those occur within sites, the majority of those being Class 1 (one Class 1 site is over 34 acres in size). This discrepancy makes proper value evaluation for the LEE soil category very problematic. Both of the Class 4 LEE sites were "found" in Combo 6, despite the lack of value for the soils (EZ) class.

Four of the "unfound" Class 4 sites are on the edge of Igneous or Limestone Mountains and extend only slightly into the Basin EZ. The structural remains of these four sites occur within the Mountain portion of the site on soils and slopes that were not actually part of the Basin analysis data. One of those sites occurs on LEE soil <u>within</u> the Igneous Mountain EZ and, on another, the tipi structure is described as "not typical."

Three sites are located near either the Rio Grande or a major arroyo. One site would have been in a higher value area had the proximity (EOA) values for the Rio Grande been merged differently. The other two are near large desert arroyos that were not included in the "flowing streams" data layer. One of these sites is in close proximity to an arroyo that was seriously considered for inclusion in that data layer, but, in the interest of restraint, was eventually excluded. The second site does have a high value in the last analysis (Combo 6). The third site has several anomalous factors, the first of which is that it too is near an arroyo that probably should have been included in the "flowing streams." A second issue with this site is that about half of the site is in the Igneous Mountains EZ on LEE soils where a rock art component occurs, placing this site in Class 4. However, the rock art does not occur within the area that was included in the analysis.

One site is near a water source known to be flowing for the past several hundred years, but the lone structure is perched on a rocky outcrop with a steep slope, so the analysis system gave it a very low score. Sites nearby, also in the highlands and in the same water proximity area and the same soil (including two other Class 4 sites) are valued as 4, so it appears that the steep slope is the excluding factor. The edge of the site is only 10–20 meters from the Value 3 and Value 4 areas as determined in the final run of the weighted overlay analysis.

The remaining three sites that were not located by the analyses are Class 4 because of structural components such as tipi rings or wikiups that are separately described as "scant and surficial," "poorly defined," and "disarticulated." These sites only marginally fit into the Class 4 criteria. One site would have had a higher EOA value had the flowing streams data been integrated differently. That site is also one of only two Class 4 sites recorded in soil LGG and neither of them was within the Model Area. The total expected area of sites in LGG soils for Class 4 was 2.77 acres and the two non-Model Area sites totaled over 22 acres, meaning that it is possible that the soils, and therefore these sites, would have had a higher value had they been included in the Model Area. However, the LGG soils were actually oversampled, meaning that these could simply be aberrant sites. A second site is near a major arroyo that possibly should have been included in the flowing streams data layer, and the third site is in an area that intuitively appears to be an unlikely location for a Class 4 site.

Twenty-one Class 4 sites were not included in the Model Area and could be used to test the efficacy of the model. Of those sites, Combo 3 located 7 (33.3 percent) and Combo 5 located 17 (76.1 percent). Of the four sites not found by Combo 5, two were small one-time use, single wikiup sites, one of which was on the boundary between the Igneous Mountains and the Basin with all site features occurring in the Igneous Mountains component and only a lithic scatter in the Basin portion. Another of the four was a multi-component site that also occurred on the boundary between the Igneous Mountains and the Basin and also with the majority of the site features in the Igneous Mountains component. The fourth site is on an anomalous landform on RTG soil that was significantly under-sampled (see "Problems Encountered in Sampling Survey Area—Undersampled Soils").

The intent of including "structures" in the Class 4 sites was to include long-term use or repeated use areas that would potentially yield more robust data were they closely investigated or excavated. However, the inclusion of ephemeral wikiup-type structures in the Class 4 dataset may be diluting or skewing the overall results of the analysis. Seymour (2009) discusses wikiups in some detail, indicating the structures are important in their own right, but are not necessarily indicative of long-term or repeated use of an area.

A second similar issue occurs with "Cielo" type structures. While no specific issues developed during this analysis, the stacked rock structures referred to as "Cielo complex" are included in the Class 4 sites. It would be enlightening to separate those structures into a subset and rerun the same analysis.

A final test of the various weighted analyses followed Rohe's (2003) "Gain" Analysis with Gain equal to 1 - (percent of area modeled / percent of site acres located). The "Gain over Random Chance" is equal to percent of site acres located minus percent of model area (Table 7).

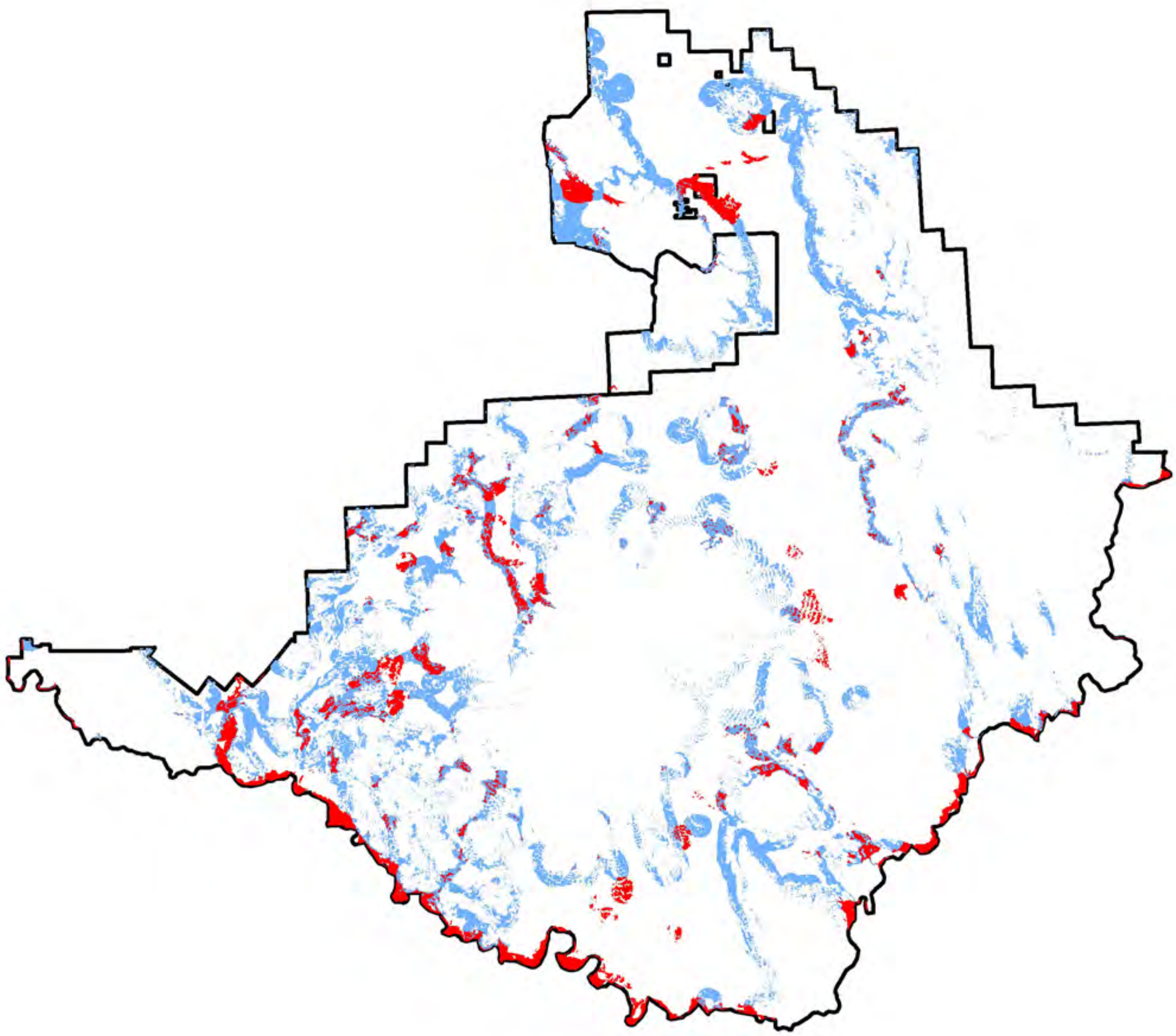
Two sets of calculations were done: one used the acreage within the sites located by each model, and the other used the number of sites located by each

Appendix 15, Table 7 Gain Analyses of Class 4 Sites.

Class 4 Sites	Combo 1	Combo 2	Combo 3	Combo 4	Combo 5	Combo 6
High Value Acres in Model	64,621	35,808	37,026	123,033	122,664	126,603
% Basin Acres in High Value Categories	13.43	7.44	7.69	25.56	25.49	26.31
Percent Class 4 Acres in High Value Model Areas	82.63	45.02	82.46	97.80	97.80	98.20
Gain	0.84	0.83	**0.91**	0.74	0.74	0.73
Percent Gain over Random Chance	69.20	37.58	**74.76**	72.23	72.31	71.89
Site Numbers						
Percent Class 4 Sites in High Value Model Areas 5	51.72	31.03	44.83	80.46	80.46	82.76
Gain	0.74	0.76	0.83	0.68	0.68	**0.68**
Percent Gain over Random Chance	38.30	23.59	37.13	54.89	54.97	**56.45**

model. The two combinations of weights that yielded the "best" results are highlighted in red. Combo 3 was very simple: each Environmental Variable had the same weight and the Highland values were 0=not highlands and 1=highlands. That combination created the smallest High Value area in the model with the highest Gain over random chance (almost 75 percent) for the acreage located. However, the number of sites analysis returned the best results with Combo 6, the combination that most strongly accentuated the value of the highlands areas. In the four "best" analyses (Combos 3–6) the total overlapping High Value area is 25,969 acres (red areas in Figure 14). These areas range from very tiny (< 0.1 acres) to over 1,500 acres. In the three analyses that located the most sites (Combos 4–6) the total overlapping High Value area is 111,452 acres (blue areas in Figure 14). These data layers should be considered a focal source for consideration in finding Class 4 sites.

As can be seen in Table 7, the values for Combos 3–6 are generally high, indicating that those analyses should



Appendix 15, Figure 14 Map showing areas with values of 3 to 5.

successfully locate between 70–75 percent of the Class 4 site acreage. The Gain value is highest for Combo 3, as is the Gain over Random Chance, and the acreage involved in the highest value areas is the smallest of the five "successful" combinations. From a strictly statistical viewpoint, that model layer would be considered the best to use for locating areas with potential Class 4 sites. However, Combo 3 only actually located about 45 percent of the known sites. Combo 3 should probably be considered a focal area within the greater area of High Value overlap between Combos 4–6.

The accuracy of the model could be significantly improved if Class 4 sites were defined differently. For example, the 13 unfound sites mentioned above are too diverse to model with confidence. If those 13 sites are discounted, the percentage of acreage found in Combo 1 and Combo 3 increases to 84 percent and the site number percentage increases to 50–60 percent. The percentage of acreage and sites found in Combos 4–6 increases to 95 percent or better and the "Gain Over Random Chance" increases to around 70 percent. The definition of Class 4 sites should be reviewed to better define a more homogenous set of sites.

Any environmental modifications planned within areas of Value 3–5 (all colored areas in Figure 14) should be carefully scrutinized for archeological sites. However, areas that are Value 0–2 should not be "written off" as having no important sites. Those locations should be carefully reviewed for small areas similar to the highlands criteria or along the edges of the Basin in close proximity to the Igneous and Limestone Mountains. Potential areas of water sources such as major arroyo systems not included in the Water Source data layer may also influence site location in those areas.

Weighted Analysis, Class 3 Sites:

The same set of data layers was used for the Class 3 analysis, with weights determined from the ratio analysis specific to Class 3 Model Area sites (Table 8). While a higher percentage of sites compared to the Class 4 analysis were "found" using the EOA, Slope, H_2O Value and Soils, the percentages were still in the 74 percent–82 percent range. The same adjustments in Weight percentages and data layers had essentially the same results as the Class 4 sites: the percentage of "found" sites went up to 91 percent for high value areas using Combo 5. This was a substantial improvement over the Class 4 analysis results. One probable explanation for this is that Class 3 sites are more "homogenous" than Class 4 sites. Class 4 sites range from tiny, single structure sites to large complex sites with multiple structures, and, in some cases, rock art (which can make an otherwise Class 3 site become a Class 4 site). Class 3 sites, on the other hand, are more narrowly defined (see "Campsite Data Differentiation").

The ratio analysis yielded a value of only "1" for the flattest area value (slope=0–2 degrees), and a value of "5" for the next flattest value (slope=2–4 degrees). These values were used in analysis runs identical to the Class 4 analysis, (six runs) but a seventh run was also

Appendix 15, Table 8 Comparison of Results of Multiple Weighted Analyses of Class 3 Sites.

Class 3 Sites	Combo 1	Combo 2	Combo 3	Combo 4	Combo 5	Combo 6
High Value Acres in Model	61,325	23,098	93,504	92,041	91,683	95,604
Percent Acres in High Value Categories	12.74	4.80	19.43	19.13	19.05	19.87
Acres in Class 3 Sites	525	525	525	525	525	525
Class 3 Site Acres in High Value Areas	429.7	348.0	480.2	480.2	480.2	467.6
Percent Class 3 Acres "Found" by Model	81.89	66.33	91.52	91.52	91.52	89.13
# Class 3 Sites	46	46	46	46	46	46
# Class 3 Sites "Found" in High Value Areas	32	24	42	42	42	39
% Class 3 Sites "Found" by Model	69.57	52.17	91.30	91.30	91.30	84.78

done using Value=5 for slope=0–4 degrees. The "found" sites dropped to only 87 percent for the High Values of 3–5. The entire acreage of the High Value areas also increased significantly: up 59,500 acres. This did not appear to be a good trade off, since one of the goals of the modeling is to narrow the area of potential High Value sites to as small a size as possible. That seventh analysis is not reflected in the discussion or Tables below. The reason(s) that the Class 3 sites appear to occur on less level areas than the Class 4 sites should be investigated. This could be simply an artifact of the analysis process but there may be another explanation.

For Combos 3–5, all statistics were the same except for the total High Value Acreage. Combo 5 had the lowest acreage (almost 2,000 acres less than the others). In those analyses, four sites were not "found." One site was only a short distance (90 m) outside the Highland buffer area, and one was in close proximity to the Rio Grande and probably should have had a higher

EOA value. The remaining two sites must be described as "oddly located." There are very few "dunes" in the park and both of these sites were located on stabilized dune areas. Both were in close proximity to a major arroyo that probably should have been included in the flowing streams data layer and the resulting elevated EOA probably would have increased the sites' value. The soil type where these sites were found is not usually represented by dune formations. However, the two areas are subject to an unusual wind regime that has blown sediment into dunes. It would probably be difficult to model the location of these two sites, since the substrate is quite anomalous.

Nine Class 3 sites did not occur within the Model Area and were used to test the efficacy of the model. Of those sites, Combos 4–6 located all but one of them; Combo 3 located about half of them; and Combos 1 and 2 located none. The single site not located by Combos 4–6 is just outside the Highlands buffer area.

The Gain and Gain Over Random Chance calculations for Class 3 sites are overall better than the values produced for the Class 4 sites (Table 9). Combo 5 has the lowest total acreage with the highest Gain Over Random Chance, located all test sites, and has the lowest total High Value Area of the three Combos that found over 70 percent of the sites. As a result, Combo 5 should be considered the best model for the Class 3 sites.

Weighted Analysis, Class 2 Sites

The same set of data layers was used in the Class 2 analysis, with weights determined from the Ratio Analysis specific to Class 2 Model Area sites (Table 10). The percentages of sites "found" using the various value and weight combinations varied from a low of 61 percent to a high of 82 percent. The analysis that produced the lowest High Value acreage (74,000 acres) was Combo 1 in which only four data layers were used, each having equal value, with the Highland

Appendix 15, Table 9 Gain Analyses of Class 3 Sites.

Class 3 Sites	Combo 1	Combo 2	Combo 3	Combo 4	Combo 5	Combo 6
High Value Model Acres	61,325	23,098	93,504	92,041	91,683	95,604
Percent of Total Acres High Values	12.74	4.80	19.43	19.13	19.05	19.87
Percent Class 3 Acres in High Value Model Areas	81.89	66.33	91.52	91.52	91.52	89.13
Gain	0.84	0.93	0.79	0.79	0.79	0.78
Percent Gain over Random Chance	69.15	61.53	72.09	72.39	**72.46**	69.26
Site Numbers						
Percent Class 3 Sites in High Value Model Areas	69.57	52.17	91.30	91.30	91.30	84.78
Gain	0.82	0.91	0.79	0.79	0.79	0.77
Percent Gain over Random Chance	56.82	47.37	71.88	72.18	**72.25**	64.92

Appendix 15, Table 10 Comparison of Results of Multiple Weighted Analyses of Class 2 Sites.

Class 2 Sites	Combo 1	Combo 2	Combo 3	Combo 4	Combo 5	Combo 6
High Value Model Acres	73,630	167,851	122,464	215,124	188,258	215,081
Percent Acres in High Value Categories	15.30	34.88	25.45	44.70	39.12	44.69
Acres in Class 2 Sites	3388	3388	3388	3388	3388	3388
Class 2 Site Acres in High Value Areas	2682.0	2252.8	2618.5	2961.0	2639.9	2961.0
Percent Class 2 Acres "Found" by Model	79.16	66.50	77.29	**87.40**	77.92	87.40
Number of Class 2 Sites	638	638	638	638	638	638
Number of Class 2 Sites "Found" in High Value Area	435	301	389	522	441	521
Percent Class 2 Sites "Found" by Model	68.08	47.18	60.97	**81.82**	69.12	81.66

layer excluded. However, only 68 percent of the Class 2 sites were "found." The combination of EOA, Soils, Highlands, and Slope (Combo 4) with all layers having the same percentage of influence (25 percent), and Highlands valued at 5, produced better results but also produced the largest area of High Value potential (215,000 acres or 45 percent of the entire Basin area). Combo 6 produced almost identical results.

Because Class 2 sites are much more diverse (more variability between sites) than Class 4 and Class 3 sites, and are also more numerous and widespread, this was expected. The Class 2 sites are those remaining after the Class 3, Class 4, and Class 1 sites have been parsed out of the site list. Class 2 sites range in size and complexity from the largest recorded site in the park (> 440 acres) to a site only 200 square meters in extent. The large site contains multiple, large, complex thermal features, multiple tools, and a non-thermal feature (stone alignment), but was excluded from Class 4 and Class 3 because no ground stone artifacts were recorded at the site. The small site contains four hearths, enough to eliminate it from Class 1. The 638 sites in Class 2 range between these two extremes and are highly varied.

Class 2 sites should be relatively simple to moderately complex sites. However, many of the larger sites in this class are, in fact, some of the more important and complex sites in the park that do not contain architecture. Conversely, 65 of the 116 Class 2 sites that were "not found" were smaller than 2 acres and 50 of those 65 were smaller than 1 acre. Because there are 639 sites in this class, no extensive evaluation was done to attempt to understand specific reasons behind the low statistical results, but the lack of homogeneity in site size and complexity probably explains the majority of the problem. As a result, Class 2 sites should be reevaluated and divided into several more homogenous groupings and the site and model analysis rerun.

As seen in Table 11, based on the percentage of sites located, and the Gain and Gain Over Random Chance calculations, the "best" model for Class 2 sites is Combo 1 (the smallest acreage involved in the results) in which Highlands are excluded from the Weighted Model because these sites generally do not occur in the Highlands.

Weighted Analysis, Class 1 Sites

The Weights analysis for Class 1 sites was conspicuously different from the previous classes. Classes 2–4 returned 4 to 6 soils with one value being 5 and 3–5 other values ranging from 1–4. Class 1 sites, on the other hand, returned 10 weight values for Class 1 soils, but 8 of those values were 1 or 2. These low values indicated that the Class 1 sites were far less "clustered" in specific soil types than other site classes. While Class 1 sites were somewhat clustered near water sources and in flat areas, values for these attributes were far wider ranging than the other classes. This was not unexpected, since Class 1 sites—being less complex—are generally short-term occupation sites with many representing a single occupation event. Table 12 details the values returned by the

Appendix 15, Table 11 Gain Analysis of Class 2 Sites.

Class 2 Sites	Combo 1	Combo 2	Combo 3	Combo 4	Combo 5	Combo 6
High Value Model Acres	73,630	167,851	122,464	215,124	188,258	215,081
Percent of Total Acres High Values	15.30	34.88	25.45	44.70	39.12	44.69
Percent of Class 2 Acres in High Value Model Areas	79.16	66.50	77.29	87.40	77.92	87.40
Gain	0.81	0.48	0.67	0.49	0.50	0.49
Percent of Gain over Random Chance	**63.86**	31.62	51.84	42.70	38.80	42.71
Site Numbers						
Percent of Class 2 Sites in High Value Model Areas	68.18	47.18	60.97	81.82	69.12	81.66
Gain	0.78	0.48	0.67	0.89	0.75	0.89
Percent Gain over Random Chance	**52.88**	12.30	35.53	37.12	30.00	36.97

analysis. Combo 4 returned the best results, with 67 percent of site acres "found" and 54 percent of sites found.

The problem in modeling Class I sites is most likely because these rather simple sites are ubiquitous across the park and, as a result, cannot be modeled effectively. For a model to work, site locations must be patterned. Thus, any model that successfully locates most of them would have to include 80–90 percent of the Basin area. The only way to better model Class 1 sites would be to create subsets of these sites based on identifiable criteria. For example, there may be hearth or artifact types (or temporal affiliation) allowing Class 1 sites to be further parsed out that might improve the accuracy of the model. A model that includes 80–90 percent of the area being analyzed is simply not a useful tool.

Appendix 15, Table 12 Comparison of Results of Multiple Weighted Analyses of Class 1 Sites.

Class 1 Sites	Combo 1	Combo 2	Combo 3	Combo 4	Combo 5	Combo 6
High Value Model Acres	51,209	91,707	50,104	143,762	49,240	215,081
Percent of Acres High Value Categories	10.64	19.06	10.41	29.87	10.23	44.69
Acres in Class 1 Sites	1,599	1,599	1,599	1,599	1,599	1,599
Class 1 Site Acres in High Value Areas	583	810	568	1,069	653	518
Percent of Class 1 Acres "Found" by Model	36.47	50.68	35.53	**66.86**	40.84	32.38
Number of Class 1 Sites	975	975	975	975	975	975
Number of Class 1 Sites in High Value Areas	262	350	274	527	262	200
Percent of Class 1 Sites "Found" by Model	26.87	35.90	28.10	**54.05**	26.87	20.51

Recommendations for Future Work

- Conduct several targeted surveys on randomly selected areas of undersampled soils to bring the percentage surveyed closer to 13 percent. (Soils are: Ninepoint Complex [NPB], Corazones very gravelly sandy loam [COE], Geefour silty clay [GEF], Musgrave silty clay [MSE], Rock outcrop-Terlingua complex [RTG], Strawhouse-Stillwell complex [STE], and Studybutte-Rock outcrop complex [SUG.])
- Create subsets of sites by time period and compare locations to H_2O Value and Highlands layers. This may clarify which extents of presently dry arroyos had reliable water, at least seasonally, and which springs were most reliable.

This could assist in better defining the prehistoric environment.

- Perform geomorphologic chrono-stratigraphic analyses of major streams that are now intermittent, but were probably perennial over the past millennia. This relates directly to the item above, and would further understanding of the prehistoric climate.
- Carefully review/check for accuracy all data in the site spreadsheet prior to further use for analysis.
- Develop a set of categorization criteria to be applied to each site as it is recorded so that data entry on future site forms will be more consistent and more easily interpreted.
- Create subsets within the Class 4 sites to better define more homogenous sets of sites.
    - Create subsets of "wikiup-type structures," "tipi rings," and "Cielo complex structures," each with specific definitions, and analyze only those sets as they relate to the landscape. Remove those sets from the Class 4 dataset and reanalyze the remaining data.
    - Create subsets of sites containing rock alignments, rock art, evidence of intensive food preparation, and other "special use" campsites and reanalyze.
    - Investigate the area within 0.5 miles of the Basin/Montane boundary including areas with the Montane EZs. Incorporate Class 4 sites occurring within that area and add those to the subsets created above. This will require creation of weights for the montane areas in EZ1 (soils).
    - Class 3 or 4 sites had to have two thermal feature types and at least one ground stone feature/tool and two or more formal tool types. Eight sites that have stone pavements and all nine petroform sites are Class 2 sites. Reevaluate these sites for inclusion in higher classes or for analysis as subsets.
- Investigate why the Class 3 sites appear to occur on less level areas than the Class 4 sites. This could be simply an artifact of the analysis process, but there may be another explanation.
- Reevaluate Class 2 sites and divide them into several more homogenous groupings. This site category was too heterogeneous to be properly analyzed. One category should be large, more complex sites.
- Devise a mechanism to give higher value to areas within reach of the Rio Grande corridor. High site density and a large number of high value sites occur along the non-canyon reaches of the river, but the EOA layer did not completely account for the heightened value of the Rio Grande. Of the 3,386 acres of Class 2 sites recorded throughout the park, 1,356 acres (151 sites) are located within 5 km of the Rio Grande. All other site classes within that 5 km buffer area only total 754 acres with 383 acres (51 percent) of those sites being Class 3 or Class 4 sites (21 sites). This means that while Class 1 sites are the most common throughout the park, they are less common within the river corridor area. Given that several of the Class 2 sites will probably be elevated to Class 3 or 4, the river corridor should have a higher value for site occurrence of those classes.
- Recalculate Slope values for sites using the LOWEST (i.e., flattest) slope value for each site rather than the slope value having the largest area within the site. Small sites, especially those located on ridges, benches, or narrow terraces, may have multiple slopes, and using the slope with the largest area may give the site a lower slope value than appropriate.
- Extraction of large sites (>4 acres) regardless of class might be quite revealing. It appears that large sites may occur more commonly in certain soils and be closely associated with specific categories of other EVs.
- Because the level of detail in recording tended to increase throughout the project and throughout the entire time sites have been recorded, all site reports from projects other than the present survey project and all site reports from early in this project should be carefully read and reevaluated. Select those that have incomplete or

ambiguous descriptions to revisit and rerecord those sites.

- Additional variables like site inter-visibility should be created and tested against site locations

Conclusion

The three "final" GIS analyses performed on Class 2–4 sites provide useful information on locations where archeological sites of the appropriate Class can be expected to occur within BBNP. The areas of High Value for Classes 3 and 4 comprise only 31.6 percent of the entire Basin area, yet located 71 percent of Class 3 and 4 sites. This indicates that the criteria used to produce this model do have some significant bearing on the location of these sites. The fact that not all sites were located indicates that there are other factors influencing site location. The importance of the proximity to Highlands was "discovered" through the original set of analyses. Further analysis of the successes and failures of the present analysis can lead to better understanding of factors influencing site locations and could well lead to discovery of additional environmental factors that should be considered in future analyses.

Any environmental modifications planned within areas of Value 3–5 for Classes 2–4 should be carefully scrutinized for archeological and historic sites. However, areas that are Values 0–2 should not be "written off" as having no important sites. Those areas should be carefully reviewed for small areas similar to the Highlands criteria or along the edges of the Basin in close proximity to the Igneous and Limestone Mountains. Potential areas of water sources such as major arroyo systems not included in the H_2O Value data layer may also influence site location in those areas and should be considered when planning surveys. Models are only a tool, not a final solution for locating cultural resources. Ground surveys will still be required even in the areas of least likelihood.

This project is the first step in understanding significant environmental variables in BBNP and how those variables articulate or influenced prehistoric site locations. With the models already developed, additions and changes can be made with far less effort than was required to develop and hone the models.

These models are tools to assist Cultural Managers in planning fieldwork and determining the level of research needed. Although the National Historic Preservation Act (NHPA) Section 106 compliance requires ground-based surveys prior to construction projects that may impact cultural resources, such surveys can be tailored according to the degree of likelihood of archeological site presence. In this way, the model should help reduce the costs related to field activities while reducing the risk of undertakings to cultural sites within the park.

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Appendix 15, Sub Appendix A Environmental Zonations.

EZ1	EZ2	EZ3
Basin	Alluvial Fans	Bajada
	Alluvial Flats	Flooded
	Dissected Clay	Badlands
	Dissected Clay Hills	Igneous and Clay
		Badlands
	Dissected Hills	Badlands Chisos Formation
	Dissected Pediment	Bajada
	Dissected Toeslopes	Badlands Chisos Formation
	Erosion Remnants	Dissected Bajada
		Transition
	Floodplains	Arroyos
		Rio Grande
	High Hills	Igneous
		Igneous and Clay
	Hills	Igneous and Clay
		Limestone
		Igneous
	Pediments	Bajada
	Relict Alluvial Fans	Upper Bajada
	Scarps	Dissected Bajada
	Strath Terraces	Arroyos
	Dissected Pediment	Dissected Bajada
Igneous Mountains	Erosion Remnants	Dissected Bajada
	Hills	Chisos Formation
		Igneous
	Moist Meadow	High Chisos
	Scarps	Dissected Mountain Slopes
	Side and Lower Slopes	Intrusive Igneous
		Chisos Formation
	Summit and Side Slopes	
	Valley Bottom	High Chisos
	Valley Side Slopes	High Chisos
Limestone Mountains	Dissected Clay	Limestone and Clay
	Erosional Remnants	Gravels
	Mid Slopes	
	Plateaus	
	Scarps	
	Side and Lower	
	Summit, Upper Slope	SE
	Uplifted Remnant	High Chisos

Appendix 15, Sub Appendix B Soils versus Environmental Zonation (EZ).

Soil	EZ1	EZ2	EZ3	ID
ADE	Limestone Mountains	Summit, Upper Slope	Santa Elena	100
	Limestone Mountains	Uplifted Remnant	High Chisos	104
ADG	Limestone Mountains	Summit, Upper Slope	Santa Elena	101
BBB	Igneous Mountains	Moist Meadow	High Chisos	60
BID	Limestone Mountains	Summit, Upper Slope	Santa Elena	102
BIE	Limestone Mountains	Summit, Upper Slope	Santa Elena	103
BIG	Limestone Mountains	Mid Slopes		88
BLD	Limestone Mountains	Plateaus		89
	Limestone Mountains	Side and Lower Slopes		94
BLE	Limestone Mountains	Side and Lower Slopes		95
BLG	Limestone Mountains	Side and Lower Slopes		96
CIC	Basin	Relict Alluvial Fans	Upper Bajada	47
CLE	Basin	Dissected Pediments	Bajada	18
	Igneous Mountains	Dissected Pediments	Dissected Bajada	51
CNB	Basin	Strath Terraces	Arroyos	49
COC	Basin	Pediments	Bajada	46
COE	Basin	Dissected Pediments	Bajada	19
EUA	Basin	Alluvial fans	Bajada	1
GEE	Basin	Dissected Clay	Badlands	5
	Basin	Dissected Clay	Badlands	6
	Basin	Dissected Clay Hills	Badlands	7
	Igneous Mountains	Summit and Side Slopes	Limestone and Clay	70
	Limestone Mountains	Dissected Clay		84
GEF	Basin	Dissected Clay Hills	Badlands	8
	Igneous Mountains	Scarps	Dissected Mountain Slopes	61
	Igneous Mountains	Side and Lower Slopes	Intrusive Igneous	66
	Igneous Mountains	Summit and Side Slopes	Limestone and Clay	71
	Limestone Mountains	Dissected Clay		85
	Limestone Mountains	Scarps		93
HRE	Igneous Mountains	Valley Side Slopes	High Chisos	82
HUC	Igneous Mountains	Valley Bottom	High Chisos	81
LMF	Igneous Mountains	Valley Side Slopes	High Chisos	83
MCC	Basin	Hills	Igneous and Clay	39
	Basin	Hills	Limestone	44
	Limestone Mountains	Plateaus		90
MDD	Limestone Mountains	Side and Lower Slopes		97
MDE	Basin	High Hills	Igneous and Clay	32
	Basin	Hills	Limestone	45
	Limestone Mountains	Side and Lower Slopes		98
MNE	Basin	Dissected Clay Hills	Igneous and Clay	10
	Basin	Hills	Igneous and Clay	40
	Igneous Mountains	Summit and Side Slopes		72
	Limestone Mountains	Side and Lower Slopes		99

MSE	Basin	Dissected Hills	Badlands Chisos Formation	15
	Basin	Dissected Pediments	Bajada	20
NNA	Basin	Floodplains	Arroyos	25
NOA	Basin	Floodplains	Arroyos	26
PKE (LEE)	Basin	Dissected Clay Hills	Igneous and Clay	11
	Basin	High Hills	Igneous and Clay	33
	Basin	Hills	Igneous	37
	Basin	Hills	Igneous and Clay	41
	Igneous Mountains	Hills	Igneous	57
	Igneous Mountains	Side and Lower Slopes		68
	Igneous Mountains	Summit and Side Slopes		73
PKG	Basin	High Hills	Igneous and Clay	34
	Igneous Mountains	Hills	Igneous	58
	Igneous Mountains	Summit and Side Slopes		74
PUG	Igneous Mountains	Summit and Side Slopes		75
RIA	Basin	Floodplains	Arroyos	27
RKG	Igneous Mountains	Summit and Side Slopes		76
RTE	Basin	Dissected Clay Hills	Igneous and Clay	12
	Basin	Dissected Hills	Badlands Chisos Formation	16
	Basin	High Hills	Igneous and Clay	35
	Basin	Hills	Igneous and Clay	42
	Igneous Mountains	Hills	Chisos Formation	53
	Igneous Mountains	Side and Lower Slopes	Chisos Formation	64
	Igneous Mountains	Summit and Side Slopes		77
RTG	Basin	Dissected Clay Hills	Igneous and Clay	13
	Basin	Dissected Hills	Badlands Chisos Formation	17
	Basin	High Hills	Igneous	29
	Igneous Mountains	Hills	Chisos Formation	54
	Igneous Mountains	Summit and Side Slopes		78
RUB	Basin	Strath Terraces	Arroyos	50
SKE	Basin	Erosional Remnants	Dissected Bajada	22
	Igneous Mountains	Erosional Remnants	Dissected Bajada	52
	Igneous Mountains	Scarps	Dissected Mountain Slopes	62
SKG	Basin	Scarps	Dissected Bajada	48
	Igneous Mountains	Scarps	Dissected Mountain Slopes	63
STC	Basin	Dissected Clay Hills	Badlands	9
	Basin	Erosional Remnants	Transition	23
	Limestone Mountains	Erosional Remnants	Gravels	86
	Limestone Mountains	Plateaus		91
STE	Basin	Erosional Remnants	Transition	24
	Limestone Mountains	Erosional Remnants	Gravels	87
	Limestone Mountains	Plateaus		92

Appendix 15, Sub Appendix B Soils versus Environmental Zonation (EZ). *(continued)*

Soil	EZ1	EZ2	EZ3	ID
SUE	Basin	Dissected Clay Hills	Igneous and Clay	14
	Basin	Dissected Toeslopes	Badlands Chisos Formation	21
	Basin	High Hills	Igneous	30
	Basin	Hills	Igneous	38
	Basin	Hills	Igneous and Clay	43
	Igneous Mountains	Hills	Chisos Formation	55
	Igneous Mountains	Hills	Igneous	59
	Igneous Mountains	Side and Lower Slopes		69
	Igneous Mountains	Side and Lower Slopes	Intrusive Igneous	67

Appendix 15, Sub Appendix C Environmental Zonations and Soils in Each.

EZ1	EZ2	ENVZON 3	Soil
Basin	Alluvial Fans	Bajada	W
	Alluvial Flats	Flooded	EUA
			TOA
			TNA
			TLA
	Dissected Clay	Badlands	GEE
			GEF
	Dissected Clay Hills	Badlands	STC
			MSE
			GEF
			GEE
		Igneous and Clay	RTG
			RTE
			SUE
			PKE
			MNE
	Dissected Hills	Badlands-Chisos Formation	RTG
			RTE
			MSE
	Dissected Pediments	Bajada	MSE
			CLE
			COE
	Dissected Toeslopes	Badlands-Chisos Formation	SUE
	Erosional Remnants	Dissected Bajada	SKE
		Transition	STC
			STE
	Floodplains	Arroyos	NNA
			RIA
			NOA
		Rio Grande	VCA

Basin *(continued)*	High Hills	Chisos Fm	SUG
		Chisos Formation	RTE
			SUG
			SUE
			RTG
	High Hills (cont.)	Igneous	RTG
			SUG
			PKE
			PKG
			SUE
		Igneous and Clay	RTE
			MDE
			MNE
			PKE
			PKG
			SUG
		Intrusive Igneous	PKG
	Hills	Igneous	PKE
			SUE
		Igneous and Clay	MCC
			MNE
			PKE
			RTE
			SUE
		Limestone	MDE
			MCC
	Pediments	Bajada	COC
	Relict Alluvial Fans	Upper Bajada	CIC
	Scarps	Dissected Bajada	SKG
	Strath Terraces	Arroyos	RUB
			CNB
	Summit and Side Slopes	Intrusive Igneous	MNE
Igneous Mountains	Dissected Pediments	Dissected Bajada	CLE
	Erosion remnants	Dissected Bajada	SKE
	Hills	Chisos Formation	SUG
		Igneous	PKE
			PKG
	Moist Meadow	High Chisos	BBB
	Scarps	Dissected Mountain Slopes	SKG
			SKE
			GEF
			PKE
			SUE

Appendix 15, Sub Appendix C Environmental Zonations and Soils in Each. *(continued)*

EZ1	EZ2	ENVZON 3	Soil
Igneous Mountains *(continued)*	Side and Lower Slopes	Chisos Formation	RTG
			SUG
	Summit and Side Slopes	Intrusive Igneous	SUE
			GEF
			PUG
			RKG
			PKE
			GEE
			PKG
			SUG
			SUE
		Chisos Formation	RTE
			RTG
			SUE
			SUG
		Intrusive Igneous	GEF
			SUE
			SUG
	Valley Bottom	High Chisos	HUC
	Valley Side Slopes	High Chisos	LMF
			HRE
Limestone Mountains	Dissected Clay	Limestone and Clay	GEE
			GEF
	Erosional Remnants	Gravels	STE
			STC
	Mid Slopes	Santa Elena, Del Carmen, Telephone Canyon, Sue Pks	BIG
	Plateaus		MCC
		Boquillas w/igneous	MCC
		Plateaus	STE
			STC
		Santa Elena, Buda, Del Rio Clay, Boquillas	BLD
	Scarps		GEF
	Side and Lower Slopes	Boquillas w/igneous	MDD
			MDE
			MNE
		Santa Elena, Buda, Del Rio Clay, Boquillas	BLD
			BLE
		Santa Elena, Del Carmen, Telephone Canyon, Sue Pks	BLG

Limestone Mountains *(continued)*	Summit, Upper Slope	Santa Elena	BIE
			BID
			ADE
			ADG
	Uplifted Remnant	High Chisos	ADE

Appendix 16

Interments and Possible interments

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Appendix 17

Federal Preservation Mandates Addressed by the Big Bend National Park Survey Project

The Big Bend National Park survey project addressed several federal mandates dealing with historical properties, notably Section 110 of the National Historic Preservation Act of 1966 and Executive Order 11593 of 1971. The specific sections addressed by the project are bolded and italicized below.

National Historic Preservation Act of 1966 as amended through 1992 Public Law 102-575

Section 110 (16 U.S.C. 470h-2)

(2) Each Federal agency shall establish (unless exempted pursuant to Section 214), in consultation with the Secretary, a preservation program for the identification, evaluation, and nomination to the National Register of Historic Places, and protection of historic properties. Such program shall ensure:

(A) ***that historic properties under the jurisdiction or control of the agency, are identified, evaluated, and nominated to the National Register;***

Executive Order 11593–Protection and Enhancement of the Cultural Environment

Source: The provisions of Executive Order 11593 of May 13, 1971, appear at 36 FR 8921, 3 CFR, 1971–1975 Comp., p. 559, unless otherwise noted.

Sec. 2. *Responsibilities of Federal agencies.* Consonant with the provisions of the acts cited in the first paragraph of this order, the heads of Federal agencies shall: (a) no later than July 1, 1973, with the advice of the Secretary of the Interior, and in cooperation with the liaison officer for historic preservation for the State or territory involved, ***locate, inventory, and nominate to the Secretary of the Interior all sites, buildings, districts, and objects under their jurisdiction or control that appear to qualify for listing on the National Register of Historic Places.***

Source Cited

Executive Orders. Federal Register. http://www.archives.gov/federal-register/codification/executive-order/11593.html Accessed 10 July 2012.

Appendix 18

Criteria for Determining and Prioritizing Site Significance

The following bulletized list captures some of the most important criteria for determining and prioritizing archeological site significance within Big Bend National Park (BBNP) and, by extension, the greater Big Bend region. This list was developed jointly by Center for Big Bend Studies (CBBS) and BBNP archeologists based on extensive work conducted in the region and the resulting perspective that work provided. The list is divided between prehistoric and historic sites in order to address elements unique to each. One of the guiding principles of the present project, and one of its earliest justifications, bears repeating here: that site significance should influence both research *as well as* management priorities (research funding and site protection should be co-related). In this way, research and management needs can be integrated into a whole that addresses both the research potential of a site as well as efforts to protect it. Undergirding all these criteria is the idea that **the most significant sites are those that *will most aid our understanding of past lifeways* or that *have strong interpretive value for public education.***

Criteria for High Significance

Prehistoric Sites:

- Sites with very early components (Paleoindian and Early Archaic) which are rare in the region;
- Buried sites or sites with intact buried components, especially multiple component stratified sites;
- Special Use (ritual or ceremonial) sites including rock imagery (pictographs, petroglyphs, petroforms), burials and possible burials, and sites that have enigmatic functions;
- Rockshelters/shelters with potential to contain rare perishable artifacts or features;
- Potentially single-component sites that contain formal tools and/or intact features and/or dateable deposits;
- Sites that contain architectural features or other unique prehistoric features;

- Sites containing rare feature or artifact types (i.e., slab hearths, pottery, sinker stones) that also have associated intact features and/or dateable deposits;
- Sites that are contextually significant (sites believed to be related temporally or functionally with other sites or specific cultural manifestations);
- Sites containing diagnostic artifacts and dateable deposits, especially when those deposits are in likely association with diagnostic artifacts; and
- Multiple component sites that contain discrete activity areas.

Historic Sites:

- Early Historic Sites, especially Historic Indian sites;
- Sites associated with significant *people* or *events* in Big Bend's past;
- Sites that exemplify regionally significant *historic themes*:
    - Spanish Entradas / Presidio sites
    - Mexican homesites
    - Early Military sites (Neville Springs)
    - Village sites (San Vicente, Pantera, Coyote, etc.)
    - Ranching sites
    - Farming sites
    - Mining sites
    - Mexican Revolution sites
    - Candelilla Wax sites;
- Sites that retain *architectural features*, especially those containing intact colloquial architectural styles:
    - Adobe
    - Rock
    - Jacal (wattle and daub)
    - Dugouts;
- Sites that retain "integrity of location or setting" (National Register of Historic Places); and
- Sites that have supporting written or oral documentation.

Criteria for Low-Priority Sites:

- Deflated multi-component palimpsests sites that have no other qualifying attributes;
- Sites that are heavily eroded or otherwise disturbed to such an extent that less than 10 percent remains intact and that have no other qualifying attributes;
- Sites lacking intact features and dateable deposits, especially in the absence of temporal diagnostics; and
- Quarry sites and/or lithic scatters that contain no other feature types or formal tools.

Appendix 19

Thematic Criteria for National Register of Historic Places Nominations in BBNP

Under Section 110 of the National Historic Preservation Act of 1966, federal agencies are mandated to "establish . . . a preservation program for the identification, evaluation, and nomination to the National Register of Historic Places, and protection of historic properties."

As stated in the original proposal (Mallouf et al. 1990) and research design (Mallouf et al. 1998), all sites documented during the course of the project were to be evaluated for their eligibility for inclusion on the National Register of Historic Places (NRHP). However, due to project budgetary constraints and the inordinate amount of time required for individual nominations, it was determined that the Center for Big Bend Studies (CBBS) would instead propose a number of historic contexts—one of which would be fully developed—that could serve as umbrellas for the wide range of site types. In addition, project sites deemed potentially eligible for the NRHP under one or more of the proposed historic contexts would be identified. A total of 561 project sites were determined potentially eligible under one or more of the six proposed historic contexts. Because some sites are potentially eligible under more than one historic context, the total number of sites listed as potentially eligible, potentially ineligible, or are of unknown eligibility exceed the total number of sites (n=1,566) recorded during the project.

Based on the archeological significance of architectural remains, and the fact that they crosscut cultural and temporal categories, a single historic context related to architectural remains through time was fully developed so that sites containing such remains could be formally nominated for inclusion on the NRHP when funding becomes available.

A summary of properties in Big Bend National Park (BBNP) presently listed on the NRHP will be followed by a brief description of the proposed historic contexts, their criteria for eligibility, and the number of sites provisionally assigned to each. The subsequent section presents the fully developed architectural historic context. A list of all project sites determined potentially eligible for listing on the NRHP under one of the six proposed historic contexts is provided in Appendix 5.

Existing National Register Listings in BBNP

Despite having been a part of the National Park System (NPS) for over 70 years, BBNP contains only 9 listings on the NRHP. By contrast, Mammoth Cave National Park, founded around the same time (1941), contains 16; and Isle Royale National Park, founded in 1956, contains 14. Similarly, Olympic National Park (at 922,650 acres, roughly the same size as BBNP) contains 33, and Joshua Tree National Park (at 790,636 acres) contains 6 although it wasn't created until 1994. Within this larger context, taking park size and date of creation into consideration, BBNP lags behind most other national parks in the number of National Register listings (National Park Service n.d.a).

Big Bend National Park properties presently listed on the NRHP consist of three historic districts—the Panther Junction Mission 66 Historic District (with 38 contributing structures), the Burro Mesa Archeological District (with 10 contributing features), and the Castolon Historic District (with 14 contributing structures)—and six individual properties: Daniel's Farm House, Hot Springs, Luna's *Jacal*, Mariscal Mine, Rancho Estelle, and the Homer Wilson Ranch.

Six of these properties (Castolon, Hot Springs, Luna's *Jacal*, Mariscal Mine, Rancho Estelle, and Homer Wilson Ranch) were nominated by David G. Battle, a historical architect with the Southwest Regional Office of the NPS in Santa Fe, New Mexico, and they were formally listed in 1974 and 1975.

The Burro Mesa Archeological District was nominated by Timothy Seaman in 1984 based on fieldwork conducted by Seaman, Virginia Wulfkuhle, and Tom and Betty Alex (Alex 2018); the district was formally listed in 1985. Daniel's Farm House was nominated by NPS research historian Arthur R. Gomez and formally listed in 1989. The most recent addition was the Panther Junction Mission 66 Historic District, nominated by historian Chris Baker and architectural historian Jayne Aaron of Aarcher, Inc., of Englewood, Colorado; it was formally listed in 2014 (National Park Service n.d.a).

Proposed Historic Contexts for Archeological Sites in Big Bend National Park

1. Archeological sites containing data important to prehistory

This historic context focuses on adaptive prehistoric use of the Chihuahuan Desert as shown through changing settlement patterns, subsistence strategies, and resource procurement preferences through time. Contributing sites would include rockshelters and open campsites with intact hearths, ring middens, and other features related to food processing or other buried deposits that could be dated or otherwise analyzed to produce data that could be used to address a range of research issues.

A total of 226 project sites are considered potentially eligible for inclusion on the NRHP under this context, primarily under criterion D, which addresses sites "That have yielded or may be likely to yield information important in history or prehistory" (National Park Service n.d.b). To be eligible, sites must have intact cultural deposits that retain enough morphological integrity and/or temporal/spatial integrity to offer reliable data.

2. Prehistoric and historic rock imagery and other ritualistic features

This historic context deals with ritualistic behavior and traditions in rock imagery in BBNP during prehistoric and historic times. Contributing sites would include those with preserved pictographs and petroglyphs and intact or partially intact petroforms, including abstract as well as representational forms (such as effigies). "Special use" sites suggestive of ritualistic behavior (such as possible vision quest sites, artifact caches, and other unusual sites of unknown function) would also be contributing.

A total of 47 project sites are considered potentially eligible for inclusion on the NRHP under this context, primarily under criterion D. In addition, those sites containing intact rock imagery determined to be representative of the aesthetic values of a cultural group may be eligible under criterion C: "That embody the distinctive characteristics of a type, period, or method of construction . . ." (National Park Service n.d.b). To be eligible under either criteria, sites must contain rock imagery or other ritualistic features having a reasonable degree of intactness to provide information about prehistoric or historic human ritualistic behavior.

3. Prehistoric quarries, procurement areas, and lithic workshops

This historic context addresses the procurement and use of lithic resources within BBNP during the full prehistoric period (ca. 11,500 B.C. to A.D. 1535). Contributing sites would include significant lithic quarries and procurement areas (demonstrating preferential use during a particular period or throughout time) as well as substantial lithic workshops and scatters. Despite the fact that BBNP contains many source areas for high-quality siliceous toolstone sought by prehistoric people, much research remains to be done (see Lithic Resources section in Chapter 2, this report). By singling out and examining such sites, questions regarding temporal affiliation and spatial distribution of locally sourced toolstone can be explored.

A total of 67 project sites are considered potentially eligible for inclusion on the NRHP under this context, primarily under criterion D for their potential to yield information about the sourcing and dispersion of lithic resources in prehistory. To be eligible, sites must contain clear and abundant evidence of quarrying, procurement, and/or lithic reduction.

4. Historic period commerce

This historic context deals with commerce in BBNP during the historic period (ca. 1850–1944). Contributing sites would include candelilla wax camps and associated sites; mines, mining prospects, and related sites; sites related to farming or ranching activities; and sites where goods and/or services were available for purchase (stores and trading posts).

A total of 60 project sites are considered potentially eligible for inclusion on the NRHP under this context, primarily under criterion D, for their potential to yield information about commerce activities during the historic period. To be eligible, sites must contain sufficient architectural or artifactual remains to provide useful information about historic period commerce.

5. Military sites and outposts

This historic context addresses sites in BBNP containing evidence of military occupation during one of five episodes of activity: Spanish entradas (ca. 1740-1821), Mexican period (1821-1848), the Indian wars (ca. 1870–1883), the Mexican Revolution (ca. 1910–1920), and the Air Corps in the lower Big Bend following Mexico's Escobar Rebellion (1929). Contributing sites would include early military outposts such as Camp Neville Springs as well as later camps established during the Mexican Revolution such as Glenn Springs, Castolon, and La Noria, and the airfields at Glenn Springs and Johnson's Ranch (to date, no BBNP sites can be definitively associated with Spanish or Mexican military).

While only three project sites are considered potentially eligible for inclusion on the NRHP under this context, many more non-project sites within the park fall within this theme, primarily under criterion D, for their potential to yield information important to understanding military occupation of the western frontier and Mexican borderlands. To be eligible, sites must contain sufficient structural or artifactual remains to demonstrate the location was occupied by Spanish, Mexican, or U.S. military personnel and must retain sufficient integrity to contribute to our understanding of military history against the larger backdrop of human conflict.

Fully Developed Historic Context for Architectural Sites in Big Bend National Park

6. Temporal, functional, and social affinities of vernacular architecture

Statement of Historic Context

This historic context focuses on vernacular architecture within the confines of BBNP throughout the full sweep of human history in the region. Although the park boundaries do not conform to known ecological or cultural boundaries, they encompass a vast area (more than 800,000 acres) comprising an unparalleled representative sample of the northern Chihuahuan Desert and its varied ecological zones as derived from geology, soils, elevation, aspect, slope, and other factors. As such, the park embraces an enormous range of ecological and cultural variability representative of the larger region of which it is a part. The temporal boundaries of this historic context apply to any human occupation of the region that left structural remains, from prehistoric times to the creation of the park in 1944, which is also around the time that more modern construction materials and styles such as concrete block, milled lumber, or manufactured houses began to supplant vernacular styles in the region.

This historic context was determined on the basis of the significance of this resource in the region as a result of its relative scarcity as well as its high degree of research potential. Architecture, particularly prehistoric architecture, is one of the least commonly documented features on sites (for example, only 158 sites out of a total of 1,566 documented during the BBNP survey contained architecture, only 92 of which were prehistoric) and is notably scarce compared to other feature classes (especially thermal features). Consequently, it's one of the feature types that we know the least about outside of the La Junta Archeological District (area surrounding present-day Presidio, Texas) where the only known example of prehistoric sedentism in the region existed. Knowledge gaps are particularly notable with relation to the evolution of nomadic prehistoric architectural technology through time as well as temporal and socio-cultural affiliations. These gaps in knowledge, coupled with the awareness of architecture's high research potential and important continuities between prehistoric vernacular styles that carried forward into the historic period, helped determine this historic context, one that crosscuts temporal boundaries and addresses a broad range of site types.

Contributing sites with prehistoric and protohistoric (ca. A.D. 1535–1700) affiliations include remains such as tipi rings, wickiup rings, shade shelters, windbreaks, vision quest structures, and pithouses. Contributing sites with historic (ca. A.D. 1700–1944) affiliations include remains of *jacal*, adobe, or dry-laid or mortared stone construction. Contributing sites should be expected to provide data on temporal, functional, or social affinities of identified architectural remains to offer a framework for contextualizing such structures. Much of the following information, in cases where there is no citation, is the result of the personal observations of the authors over their collective 50-plus years of research in the region. At the broadest level, there are four principal types of vernacular architecture recognized in BBNP: **stone enclosures**, ***jacal***, **adobe**, and **stone.**

Stone enclosures apply primarily to the pre-contact period, adobe and stone apply to the post-contact period, and *jacal* crosscuts both. Each of these types and their variants will be discussed below. As the broadest category of pre-contact vernacular architecture, the term *stone enclosure* encompasses a great deal of morphological and functional variability, and captures the vast majority of prehistoric structures documented in the park. In fact, along with rockshelters and boulder shelters, stone enclosures round out known examples of prehistoric "houses" in BBNP. Although other styles of pre-contact architecture exist in the region (such as pithouses at La Junta de los Rios), no evidence of these structures has been found in the park. Instead, known types have been restricted to the architecture of nomadic hunters and gatherers, namely that of stone enclosures.

Based on ethnographic evidence and similar features documented in surrounding regions, most of the stone enclosures are believed to be the basal portion of thatch or hide-covered structures (wickiups and tipis). All are formed of rocks arranged to create or support a structure as a foundation element and/or parts of walls. They occur as one or more courses of stone, but never so high as to form an entire wall; they typically form the base or lower 50–80 cm of a foundation or footing. They also vary significantly in maximum (exterior) diameter. Of 12 stone enclosures randomly selected from the BBNP project data set, the smallest was 87 cm (34 in) across, the largest was 506 cm (16.6 ft) across, and the average was 289 cm (9.5 ft) across (see Chapter 6-II).

Stone enclosures documented in BBNP are typically round or U-shaped in plan view, but there are also examples of square, rectangular, and odd polygon shapes. Many are constructed opportunistically against existing boulders or bedrock exposures. They may occur as isolated structures, small groupings of two to four features, or as complexes of village-like arrangements. They are almost always independent stand-alone features although there are examples of adjacent/conjoined enclosures and one rare example of a multi-structure complex with adjoining walls. Stone enclosures are sometimes situated on the crest of plateaus or elevated landforms with considerable viewsheds, in which case they are often interpreted as "special use" features that could have served as vision quest sites, lookouts, or as defensive structures. Stone enclosures are also found amidst boulder fields, on mid-elevation benches, and a range of other settings although they rarely occur on lower alluvial flats.

Because construction of prehistoric structures required a relatively significant investment of energy, they are often thought to represent longer-term encampments or base camps—locations of extended residential activities. However, these feature types likely represent greater variation in behavior than is presently understood. The temporal range and cultural affiliation of stone enclosures in the region are also poorly known. However, based on survey data in the park and excavation data outside it, there is some evidence that such structures have been used since at least the Late Archaic, and most likely long before. Research into the Cielo complex (Mallouf 1999) has demonstrated that at least one variety of stone enclosure was a hallmark of a distinct sociocultural group during the Late Prehistoric period (see below).

During the protohistoric and Early Historic period, architecture in BBNP was restricted to *jacal*, adobe, and dry-laid or mortared stone construction, with *jacal* generally representing the least time and energy investment, and stone construction the greatest investment. *Jacal* construction, in particular, represents an extension of building methods used during the latter portion of the Late Prehistoric in the pithouses of the La Junta Archeological District although variations of *jacal* construction have been used in desert environs worldwide (Lehmer 1939). At La Junta these early villagers constructed rectangular or circular houses in pits, with framework consisting of large posts and beams of cottonwood, and walls made of upright stalks of ocotillo, lechuguilla, or river cane plastered with mud. Significantly, the walls of these pithouses extended to the pit floors, unlike typical pithouses across the American Southwest that extended to the exterior grade. Entry was probably gained through rooftop openings rather than doors. The houses were sometimes joined to form long tiers, and at least some villages had central plazas (Kelley 1985:150–151).

Historic *jacal* construction followed closely in the pithouse tradition minus the pit and with the addition of doors and windows built into walls. Roofs were slightly pitched (either as a shed roof or gabled) and topped with several inches of clay-rich earth. Otherwise, construction details, such as a range of methods employed and materials used, were quite variable as seen in historic photographs from the late 1800s to the 1930s. Elements common to most were the use of thick posts and beams, walls of upright poles lashed to horizontal rails, and the interior typically plastered with mud. Similar construction methods were used for fencing around houses, ramadas, animal pens, and outbuildings. Materials were always locally procured and could incorporate almost anything that could be harvested or scavenged. In the open desert, ocotillo was often used extensively. Near the river, cane and cottonwood might be utilized (Lehmer 1939). In one example associated with the Glenn Springs candelilla wax factory, the *jacal* was constructed of spent candelilla stalks tied in bundles as roofing and wall materials (see Smithers 1976:117).

Adobe construction was used to some degree during the earliest part of the La Junta phase occupations (ca. A.D. 1200–1450), as documented by J. Charles Kelley during excavations at the Millington, Polvo, and Loma Seca (Chihuahua, Mexico) sites. However, the technology appears to have been limited to interior curbs, floors, and altars—practices that seem to have been abandoned during the subsequent Concepcion and Conchos phases (Kelley 1985:153). Adobe construction was possibly reintroduced to the region as early as the 1680s when Spanish missions were first built at the La Junta pueblos. Although *jacal* construction appeared to persist as the preferred style of the Indians and mestizos, over time the more substantial and thermally efficient adobe prevailed. Sun-dried adobe blocks (which, in the Big Bend region, are typically 4 x 12 x 18 inches in size) were laid in a running bond in a thick mortar bed of wet adobe mud. Cottonwood was typically used for roof beams (*vigas*) as well as door and window headers (lintels). River cane, ocotillo, willow, or lechuguilla *latillas* were installed over the *vigas* which were overlain with reeds, grasses, or other vegetation, then plastered with clay-rich mud for a near-watertight roof. Gentle swales (*grillas de techos*) directed water to wooden or metal spouts (*canales*) that drained water away from the structure wall (Madrid 2005). Adobe construction predominated across the greater Big Bend region (encompassing roughly Brewster, Jeff Davis, and Presidio counties) except in areas having a ready supply of stones, in which case mortared stone was often used.

Early stone construction was most common in livestock corrals (as dry-laid stone) and in dwellings (as mortared stone), especially in the southernmost reaches of the region and the park, notably around Terlingua—where the Boquillas formation offers multiple layers of easily quarried platy limestone—and San Vicente where exposures of blocky Aguja sandstone offered readily available building stone. By laying these stones in a thick mud mortar, house walls could be erected that were far more durable and weather resistant than either *jacal* or adobe construction although roof elements typically were the same. Early examples of each of these styles utilized only locally available natural materials. After the arrival of the railroad in 1882 to the northern portion of the Big Bend, however, imported milled lumber came to replace cottonwood *vigas* and lintels, and factory-made doors and windows became available in the region for the first time. Except for some areas along the Rio Grande near Presidio, surviving examples of structures retaining only natural local materials are exceedingly scarce.

Cultural Context

This section briefly outlines the culture history of the greater Big Bend region, with a focus on associations with architectural remains. For a more comprehensive treatment, readers are referred to the culture history in Chapter 4 of this report. Unless otherwise indicated, the following section references the various authors of that chapter.

Prehistory in the Big Bend is divided into major and minor time periods. The major time periods are the Paleoindian, Archaic, and Late Prehistoric periods. The Paleoindian period is often divided into Early and Late. The Archaic period is subdivided into Early, Middle, and Late. The Late Prehistoric period is sometimes divided into different phases although most of these are only strictly relevant to the prehistoric villages at La Junta (present-day Presidio, Texas).

Appendix 19, Table 1 Big Bend Cultural Chronology.

Early Paleoindian	11,500–10,200 B.C.
Late Paleoindian	10,200–6500 B.C.
Early Archaic	6500–2500 B.C.
Middle Archaic	2500–1000 B.C.
Late Archaic	1000 B.C.–A.D. 700
Late Prehistoric	A.D. 700–1535
Protohistoric	A.D. 1535–1700
Historic	A.D. 1700–present

Evidence of the earliest periods of prehistory in the Big Bend is sparse. While surface finds of Late Paleoindian and Early Archaic projectiles are not uncommon, only four buried sites have been discovered in the region that date to the Paleoindian period and nine sites dating to the Early Archaic. Perhaps as a result of their scarcity, post-occupational processes, or—possibly—because they did not build structures that preserve, no architectural remains have been associated with these time periods. And despite much higher population levels as inferred from the relative number of projectile points collected dating to the Middle Archaic (225 recovered during the BBNP project as compared to 73 Early Archaic and 20 Paleoindian), again, no architectural remains have yet been found in good association with diagnostic artifacts or datable deposits. However, it is noteworthy that shallow pithouses dating to the Middle Archaic period have been documented at the Keystone Dam site near El Paso, indicating that the technology was being used at this time in at least one neighboring region (O'Laughlin 1980).

To date, the earliest possible examples of prehistoric architecture discovered in the Big Bend are from the Late Archaic period. As discussed in the Associated Property Types in this document, two sites in the region—including one in BBNP—may be associated with the Conejo point—a projectile that has been dated outside the region to the early part of the Late Archaic. However, definite affiliation has yet to be conclusively demonstrated at either site. The early portion of this period in the Big Bend correlates with the onset of moister conditions, an approximately 500-year mesic interval believed to have improved range conditions, increased the availability of edible plants, and facilitated the growth and expansion of both resident and migratory animal populations (Dering 2005:248). Higher numbers of these larger prey animals may have allowed an adaptive shift towards hunting and may explain the greater number of Late Archaic campsites relative to earlier periods as well as their occurrence in all ecological zones across the region. Later in the period, as more xeric conditions returned, the use of earth ovens to process succulents appears to have increased. The Late Archaic also witnessed a bewildering array of dart point styles that contrast sharply with the limited number of contracting stem forms from the preceding period and may signal an influx of hafting technologies introduced by groups from adjacent regions (Mallouf 1985:116–128).

The Late Prehistoric period is the first in which structural remains have been found in indisputable context, both as pithouse remains in the La Junta Archeological District as well as nomadic aboriginal stone enclosures. Whether this suggests that Late Prehistoric peoples utilized such shelters more frequently than earlier periods or that their remains are simply better represented in the archeological record is unknown. But if stone enclosures represented a new or increasingly utilized technology, it was only one of many—most notably the bow and arrow, agriculture, and ceramics. However, across the majority of the region, the bow and arrow was the only advancement that was universally embraced, and there is some evidence that dart points and atlatls continued to be used concurrently with bows and arrows for an unknown period of time (Mallouf 2005:226).

Despite the importance of these newly introduced technologies, there was very little change in the region to the long-standing and well-established nomadic lifeways of the Archaic period. Structural foundations at a number of rockshelters that date to this period appear to have been constructed and used during a climatic period known as the "Little Ice Age" (between ca. A.D. 1300/1400 and 1850/1900) when winters were appreciably colder than preceding or succeeding times (see Chapter 4, this volume). If such interior structures from this time were in response to colder winter temperatures, it may also have triggered an increase in the use of structures in open campsites. It is noteworthy, however, that many shelters in the region containing structural elements remain undated.

One undated shelter of particular significance is Bee Cave (41BS8), the largest known rockshelter in the region, located approximately 5.48 km (3.35 mi) northwest of the BBNP boundary. Here, the remains of at least 10 stone enclosures were documented by archeologists in the late 1920s. All had low stone walls no higher than two feet above the ground surface, appeared to lack doorways, and all but one were 3–4 meters in interior diameter. In addition, one was noted to have habitation levels that extended two feet below the surface, suggestive of a pithouse. Notably, some of the stone walls were chinked with a mixture of adobe and ash and the lower wall of one structure was said to be plastered (Coffin 1932). Additional work at these undated sites may well extend the prehistoric architectural sequence in the Big Bend region.

The earliest identified cultural complex assigned to the Late Prehistoric period is the Livermore phase (ca. A.D. 700 to 1300) characterized by the consistent presence of Livermore, Toyah, and Fresno arrow points and a hunting-gathering toolkit that included double-beveled knives, small scrapers, and distinctive gravers, as well as robust rock art sites suspected of being affiliated with this period. While the complex appears to have concentrated in the Davis Mountains, the phase is represented to a lesser degree across the greater Big Bend region. Although the Livermore material culture bears some artifactual similarities with Great Plains groups, the origin of the phase is unknown (Kelley et al. 1940:30–31). To date, no structural remains have been associated with this complex with a singular possible exception. A recently discovered site on the western edge of the Big Bend contained a stone enclosure with charcoal that yielded date ranges (2-sigma) of cal. A.D. 1040–1220 and cal. A.D. 1020–1160, which fall within the Livermore phase. In addition, a Livermore-like projectile point—the only diagnostic on site—was found approximately 8 m (26 ft) from the structure and may be related (Cason 2015, 2017). However, a definitive cultural affiliation for this structure remains to be established.

The subsequent phase, termed the "Cielo complex" (ca. A.D. 1250–1680) is the first to be strongly associated with architectural remains. Indeed, stacked stone enclosures are a hallmark of the complex and its type sites include numerous examples of these structures. Found across most of the Big Bend and for an undetermined distance southward into Mexico, the complex is perhaps best represented by sites near the La Junta district on elevated pediments overlooking the river basins used by agricultural groups. Base camps and short-term campsites of the complex are characterized by above-ground, circular-to-oval stacked-stone wickiup foundations with narrow entranceway gaps, and a variety of constructions related to various special functions. Significantly, virtually all Cielo complex sites with wickiup foundations are in elevated settings, with many of these suggestive of defensive positioning (Mallouf 1999).

Although their origins remain unknown, it has been theorized that they, as well as the La Junta villagers, might be ancestral to the early historic group known as the Jumanos, who may have been indigenous to the Southern Plains or the northwestern Chihuahuan Desert region. According to one model, the Cielo complex people interacted with the La Junta villagers through seasonal trading. Following the collapse of the Casas Grandes interaction sphere, the La Junta phase peoples may have joined their "cousins" in reverting back to a hunting and gathering lifeway, archaeologically manifested as the Cielo complex. Data from the last occupation at one of the Cielo type sites suggests a linkage between this group and early Apachean groups by approximately A.D. 1650 (Mallouf 1999).

No evidence has surfaced in BBNP of pithouse villages like those found at La Junta. However, because of the district's strong association with architecture, aspects of which survived and spread in modified form across the region, it warrants a brief discussion. The La Junta phase (ca. A.D. 1200–1450) represents the first cultural manifestation in the region representative of sedentary or semi-sedentary occupations. Inhabitants of the phase lived in adobe and *jacal* structures placed in pits on terraces along the Rio Grande and lower Río Conchos; they used non-local pottery, and derived their sustenance from agriculture, hunting, fishing, and from the gathering of plant foodstuffs (Kelley et al. 1940).

Houses of the phase had various shapes and forms, entranceways, and roof supports, with most all of these having wattle-and-daub superstructures. During this phase three types of houses built in pits of varying depth have been identified: 1) a single example of a multi-room structure constructed in a relatively shallow pit, 2) rectangular structures, and 3) circular structures. The rectangular variety was dominant, built within relatively deep pits. Floors were of prepared adobe or tramped gravel, occasionally with low adobe curbs around their peripheries. The *jacal* (wattle-and-daub) superstructures were anchored by both large and smaller interior posts; walls were of a pole framework and often plastered with mud/daub. The circular structures were relatively small (diameters of <3 m [9.8 ft]), and had gravel floors, interior framework posts around their edges, and were built over pits cut into terrace gravels (Kelley 1985).

Artifacts from the phase include both non-local ceramics and a hunter-gatherer toolkit common across the region which included Toyah, Perdiz, and Fresno arrow points. The end of the La Junta phase coincides with the collapse of both the El Paso phase of the Jornada Mogollon and the Casas Grandes interaction sphere. As a result of these events, the La Junta area may have been almost entirely abandoned by pottery-making agriculturalists, possibly reverting to a hunting-gathering lifeway (Kelley et al. 1940; Mallouf 1999).

The subsequent Concepcion phase (ca. A.D. 1450–1684) marks changes in architecture and material culture within the La Junta district. Following what may have been a century-long hiatus, the La Junta region is believed to have been recolonized. Pithouses remained similar to those of the La Junta phase but were larger, with both rectangular and circular-to-oval varieties represented. Rectangular houses were dominant, either isolated or in east-west tiers, and about twice the size of those of the preceding phase—averaging 8.5 x 9.1 m (27.9 x 29.9 ft). These houses also differed from those of the La Junta phase by the absence of adobe. Instead of prepared adobe floors, tramped gravel or packed refuse served as floors within the pits, and adobe was not used at all. Circular houses had diameters of about 3.7–5.5 m (12.1–18 ft) and and more supporting posts than those of the La Junta phase. Although most artifacts remained the same, ceramics associated with the phase are believed to have been almost entirely locally produced. It was also during this phase that first contact with the Spanish occurred (in 1535 when Cabeza de Vaca is believed to have passed through La Junta) followed by several Spanish entradas, which provided the first written accounts of sedentary and nomadic Indians in the region (Kelley 1985).

The Conchos phase (ca. A.D. 1684–1760) or "Mission period" began with the establishment of Spanish missions at La Junta and ended with the siting of a Presidio there in 1760. The primary archeological distinction is the presence of artifacts of European or Mexican origin, such as Spanish majolica and utility wares, in addition to metal items. However, lithic assemblages remained unchanged from the previous period and large rectangular pithouses remained the predominant architectural style although pits appear to have been gradually eliminated. There is also some evidence of the continued use of circular houses during this phase (Kelley 1985).

Although at least one source suggests Spanish missions were constructed in the La Junta area as early as 1660, the most probable early date for the construction of substantial adobe missions was either 1683–1684, with the Lopez-Mendoza expedition to La Junta, or in 1715 after the Traviña y Retis expedition brought two priests expressly to re-establish missions (Jones 1991:46). By 1717, six missions had been constructed at different villages but, due to raids and Indian uprisings, they were not continuously maintained until around 1750. In 1747, the Joseph de Ydoiaga entrada noted the abandoned village of Tapacolmes (present-day Redford) and the ruined walls of an adobe church there (Madrid 1992). Due to Apache incursions, the area remained depopulated until it was resettled by Mexican American colonists beginning in the early 1870s (Elam 1993:58).

By the time El Polvo (Tapacolmes) was resettled, adobe construction was well established in the region. In addition to the missions, an adobe presidio was built at the village of Guadalupe in 1760. However, due to abuses committed by Spanish soldiers and continuous attacks from Apaches and Comanches, the La Junta pueblos were virtually abandoned towards the latter part of the century. The Spanish attempts to settle Apaches in the area were met with only limited success and served to completely restructure the ethnic makeup of the region's inhabitants. By the early 1800s, Spanish marriage and baptismal records at Presidio del Norte (La Junta) reported increasing intermarriage between Spanish soldiers and Indians and indicated what remained of the native population was becoming increasingly acculturated (Jones 1991).

Following Mexican Independence, the nascent government was largely unable to address problems along its northern frontier, and Apache and Comanche raids increased dramatically, causing the region to be largely depopulated for decades. The U.S. inherited the Indian problem after the war with Mexico, which it eventually addressed through persistent military pressure. But it was not until the 1880s that the area was finally safe enough for settlement on a large scale. In the interim, above-ground *jacales* and adobe construction had largely replaced the traditional pithouses. The residents of La Junta were ethnically diverse (being a mix of descendants of La Junta villagers, settled Apache groups, Mestizos, and Spanish—among others) but also represented the sole community in the greater Big Bend region beyond the confines of the U.S. military establishment of Fort Davis.

Early adobe construction in the region was of fortress-like compounds, notably that of Fort Leaton (in present-day Presidio, Texas) and at the ranches of Milton Faver near present-day Shafter (including his main ranch on Cibolo Creek in addition to the smaller Cienega ranch headquarters), where he had walls constructed that were several feet thick enclosing a large central patio into which livestock could be driven at night. These early compounds were designed to offer protection from Indian raids and, due to their mass and height, were largely effective. (However, because Faver failed to fortify his third ranch at La Morita, it was later successfully attacked by Apaches.) The earliest historic construction in what is now BBNP was probably that of the U.S. military's Camp Neville, established in 1885 by Seminole negro scouts as a base from which to patrol the rugged lands to the south. One long men's barracks of adobe and a mortared stone officer's quarters were constructed in addition to a blacksmith shop and outhouses (of unknown construction). By that time, however, the Indian menace had passed, and the outpost was abandoned in 1891 (Casey 1969:26–27; Gomez 1990:85–91; Keller 2009).

The earliest residential settlement in what would become BBNP was likely along the lower reaches of Terlingua Creek, at a site later known as Terlingua Abajo, in addition to small settlements along the Rio Grande such as San Vicente, which was settled by at least 1895. The arrival of the railroad in 1882 to the northern portion of the county presaged the first land rush. Homesteaders rapidly filed on the best waterholes and streams and began ranching in earnest. For years Mexicans filtering out of population centers such as Presidio del Norte, San Carlos, and San Vicente had been slowly settling across the area although they seldom owned the land on which they lived. Although Hispanics generally appear to have been more likely to construct *jacales* than Anglos, both groups constructed and utilized all classes of historic vernacular architecture, surviving examples of which include remains at the village sites of San Vicente, Pantera, Coyote, and Terlingua Abajo, as well as ranching sites such as Sam Nail Ranch, Wilson Ranch, Alvino House, and a number of others.

Vernacular styles persisted as the primary building style, at least in the southern portions of the greater Big Bend, into the 1940s. The 248 Mine just east of Terlingua is one example of a community of houses constructed in the vernacular style (mortared limestone and adobe) in the late 1940s. Increasingly, however, wood, cement block, and manufactured homes began to predominate, concomitant with cultural bias that relegated vernacular structures into housing for the poor—architecture utilized only as a last resort. Recent decades have seen a reversal of this stigma, but the intervening years witnessed widespread destruction of many of the best examples of vernacular architecture in the region as these houses were left to the elements and eventually razed to make room for modern housing.

Research Themes

Contributing sites containing vernacular architecture should be expected to provide data that can be used to address a range of research themes. Because we know so little about pre-contact vernacular architecture in general, some of the most pressing questions are also the most basic. Although it is a reasonable assumption that prehistoric people fashioned some kind of shelter throughout time, there are no known structural remains in the region that can be definitively associated with any time period preceding the Late Prehistoric. As such, temporal affiliation remains an overarching concern. Similarly, while most stone enclosures are inferred to be simple shelters, the degree of morphological variation, site location, and associated cultural materials suggest that they may have had a broader range of functions. And with the exception of the Cielo complex, social affiliation of structures also remains unknown.

Beyond such normative questions are those relating to broader themes through time that sites bearing architectural remains may help address, including regional subsistence and settlement patterns, sociopolitical and settlement structure, the evolution of structural design through time, and architectural adaptations to the Chihuahuan Desert. Each of these themes are discussed in greater detail below.

1. Temporal, functional, and social affinities

Pre-contact vernacular architecture that has been documented in BBNP to date consists only of stone enclosures in their various manifestations. Despite the well-documented architectural sequence in the La Junta Archeological District that includes several styles of *jacal* and adobe constructions in pits, no such sedentary structures have been found within the park. Instead, most of the much more generic and morphologically variable stone enclosures have no chronological framework, no functional typology, and no affiliation with any particular group. The singular exception, of course, is that of the Cielo complex. However, in the absence of the requisite diagnostic attributes of that complex, few stone enclosures can be assigned to any time period, function, or social group with any degree of confidence.

As such, contributing sites should be able to provide some degree of information towards determining these associations. Stone enclosures that are well defined and well preserved, or that have intact subsurface deposits, or that are found in association with diagnostic artifacts or features, should be able to add important data to these pressing questions. While surficial data certainly adds to the discussion, controlled subsurface investigations, where the basal portions of structures can be correlated with old living surfaces bearing datable deposits or diagnostic artifacts, is critically needed.

2. Variation in subsistence and settlement patterns

Among the most basic of research themes in archeology, data on settlement and subsistence patterns can be gained through a range of theoretical and methodological approaches. As the question relates to stone enclosures, information regarding the location of sites and activity areas on the landscape and their spatial relation to other sites, landforms, and critical resource areas is of significant value. Such inter-site patterning can reveal important details about adaptive use of the environment and associations with resources such as springs, lithic quarries, ecotones, or ecological niches where specific resources were sought or specialized tasks may have taken place. Such data can, among other things, allow inferences about variability in spatial and functional patterning of sites and subsistence patterns through time.

3. Sociopolitical and settlement structure

Just as inter-site patterning reveals important clues at the landscape-level of inquiry, intra-site patterning—patterning within sites and between individual structures—offers insights into sociopolitical and settlement structure at the level of the most basic functional social unit in prehistoric times, the band. When temporal affiliations or functional attributes of features are revealed, important aspects of economic, demographic, and social organization can sometimes be inferred. The size and shape of stone enclosures in addition to the number of enclosures within a site can bear on issues such as family size, group size, and sociopolitical arrangements at the level of the band. The location of associated features such as hearths and bedrock mortars, as well as artifacts such as metates and chipped stone, may offer clues about seasonality, local resources, and site and feature function.

4. Evolution of structural design through time

This theme stresses continuity and change through time, notably that of pre-contact architectural styles carried forward into post-contact times, but also addresses postulated changes in pre-contact architecture of nomadic people. A great deal of variability in the morphology and siting of stone enclosures has been observed but, with one exception (Cielo complex sites), has not been correlated with a specific time period or group. As a result, a true evolution of construction methods in prehistory remains purely hypothetical. It is also plausible that different styles existed in prehistory that have recognizable temporal attributes but that might be discrete forms introduced by new groups rather than the evolution of existing forms.

A more definite and defensible argument can be made for the continuation of construction styles from prehistoric pithouses to historic *jacales*. The continuity was apparent enough to early archeologist Donald J. Lehmer for him to pen an article about the "Modern *Jacales* of Presidio" where he argued that "*jacales* are built today [1939] which appear to be direct lineal descendants of those made by the Indian population several hundred years ago" (Lehmer 1939:183). Based on observations made during his excavations of prehistoric pithouses at La Junta under direction of J. Charles Kelley, Lehmer concluded that modern *jacales* "vary from the proto-types only in the presence of doorways and the absence of deep pits" (Lehmer 1939:186).

The adaptive characteristic of constructing with pits is one that also may have carried forward from the prehistoric pithouse tradition into that of adobe construction. This trait has been observed at a number of adobe structures in the lower Big Bend and in some of the older adobe houses further north (such as Alpine), where original earthen floors were originally set from 6 inches to a foot below exterior grade. While this was also sometimes a component of adobe construction such that dirt for the bricks was excavated from within the house footprint, and thus a byproduct of a method, it is also probable that this was an intentional characteristic that evolved from the pithouse tradition in the La Junta district and spread outward from that center. However, this is a hypothesis that will require additional research.

5. Architectural adaptations to the northern Chihuahuan Desert

This overarching theme addresses specific technologies in architecture that provide adaptive advantages in the hot and dry Chihuahuan Desert. Pithouses undoubtedly represent such an adaptation. Lacking the technology to create massive walls, the early villagers at La Junta instead excavated pits, sometimes as much as 1.5 m (4.9 ft) or more deep (Kelley 1949:98; Kelley n.d.), which conveyed thermal advantages. Although ground-level temperatures can rise to 160 degrees F., several feet below the surface temperatures remain near constant 50–55° F. (Hart 2012). Indeed, considering La Junta is one of the hottest places in the United States, with summer temperatures often exceeding 105° F. and the record high at 117° F., without such adaptive housing, life would have been exceedingly uncomfortable if not impossible (Western Regional Climate Center n.d.). This is also likely one of the reasons that many historic adobes also had (and many still retain) interior floors below grade, if only a foot or less deep.

Whereas La Juntan villagers utilized thermal mass provided by subterranean construction, contemporaneous desert nomads utilized different strategies. Restricted by their requisite subsistence strategy to a roving existence, it would have been maladaptive for nomadic prehistoric people in the Big Bend to invest significant amounts of time or labor in construction activities. Where rockshelters, caves, or boulder fields could be pressed into service as shelter, thermal mass again became a constituent. But where such resources were not available, the strategy appears to have focused more on shade and ventilation. Temporary shelters such as wickiups offered only moderate protection from the elements—such as shade and some wind and rain protection—but at least were well ventilated so that heat did not build up within them. Even so, it may be argued that the greatest adaptive function of wickiups was the ease with which they could be built using readily available materials and that, when it was time for the band to move on, they could simply be abandoned without a great loss of investment.

To some degree, the same might be said for *jacal* construction which is the nearest equivalent in protohistoric and historic times to the wickiup in that it was easily constructed of readily available materials, represented a minimal time investment, and could be abandoned without relinquishing a substantial asset. Although *jacales* were more permanent, they appear to have been used most commonly by transient Hispanic workers on ranches, farms, and candelilla wax operations where they did not own the land they lived on, and fluctuations in climate or market conditions or local resource scarcity caused their employment to be tenuous and ephemeral. While there were certainly examples of large and fairly elaborate *jacales* (especially around La Junta), in general the longer an area was occupied, and the greater the investment in the land, the more likely that adobe or rock construction would be used.

As an adaptive technology for hot and arid climates, adobe is unparalleled. The Chihuahuan, like most hot deserts, experiences dramatic fluctuations in daytime and nighttime temperatures. The thermal mass offered by the thick adobe walls (often spanning 18 or more inches) helps to regulate these fluctuations. Like all of the vernacular forms, adobes were constructed of readily available materials but, unlike *jacales*, represent a significant time and labor investment. Due to the fact that each adobe brick (weighing from 35 to 55 pounds or more) must be made and moved by hand, usually several times, before being placed in the wall, it requires a considerable amount of labor (indeed, the explosion in the cost of labor has been one of the primary reasons why adobe is seldom used today for new construction).

Finally, mud-mortared or lime-mortared stone construction—whether cut stone or fieldstone—represents perhaps the greatest time and labor investment of all vernacular building styles. Because of the energy it takes to transport stone, quarry locations needed to be close by; thus, the only areas in which early stone construction occurred were those in which stone was a readily available resource. Due to the unique geology of the region, there are many exposures of quality building stone, most notably limestone and sandstone. Being less susceptible to erosion, such structures tend to be more structurally robust and generally survive longer than either *jacal* or adobe. Thermally, thick stone walls (typically 18 inches or more) behave in a manner similar to adobe due to their thermal mass. It takes the same amount of energy to heat stone as it does adobe; however, stone has higher thermal conductivity so that it releases heat somewhat faster, making it slightly less effective at regulating diurnal temperature fluctuations (Wilson n.d.).

Associated property types

Single-Course Stone Enclosures

I. Name of Property Type: Single-Course Stone Enclosures

II. Description

Single-course or single-tier stone enclosures are a morphological variant of enclosures where stones are arranged in a single continuous or discontinuous layer rather than stacked multiple courses high. Single-course stone enclosures may represent tipi rings, wickiups, ramadas, or other forms of aboriginal architecture. Enclosures documented in the park were typically classified as tipi rings when they exhibited symmetrical rings in cleared areas, especially when the ring was exceedingly large (roughly 4.5 m [14.8 ft] across or larger). Smaller enclosures, especially those located within boulder fields or that incorporated existing boulders, were usually classified as wickiup rings. The size range of all single-tier stone enclosures (outside to outside edge) ranged from 2.14 m to 9.8 m (7 to 32.2 ft) in maximum diameter.

In the findings section of the present report that tabulated metric data on such enclosures, 44 single-course features are classified as either tipi rings (n=11) or single-tier enclosures (n=33). Enclosures were typically classified as tipi rings when they exhibited continuous, symmetrical rings or when the rings were relatively large (greater than 4.5 m [14.8 ft] across). Other rings believed to represent tipis rather than wickiups are cases where clusters of stones are arranged in a circular pattern, in which case they are suspected of having been pole supports. It is noteworthy, however, that size alone may not be a reasonable diagnostic indicator since the average size of the two feature types did not vary greatly: single-tier enclosures averaged 4.10 m (13.5 ft) whereas those suspected of being tipi rings averaged 4.67 m (15.3 ft). It is also worth noting that tipi rings are not well defined in the region, or even in the state, as this is a feature type far more common on the northern and central Great Plains. One study that examined site data from 3,286 sites in Montana and Alberta containing a total of 16,057 tipi rings, reported the average size to be 4.9 m (16.1 ft) and the "normal range" to be 1.8 to 7.9 m (6 to 26 ft) (Deaver 1999). As such, all of the stone enclosures documented during the project fall within this size range. It seems evident that additional research is needed to determine the validity of interpreting stone enclosures in the Big Bend as tipi rings.

In addition to wickiup and tipi rings, some single-course stone enclosures recorded during the project are believed to be the remains of shade shelters or ramadas. Typically, these are partial rings of stones, often half rings rather than complete rings—more crescent shaped than circular. Their morphology suggests a one-sided or partial shelter rather than a fully enclosed structure. In some instances (BIBE 2346 and others in Block L), metates were found within these arcs, suggesting that the shelter was arranged around an activity area. Because prehistoric ramadas are not well documented in archeological or ethnohistoric literature in the study area, their nature and character remains speculative. However, a likely rectangular ramada feature was documented during excavations of a Cielo complex village at the Cielo Bravo site outside the national park (Mallouf 1999:69). It is also likely that many more exist than have been recorded, as they can easily be interpreted as wickiup rings that are simply incomplete or disarticulated.

Although most of these features likely represent prehistoric structures, a small number display unusual precision or symmetry in the placement of stones, suggesting other uses. For example, Feature 4 at BIBE 2440 is a single-tier enclosure that is atypical on several counts: the feature is unusually symmetrical, most of the stones are heavily embedded in the ground surface in a continuous arrangement, several of the stones are tilted vertically, and some of the stones appear too small to serve as structural elements. Similarly, Feature 1 at BIBE 2537 is atypical because most of the tabular stones are embedded and vertically tilted. Such spacing and tilt of the stones may indicate a heretofore unrecognized utilitarian function. Alternatively, it may have held ceremonial or ritual significance.

While the vast majority of stone enclosures documented in the region are believed to be Late Prehistoric in age, the true temporal range of stone enclosures in the region is poorly understood, and some evidence exists of earlier use. At the Double House site in Brewster County, roughly 65 km (40 mi) north-northwest of the BBNP boundary, two distinctive features consisting of clustered stones in semi-circular arrangements were documented. One of these features was excavated and three projectile points, point fragments, and one preform were collected. Although the preponderance of evidence suggested a Late Prehistoric-Protohistoric affiliation (with the recovery of a Perdiz arrow point medial fragment and a Perdiz-like distal fragment), one dart point (Conejo) and one dart point preform were also recovered, suggesting a possible Late Archaic affiliation. Unfortunately, because the floor of the feature was completely destroyed from animal disturbance, the feature's true affiliation remains elusive (Cloud 2013). However, one additional site documented during the BBNP project (BIBE 2501) had two semi-circular to U-shaped stone enclosures, one of which also contained a Conejo point. Originally typed from the Devil's Mouth site in Val Verde County, the point is chronologically placed within the early part of the Late Archaic period. As such, there is a modest amount of data that suggests at least some prehistoric structural remnants may pre-date the Late Prehistoric period. The absence of abundant evidence of earlier affiliation may be attributed to the effects of post-occupational processes (notably erosion and subsequent human agency) as well as significant overlay during the more recent Late Prehistoric period when population levels and aggregations of people appear to have been significantly higher. Regardless, it is a reasonable assumption that people have created shelters in the region throughout time—most likely of a similar general style such that they may lack distinguishing temporally diagnostic indicators. Future research should attempt to correlate such structures with datable deposits to enhance our understanding of temporal affiliation.

III. Significance

Single-course stone enclosures, like other styles of regional vernacular architecture, are significant because they have been understudied and are poorly understood, yet hold great potential for helping us to understand past lifeways and evolving technological adaptations to the northern Chihuahuan Desert. They are also an increasingly scarce resource. Disturbance due to natural impacts such as erosion and bioturbation, as well as cultural impacts such as unauthorized artifact collecting or vandalism by park visitors, has taken a toll on these resources within the park. In addition, before the park was established, it was a nearly universal pastime to collect artifacts from open campsites and rockshelters (and, unfortunately, it remains a pastime on some private property even today). Because architectural elements are highly visible on the landscape, these features and their associated sites are particularly vulnerable. Outside of the park such features are also lost to vandalism, industry (ranching/farming/mining), and development. As human population in the region rises, such features are increasingly at risk for impacts that would diminish or destroy their significance entirely. The research potential for stone enclosures hinges primarily on location, morphological attributes, presence of subsurface deposits, and affiliation with other features or artifacts.

IV. Registration Requirements

Sites containing single-course stone enclosures should have one or more of the following attributes to be considered contributing to this historic context:

1. structures attributable to a discrete social group or chronological period;
2. structures retaining enough morphological integrity to allow for the collection of meaningful metric data;
3. structures that may contain intact cultural deposits;
4. structures associated with features that are intact and/or that contain datable deposits;
5. structures associated with diagnostic artifacts;
6. structures composing "type sites" for identified forms of single-course stone enclosures;
7. structures that embody distinctive attributes or methods of construction of single-course stone enclosures;
8. structures that are significant as representative examples of single-course stone enclosures; and
9. structures that may retain pedogenic or geomorphic features that have potential to yield past environmental data.

Stacked Stone Enclosures

I. Name of Property Type: Stacked Stone Enclosures

II. Description

The second major category of stone enclosures is the stacked stone enclosure. These features are distinguished only by multiple courses of stone as opposed to a single course. They are typically round or oval but, like stone enclosures in general, they can utilize existing boulders or bedrock to create a wide variety of different shapes and configurations. There is considerable morphological diversity in this category, and metric descriptions are often complicated by their various states of preservation. Because the enclosures are almost always wider at the base than at the top, the upper courses often topple over time, making it difficult to record accurate interior-exterior measurements. However, based on a representative sample of stacked stone enclosure feature descriptions, the interior diameter typically ranges from 1 to 3 m (3.3 to 9.8 ft), and the exterior ranges from 1.5 to 5 m (5 to 16.4 ft).

The type and size of stones vary significantly and almost always depend on the materials that are locally available. Workmanship can be equally variable. In some cases irregular stones have been haphazardly stacked, whereas at other times tabular or rectangular stones are laid almost like bricks to form neat, orderly walls. Feature 3 at BIBE 462 is an interesting example of a stacked stone feature that has several notable characteristics. The interior measures roughly 2 m (6.6 ft) in diameter and the exterior measures about 5.5 m (18 ft) across (although toppled stones require the latter measurement to be qualified). Portions of the inner wall are partially intact, and they are formed of closely packed and carefully laid tabular stones five to six courses high. Stones along the outer ring are larger and more tabular than the interior stones. Several are tilted vertically along the outer wall. Additional large stones are scattered around the periphery of the feature. When the feature was intact, it is suspected the stone walls may have stood as much as 70 cm (2.3 ft) high. Sediment has accumulated inside the enclosure, allowing for subsurface archeological potential.

Like many single-course stone enclosures, stacked stone enclosures are usually interpreted as being wickiup foundations with the stones used to support poles to form the superstructure, itself covered with thatch, grass, or hides. Photographs and descriptions from ethnographic accounts provide ample evidence of the use of wickiups in the larger region (e.g., Seymour 2009) although stacked rocks around the perimeter of such features is not often evident. However, because the construction and configuration of stacked stone structures was often opportunistic— taking advantage of locally available resources—we should expect that construction techniques would vary in different settings.

III. Significance

Like single-course stone enclosures, stacked stone enclosures are significant because they have been understudied and are poorly understood, yet hold great potential for helping us to understand past lifeways and evolving technological adaptations to the northern Chihuahuan Desert. They are also an increasingly scarce resource and may be more at risk of human disturbance due to their greater visibility (being taller) as well as natural impacts due to their precarious stacked nature. Like other stone enclosures, disturbance due to natural and cultural impacts have taken a toll on these resources within the park. Outside of the park, such features are also lost to vandalism, industry (ranching/farming/mining), and development. As human population in the region rises, such features are at increasing risk of impacts that would diminish or destroy their significance entirely. The research potential for stacked stone enclosures hinges primarily on location, morphological attributes, presence of subsurface deposits, and affiliation with other features or artifacts.

IV. Registration Requirements

Sites containing stacked stone enclosures should have one or more of the following attributes to be considered contributing to this historic context:

1. structures attributable to a discrete social group or chronological period;
2. structures retaining enough morphological integrity to allow for the collection of meaningful metric data;
3. structures that may contain intact cultural deposits;
4. structures associated with features that are intact and/or that contain datable deposits;
5. structures associated with diagnostic artifacts;
6. structures that compose "type sites" for identified forms of stacked stone enclosures (such as the Cielo Bravo site);
7. structures that embody distinctive attributes or methods of construction of stacked stone enclosures;
8. structures that are significant as representative examples of stacked stone enclosures; and
9. structures that may retain pedogenic or geomorphic features that have potential to yield past environmental data.

Cielo Complex Stone Enclosures

I. Name of Property Type: Cielo Complex Stone Enclosures

II. Description

The Cielo complex is a Late Prehistoric cultural taxonomic unit considered to represent a distinct cultural group in which structural remains form one of several key traits. Cielo structures are stacked stone enclosures, typically 2–5 courses high, with well-defined entryways. Like other stone enclosures, these are believed to have formed the foundation for wickiups. Unlike other stone enclosures, however, these structures are the only ones in their class that serve as diagnostic indicators of a particular cultural complex. Although some Cielo sites have been documented where structures share walls in a nested complex or village-like arrangement, most sites attributed to the Cielo complex consist of fewer than three such structures, sometimes associated with hearths, middens, and artifact scatters.

Despite their interpretive weight, Cielo complex sites and features are difficult to differentiate from the larger suite of structural sites without the unambiguous association of the material correlates of the phase, principally Perdiz arrow points and preforms, flake drills, unifacial end-scrapers and side-scrapers, and beveled bifacial knives (Mallouf 1999:60). It is likely that many stone enclosures recorded during the BBNP project are Cielo complex but were not designated as such for lack of contextual evidence. Consequently, such sites are likely underrepresented in the project data set.

Site BIBE 248 is a notable exception. On a bench overlooking the Rio Grande, this large (160 x 300 m [525 x 984 ft]) site consists of some 57 stone enclosures believed to be affiliated with the Cielo complex. Among the many enclosures are a number of morphological variants, including circular, U-shaped, rectilinear, single-course, and multi-course stacked examples. Several features have joined or shared walls and possibly interior entryways between joined enclosures. Despite the fact that many of the features do not fit neatly with classic Cielo complex structures and that some Archaic-aged artifacts were present at the site, the location along with the presence of Perdiz arrow points and the absence of ceramics suggest its Cielo complex affiliation.

III. Significance

Like other stacked stone enclosures, Cielo enclosures are significant because they are still poorly understood yet hold great potential for helping us to understand past lifeways and evolving technological adaptations to the northern Chihuahuan Desert. Unlike other stone enclosure types, more research has been conducted on these enclosures than any other, and they are the only enclosures with known temporal and cultural affiliations. They are also a very scarce resource and may be more at risk of human disturbance due to their greater visibility (from being more prominent on the landscape) as well as natural impacts due to their precarious stacked nature. Like other stone enclosures, disturbance due to natural and cultural impacts have taken a toll on these resources within the park. Outside of the park, such features are also lost to vandalism, industry (ranching/farming/mining), and development. As human population in the region rises, such features are at increasing risk of impacts that would diminish or destroy their significance entirely. The research potential for Cielo enclosures hinges primarily on location, morphological attributes, presence of subsurface deposits, and affiliation with other features or artifacts.

IV. Registration Requirements

Sites containing Cielo complex stacked stone enclosures should be clearly attributable to this complex and time period by virtue of the presence of diagnostic elements and have one or more of the following attributes to be considered contributing to this historic context:

1. structures retaining enough morphological integrity to allow for the collection of meaningful metric data;

2. structures that may contain intact cultural deposits;

3. structures associated with features that are intact and/or that contain datable deposits;

4. structures associated with diagnostic artifacts (although, typically, the presence of Perdiz and/or Garza arrow points is necessary to assign sites to this complex);

5. structures that compose "type sites" for identified forms of stacked stone enclosures (such as the Cielo Bravo site);

6. structures that embody distinctive attributes or methods of construction;

7. structures that are significant as representative examples of Cielo stone enclosures; and

8. structures that may retain pedogenic or geomorphic features that have potential to yield past environmental data.

Jacal Structures

I. Name of Property Type: *Jacal* Structures

II. Description

Jacal, a Mexican-Spanish word from the Nahuatl *xacalli*, meaning "hut," typically refers to vernacular structures in Mexico and the southwestern United States made of wattle-and-daub construction except that rather than being woven, the walls typically consist of a series of upright poles covered and chinked with mud plaster (Graham 1988). Aside from the portable or temporary structures of nomadic groups, it is the oldest indigenous architectural style in the region. The agricultural villages at La Junta, established around A.D. 1200, were comprised of collections of pithouses—houses made of wattle-and-daub constructed within deep-to-shallow pits. This same construction style persisted into the Historic period (A.D. 1535–ca. 1950) with few major modifications except that they became increasingly surficial through time (rather than being built in pits) and entrances—believed to be rooftop entrances during the prehistoric and protohistoric periods—were placed in the wall. Detailed descriptions of these later *jacales* were offered by archeologist Donald Lehmer (1939) and later by anthropologist and folklorist Joe Graham (1988). Graham described these structures as consisting of large support posts set into the ground inside a square or circular pit, the top of which were typically forked to hold *vigas* topped with smaller *vigetas* that supported a heavy earthen roof. Branches (often ocotillo) were set vertically in a small trench between the posts and sandwiched between horizontal rails, called *testeras*, that were lashed to the posts. This latticework of posts and branches (the wattle) was then plastered with adobe (daub), creating a quick and effective, if crude, habitation (Graham 1988).

The technology remained a part of the vernacular architecture throughout the nineteenth and well into the twentieth century in spite of access to lumber and the technological advantages of rock and adobe. Because *jacal* construction could be made quickly and cheaply with readily available materials, it was often the structure of choice for temporary habitation until a more substantial structure could be built. *Jacal* construction also remained a common method for building animal sheds and other outbuildings on ranches and farms.

Because of the relatively fragile nature of *jacal* structures, they preserve poorly. Lacking the mass of adobe bricks, or the weather resistance of rock, the stick and mud structures quickly erode and decay (likely aided by terrestrial termites), leaving a diminutive erosional mound, if any at all. Consequently, only three sites documented during the BBNP project contained remains substantial enough to assign to this building type—and two of these are believed to be ramadas or animal pens.

The only site containing a definite *jacal* structure that appeared to serve as the primary dwelling was at site BIBE 1920. What remains is an elongated rectangular mound of earth over a stone footing. Because of irregularities in the floor plan, it appears to have been built over several different episodes. Light troweling revealed burnt daub with clear vertical imprints of the sticks it once covered just below the mound (the latter presumably the eroded earthen roof). Some areas also showed the remains of upright ocotillo stalks. Had the structure not burned, creating fire-hardened daub, it is likely it would not have been recognized for what it was—but rather interpreted as an adobe structure in advanced stages of erosion. Even at sites, such as San Vicente, that were known to have contained a number of *jacales* historically, their archeological remains were conspicuously absent or not detectable during its documentation. Consequently, although *jacal* construction was very common historically, because of its poor preservation it is undoubtedly under-represented in the archeological record in BBNP.

III. Significance

As the earliest historic construction method in the region, *jacales* are significant to understanding the area's human history. Also, this construction method, which was used in pithouses during prehistoric times, carried forward to historic times, demonstrating a degree of continuity through time not evident with other construction styles. As such, *jacales* represent both an early historic/transitional vernacular construction method as well as a method used episodically throughout history as a form of temporary housing. While it is unknown how long *jacales*—whether in pits or on the surface—persisted as the predominant housing style in the La Junta Archeological District, it is evident that their use continued well into the twentieth century. Over time, *jacales* were typically replaced by more substantial adobe construction. However, when emergency or temporary housing was needed, *jacal* construction was frequently employed. Following the massive flood on the Rio Grande in 1904 that destroyed most of the adobe houses in Presidio, many people built *jacales* as temporary homes. Their use, however, gradually declined such that by the time Joe Graham conducted research on *jacales* in the Big Bend, he was only able to locate 21 structures, most of which were in Mexico (Graham 1988). Today, *jacales*—at least on the U.S. side—survive only in a ruin state or as archeological deposits. As such, *jacales* are exceedingly rare—a product both of poor preservation as well as changes in construction methods that favor modern materials.

It is noteworthy that Luna's Jacal—one of BBNPs signature National Register properties—is not a "true" *jacal* as defined here since it is not a wattle-and-daub structure, but one composed of mud-mortared stone. However, the term in colloquial use can mean any small or temporary structure or outbuilding of almost any construction. This difference in definition between the word's technical meaning compared to its colloquial one is an important distinction to keep in mind since it has the potential to introduce confusion.

IV. Registration Requirements

Sites containing evidence of *jacal* construction should have one or more of the following attributes to be considered contributing to this historic context:

1. *jacales* or *jacal* remains that retain enough morphological integrity to allow for the collection of meaningful metric data;
2. those that may contain intact cultural deposits;
3. those associated with other structures or features that are intact and/or that contain datable deposits;
4. those associated with diagnostic artifacts;
5. those that are "type sites" for identified forms of *jacal* construction;
6. those that embody distinctive attributes or methods of *jacal* construction; and
7. those that are significant as representative examples of *jacal* construction.

Adobe Structures

I. Name of Property Type: Adobe Structures

II. Description

The most common construction method in the region historically (and, indeed, worldwide) is that of form-molded, sun-dried adobe brick. As a technology, adobe bricks have been used as a principal building material for thousands of years and is still common in much of Latin America, Africa, the Indian subcontinent, the Middle East, and parts of Asia and southern Europe. Even today, as much as 30 percent of the world's population lives or works in earthen buildings (World Housing Encyclopedia 2012).

The thermal efficiency of adobe is most effective in dry, arid climates—such as the Big Bend—where the difference between nighttime lows and daytime highs is most pronounced. Known as the "thermal flywheel effect," it is essentially thermal lag that makes adobe effective—allowing indoor temperatures to remain cooler during the day and warmer during the night than outdoor temperatures. Because it is so well suited to desert climates, as well as the ubiquitous nature of the building materials and relative ease of construction, adobe historically has been the most popular building method across the Big Bend.

Adobe bricks are made by pouring wet adobe mud into wooden molds. The molds are then pulled, and the bricks allowed to sun dry. Once dried, these bricks are laid in a mud mortar and arranged in a running bond (with staggered vertical joints) to create the walls. Door and window openings are spanned with thick wooden lentils. The roof structure is made of *vigas* (commonly cottonwood trunks or milled lumber) which rest upon a wooden bond beam on top of the uppermost course of adobe brick. *Latillas* (typically ocotillo or sotol stalks) are laid on top, perpendicular to the *vigas*. Adobe mud is troweled on top to create a roof that is slightly pitched and shaped to direct water to *canales* (water spouts) that extend outward from the wall to safely channel water away from the building.

Despite its many advantages, aside from *jacales*, adobe is one of the least durable when exposed to the elements. Consequently, once roofs are no longer present and the walls erode away, adobe ruins tend to become little more than mounds of earth, known as "adobe melt," often with no recognizable structural elements. This archeological signature was among the most common encountered at homestead sites in BBNP. In fact, no substantial standing adobe walls were noted during the entire survey. With 60 or more years of erosive forces at work, most walls had long since "melted" away. Because, in many cases, even the mounds themselves had eroded away, some adobe ruins completely escaped detection.

Even though preservation of adobe ruins in the park tended to be poor, in some instances brick outlines could be recognized within the mound—sometimes on the surface; at other times, visible only after light surface troweling. In certain cases (such as at site BIBE 1942), outlines or remains of ceiling structures, such as *latillas* were also observed. Roof timbers (such as *vigas*), however, were virtually always absent. Because lumber is among the scarcest of commodities in the region, and heavy timbers even scarcer, such wood was readily scavenged for other uses. Most of these timbers were pressed into service in other construction projects. Some of them were probably burned as fuelwood.

III. Significance

Throughout the early historic settlement period in the Big Bend (ca. 1850–1920), adobe construction remained the primary mode of building. As such, this construction style can be considered quintessential Big Bend vernacular. Since the requisite clay-rich dirt suitable for adobe brick manufacture can be found almost anywhere and because labor was easily and cheaply obtained—partly as a result of the proximity to the border with Mexico—adobe was typically the natural choice for both homes and businesses until the second half of the twentieth century. Some adobes in the region demonstrate certain continuities that reference earlier technological innovations, such as having interior floors below outside grade in the tradition of the pithouse. While early adobes in the region had flat roofs, with the arrival of the railroad and access to outside markets, most residents chose to pitch their roofs and/or add corrugated metal as a more effective and lower maintenance roofing system. With the exception of some adobe homes in the towns of Marfa, Alpine, and Fort Davis, most in the region were simple affairs, lacking ornamentation of any kind. Although very common in New Mexico, for example, the "Territorial Style" with pedimented windows and doors, brick coping, and similar features is conspicuously absent in the Big Bend.

Indeed, with reference to "styles" of adobe construction, early adobes in the Big Bend (especially those in the northern part of the region) most resemble the rural "Northern New Mexico" style, distinguished by a lack of ornamentation, a fairly steep-angled roof pitch, and the use of corrugated sheet metal.

IV. Registration Requirements

Sites containing evidence of adobe construction should have one or more of the following attributes to be considered contributing to this historic context:

1. adobe structures or adobe remains that retain enough morphological integrity to allow for the collection of meaningful metric data;
2. those that may contain intact cultural deposits;
3. those associated with other structures or features that are intact and/or that contain datable deposits;
4. those associated with diagnostic artifacts;
5. those that embody distinctive attributes or methods of adobe construction; and
6. those that are significant as representative examples of adobe construction (the Alvino House at Castolon in BBNP is the park's best surviving example).

Stone Structures

I. Name of Property Type: Stone Structures

II. Description

Structures constructed out of rock are the second most common indigenous historic structures in the region and, in areas where building stone was readily available, was often the preferred method. Consequently, stone construction was as common, if not more common, than adobe in the lower Big Bend due to the prevalence of a wide variety of stone sources. In addition to its use in constructing buildings, stone was used to build foundations, walls, dams, corrals, and a variety of expedient shelters.

Because of the nature of the material, rock structures tend to preserve better than their adobe counterparts, especially once roofs are removed. Unlike adobe structures, which can erode rapidly, well-built stone structures can remain standing for a century or more. Because only the mud mortar tends to erode out from between mortar joints, stone walls can remain standing indefinitely if the stones were well-placed or tightly fitted.

Stone structures in the region are made out of both cut (quarried) stone as well as undressed field stone and can be found both dry-laid as well as mortared. In building construction, the walls are most often two courses wide, with rubble infill. In this way, the flattest side of a stone would be facing out. When mortared, the stones were usually laid in a mud mortar (less frequently in a lime- or cement-based mortar), with smaller rocks used to chink or otherwise fill voids. In both styles, wood or metal was used to span the tops of window and door openings. Roofs tended to be similar to those used for adobe (flat) although they might be pitched and shingled or covered with corrugated metal roofing.

Where stone structures had not been destroyed by the NPS, those encountered during the survey often retained standing walls. Even in cases where deterioration was advanced, the archeological signature (rock rubble) was always much more obvious than with adobe. Consequently, stone ruins were easily identifiable and always reported. Because some of the 38 sites in the park noted as containing stone structures included stone foundations, corrals, and other structures, this construction method significantly surpassed cases of adobe reported during the survey.

III. Significance

Stone construction holds a close second after adobe in terms of preference during the settlement period. While its use was more conditioned by the local geology (presence of suitable building stone), where present, stone construction was often preferentially chosen. It was also the construction method of choice for the earliest corrals in the region, which were constructed of dry-laid stone. It also appeared frequently in conjunction with other building modes, including *jacal* and adobe. Stone construction is also significant in that it preserves much better than other historic vernacular styles. In the absence of roof structures, adobes erode rapidly. Stone construction also erodes, but much more slowly since the erosion-resistant rock largely protects the interior mortar joints. This is most pronounced in cases where cut stone was used. Structures of more irregular-shaped fieldstone tend to erode faster. In cases where the mortar was lime or Portland cement-based, such walls can stand indefinitely. Mud mortar, however, inevitably erodes, usually causing failure from the tops of the walls down. But barring surficial erosion that might undercut a foundation, rarely do stone remains have the types of basal erosion issues that plague adobes. Because stone construction preserves better, it frequently offers a much greater degree of site integrity and interpretability. Stone structures are also often good candidates for restoration efforts where appropriate.

IV. Registration Requirements

Sites containing evidence of stone construction should have one or more of the following attributes to be considered contributing to this historic context:

1. stone structures or structural remains that retain enough morphological integrity to allow for the collection of meaningful metric data;
2. those that may contain intact cultural deposits;
3. those associated with other structures or features that are intact and/or that contain datable deposits;
4. those associated with diagnostic artifacts;
5. those that embody distinctive attributes or methods of stone construction; and
6. those that are significant as representative examples of stone construction.

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Appendix 20

The Lizard Hill Site (BIBE1853/41BS1779)

David W. Keller

Discovered in the fall of 2006, this unique and significant site consists of a cairn, a small stone circle, three large limestone cobble clusters, a V-shaped rock alignment, and a dart point cache—all of which are presumed to be contemporaneous (Figure 1). Also within the site is a modern petroform (a cross made of rocks) as well as a modern campfire ring.

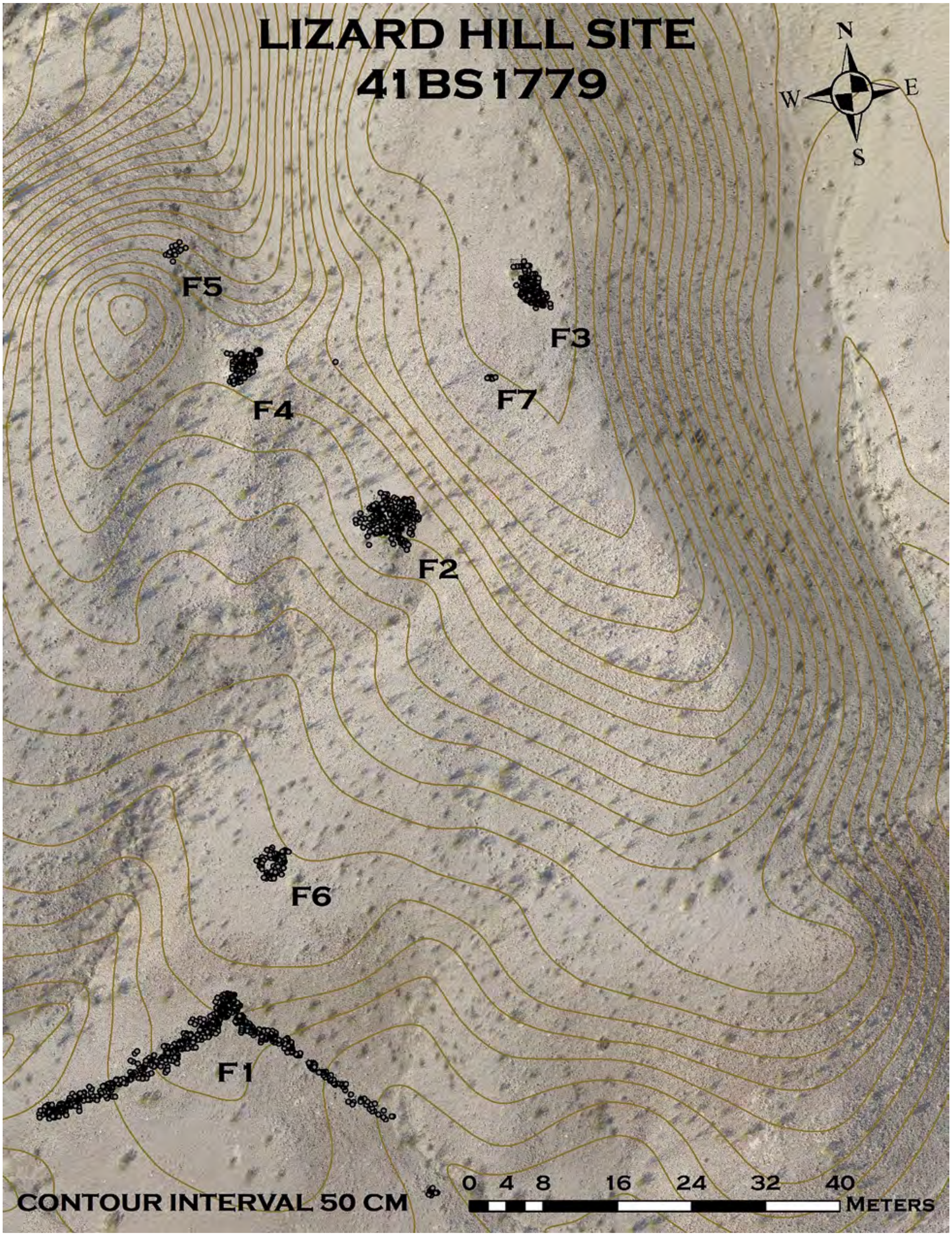
The cairn, located on a small hill in the northeastern portion of the site, consists of 9 limestone rocks in a 60 cm diameter area, one of which is considerably larger (38 cm maximum diameter) than the others and is propped up at an angle by the smaller rocks (10–15 cm maximum diameter). Within the cavity is a piece of unmodified silicified wood.

The small stone circle, appearing like an ephemeral wikiup ring, is approximately 3.5 m in maximum diameter and consists of roughly 35 rocks that average ca. 17 cm in diameter. The rocks are mostly limestone, but with several sandstone and one volcanic cobble.

Three cobble clusters are located approximately 25 m apart, and equidistant, from each other, forming a rough triangle, with the cluster forming the "apex" of the triangle occurring on a small hill adjacent to the cairn. The clusters are of slightly different sizes and shapes, but are similar in most respects, each consisting of 100 or more gray, weathered, rounded limestone cobbles, approximately 25–30 cm in maximum diameter arranged in a roughly circular to oval pattern, 300–500 cm in maximum diameter. The rocks appear to have been laid tightly together in a single course to form a kind of cobble "pavement." All stones are surficial with minimal embeddedness. There is no evidence of fire cracking or thermal alteration. Two of the clusters have two associated manos each. One of the four manos is broken.

The V-shaped alignment is composed of roughly 300 naturally occurring, weathered limestone, rhyolite, and sandstone cobbles ranging in size from 10–20 cm in maximum diameter. The "arms" extend southeast and southwest respectively, are both approximately 21-m long, and were laid in a slightly serpentine fashion. All stones are surficial although some are slightly silted in and others slightly pedestaled. The apex of the alignment appears to "point" northward in the direction of the nearby (68 m) cache.

All of the above-mentioned features are believed to be contemporaneous with the possible exception of the cairn and the small stone circle which are less certain. In the case of the former, its construction and



Appendix 20, Figure 1 Lizard Hill site map.

somewhat tenuous position of the angled stone suggest it may have been of more recent origins. Similarly, the small stone circle lacked the robustness of the cobble clusters or the petroform, also calling its affiliation into question.

The cache consisted of eight surficial contracting stem dart points around and below a loose rock cluster on the east-facing slope of a small hill. This cluster was composed of approximately 20 stones, 15–45 cm in maximum diameter with an average size of around 30 cm. The cobbles were mostly heavily weathered limestone with a very rough outer texture. Two were sandstone and were more rounded and smooth in appearance. The points were all located within a 1.6-m diameter area and appeared to have eroded downslope by sheetwash and colluvial erosion.

All points were found in various orientations, the main cluster of which was contained within a 50x50 cm area in and around several large limestone and sandstone cobbles that suggest a rock cluster or cairn that contained or overlaid the points. All were lying flat except two, one at a ca. 20 degree angle and one which was almost vertical. All eight points were contracting stem dart points affiliated with the Middle Archaic period. All were thin and some were extremely well made. No other associated artifacts were observed near the cache with the exception of one blade flake with retouched edges. Based on the presence of several presumably non-utilitarian features on the site and the ritualistic appearance of the petroform, this feature is interpreted as a ceremonial dart point cache.

About a month after the site's initial discovery, park archeologist Tom Alex and project archeologist David Keller, along with Ann Ohl, Jason Bush, and Dawnella Petrey of the CBBS, opened a 1 x 2 m unit over the surficial cache location with the long axis running parallel to the slope (Figure 2). During initial cleaning of small gravels around the feature, an additional point was found, bringing the total to 9 surficial dart points.

After the feature had been accurately mapped and the surficial points collected, rocks were removed and excavation began. Other than some soil color changes that appear to have been old rodent disturbance, no pit outline could be detected, nor cultural materials found until reaching ca. 20 cm below the surface where the blade edge of an additional point began to appear. Ultimately, four additional points clustered with a smooth river cobble and two halves of worn and drilled musselshell were recovered, bringing the total to 13 contracting stem (Middle Archaic) dart points. It was surmised that the musselshells (which were probably from the same mussel, but were too worn to say definitively) may have "contained" the points when the cache was originally constructed, and the smooth river cobble may have capped the subsurface cache (Figure 3).

Since surficial points were separated from the buried cache, it is possible there could have been two caching episodes. However, the researchers believe that the points were most likely brought up by rodents. There was definite evidence of rodent tunnels above and through the buried cache, which supports this idea, and the size of the artifacts are within the range of items often moved by pocket gophers, the most common burrowing rodent in the area.

The research value of the site, and the cache itself, is immeasurable. No other Middle Archaic dart point cache has been discovered in the region (if not the state) and it is especially significant that 11 of the points have been typed as Almagre points and the remaining 2 as Langtry points (Figure 4). Although both point types have been dated to the Middle Archaic (in adjacent regions) it was unknown if these point types were contemporaneous. Although it is possible that the Langtry points were curated, this cache lends support to the idea that they may be coeval.

For these many reasons, the Lizard Hill site is considered to be of the highest priority in terms of research value and eligibility for the National Register of

Appendix 20, Figure 2 Excavation of the cache. From left David Keller, Tom Alex, Ann Ohl.

Historic Places, offering a rare glimpse into ritualism during the Middle Archaic period some 4,000 years ago. The full results of the excavation as well as a detailed analysis of the dart points are in preparation for publication by the CBBS in the near future.

Appendix 20, Figure 3 Central core of buried cache showing four dart points, one mussel shell, and the "capstone."

Appendix 20, Figure 4 Dart points of the Lizard Hill cache. All points are typed as Almagres except for specimens 1 and 8, which are Langtry.

Appendix 21

Trinomial Key: BIBE Number to State Trinomial

The following key lists project site numbers and their associated state trinomials. Although all site data compiled during the present project was entered into the Texas Archeological Sites Atlas (TASA), 83 project sites have yet to be assigned trinomials. Thus, of the total of 1,566 sites documented during the project, only 1,483 are listed below.

Appendix 21, Table 1 BIBE Number to State Trinomial.

BIBE #	Trinomial
BIBE00044	41BS1184
BIBE00045	41BS1185
BIBE00046	41BS1193
BIBE00047	41BS1194
BIBE00048	41BS1195
BIBE00049	41BS1196
BIBE00050	41BS1197
BIBE00051	41BS1198
BIBE00052	41BS1199
BIBE00092	41BS1924
BIBE00093	41BS1925
BIBE00094	41BS1926
BIBE00123	41BS1200
BIBE00124	41BS1229
BIBE00135	41BS1230
BIBE00136	41BS1231
BIBE00140	41BS1927
BIBE00152	41BS1928
BIBE00185	41BS1929
BIBE00186	41BS1930
BIBE00187	41BS1931
BIBE00246	41BS2277
BIBE00284	41BS750
BIBE00296	41BS822
BIBE00297	41BS823
BIBE00338	41BS903
BIBE00415	41BS755
BIBE00418	41BS758
BIBE00430	41BS774
BIBE00438	41BS782
BIBE00448	41BS792
BIBE00449	41BS793
BIBE00450	41BS794
BIBE00462	41BS806
BIBE00497	41BS1415
BIBE00498	41BS1416
BIBE00503	41BS1402
BIBE00536	41BS51
BIBE00537	41BS52
BIBE00545	41BS60
BIBE00546	41BS61
BIBE00547	41BS62
BIBE00548	41BS63
BIBE00549	41BS64
BIBE00593	41BS2491
BIBE00607	41BS126
BIBE00747	41BS278
BIBE00748	41BS279
BIBE00749	41BS280
BIBE00755	41BS285
BIBE00758	41BS288
BIBE00761	41BS2492
BIBE00767	41BS299
BIBE00771	41BS303
BIBE00775	41BS307
BIBE00812	41BS344
BIBE00813	41BS345
BIBE00814	41BS346
BIBE00817	41BS349
BIBE00853	41BS0385
BIBE00859	41BS391
BIBE00908	41BS908
BIBE00920	41BS2278
BIBE00921	41BS2279
BIBE00951	41BS1303
BIBE00952	41BS1304
BIBE00953	41BS1372
BIBE00955	41BS1534
BIBE00970	41BS2493
BIBE00971	41BS2494
BIBE00972	41BS2495
BIBE00978	41BS2280
BIBE00979	41BS2281
BIBE00985	41BS1403
BIBE00986	41BS2282

Appendix 21, Table 1 BIBE Number to State Trinomial. *(continued)*

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Appendix 21, Table 1 BIBE Number to State Trinomial. *(continued)*

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Appendix 21, Table 1 BIBE Number to State Trinomial. *(continued)*

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Appendix 21, Table 1 BIBE Number to State Trinomial. *(continued)*

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Appendix 21, Table 1 BIBE Number to State Trinomial. *(continued)*

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BIBE02764	41BS2478
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BIBE02766	41BS2480
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BBNP Geographic Information Systems (GIS) Reference Files

Below is a list of the primary GIS files used for the report, listed alphabetically under their respective subject headings. Although a great many additional files were also used for the report, all were derived from these parent files.

Boundary

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Geology

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