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Holocene Archeology Near Squaw Butte, Canyonlands National Park, Utah

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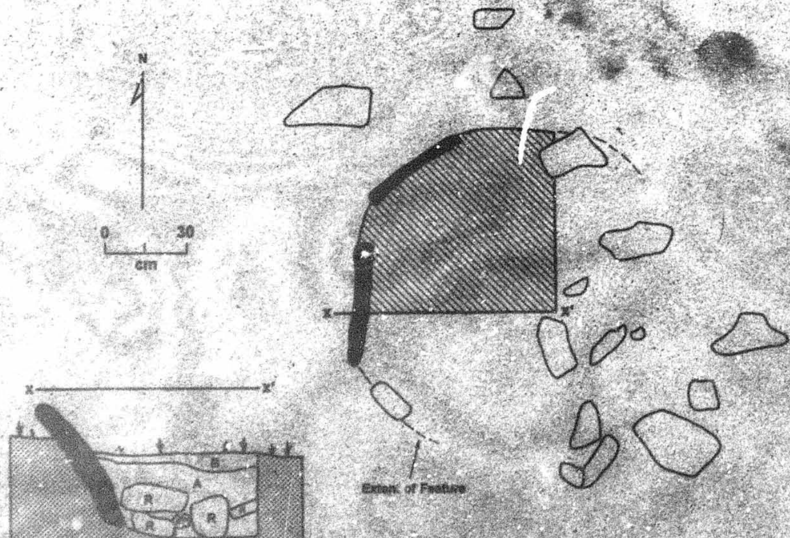
by

Betsy L. Tipps



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This document is the final technical report of cultural resources investigations in the Needles District of Canyonlands National Park, southeastern Utah. These investigations were part of the multiyear Canyonlands Archeological Project. Inventory of 878 acres in the Squaw Butte Area revealed 80 sites which were occupied by Archaic people during all phases of the Archaic period, aborigines of unknown cultural affiliation during the Early Formative period, Mesa Verde Anasazi during Pueblo III or late Pueblo II-III, and the Navajo during historic or modern times. Paleoindians may have also been in the general area, if not the actual project area. Limited testing of hearths and cultural deposits at six sites documented occupation during the poorly known Middle Archaic period and during two periods not represented by the inventory data--the Terminal Archaic and Early Formative. Flotation samples from these sites show a hunting and gathering subsistence strategy for the pre-A.D. 1100 period. Continuing research on lithic raw materials allowed refinement of the preliminary classification presented after the first year's work. The final aspect of the project was dating the Barrier Canyon rock art style. Though somewhat preliminary, available information suggests this distinctive style dates sometime between 1900 B.C. and A.D. 300.

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by

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Submitted in partial fulfillment of Contract CX 1200-4-A063

to

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FOREWARD

The significant archeological features of Canyonlands National Park are one of the many reasons it was set aside for protection and public enjoyment. As a means of better managing these remains, the park has undertaken a multi-year, archeological investigative program designed to provide interpretive, management, and scientific information. This resultant report on the Squaw Butte Area documents perhaps 12,000 years of prehistoric utilization of the general region. It provides additional evidence of Early, Middle, Late, and Terminal Archaic utilization of the park which was first documented by Tipps and Hewitt (1989) in Volume 1 of this same series. This was an important contribution since the Archaic occupation had been overlooked by earlier researchers. Also, in addition to further investigating the better known ancestral Pueblo occupation, we are able, for the first time, to document Paleoindian presence in the general area. Through a cooperative venture with allied scientists and researchers in other disciplines, this study also has begun to address the paleoenvironmental context that was available to these early inhabitants.

Home of the type location of the Late to Terminal Archaic-age Barrier Canyon rock art style, Canyonlands National Park's outstanding prehistoric pictographs have long captured the imagination of visitors and researchers alike. Better understanding these spectacular images is one of the program's research thrusts, and Chapter 7 provides rare information on radiocarbon dating of minute amounts of organic carbon contained within the pigments.

It is a pleasure to make this information available.

John Cook
Regional Director
Rocky Mountain Region

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ABSTRACT

This document is the final technical report of a cultural resources inventory and limited testing project in the Squaw Butte Area, Needles District, Canyonlands National Park, Utah. This project was conducted as part of a multiyear cultural resource program conducted by P-III Associates, Inc., on behalf of the National Park Service, Rocky Mountain Regional Office. The purposes of this multiyear effort are to provide management, scientific, and interpretive information on the prehistory of the park.

An intensive pedestrian inventory of 878 acres in the Squaw Butte Area resulted in the documentation of 80 sites and 39 isolated finds. Approximately one-third of the sites can be assigned to a time period or cultural group based on diagnostic surface artifacts and features or radiocarbon dates. At a minimum, these sites were occupied by Archaic people during all phases of the Archaic period, aborigines of unknown cultural affiliation during the Early Formative period, the Mesa Verde Anasazi during Pueblo III or late Pueblo II-III, and the Navajo during historic or modern times. Paleoindians may have been in the general area, if not the actual project area, but there was no solid evidence of Fremont, Ute, Paiute, or Hopi utilization.

The density of cultural properties in the Squaw Butte Area is substantially higher than surrounding areas also subject to intensive inventory. However, in spite of this high site density, the project area appears to have been primarily used on a transient and temporary basis. Many sites consist of temporary camps and specialized activity loci associated with procurement and processing of the locally abundant Cedar Mesa Chert. Other sites are short-term camps probably used by people attracted to the area because of the early availability of seeds and greens due to the project area's relatively low elevation. One site may have been a hunting ambush stand.

Demonstrating slightly more intensive utilization, several Anasazi sites appear to be summer farmsteads inhabited by people cultivating the few patches of arable alluvium in the lower Salt Creek area. These farmers probably maintained more permanent residences in the surrounding highlands and farmed in the Squaw Butte Area because of its longer and earlier growing season. Anasazi occupation of the project area was neither heavy nor intensive.

A limited testing program that involved sampling hearths and cultural deposits was undertaken at six sites to obtain information on chronology and subsistence during the pre-Pueblo II era. Though of limited scope, the testing program provided additional evidence of the poorly understood Middle Archaic era. It also documented occupation during two periods not represented by the diagnostic artifacts and features discovered during the inventory—the Terminal Archaic and the Early Formative—and provided a glimpse at the associated lifeways. During these time periods, local populations were practicing a hunting and gathering, rather than a horticultural lifeway.

Continuing research on lithic raw materials allowed refinement of the preliminary lithic raw material typology presented after the first year's work (Tipps and Hewitt 1989). Numerous types were collapsed into the Cedar Mesa Chert category as more became known about the range of variation of this local type. This material is of variable quality. Heat treatment experiments and analyses of a small archeological collection revealed that this material was routinely heat treated to improve its flakeability.

Finally, a research program was undertaken in cooperation with the National Park Service to develop and collect dating information on the Barrier Canyon rock art style. Though somewhat preliminary, available information suggests that this distinctive rock art style dates sometime between 1900 B.C. and A.D. 300.

ACKNOWLEDGMENTS

Funding for this project was provided by the National Park Service, Rocky Mountain Regional Office, under Contract CX-1200-4-A063. Rocky Mountain Regional Archeologist, Dr. Adrienne B. Anderson, served as the contract officer's technical representative. She provided technical advice and review comments; she also secured additional funding to conduct limited testing on several of the sites located during the survey. We appreciate her cooperation and her ongoing enthusiasm about the project. We also appreciate the input of the former Canyonlands Archeologist, Chas Cartwright, who helped select the survey parcel and the sites to be tested. Dr. Nancy J. Coulam, the current Canyonlands Archeologist, provided reference material, review comments, two radiocarbon dates, and her opinions on local chronology. We gratefully acknowledge her help.

We thank the former Canyonlands National Park Superintendent, Harvey Wickwire, and Chief of Resource Management, Larry Thomas, for their ongoing interest in our work; they also helped us obtain maps and a comfortable, secluded campsite. In the Needles District, where the work was conducted, park personnel were cordial, helpful, and interested in what we had found. They routinely offered showers, included us in their social activities, and made visits to the field to help with the work and observe our finds. We thank Bruce Dombrowski, Park Ranger, Randy Follett, Seasonal Park Ranger, Maggie Johnston, District Ranger, Sarah Marshall, Seasonal Park Ranger, Jerry McTaggart, Maintenance Worker, Thea Nordling, District Interpreter, and the rest of the 1988 Needles staff.

We thank Larry D. Agenbroad and Jim I. Mead, Northern Arizona University (NAU), for providing information on the paleoenvironmental setting of the project area. We also appreciate their comments on the age and significance of site 42SA20615 as well as sites lying on the claypan near Squaw Butte. We thank Steve Dominguez of the Midwest Archeological Center for providing unpublished data on his work in the Needles, Signa Larralde, Bureau of Reclamation, for directing us to several recent, unpublished references, and Ralph J. Hartley for several rock art references. We also thank K. Renee Barlow for a thought-provoking discussion on plant utilization and Steven J. Manning for calling our attention to the "pigment cylinder" at Cottonwood Cave.

The mainstay of any project is the crew who does the actual fieldwork. The crew members were K. Renee Barlow, John A. Evaskovich, and Gary M. Popek. Despite the heat, gnats, and, in some places, dense riparian vegetation, they cheerfully hiked back and forth across the sand dunes and never complained about recording one more lithic scatter. Their dedication to conducting quality work is much appreciated. Mr. Popek deserves an additional thanks for helping with the testing.

In the laboratory, T. Todd Prince processed the flotation samples from the hearth testing. Nancy J. Coulam analyzed and interpreted the samples, and prepared a section for the report. Winston Hurst analyzed a small sample of sherds collected in the project area. Richard Hughes studied the obsidian and André D. La Fond analyzed the debitage collected during the testing. Robert I. Birnie compiled and wrote up some of the paleoenvironmental information previously reported by NAU.

Most other laboratory tasks, including the tedious jobs of calculating UTM's, compiling figures, and coding the site data were performed by Mr. Popek. Scott W. Whitesides helped compile some background information. In the course of preparing the report, two of P-III Associates' staff members, Mr. Birnie and Mr. La Fond, provided comments, ideas, and opinions, which we greatly appreciate.

Drafting was accomplished by Lisa M. Jarrow and Susan C. Kenzle. Jeremy J. Main scanned and manipulated the cover art. Michelle A. Sanders typed all of the site forms, handled all word processing tasks, and helped with editing

and proofreading. Her excellent and thorough work made our job much easier. To these and all others who helped with the project, we express our sincere thanks.

Betsy L. Tipps
Project Director

Alan R. Schroedl
Principal Investigator

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Chapter 1

INTRODUCTION

This report documents archeological investigations conducted by P-III Associates, Inc. (P-III Associates), in the Squaw Butte Area of the Needles District, Canyonlands National Park, Utah. The investigations involved intensive inventory of 878 acres near Squaw Butte, limited testing at six of the recorded sites, describing and analyzing the results of the fieldwork, and discussing the prehistory of the area based on the recovered information. Research was also undertaken on the age of Barrier Canyon Anthropomorphic Style rock art which is common in many areas of the park. The inventory was conducted between May 20 and June 9, 1988, by a crew of four archeologists; a two- to three-person crew accomplished the testing between September 30 and October 5, 1988. Limited additional fieldwork, primarily paleoenvironmental investigations, was carried out in May, 1990. Finally, fieldwork and heat treatment experiments concerning local lithic material types took place in March of 1994.

These investigations were part of the Canyonlands Archeological Project, an ongoing, multiyear, cultural resource program being conducted by P-III Associates for the National Park Service under Contract CX-1200-4-A063. The Canyonlands Archeological Project is part of a larger, multidisciplinary research effort that includes studies of Late Quaternary geology and paleoenvironment, rock art, and historic sites, as well as data recovery excavations and ruins stabilization. Its primary purpose, and indeed the objective of the overall multidisciplinary effort, is to enhance visitor appreciation of the park's prehistory by supplying information that can be used for public interpretation.

Other objectives of the multiyear Canyonlands Archeological Project are to collect scientific data relevant to unraveling Canyonlands' cultural past, provide cultural resource information for management actions, and determine the research potential of the existing data base. These goals are to be accomplished through field inventory of selected parcels, limited testing, radiocarbon dating, laboratory studies, library research, and limited analyses of existing artifact collections.

This report documents inventory and testing in the Squaw Butte Area, discusses the local prehistory based on the investigations, and provides new dating information on the Barrier Canyon rock art style. Where possible, it follows the format of the first year's report to facilitate comparisons. At the request of the National Park Service, this and all other inventory reports are basically descriptive in nature and written for use by any interested reader, not just professional archeologists.

Project Location

Canyonlands National Park is located in southeastern Utah, southwest of Moab, northwest of Monticello, and east of Hanksville. The work was conducted in the Needles District of the park which lies east of the Colorado River in the northwestern part of San Juan County. More specifically, the field investigations were conducted in the northeastern portion of the Needles District, in the vicinity of the Needles Visitor Center (Figure 1). Two separate, but adjacent, parcels were inventoried. One is near Squaw Butte, a prominent

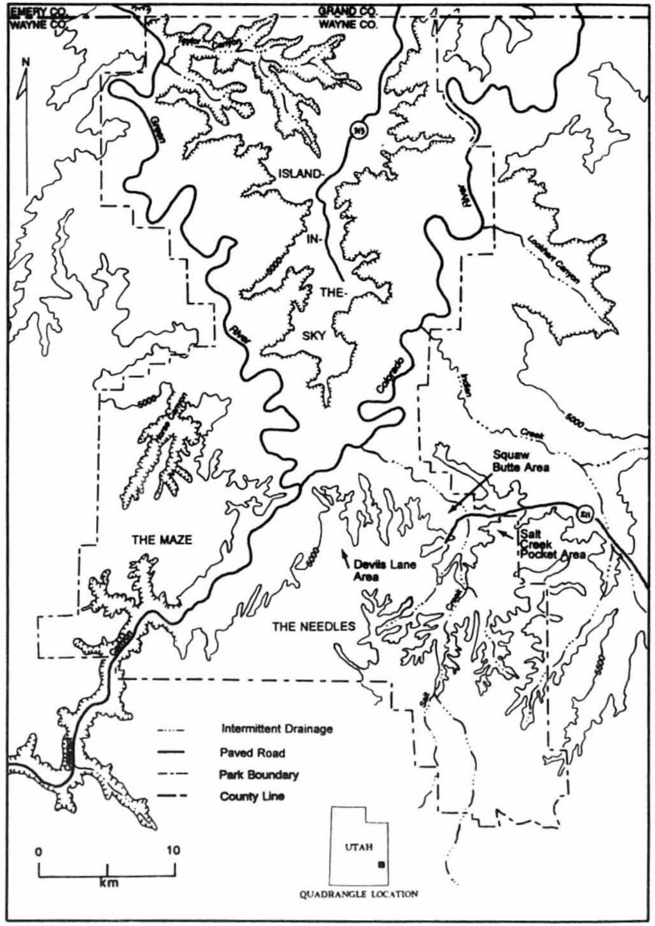

Figure 1. General location of the Squaw Butte Area.

sandstone remnant that rises 120 m above the surrounding broken tablelands; it is referred to as the Squaw Butte Parcel. The other is near Salt Creek and termed the Salt Creek Parcel. Together these two parcels compose the Squaw Butte Area. Detailed verbal and legal descriptions of this area are presented in Appendix A.

The National Park Service selected these parcels for inventory because increased use of the area is expected as planned developments are completed. These developments include a new visitor center and museum, additional camping facilities, new employee housing, and various utility lines.

Research Orientation

Research designs are an important aspect of all archeological investigations because they help structure the field, analytical, and interpretive efforts, and allow research results to be placed within the context of current archeological theory and regional knowledge. Four research domains—Chronology and Cultural Affiliation, Settlement Patterns, Environmental Adaptation, and Cultural Interaction—were identified at the outset of the project (P-III Associates, Inc. 1984). Tipps and Hewitt (1989) discuss these domains, and specific research issues within these domains, for the nearby Salt Creek Pocket and Devils Lane areas in their report of the first year's investigations for the Canyonlands Archeological Project.

The Squaw Butte Area investigations, in general, were guided by the research domains and issues identified during the earlier work (P-III Associates, Inc. 1984; Tipps and Hewitt 1989). As discussed below, research issues believed to be relevant to the types of data expected from the Squaw Butte Area were selected for particular emphasis from three of the original domains.

Research issues that can be profitably addressed by the project are constrained by a variety of factors (cf. Tipps and Hewitt 1989). Among these are selection of the project area based on management rather than research considerations, limitation of the project to field inventory and minimal testing, the stipulation that artifact collections be minimized, the requirement that research concentrate on issues that are intrinsically interesting and understandable to park visitors, and, finally, the nature and age of the sites themselves. The research issues noted below are not exhaustive but are appropriate given the focus of the original research design, the constraints noted above, and the types of expected remains in the Squaw Butte Area.

Chronology and Cultural Affiliation

Chronological control is the foundation of archeology and a necessary prerequisite for understanding and explaining cultural diversity through time and space, and for many other research topics. Because actual Needles District chronology was so poorly known at the inception of the Canyonlands Archeological Project, documenting the local chronology was defined as a major research priority.

Based on a reconnaissance inventory of the park, Sharrock (1966:41) reported that "The most significant occupation within Canyonlands was in the late Pueblo II-early Pueblo III period, ca. A.D. 1075-1150, by people of the Mesa Verde Branch of the San Juan Anasazi." Sharrock (1966:41) observed ". . . scant evidence of material . . . earlier than late Pueblo II . . .," and stated that ". . . significantly earlier material was not encountered." Finally, he reported scant and tenuous evidence of Navajo and Ute occupation, respectively.

So little was known about the nature and extent of pre-Pueblo II occupation in the Needles District that the research design for the first year's investigations included questions such as: "did Archaic people reside in the Needles District . . . and if so, to what extent," "during what time period(s) were they present," "does the occupation follow the chronological sequence developed by Schroedl (1976) for the northern Colorado Plateau," and "was the park used by Basketmaker III or early Puebloan peoples . . ." (Tipps and Hewitt 1989:27, 29).

During the first season of the Canyonlands Archeological Project, Tipps and Hewitt (1989) identified 15 Archaic sites and components and several Basketmaker III-Pueblo I age sites, in addition to numerous Pueblo II-III sites. Paleoindian and Protohistoric sites were lacking in their sample. In spite of substantially broadening the

known time frame of occupation in the Needles District of Canyonlands, much remained tentative or unknown. For example, approximately 60 percent of their sites were lithic scatters that could not be assigned to a specific time period or cultural group. Of the 15 Archaic sites, two-thirds were attributed to the Archaic based on Barrier Canyon or Glen Canyon Linear Style rock art, which themselves were only tentatively dated to the Archaic period (Schaafsma 1980; Schroedl 1977), and only four of the Archaic sites could be attributed to a specific Archaic period (two based on radiocarbon dating and two based on projectile point typology). There were several gaps in the chronological record for the pre-Pueblo II era (e.g., circa 2800-1900 B.C., 1500-200 B.C., and A.D. 1-575) but it was uncertain whether these were the result of hiatuses, a decrease in population, a lack of inventory-visible diagnostic artifacts, or the limited nature of investigations to date. Furthermore, due to the judgmental selection of the inventory parcels, it was not certain how well the observed patterns represented the situation in other portions of the Needles District.

As such, important research issues for the Squaw Butte Area investigations included confirming and refining the local chronology, ascertaining the ages of the ubiquitous nondiagnostic open lithic scatters, and determining if occupation was continuous or sporadic. An integral component of these investigations was determining if local geomorphic processes had any effect on whether sites of various ages would be preserved and found, or whether the observed patterns were strictly the result of cultural processes.

Another major research issue concerned cultural affiliation during several time periods. Like chronology, an understanding of cultural affiliation provides a foundation for addressing other issues. One of the important research problems identified by Tipps and Hewitt (1989) was the cultural affiliation of Basketmaker II-age sites in the Needles District, specifically, whether such sites represent the Archaic, Basketmaker II Anasazi, ancestral Fremont, or some other cultural tradition. Since then, Horn (1990:86) and Reed (1993:158-159) have also encountered this issue in the park. Tipps and Hewitt (1989:25, 136) noted the difficulty of addressing this issue with inventory data from open sites, and called for more research including excavation and radiocarbon dating.

An additional problem of cultural affiliation regarded the reputed Fremont occupation. In the 1950s, Rudy (1955) speculated that Canyonlands was occupied by both the Anasazi and Fremont. In a later park-wide reconnaissance inventory that included large parts of the Needles District, Sharrock (1966:20, 37) found little evidence of Fremont occupation except for numerous examples of Fremont style rock art. Though puzzled by the abundance of Fremont style rock art, he refuted Rudy's assertion regarding Fremont occupation and speculated that the Fremont style rock art must have been made by Fremont men incorporated into Anasazi culture or, more likely, by Anasazi who borrowed the motifs from the Fremont.

Rock art research has since suggested that many of the styles once believed to be Fremont were made by another cultural group. The so-called Fremont ghost figures represent the Barrier Canyon Anthropomorphic Style and date to the Archaic period (see Chapter 7). At least some shield figures are Anasazi (Chaffee et al. 1994; Noxon and Marcus 1985:352). Though not demonstrated, even the Faces Motif, originally believed to be Fremont (Schaafsma 1971:50-53), is now considered Anasazi by some (Noxon and Marcus 1985:81), leaving only the horned anthropomorph as possible Fremont manifestations. Other than a horned anthropomorph pictograph, Tipps and Hewitt (1989) found no evidence of Fremont occupation or presence during their investigations in the Needles. Investigations conducted by others since that time (e.g., Bond 1994; Dominguez 1988, 1989, 1990, 1991, 1994; Firor 1986a; 1988; Metzger et al. 1989; Reed 1993) have also failed to reveal hard evidence of Fremont occupation in the Needles District. However, the research issue was retained because of the possibility that a light Fremont occupation might have been overlooked during previous investigations.

The final research issue in this domain concerned the age and cultural affiliation of the Barrier Canyon Anthropomorphic Style rock art. With the exception of Paleoindian, this distinctive rock art has been attributed to every prehistoric culture known to occupy the northern Colorado

Plateau (Grant 1967:117; Gunnerson 1969:68, 158-159; Schaafsma 1971:128-135, 1980:61, 70, 1988:18; Schroedl 1977:262-263, 1989:17), and even a protohistoric or historic people (Manning 1990:76). Determining the age and cultural affiliation of the Barrier Canyon rock art style was identified as a research priority because of its great interest to the visiting public and because this information is essential to its use as a vehicle for understanding past human behavior. Its widespread occurrence in a broad band across eastern Utah (Cole 1990:Map 4) and concentration in the Canyonlands area suggest that many avenues of research will be opened once the style is accurately dated.

Settlement Patterns

Research issues identified for the settlement pattern domain concerned the types of settlement patterns practiced in the project area, in particular what settlement patterns characterized each time period and cultural group, and whether the project area was used on a year-round or seasonal basis. Ascertaining the season(s) of use was also an important question.

One means of examining settlement strategies is Binford's (1979, 1980) middle range theoretical model known as the forager-collector continuum. This model describes the basis for hunter-gatherer settlement systems by contrasting two extremes on a worldwide level: foragers and collectors. It is based on the premise that large-scale differences in environment create regular patterns in the way hunter-gatherers use the environment. A forager strategy is expected when resources are spread evenly in space and time. Because of the spatial and temporal homogeneity of resources, foragers practice residential mobility, mapping onto resources. They commonly exploit resources within a short distance (usually 10 km) of their residential base camp and move their residence when the resources are depleted. Foragers typically experience little need to store food.

At the other extreme, a collecting strategy is expected when resources are unevenly distributed through space or time (seasonally). Hunter-gatherers compensate for resource incongruity by establishing residential bases near key resources such as water and fuel and sending task specific groups on logistical forays to procure specific resources and bring them back to the residential base. These logistically organized groups ". . . are not . . . 'searching' for any resource encountered; they are . . . seeking to procure *specific resources* in specific contexts" (Binford 1980:10; emphasis in original). Instead of moving residential bases to the resources, collectors practice a logistical strategy of moving resources to the residential bases. Collectors commonly store food to adjust for temporal and spatial variability in resource availability.

In general, foragers have a high residential mobility and invest little time in logistical activities. Collectors make fewer residential moves, instead initiating frequent logistical forays. However, the relative mobility and frequency of moves in both the forager and collector categories varied relative to food density in a particular group's environment (Kelly 1995:120, Table 4-1). It should also be noted that these two settlement types are at opposing ends of the hunter-gatherer settlement continuum and, in actual practice, hunter-gatherers may have used a foraging strategy during one season, a collector strategy during another, or various combinations of both throughout the year.

While this model was developed to explain variability in contemporary hunting and gathering societies, it is believed to be suitable for evaluating both Archaic and Anasazi settlement patterns in the project area. By definition, local Archaic groups practiced a hunting and gathering lifeway. The Anasazi are known horticulturalists; however, various authors (Kent 1989; Szuter and Bayham 1989; Vickers 1989) note that horticulturalists need not be sedentary and that ethnographically, some horticulturalists are seasonally mobile. In addition, sedentism is a relative concept because mobility may be achieved at different levels in a society (e.g., the entire group, task groups, individuals) on daily, seasonal, or annual scales (Kelly 1995). Furthermore, previous research has suggested that local Anasazi settlement strategies were strongly oriented toward a mobile, hunting and gathering adaptation (Tipps and Hewitt 1989).

Another settlement pattern issue to be addressed was verification and possible refinement of the model of Anasazi occupation advanced by Tipps and Hewitt (1989) for the adjacent Salt

Creek Pocket and Devils Lane areas. Because Anasazi occupation of those areas was short term and intermittent, Tipps and Hewitt (1989) proposed that it was initiated by Anasazi farmers from adjacent highlands who came to hunt, gather wild plant foods, and collect nonfood resources. They also suggest that some of the sites were stopover points for Anasazi seasonally moving to farmsteads along the Green and Colorado rivers. This model was viewed as preliminary and one in need of verification and possible modification. As such, this topic was one of the research issues outlined for the Squaw Butte Area investigations.

Environmental Adaptation

Research issues for this domain concerned use of the natural environment, in particular, what resources might have attracted people to the area and how local resources were being used. Prehistoric peoples required certain critical resources for survival such as food, water, and abiotic resources suitable for the manufacture of necessary tools. One goal of the project was determining the nature and extent of these resources during the periods of occupation through observations of the modern environment and paleoenvironmental reconstructions. Another was identifying what opportunities and constraints the array of available resources may have provided.

Among the utilized resources, the local Cedar Mesa Chert was singled out for particular emphasis. Tipps and Hewitt (1989) identified a large number of Cedar Mesa Chert source areas in the Salt Creek Pocket Area and similar sources were expected in the Squaw Butte Area. Because studies of chipped stone technology and methods of quarry utilization can provide insights into prehistoric economy, craft specialization, settlement strategies, patterns of mobility and sedentism, and trade networks, among other issues (e.g., Elston and Raven 1992a:2), another research topic was determining how and to what extent the lithic source areas were being utilized.

Proving a good framework for such investigations, Elston and Raven (1992b:55-58) discuss several strategies that prehistoric groups might have used to procure material from source area sites: encounter, diurnal, residential, and logistical. Encounter strategies occur when foragers opportunistically encounter the raw material through residential or logistical mobility. Such strategies can occur at any time but are most effective among mobile people traveling from one place to another (Elston and Raven 1992b:55). Diurnal strategies involve up to a few people traveling from their residential base, collecting the raw material, and transporting it back the same day. Residential procurement strategies occur when ". . . propinquity to other resources has been sacrificed for propinquity to toolstone . . .," unless the raw material source coincides with the location of food, water, and other key resources. Logistical strategies involve multiday trips to the source and transporting the material back to the residential base. Transport costs in this instance are high unless ameliorated by the inclusion of other activities such as resource monitoring or procurement (Elston and Raven 1992b:58).

Ancillary to this, Tipps and Hewitt (1989) proposed a tentative and preliminary classification of chipped stone raw materials in the Salt Creek Pocket Area. Accurate identification of local and nonlocal materials is essential to correctly interpreting settlement patterns, degree of sedentism and mobility, and the size and location of a groups' annual range or territory, among other topics. As such, research also focused on evaluating and refining their material type classification.

Research regarding subsistence practices was directed at evaluating Tipps and Hewitt's (1989) proposals that (1) local Archaic and Anasazi peoples' subsistence strategies were similar and primarily emphasized hunting and gathering and (2) gathering was relatively more important than hunting in local economies.

The final research priority was oriented to deriving information on the local timing of the transition from a hunting and gathering lifeway to one based on agriculture, a change that transformed many aspects of society. Recent research has demonstrated earlier use (pre-1000 B.C.) of domesticates across the southern Southwest than previously accepted (Smiley 1994), although horticulture appears to have been a more recent phenomenon on the northern Colorado Plateau (Geib 1990a; Janetski 1993; Wilde and Newman 1989). A separate, but related, and equally important issue, as noted above, was identification of the cultural tradition associated with early corn use in the Needles District or Canyonlands area.

Methods

With a few exceptions, the field methods and analytical categories used during the investigations are the same as those outlined in the report of the first year's work (Tipps and Hewitt 1989). As a convenience to the reader, this section provides a brief overview of the project methods. It also points out changes in procedures from the earlier work. Refer to Tipps and Hewitt (1989) for additional information on project methods and terminology.

Field Procedures

The inventory was accomplished on foot, in adjacent sweeps spaced no more than 15 m apart. A concerted effort was made to access all shelters, ledges, and hard-to-reach areas. Following Tipps and Hewitt (1989), sites were defined as any (1) concentration of 10 or more artifacts or cultural items in a discrete scatter, (2) concentration of fewer than 10 artifacts or cultural items if accompanied by 1 or more features, (3) isolated architecture, and (4) isolated rock art. Except for a few situations, this site definition worked well for the cultural remains observed in the project area.

Problems were only encountered in selected locations near Squaw Butte where the ground surface is littered with numerous nodules of Cedar Mesa Chert. Two factors contributed to the problem of site definition in this area. First, the lithic sources at these localities appear to have been repeatedly used through time and are the result of multiple overlapping occupations that cannot be reliably segregated into meaningful analytical units. Second, the above problem was greatly exacerbated by severe sheetwash which caused additional blending of the surface remains. As a result of this situation, two very large lithic source area sites were defined, both of which appear to represent multiple occupations over a long period of time. Other archeologists might draw the boundaries differently in this area, making more or less sites, but we believe the boundaries are sufficient for current management and analytical purposes.

Sites were recorded on the most recent version of the Intermountain Antiquities Computer System (IMACS) site form and all sites with standing architecture were evaluated for possible stabilization needs using the Prehistoric Stabilization Attachment. Three additional forms were used at the request of the National Park Service: the IMACS "Rock Art Attachment" for sites with rock art, the IMACS "Prehistoric Architecture Attachment" for aboriginal sites with standing architecture, and the "Rocky Mountain Region Archeological Site Status Evaluation" for all sites. The National Park Service instituted use of the latter form to document site condition and impacts for management purposes.

Sites were plotted on 1:12000 blueline maps in the field and also transferred onto 7.5-minute U.S.G.S. topographic maps in the laboratory. Black and white film was used to photograph each site. Selected sites, artifacts, and features were also documented with color slide film. At the request of the National Park Service, all sites were marked with a flat aluminum tag inscribed with "P-III Associates, 1988" and the sequentially assigned temporary site number, 4-1, 4-2, etc. Appendix B correlates the temporary field numbers with the permanent Smithsonian site numbers.

Testing procedures were the same as those established at the outset of the project (Tipps and Hewitt 1989:58-59) except that features were backfilled with excavated backdirt which had been collected on a tarp rather than with sterile sand. Briefly, the testing involved photographing, mapping, and excavating some or all of each feature and collecting appropriate flotation and radiocarbon samples. Depending on feature size and depth, either one-quarter or one-half of each feature was typically excavated. All fill not collected as a sample was sieved through one-quarter-inch hardware cloth to retrieve any artifacts.

Definitions

The report of the first year's work provides definitions of artifact, feature, and site types encountered or expected over the life of the project. Because of finds in the Squaw Butte Area, types were added in all of these categories. Two additional artifact categories were encountered in the project area and added to the list of artifact types recognized by the project: polishing stones and utilized cores. Polishing stones were defined as small, globular or discoidal stones, usually of a hard, dense material, exhibiting at least one polished or striated surface. Utilized cores were

defined as any core exhibiting retouch or usewear along one or more margins.

Flaked cobbles were also noted due to their recent inclusion into the IMACS site recording system. Although the presence or absence of flaked cobbles was useful in defining site types, interval quantification of flaked cobbles as envisioned by IMACS was problematic. On the large lithic procurement sites, there were thousands of flaked cobbles. It did not seem useful to count or examine each one, and, in many cases, it was difficult to discern whether the flaking was natural or was done deliberately to appraise material quality and flakeability. As a consequence, few flaked cobbles were tabulated in the field and flaked cobbles were not analyzed as a separate category in the laboratory.

Several additional feature types were added to the original list: cultural stratum, burial, hand and toe holds, storage bin, upright slab, rubble/rock concentration, rock alignment, wooden structure, and woodpile area. Most of these categories are self-explanatory. "Cultural stratum" refers to subsurface cultural units visible in cutbank walls or natural profiles, and cultural deposits composing a definite stratum that was visibly stained with ash, charcoal, and decomposed organic debris.

One additional descriptive site type was added, "Masonry Architecture and Lithic Source Area," to accommodate sites with masonry architecture which are situated on natural occurrences of flakeable lithic material and contain evidence of on-site procurement of that material. These sites may also exhibit expedient features and generally possess lithic and ceramic artifacts.

While the functional site typology presented by Tipps and Hewitt (1989:48-52) seemed appropriate for settlement and subsistence strategies practiced in the project area, Tipps and Hewitt (1989:48-49) noted some difficulties in its actual application and additional problems were noted during the present study. As a result, this report uses Tipps and Hewitt's (1989) functional typology in a less rigid manner and simply to convey a general understanding of prehistoric settlement strategies in the project area.

Laboratory Procedures

Site age and cultural affiliation were assigned in the same manner and using the same diagnostic remains as the earlier work (cf. Tipps and Hewitt 1989). However, the cultural chronology has been revised to reflect new information available since the publication of that report (Table 1). This chronology generally follows Schroedl (1991, 1992a) with a few minor modifications. Throughout this report, radiocarbon years are presented as uncalibrated B.P. dates. References to calendar

Table 1. Cultural chronology used to place sites in a cultural and temporal framework.

Time Period	Possible Cultural Affiliations	Schroedl's (1992a) Phase Name	Approximate Calendrical Age
Paleoindian	Paleoindian	N.A.	12,250-7800 B.C.
Early Archaic	Archaic	Black Knoll	7800-5100 B.C.
Middle Archaic	Archaic	Castle Valley	5100-3300 B.C.
Late Archaic	Archaic	Green River	3300-1500 B.C.
Terminal Archaic	Archaic	Dirty Devil	1500-300 B.C.
Terminal Archaic	Archaic, Basketmaker, ancestral Fremont	Escalante	300 B.C.-A.D. 500
Early Formative	Anasazi, Fremont	N.A.	A.D. 500-1000
Late Formative	Anasazi, Fremont	N.A.	A.D. 1000-1300
Late Prehistoric/ Protohistoric	Ute, Paiute, Navajo, Hopi	N.A.	A.D. 1300-1775

ages (B.C./A.D. dates) are always calibrated. Tree-ring corrections of radiocarbon dates follow Pearson and Stuiver (1993) and Stuiver and Pearson (1993) and were calculated using CALIB, version 3.0.3 (Stuiver and Reimer 1993).

Aboriginal occupation of the Needles District can be subsumed into four major periods: Paleoindian, Archaic, Formative, and Late Prehistoric/Protohistoric. The Archaic era is separated into Early, Middle Late, and Terminal periods, whereas the Formative period is divided into Early and Late periods. The Pecos Classification for Anasazi sites subdivides the Early (Basketmaker III and Pueblo I) and Late (Pueblo II and III) Formative periods and is retained from the earlier work without modification. Although the various periods often connote a particular lifeway or cultural affiliation, they are intended here as broad temporal categories to be used in a strictly chronological sense. Following Tipps and Hewitt (1989:19), lifeway and cultural affiliation are treated separately for each chronological period.

Most of the categories in Table 1 are self-explanatory though the Terminal Archaic may require additional clarification. The latter portion of the Terminal Archaic period, and more specifically Schroedl's (1992a) Escalante Phase, is viewed as a time of transition from a hunting and gathering lifeway to one based on corn horticulture. This transition appears to have been gradual in the area north of the Anasazi (Janetski 1993), ending by approximately A.D. 500. Because sites dating to this period in the greater Canyonlands area primarily appear to represent a hunting and gathering rather than horticultural lifeway, Terminal Archaic, rather than Preformative, Basketmaker II, Early Agricultural era, etc., is used to refer to this period.

Flotation samples were processed according to the procedures described in the first year's report (Tipps and Hewitt 1989:59). As in that report, all identifications represent charred plants; noncharred plants are assumed to be modern contaminants. The only methodological difference is that identified plants were quantified in this report using the following method. While entire flotation samples were carefully examined for identifiable plants, only a portion of each sample was quantified. Each sample was coned and quartered and the number of identifiable charred plant taxa in one-quarter was counted. This number was then multiplied to estimate the number in the entire sample.

Curation

Maps and site forms for the Squaw Butte inventory are on file at the National Park Service, Midwest Archeological Center, Lincoln, Nebraska, and the Southeast Utah Group Museum in Arches National Park, Moab, Utah. At the end of the multiyear project, artifacts and samples not consumed during analysis will be curated at the museum along with the testing notes, original photographs, and negatives.

Synopsis of the Results

Cultural resource investigations in the Squaw Butte Area in the Needles District, Canyonlands National Park, resulted in the discovery and documentation of 80 sites and 39 isolated finds. Four of the sites had been previously recorded by Sharrock (1966) but were rerecorded to modern standards on IMACS site forms. The Squaw Butte Area has a substantially higher site density than that recorded by Tipps and Hewitt (1989) in the adjacent Salt Creek Pocket Area and in most other nearby areas also subject to intensive inventory. This high density may relate to the easy accessibility and abundance of Cedar Mesa Chert sources and the early availability of seeds and greens due to the project area's relatively low elevation.

The 80 sites have 86 surface-identifiable components but many of the sites are believed to have more components than could be readily identified from the surface evidence. Thus, the 86 components should be considered a *very* conservative estimate of the actual number present. Approximately one-third of the sites could be assigned to a particular culture or time period based on surface indications. Several diagnostic artifacts reveal that Paleoindians inhabited the general area, if not the actual project area. The full range of Archaic occupation is indicated based on radiocarbon dates and diagnostic projectile points. Definite Anasazi sites are restricted to the Pueblo III or late Pueblo II-III time period and are affiliated with the Mesa Verde Anasazi. One site has a modern or historic Navajo component. Several Early Formative sites were identified, but

their cultural affiliation remains unknown. No absolute evidence of Fremont occupation was encountered.

Six of the recorded sites were subjected to limited testing to obtain information on chronology and subsistence during the pre-Pueblo II era. The testing program provided additional evidence of the poorly understood Middle Archaic era and documented occupation during the Terminal Archaic and Early Formative periods, neither of which were represented by the inventory data. Flotation evidence revealed an emphasis on the gathering and processing of wild plants during the Archaic and Early Formative periods. This result is supported by the abundance of groundstone implements displaying a wild plant processing technology and the locations of sites in environmental settings where wild seeds and greens would have been abundant. Wild plant processing may have continued during the Pueblo III or late Pueblo II-III Anasazi occupation, but the emphasis had shifted to farming the few small plots of arable alluvium in the project area. At no time does the use of faunal resources appear to have been great, but scattered hunting implements indicate that animal resources were procured when available.

Short-term open camps are the most common cultural expression in the project area. Many of these sites are lithic extraction loci where chunks of Cedar Mesa Chert were collected, tested, and reduced into more portable forms. Other open lithic scatters are primary and secondary reduction areas where the toolstone was further reduced for either local use or transport away from the project area. Some sites are short-term camps probably used by people collecting seeds and greens made available in the spring by the project area's relatively low elevation. One site with Great Basin-style petroglyphs is a probable hunting ambush stand. Anasazi sites include several summer farmsteads inhabited by people cultivating the few local patches of arable alluvium. These farmers probably maintained more permanent residences in the surrounding highlands and farmed the Squaw Butte Area because of its longer and earlier growing season. Several Anasazi storage sites and camps are apparently related to this occupation.

Continuing research on lithic raw materials allowed refinement of the preliminary lithic raw material typology presented after the first year of the Canyonlands Archeological Project in nearby areas of the Needles District. Numerous types were collapsed into the Cedar Mesa Chert category making it clear that an even higher percentage of the toolstone on area sites was locally procured than previously realized.

Culminating almost 10 years of cooperative effort with the National Park Service in the collection and dating of samples, this report documents and evaluates dating information concerning Barrier Canyon Anthropomorphic Style rock art. Though still preliminary, it appears that this distinctive style dates sometime between 1900 B.C. and A.D. 300.

Report Organization

Chapter 2 provides background information on the project area, focusing on the identification and reconstruction of resources that might have been available to project area inhabitants. Chapters 3 and 4 present descriptive summaries of the artifacts and features, respectively. Chapter 5 reports the age and cultural affiliation of the sites, includes a brief discussion of site types, and summarizes adaptive strategies observed in the Squaw Butte Area. Results of the testing program are presented in Chapter 6. Chapter 7 discusses available chronometric information regarding the Barrier Canyon Anthropomorphic Style rock art. Chapter 8 provides a summary of the project and addresses the research issues presented earlier in this chapter. Appendices A-G provide various supporting documents.

Chapter 2

BACKGROUND INFORMATION

The Environmental Setting

Geologic and Physiographic Setting

Canyonlands National Park is in the rugged Inner Canyonlands subdivision of the Colorado Plateau physiographic province (Hunt 1974; Stokes 1977). This area is characterized by thick layers of horizontally bedded sedimentary rocks (Hunt 1974) that have been eroded on a monumental scale creating plateaus, canyons, cliffs, mesas, ridges, buttes, and pinnacles.

The Needles District, where the project area is located, has a dramatic landscape of eroded rock forms. Perennial and intermittent watercourses wind their way through meandering canyons many meters below the plateau surface whereas a variety of rock forms such as mesas, buttes, and rock spires rise above the plateau landscape. Contributing greatly to the rugged topography of the Needles District are numerous faults and joints. Settling and upthrusting of sandstone blocks between parallel fault lines have created local areas of grabens and horsts (Barnes 1978:122).

On a smaller scale, the closely spaced and crisscrossed nature of the faults and joints has also contributed to the development of hoodoos, large, mushroom-shaped formations; the crisscrossed faults subdivide rock outcrops into vertical blocks of variable size and hoodoos form as the less resistant red sandstone erodes back beneath the more resistant white caprock. The hoodoos occur in large concentrations or fields and, where more erosion has occurred, isolated clusters. Some of the hoodoos provide excellent overhangs suitable for habitation. Offering a striking contrast to the surrounding landscape are low-relief parks or flats scattered between the canyons, buttes, and hoodoos.

The Squaw Butte Area is in one of the lower-relief areas of the Needles District but is surrounded by a rugged landscape of high mesas and buttes, deep canyons, and eroded rock formations (Figure 2). The project area lies in the wide valley bottom of Salt Creek, one of the major drainages in the Needles. It consists of a gently sloping plain dotted with low sandstone ridges, isolated hoodoo clusters, and one prominent sandstone butte (Figures 3 and 4). Salt Creek and several of its tributaries bisect the project area. Salt Creek has a gentle gradient of approximately 58 ft/mi as it crosses the project area, having emerged from a deep canyon a few kilometers upstream.

The Cedar Mesa Formation is the only bedrock unit exposed in the project area; Cedar Mesa outcrops account for approximately 25 percent of the project's surface area. The remaining surface exposures consist of unconsolidated Quaternary alluvium and dune deposits (Huntoon et al. 1982) which are discussed below. The Cedar Mesa Formation is a thick, cross-bedded stratum consisting of white to pale reddish brown to salmon sandstone interbedded with lenses of red, gray, green, and brown siltstones (Huntoon et al. 1982). The white strata probably represent subaqueous, nearshore deposition along the eastern margin of an extensive sea to the west, whereas the iron-rich, red arkosic units represent continental deposition

Figure 2. View of the Squaw Butte Area showing Squaw Butte (center) and the rugged topography surrounding the project area.

from the north and east (Baars 1983:84-86, 1989:44-48). Fluctuations in the shoreline of the ancient sea caused the interfingering of these units across Canyonlands creating the red and white banding characteristic of the Needles District. Limestone beds also occur in the sandstone layers (Gregory 1938:43-44).

Because the sandstone is chiefly fine grained and calcareous, the outcrops are rounded rather than straight edged, and vertical cliffs are rare. But overhangs and outward curving cliffs that provide shelter suitable for habitation are present, having been formed by erosion of the less resistant red beds.

The iron-rich shale units provide at least two resources that were important to the prehistoric inhabitants: lenses of blue-gray limestone, which was occasionally used for hammerstones and building material, and Cedar Mesa Chert and Chalcedony, siliceous material suitable for chipped stone tool manufacture (cf. Tipps and Hewitt 1989:82, 84). The chippable limestone and chert materials literally cover the benches north, east, and south of Squaw Butte and provided ample toolstone for inhabitants of the project area. More information on the Cedar Mesa materials is presented in Chapter 3.

Most of the Salt Creek Parcel of the Squaw Butte Area is on a former Salt Creek floodplain composed of alluvial deposits with a claypan surface; this surface is intermittently covered by low, eolian dunes (Figure 5). Rising above the surface of the floodplain are several outcrops, hoodoos, and sandstone ridges, all composed of Cedar Mesa Formation sandstone (Figures 6 and 7). The ridges are low and rounded with occasional ledges, benches, and overhangs, but few talus deposits along their margins. Most of the parcel slopes gently to the northeast.

A formidable sandstone structure, Squaw Butte, is the most pronounced feature in the Squaw Butte Parcel (see Figure 2). This central feature is scalloped, its numerous projecting fingers outlining coves on all but the south side. The

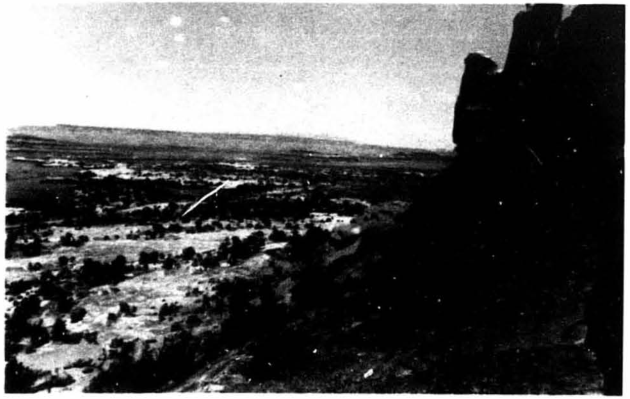

Figure 3. View of the Squaw Butte Area showing the gently sloping plain dotted with ridges, hoodoos, and bedrock outcrops and the open pinyon-juniper vegetation.

uneven floors of these coves are formed by stepped, sloping sandstone platforms, intermittently covered with unconsolidated dune deposits. The south end of the butte is composed of a series of benches, some of which harbor small overhangs, and to the southwest are ridges outlining a small canyon filled with deep alluvial deposits (Figure 8). Immediately south of this parcel is Squaw Canyon Wash, which is also rimmed by arable alluvial deposits.

Although the inventory area ranges in elevation from 1470 m (4830 ft) in the bed of Salt Creek to 1645 m (5400 ft) on top of Squaw Butte, most of the inventory area lies between 1480 m (4860 ft) and 1555 m (5100 ft) in elevation, with the average elevation of the Salt Creek Parcel about 30 m lower than the parcel around Squaw Butte.

Soils

Six soil types have been recorded in the project area (Lammers 1991). The most common, estimated to cover approximately 30 percent of the inventory parcels, is the Rock Outcrop-Rizno, Dry Complex. This unit is found in both inventory parcels. It consists of 65 percent rock outcrop, 20 percent Rizno gravelly fine sandy loam, and 15 percent other soils. Rizno is a shallow, well-drained soil that formed in eolian deposits overlying residuum. It is classified as a ustic torriorthent. Its agricultural potential is severely limited by its shallow depth, alkalinity, and low available water capacity, but it would have supported several plant taxa attractive to aboriginal peoples such as Mormon tea, Indian rice grass, and Utah juniper (Lammers 1991:Table 4).

The only other common soil unit is Thoroughfare Loam which covers approximately 20 percent of the project area including almost half of the Salt Creek Parcel, basically the Salt Creek floodplain. Thoroughfare Loam is a deep, well-drained unit that formed in alluvium derived from sandstone and shale. It is classified as a typic torrifluvent. Although it has a high available

Figure 4. View of the Squaw Butte Area showing the gentle topography and open pinyon-juniper vegetation.

water capacity, it is moderately sodic and subject to occasional flooding, limiting its agricultural potential (Lammers 1991:75-76). Reflecting its alkaline composition, the potential natural vegetation would have been halophytes such as greasewood, bottlebrush squirreltail, alkali sacaton, and seepweed. Among these, greasewood was probably the major plant used by aboriginal peoples.

Begay Fine Sandy Loam is a ustollic camborthid that covers approximately 10 percent of the project area, mainly the central portion of the Salt Creek Parcel. It is a very deep, well-drained soil that formed in eolian sand derived mainly from sandstone. Although this unit has severe limitations that make it unsuitable for commercial cultivation (Lammers 1991:22), it has the highest available water capacity of any soil unit in the project area and can support grasses, legumes, and wild herbaceous plants in most areas (Lammers 1991:Table 6). Prior to grazing and widespread human disturbance, this unit would have supported wild plant taxa that were important to hunter-gatherers such as saltbush, Mormon tea, Indian rice grass, and dropseed.

Soils along the major drainages—Salt Creek and Squaw Canyon Wash—consist of ustic torrifluvents; ustic torrifluvents, sodic; and typic ustifluvents. These are very deep, alkaline loams that developed in alluvium from sandstone and shale. Under careful management, all three of these soils are suitable for growing corn (Lammers 1991:82), but crops on these soils along Salt Creek and Squaw Canyon Wash would have been at considerable risk of being washed out by flooding. A small canyon which drains the south end of Squaw Butte and feeds Squaw Canyon Wash is filled with ustic torrifluvents and typic ustifluvents but has only a small, intermittent watercourse, greatly reducing the risk of flooding (see Figure 8). This canyon probably contains the best agricultural land in the project area. These soils have the highest total plant production of the soil types present in the project area.

Figure 5. The floodplain along Salt Creek showing the alluvial deposits with a claypan surface and low, intermittent, overlying dunes.

Mido Loamy Fine Sand and Sheppard Fine Sand cover less than 5 percent of the project area, each. The Mido is a very deep, well-drained, loamy fine sand classified as a ustic torripsamment. Sheppard soil is an excessively well-drained sand classified as a typic torripsamment. While neither soil possesses high agricultural potential (Lammers 1991:Table 4), both would have supported plant taxa that were used by aboriginal peoples such as Indian rice grass, saltbush, and buckwheat.

Climate and Water Resources

The project area has an arid to semiarid continental climate. At the Squaw Butte weather station, which is located inside the project area, the average annual precipitation between 1965 and 1986 was 219 mm (8.6 in) with almost half occurring in late summer and early fall. The average annual snowfall was 409 mm (16.1 in) (Brough et al. 1987). The general moisture pattern involves summer precipitation occurring during late afternoon thundershowers and winter precipitation being associated with frontal storms.

Temperatures exhibit a great diurnal range, often varying up to 50°F. Winters are mild, whereas summers are hot. January is the coldest month with an average maximum temperature of 40°F and an average minimum of 15°F. July, the hottest month, has an average maximum temperature of 95°F and an average minimum temperature of 62°F (Brough et al. 1987). June through September are generally frost free, providing a growing season of about 120-140 days (Lammers 1991).

The availability of water does not appear to have been a limiting factor to occupation in the Squaw Butte Area. Salt Creek, near the northeastern perimeter of the project area, has a regular, though variable waterflow, and is perennial throughout much of its course. Springs are also found in the area, in Squaw Canyon Wash to the southwest and at Cave Spring to the east. Another source of water, albeit intermittent, are numerous

Figure 6. Hoodoos in the project area.

small depressions or potholes which cluster on ridgetops and sandstone outcrops throughout the area (Figures 9 and 10). These natural depressions hold water after rainstorms and snowmelt, and provide periodic opportunities to obtain water on or very close to many of the sites.

Vegetation

The current vegetation of the project area is typical of the Upper Sonoran Life Zone; snakeweed (*Gutierrezia sarothrae*), juniper (*Juniperus osteosperma*), and prickly pear cactus (*Opuntia* spp.) are the most frequently occurring species. Modern taxa currently in the project area are described below. Potential vegetation during the prehistoric period is described in the succeeding section.

Four plant associations are currently found in the project area (National Park Service 1985) generally corresponding with the soil units noted above. The first, characterized as "pinyon-juniper uplands" by the National Park Service, occurs on the rocky terrain surrounding Squaw Butte and the rocky ridges in the Salt Creek Parcel, basically on the rocky outcrops and the Rock Outcrop-Rizno, Dry Complex soil unit (see Figures 3 and 4). The principal taxa in this association are pinyon pine (*Pinus edulis*) and juniper, in approximately equal amounts, with an understory consisting primarily of snakeweed, sagebrush (*Artemisia tridentata*), yucca (*Yucca* spp.), Mormon tea (*Ephedra* sp.), prickly pear cactus, cryptantha (*Cryptantha flava*), pepper grass (*Lepidium* sp.), Indian rice grass (*Stipa hymenoides*), and various other grasses.

Other taxa occurring less frequently or in smaller amounts are single leaf ash (*Fraxinus anomala*), birch-leaf mountain mahogany (*Cercocarpus betuloides*), Fremont barberry (*Berberis fremontii*), Gambel oak (*Quercus gambelii*), cliffrose (*Cowania mexicana*), rabbitbrush (*Chrysothamnus nauseosus*), four-wing saltbush (*Atriplex canescens*), and blackbrush (*Coleogyne ramosissima*). Scarce taxa are serviceberry (*Amelanchier* spp.), globemallow (*Sphaeralcea* spp.), buckwheat

Figure 7. View of the Salt Creek inventory parcel showing the Salt Creek floodplain, bedrock outcrops, and a sandstone ridge.

(*Eriogonum* spp.), fishhook cactus (*Sclerocactus whipplei*), and hegehog cactus (*Echinocereus* sp.).

This association appears to represent the Great Basin Conifer Woodland, a cold-adapted, evergreen woodland that usually grows in rocky habitats on thin soils (Brown 1982:52-53). At the lower contact, it gives way to open grasslands characterized by various grasses and shrubs.

The second modern association, "galleta grass-Indian rice grass" (National Park Service 1985), is mainly found on the Thoroughfare L. am and Begay Fine Sandy Loam; it covers most of the Salt Creek Parcel and a small amount of the Squaw Butte Parcel (see Figures 5, 7, and 11). Today, snakeweed, cheatgrass (*Bromus tectorum*), Indian rice grass, and galleta grass (*Hilaria jamesii*) are the dominant taxa. Occurring in fewer numbers, but present throughout the area, are prickly pear cactus, greasewood (*Sarcobatus vermiculatus*), shadscale (*Atriplex confertifolia*), four-wing saltbush, yucca, rabbitbrush, and pepper grass. Juniper occurs sporadically, mainly in dune deposits accumulated on the floodplain and near the rocky outcrops. Infrequent taxa are sunflower (*Helianthus* spp.), dock (*Rumex* spp.), yellow bee plant (*Cleome lutea*), and squawbush (*Rhus trilobata*).

The alluvial benches and arroyo slopes along Salt Creek are characterized by the National Park Service (1985) as having "sagebrush-saltbush" vegetation, but in-field observations revealed taxa characteristic of that association as well as the "salt cedar-willow" association (National Park Service 1985) which occurs along other parts of Salt Creek. The banks of the creek are choked with dense salt cedar (*Tamarix pentandra*) but give way rapidly to saltbush and sagebrush.

At the time of the inventory, a small marsh was observed near the Salt Creek Parcel, adjacent to Salt Creek (Figure 12). Because marshes are ephemeral features on the geologic time scale, this marsh may not have been present during the period of aboriginal use in Canyonlands, but marshes could have been present at other

Figure 8. View of side canyon to Squaw Canyon Wash showing the deep alluvial deposits and overhangs formed by the Cedar Mesa Formation.

locations in or near the project area and offered a variety of riparian and aquatic plant taxa and aquatic birds. Plant taxa found at the marsh today include coyote willow (*Salix exigua*), cattail (*Typha* spp.), pondweed (*Potamogeton* spp.), cinquefoil (*Potentilla* sp), horsetail (*Equisetum* sp.), reed (*Phragmites communis*), and sedge (*Carex* spp.).

Fauna

Wildlife observed during the fieldwork was mainly limited to avian species such as sharp-shinned hawk (*Accipiter striatus*), red-tailed hawk (*Buteo jamaicensis*), mourning dove (*Zenaidura macrovra*), white-throated swift (*Aeronautes saxatalis*), raven (*Corvus corax*), pinyon jay (*Gymnorhinus cyanocephala*), canyon wren (*Catherpes mexicanus*), rock wren (*Salpinetes obsoletus*), prairie falcon (*Falco mexicanus*), and blue grosbeak (*Guiraca caerulea*), as well as a few small and medium mammals: desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), coyote (*Canus latrans*), porcupine (*Erethizon dorsatum*), Colorado chipmunk (*Eutamias quadrivittatus*), ground squirrel (*Spermophilus* spp.), and white-tailed antelope squirrel (*Ammospermophilus leucurus*). Lizards and rattlesnakes were also observed.

Other wildlife present in the Needles District but not observed during the survey are mule deer (*Odocoileus hemionus*), red fox (*Vulpes vulpes*), skunk (*Spilogale putorius* and *Mephitis mephitis*), badger (*Taxidea taxus*), muskrat (*Ondatra zibethicus*), ringtail (*Bassariscus astutus*), long-tailed weasel (*Mustela frenata*), several species of woodrat (*Neotoma* spp.), and rock squirrel (van Gelder 1982). Beaver (*Castor canadensis*) and gray fox (*Urocyron cinereoargenteus*) are said to be abundant along the river; bobcat (*Felis rufus*) has been observed at various localities in the park, and mountain lion (*Felis concolor*) is occasionally reported (van Gelder 1982). Bighorn sheep (*Ovis canadensis*) was present prehistorically (Chandler 1988:Table 15).

Figure 9. Potholes in a rock outcrop in the Squaw Butte Area.

The Past Environment

Through a separate multiyear contract with the National Park Service, the Quaternary Studies Program/Department of Geology at Northern Arizona University (NAU) was charged with developing a geochronological framework and paleoenvironmental reconstruction to help elucidate the human prehistory of Canyonlands National Park, particularly for the areas being concurrently subjected to archeological investigations. The NAU paleoenvironmental project included studies of late Quaternary alluvium, soils, paleobotany, paleohydrology, malacology, and other data sources (Agenbroad and Mead 1990:6).

Due to constraints of time and money and the availability of appropriate samples, NAU's investigations in the Squaw Butte Area consisted of a limited examination of the late Quaternary alluvium and studies of paleohydrology and paleovegetation as reflected by mollusks and pack rat middens, respectively. The results of each of these studies are fully reported in Agenbroad and Mead (1992a) and summarized here for the convenience of the reader.

It should be emphasized that the two former studies were directed at the Salt Creek and near-Salt Creek environment. The latter study focused on the rocky habitats typically inhabited by woodrats. To provide a more complete view of possible paleoenvironmental conditions in the full range of project area environmental settings, this section also includes summaries of relevant paleoenvironmental data available from other published studies.

Alluvial and Eolian Stratigraphy

by Robert I. Birnie

As discussed in Chapter 1, the Squaw Butte Area incorporates two separate inventory parcels: one near Salt Creek and one near Squaw Butte. These two parcels can be considered separate physiographic sections and are referred to as the Salt Creek and Squaw Butte parcels, respectively.

Figure 10. Large pothole in a rock ridge in the Squaw Butte Area.

Salt Creek Parcel

The Salt Creek Parcel includes a large portion of the lower Salt Creek floodplain and an adjoining series of terraces and dissected bedrock mesas. A brief discussion of the alluvial chronology in the entire Salt Creek drainage will be discussed because the alluvial stratigraphy above the project area may illuminate the alluvial record in the project area (e.g., erosional episodes in upper and middle Salt Creek may have resulted in a greater sediment supply to lower Salt Creek consequently resulting in aggradation rather than incision and erosion).

Salt Creek has a drainage area of approximately 285 km^2 and extends for approximately 40 km from its headwaters near Cathedral Butte to the Colorado River. Agenbroad and Mead (1992b) divide Salt Creek into upper, middle, and lower reaches (Figure 13). The upper reach extends for approximately 10.6 km from a set of falls near Kirk's Cabin north to the Upper Jump. This portion of the Salt Creek drainage is relatively wide with a series of parklands and terraces. Stream gradient is 68 ft per mile (Agenbroad and Mead 1992b:28). Agenbroad and Elder (1986), Agenbroad and Mead (1992b) and Mead et al. (1992) report a series of seven mappable terraces (T1-T7) in the upper Salt Creek alluvial record that date from approximately 8600 to 200 B.P. Snail species, depositional sedimentary characteristics (e.g., silt and clay lenses), and the presence of organic material on the high terrace level (T7) are interpreted as indicating a marshy riparian environment during the late Pleistocene and early Holocene. Radiocarbon dates place the minimum age of this terrace from approximately 12,000 to 8,000 B.P. (Agenbroad and Mead 1992b:29). Cut and fill cycles produced the remaining terraces. A post-8600 B.P. erosional cycle resulted in downcutting of the upper terrace and formation of a lower terrace (T5) that was stable until approximately 5000 B.P. Four additional terraces formed in the last 5000 years (ca. 5000-3800 B.P., 1450-200 B.P., and post-A.D. 1750 for the T1 and T2 terraces). The presence of archeological sites on these terraces

Figure 11. View of the floodplain along Salt Creek showing the halophytic vegetation.

indicates that they provided stable surfaces during portions of the late Holocene.

The middle reach of Salt Creek extends for approximately 14.3 km from the Upper Jump to the confluence of Salt Creek and Horse Canyon. The section is much narrower than the upper and lower reaches and has a much steeper stream gradient, 102 ft per mile. The presence of steep slopes and extensive bedrock exposures result in relatively high amounts of runoff following precipitation events. Runoff and streamflow have been concentrated within a much narrower floodplain and have had more erosive impact in this reach than in upper Salt Creek. No late Pleistocene or early Holocene radiocarbon dates are reported for this section of the drainage despite a concerted search for samples dating to these periods. Agenbroad and Mead (1992b:32-33) and Mead et al. (1992:73) believe that late Pleistocene, early Holocene, and mid-Holocene deposits have been removed by erosion.

The lower reach of Salt Creek extends from the confluence of Salt Creek and Horse Canyon to the Lower Jump. The bedrock sill at the Lower Jump provides a local base level (the lowest level to which sediments can be eroded) for lower Salt Creek and can be interpreted as a hydrologic and alluvial control for the area.

The Salt Creek Parcel of the project area is situated along the lower reach of the Salt Creek drainage system. It extends along the floodplain of lower Salt Creek from a 300-m-wide bedrock constriction south of State Route 211 to a 250- to 280-m-wide bedrock constriction southeast of the Lower Jump Squaw Canyon Wash and Salt Creek come to a confluence near State Route 211. Salt Creek then flows northwest and to the north of a large sandstone ridge located north of State Route 211. The alluvial terraces and floodplain are very wide in this area. A broad parkland, approximately 800-1500+ m wide, is situated north and west of the sandstone ridge. The floodplain and terraces south and southeast of this ridge are somewhat narrower (340-700+ m).

Agenbroad and Mead (1992b) and Mead et al. (1992) have defined three alluvial terraces (T1-T3) along this reach of Salt Creek. Sediments within these terraces include fluvial and paludal

Figure 12. Marsh near Salt Creek.

deposits (Agenbroad and Mead 1992b:33). Eolian sediments of variable depth and distribution overlie the terrace deposits. The upper terrace (T3) is quite large (800-1500+ m wide) and has been primarily defined in the area north and west of the large sandstone ridge located north of State Route 211 (Mead et al. 1992). A claypan is exposed at the modern ground surface in portions of this area. The remainder of the terrace surface is covered with eolian deposits of varying depths.

The claypan may have formed as the result of several factors including translocation of clay as a result of the decomposition of greasewood leaves (Agenbroad and Mead 1992a:59-60) and as a result of deflation of the overlying sediments (Larry D. Agenbroad, personal communication 1995). The presence of the claypan may provide evidence of a larger marsh area at one time but further work needs to be completed to investigate this possibility (Larry D. Agenbroad, personal communicaiton 1995).

Radiocarbon dates from the general area include a date of 4070 ± 80 B.P. (Beta-37492) from scattered charcoal shallowly buried in the claypan, a date of 5290 ± 80 B.P. (Beta-37954) from a hearth in eolian sediments in site 42SA20615, and a date of 4510 ± 130 B.P. (Beta-33355) from a hearth in eolian sediments at an unrecorded site near Salt Creek (Table 2). These dates provide evidence that increased eolian deposition identified elsewhere in the Southwest during the mid-Holocene (Ahlbrandt et al. 1983; Antevs 1955; E. Karlstrom 1988; T. Karlstrom 1988; Wells et al. 1990) was also occurring in the project area. They also indicate that, except for eolian activity, the claypan surface has been relatively stable for at least the last 4000 years (Agenbroad and Mead 1992b).

Excluding the current entrenchment of Salt Creek, there have been two episodes of channel incision, entrenchment, and aggradation since approximately 4000 B.P. These have been limited to a near-channel position along Salt Creek and have not extended over large portions of the T3 terrace surface. The T2 terrace ranges from approximately 120 to 330+ m wide. T1 is a discontinuous

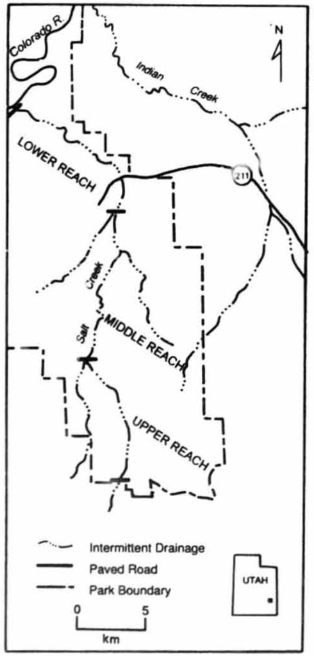

Figure 13. Map of the Salt Creek drainage showing the locations of the upper, middle, and lower reaches.

inset terrace next to the modern stream channel and floodplain.

A radiocarbon date of 1790 ± 90 B.P. (Beta-33356) was obtained from several unburned sticks recovered from T2 alluvium exposed in a cutbank along the modern channel of Salt Creek (Larry D. Agenbroad, personal communication 1995; Agenbroad and Mead 1992b). A radiocarbon date of 2490 ± 210 B.P. from scattered charcoal collected 70-80 cm below the modern ground surface at site 42SA20286 (Dominguez 1994) within the project area may provide a temporal span for the first cut and fill cycle with erosion and entrenchment beginning sometime after 4000 B.P. and aggradation beginning prior to 2490 B.P. The 1790 ± 90 B.P. radiocarbon date indicates that aggradation continued at least until that time. Thus, sediments in the T2 terrace may date between 4000 and 1790 B.P. and possibly more recently. The cut and fill cycle associated with the development of the T1 terrace began sometime after 1790 B.P.

The depth of deposits on the T3 terrace is at least 6-9 m in some areas of the floodplain as indicated by the depth of these sediments exposed in a cutbank along Salt Creek (Larry D. Agenbroad, personal communication 1995). Thus, there is some potential for undisturbed early and mid-Holocene deposits in some portions of the lower Salt Creek drainage. However, the potential location, depth, and temporal span of any early and mid-Holocene deposits were not investigated during the project because it would have required more intensive investigations than the reconnaissance nature of the fieldwork allowed (Larry D. Agenbroad, personal communication 1995).

The decreased stream gradient in the lower Salt Creek area, the wide floodplain, and the bedrock threshold at the Lower Jump indicate that the lower Salt Creek area is a depositional environment for sediments eroded from the upper and middle reaches of Salt Creek (also see Dominguez 1994:21). Thus, it is likely that a significant portion of the late Pleistocene and early Holocene deposits eroded from the upper and middle reaches of Salt Creek was deposited in the T3 terrace during the mid-Holocene.

Consequently, the T3 terrace may contain in situ late Pleistocene and early Holocene sediments in addition to mid-Holocene sediments consisting of reworked late Pleistocene and early Holocene sediments eroded from upstream contexts. The presence of bedrock constrictions and the large sandstone ridge north of State Route 211 have restricted the potential channel alignments of Salt Creek and may have resulted in the differential preservation of older sediments in areas sheltered by these bedrock alignments. Channel entrenchment in the latter portion of the mid-Holocene and in the late Holocene may have removed most, if not all, of the late Pleistocene, early Holocene, and mid-Holocene sediments from locations near

Table 2. Radiocarbon dates for lower Salt Creek, Canyonlands National Park, Utah.

Laboratory Number	Carbon-14 Age in Radiocarbon Years B.P. ± 1 Sigma	Location of Sample
Beta-33356	1790 ± 90	Wood sticks in alluvium
Beta-37492	4070 ± 80	Wood charcoal in top of claypan, below dunes
Beta-33355	4510 ± 130	Wood charcoal from hearth at unrecorded site near Salt Creek
Beta-37954	5290 ± 80	Wood charcoal from Feature 16 at site 42SA20615

the modern channel and over the extent of the T2 terrace. The presence, depth, and temporal span of late Pleistocene, early Holocene, and mid-Holocene deposits in areas away from the modern channel and the T1 and T2 terraces is conjectural at the present and will require more extensive fieldwork to investigate.

Radiocarbon dates of 2220 ± 70 B.P. (Beta-30485) and 2120 ± 60 B.P. (Beta-30484) were obtained from site 42SA20292 (this report) which is located in an area of eolian deposits overlying the claypan surface of T3. These dates may correlate to an increase in dune development and eolian activity reported in other portions of the Southwest (Ahlbrandt et al. 1983; Stokes et al. 1991; Wells et al. 1990). There is some potential that a weakly developed Puebloan age soil identified in other portions of the Colorado Plateau (Del Bene 1982; Hack 1942; E. Karlstrom 1988; Nials 1982; Schoenwetter and Eddy 1964) is also present in the project area. However, no evidence of this "Puebloan soil" was observed in the project area (Larry D. Agenbroad, personal communication 1995).

If present, deposits of Paleoindian and early Archaic ages may have poor archeological visibility in the Salt Creek Parcel because they are deeply buried in alluvium or are deeply buried in rockshelters and alcoves along the bedrock ridges. Later Archaic sites may be present in alcoves and rockshelters along the ridges, in the upper portions of the T3 terrace, in eolian dune deposits overlying the T3 terrace, and on the T2 terrace. Puebloan sites should be restricted to eolian deposits overlying the T2 and T3 terraces, the T1 terrace, and in alcoves and rockshelters along the bedrock ridges.

Squaw Butte Parcel

The Squaw Butte Parcel of the project area is dominated by Squaw Butte and is primarily an area with extensive bedrock exposures and shallow soils. Soils have formed predominantly on eolian sediments although colluvium is present in alcoves and under overhangs. Alluvium is present along Squaw Creek Canyon and in small drainages around the margins of Squaw Butte. The alluvial record of Squaw Canyon Wash was not investigated. Narrow stretches of arable land are present along Squaw Canyon Wash (see previous section). Deposition appears to be limited primarily to the accumulation of eolian sands in some portions of the area. The majority of the area appears to have been primarily an erosional landscape throughout the Holocene. Thus, archeological deposits of varying ages may be found on the same surfaces. Older deposits may be present in rockshelters and alcoves in these areas and on surfaces with deeper soils.

Regional studies (Ahlbrandt et al. 1983; Anderson 1991; Antevs 1955; Hack 1942; E. Karlstrom 1988; T. Karlstrom 1988; Stokes et al. 1991; Wells et al. 1990) have proposed an increase in eolian activity beginning approximately 5000 B.P. A similar pattern may be present in the project area. Archeological testing by the Midwest Archaeological Center (Dominguez 1988, 1991; National Park Service 1990) and by Alpine Archaeological Consultants, Inc. (Reed 1993), identified buried Middle and Late Archaic archeological remains in eolian deposits near the project area. The Midwest Archeological Center (National Park Service 1990:6) identified weakly developed buried soil horizons in association with diagnostic artifacts at sites 42SA8489 and 42SA2116 and suggests that there was ". . .

intermittent eolian deposition on these sites from the end of the Early Archaic extending to Anasazi occupations." Reed (1993) identified four components at site 42SA8477. The most recent component is limited to the modern ground surface and is interpreted as a possible Numic occupation dating between A.D. 1200 and 1700. An early Basketmaker II or Late Archaic component is shallowly buried and dates sometime between 353 B.C. and A.D. 128. One earlier Late Archaic component (1598-1136 B.C.) and one undated more deeply buried component are also present.

Analysis of Pack Rat Middens from the Lower Salt Creek Area

by Jim I. Mead and Larry D. Agenbroad

This section contains primarily descriptive data. These data are intended for incorporation into an archeological report of the Squaw Butte Area. This section is not intended to be a detailed report concerning the reconstruction of the local communities based on pack rat midden analyses. For more information, see Agenbroad and Mead (1992b).

The purpose of our investigations was to provide a reconstruction of the local biotic communities—those that would have been available for human inhabitants as potential resources. Pack rat middens provide a fairly detailed sample of the local floral communities (within up to 100 m of the nest or den). Because these pack rat middens are preserved in shelters and crevices, they only provide data on that rocky habitat area. Often this area does not provide the most useful resources for the early human inhabitants.

The present geologic situation of the lower Salt Creek area indicates that the region has had a much larger marsh or cienega community. The question is when and for how long did this valley-bottom community exist? Such a community contains many useful resources for humans, including aquatic birds, water, and water plants, among others. Pack rats will rarely adequately incorporate this community into their midden unless it happens to be immediately adjacent to the nest. Mollusks are an ideal fossil resource for reconstructing this riparian habitat. This section discusses only the pack rat midden information which was collected from the fringes of the valley-bottom community for the lower Salt Creek region. Mollusk samples collected by the National Park Service are reported in Mead et al. (1992) and summarized by Tipps later in this chapter.

Salt Creek Canyon was sampled for pack rat middens in three unequal regions: upper, middle, and lower (see Figure 13). The lower Salt Creek region, where the project area is located, contains 14 middens with an age span of from 38,150 to 10 B.P. (Table 3). The middle Salt Creek section contains five middens with radiocarbon ages from 34,820 to 430 B.P. The upper Salt Creek region contains a sample of eight middens with an age span of from 23,900 to 480 B.P. (Table 4).

The region today is within the boundaries of a pinyon-juniper woodland and big sagebrush parkland. Certain areas are more xeric and saline and therefore contain more desert species (desert shrubland) and no woodland species. Plant nomenclature follows Welsh et al. (1987). The wet areas contain riparian species such as *Populus fremonti* (cottonwood tree), the introduced *Tamarix* (salt cedar), *Salix* (willow), and the numerous aquatic plants such as *Potentilla* (cinquefoil), *Equisetum* (horsetail), *Typha* (cattail), and *Carex* (sedge). The montane conifer *Pseudotsuga menziesii* (Douglas fir) is found only at the higher elevations in upper Salt Creek on north-facing exposures where there is more available moisture due to less evaporation (1800 m elevation). The present climate is such that this tree and other boreal species cannot live in the canyon outside of these relict and restricted microhabitats. The canyon does contain water along various stretches just about all yearlong. Surface water occurs during the dry season in areas of the canyon controlled by bedrock outcrops—this can be observed in the lower reaches of Salt Creek and up canyon adjacent to Kirk's Cabin and the Upper Jump.

Methods

All pack rat middens were analyzed by water washing, screening through a 1-mm mesh sieve, drying, hand picking for floral and faunal remains, radiocarbon dating, and then specimen identification. Only the floral data are presented here. All middens contained the dung pellets of the pack rat (*Neotoma*). Because the pack rat is making the midden debris pile and these

Table 3. Radiocarbon dated pack rat middens from the lower Salt Creek drainage, Canyonlands National Park, Utah.

Sample Number	Pack Rat Midden Name	Laboratory Sample Number	Uncorrected Radiocarbon Date (year B.P.)	Elevation (m)
1	WBS 3B	Beta-37972	10 ± 50	1499
2	WBS 3A	Beta-37971	540 ± 60	1499
3	WBS 1	Beta-37968	1920 ± 70	1499
4	WBS 2A	Beta-37969	2530 ± 60	1499
5	WBS 2B	Beta-37970	2710 ± 70	1499
6	Woodenshoe 1	Beta-27214	6980 ± 120	1535
7	Needles 3	Beta-24926	7320 ± 100	1535
8	Needles 1	Beta-24925	8300 ± 110	1535
9	Salt Creek Pocket 3	Beta-15965	10820 ± 140	1490
10	Paul Bunyan's Potty 1	Beta-15964	14970 ± 150	1510
11	Salt Creek Pocket 2	Beta-37967	19450 ± 150	1490
12	Hoodoo 1	Beta-27213	27660 ± 340	1505
13	Salt Creek Pocket 4B	Beta-15967	>35500	1490
14	Salt Creek Pocket 4A	Beta 15966	38150 ± 1050	1490

NOTE: All radiocarbon dates analyzed on pack rat (*Neotoma* sp.) dung pellets from the midden unit.

Table 4. Radiocarbon dated pack rat middens from the upper and middle reaches of the Salt Creek drainage, Canyonlands National Park, Utah.

Sample Number	Pack Rat Midden Name	Laboratory Sample Number	Uncorrected Radiocarbon Date (year B.P.)	Elevation (m)
		Middle Salt Creek		
15	Hip Pocket 1	Beta-44195	430 ± 60	1706
16	Jump 2	Beta-44196	5150 ± 60	1706
17	Kiva 1	Beta-44197	11960 ± 80	1755
18	Kiva 2	Beta-43253	12800 ± 180	1755
19	Jump 1	Beta-43254	34820 ± 2060	1706
		Upper Salt Creek		
20	Waterfall 1	Beta-16661	480 ± 70	1805
21	Big Pocket 1B	Beta-16660	1440 ± 60	1805
22	Dead Owl 1A	Beta-18267	3830 ± 70	1755
23	Twin Arch 1	Beta-16658	3990 ± 70	1830
24	Bodecia 2	Beta-16662	13300 ± 110	1830
25	Bodecia 4	Beta-16664	21600 ± 160	1830
26	Dead Owl 1B	Beta-18628	22320 ± 260	1755
27	Bodecia 1B	Beta-16659	23900 ± 180	1830

NOTE: All radiocarbon dates analyzed on pack rat (*Neotoma* sp.) dung pellets from the midden unit.

construction items are not always food remains, we decided to have microhistological analyses run on certain dung pellets from selected middens to provide an at random examination to see if additional plant species could be recovered. These identifications are labeled with an "X" in Table 5, different from the "+" indicating the presence of a macrobotanical specimen.

Discussion and Conclusions

Fourteen pack rat middens were recovered from the lower Salt Creek region. Picked at random with some idea of obtaining as much age span as possible, the middens range in age from 38,150 to 10 B.P. The overall age span is excellent considering the few number of middens sampled. However, there are large gaps in the record.

The first gap is between approximately 1920 and 540 B.P. This is equal to about A.D. 30-1410 (the Anasazi period); these are not tree-ring or ^{13}C calibrated dates. The next large gap in the time record is between 6980 and 2710 B.P. (5030-760 B.C.), much of the mid-Holocene climatic episode (Altithermal). This time gap also represents much of the time of the Archaic. Two of the middens do represent the early part of the Early Archaic. Once the record reaches into the Pleistocene, we have a fair record with two ± 5000 year gaps and an 8000 year gap. This is basically a very complete preliminary record for the region, especially given the few number of middens sampled.

Thirty-four species of plants were recovered from the middens in the lower Salt Creek region. Most of the species recovered date to the early Holocene and late Pleistocene and are found living someplace within the drainage today. The major exceptions are with the boreal conifer species. During the late Pleistocene, *Picea* (spruce), *Pseudotsuga menziesii* (Douglas fir), and *Pinus flexilis* (limber pine) were growing together in a community in the lower drainage at elevations of approximately 1500 m as late as 15,000 B.P. Spruce and Douglas fir were growing together this low as late as 10,800 B.P.

All three conifer species are found living today at elevations typically well above 2200 m, however, in special circumstances, all will live down to approximately 1830 m altitude. *Pseudotsuga* lives today in secluded north-facing slopes in the upper canyon. *Pinus flexilis* requires xeric and rocky soils. The three conifer species do not presently live together in the drainage. The recovery of these conifers indicate a minimum (conservative estimate) elevational depression of 330 m during the Wisconsin late glacial period. The last time that these montane conifers, including *Juniperus scopulorum* (Rocky Mountain juniper), lived in the lower reaches of Salt Creek is recorded by Salt Creek Pocket Sample #3 at 10,820 B.P. A midden nearby (Needles Sample #1), dating 8300 B.P., does not contain any of these tree species. This "disappearance" time from the lower Salt Creek region could, and should, be refined by dating additional middens containing these species.

Although *Juniperus osteosperma* (Utah juniper) and *J. scopulorum* were found to be living in the same community in lower Salt Creek at approximately 38,000 B.P., that was the time of the mid-Wisconsin warming (interstadial). *Juniperus osteosperma* does not reappear until at least 8,300 B.P.—probably during the time gap period between 10,820 and 8,300 B.P.

Other midden sequences have been found in the region. The Allen Canyon sequence (2195 m elevation) dates from 11,310 to 1,820 B.P. (n=9 middens) and is located on the southwest side of the Abajo Mountains—adjacent to Salt Creek (Betancourt 1984). The Fishmouth Cave sequence (1585 m elevation) is located farther south, near Bluff along Comb Ridge, and dates from 12,770 to 2,260 B.P. (n=8 middens) (Betancourt 1984). Additional middens have been preliminarily reported from the Fishmouth Cave region: The Loop (1525 m elevation; east and west exposures; 4 middens; dating from 9500 to 1200 B.P.), Falling Arch (1460 m elevation; southeast exposure; 6 middens; dating from 19,700 to 2,400 B.P.), and Cottonwood Cave (1390 m elevation; south exposure; 5 middens; dating from 15,700 to 6,000 B.P.) (Betancourt 1990).

The Salt Creek Canyon pack rat midden sequence is unique for vegetational records of the central Colorado Plateau. Although it has provided material comparable to that found by Betancourt (1984, 1990), it has also extended the midden record from 19,700 B.P. back to 38,150 B.P. Although the pack rat midden record has provided a detailed plant record for Salt Creek Canyon, and the central Colorado Plateau in

Table 5. Preliminary list of plant fossils identified in the 14 pack rat middens collected in the lower Salt Creek drainage, Canyonlands National Park, Utah.

	Holocene Samples								Pleistocene Samples					
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Artemisia sp.	-	-	-	-	-	X	X	-	X	-	-	-	-	-
Artemisia tridentata	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Astragalus sp.	-	-	-	-	-	-	-	-	-	-	X	+	-	-
Atriplex sp.	-	-	-	-	-	X	X	-	-	-	X	-	-	-
Berberis fremontii	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Bromus sp.	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Celtis reticulata	-	-	+	-	-	+	-	-	-	-	-	-	-	-
Cercocarpus intricatus	-	-	-	-	-	-	-	-	+	-	X	-	+	+
Chrysothamnus nauseosus	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Compositae	-	-	-	-	-	-	-	-	-	-	X	X	-	-
Ephedra sp.	-	-	-	-	-	+	+	-	+	X	-	-	-	-
Equisetum sp.	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Eriogonum sp.	-	-	-	-	-	X	-	-	-	X	-	X	-	-
Eurotia sp. (=*Ceratoides*)	-	-	-	-	-	-	X	-	X	X	X	-	-	-
Fraxinus anomala	-	-	-	-	-	+	-	+	-	-	-	-	-	-
Juniperus osteosperma	+	+	+	+	+	+	+	+	-	-	-	-	+	+
J. scopulorum !	-	-	-	-	-	-	-	-	+	-	-	+	+	+
Juniperus sp.	-	-	-	-	-	X	X	-	X	X	-	-	-	X
Lesquerella sp.	-	-	-	-	-	X	-	-	-	X	-	X	-	-
Opuntia sp.	-	-	-	-	-	+	X̲	+	X	-	X	+	-	X
Stipa hymenoides	-	-	-	-	-	+	+	-	+	-	-	+	-	-
Oxybaphus (=*Mirabilis*) sp.	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Picea sp. !	-	-	-	-	-	-	-	-	X	X̲	-	-	-	-
Pinus sp.	-	-	-	-	-	-	-	-	-	X	-	-	-	-
P. flexilis !	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Pseudotsuga menziesii !	-	-	-	-	-	-	-	-	+	+	-	-	-	-
Purshia tridentata	-	-	-	-	-	-	X	-	X	-	-	-	-	-
Quercus sp.	-	-	-	-	-	-	-	-	X	-	-	X	-	-
Q. turbinella	-	+	-	-	-	+	-	-	-	-	-	-	-	-
Rhus aromatica	-	-	-	-	-	+	-	+	X	-	-	-	-	-
Rosa sp.	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Sphaeralcea sp.	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Yucca sp.	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Y. angustissima	-	-	-	-	-	-	-	+	-	-	-	-	+	-

NOTE: Numbers across the top refer to the numbered middens in Table 3; they are chronological from left (youngest) to right (oldest). Macrofossils: + = present. Microfossil recovered as microhistological specimen: X = present. X̲ = specimen present as macro- and microfossil. - = species not present. ! = extralimital to canyon today.

general, the reconstruction is biased. Like any data set, it will be biased toward one set of ecological and taphonomical parameters. Salt Creek has another unique aspect for paleoenvironmental reconstructions, its mollusk record. The mollusk record provides a fairly detailed scenario for the changing riparian water community—a record that is all but unnoticed in the pack rat midden sequences.

Soils and Pregrazing Vegetation

by Betsy L. Tipps and Kathleen M. Heath

Even though Canyonlands became a National Park Service unit in the 1960s and grazing was phased out, the current vegetation has been affected by grazing and other human influences. For instance, sagebrush and galleta grass (*Bouteloua gracilis*) are common, whereas blue grama grass is restricted to a few areas (National Park Service 1985) that have been protected from large-scale modern intrusion. Thus, while the modern vegetation described earlier offers some clues at the types of plant resources available to the prehistoric inhabitants of the Needles District, knowledge of the actual resources that were present at the time of occupation is more important.

Based on a sample of pack rat middens collected in and near the project area, Mead and Agenbroad (above) provide a sketch of local biotic communities that would have been available to the prehistoric inhabitants. As they note, however, reconstructions from pack rat data are but a contributing aspect in a complete reconstruction. This section briefly reviews another set of available information—the potential natural vegetation, under current climatic conditions. This review is based on soil and range site data collected by the U.S. Soil Conservation Service and presented by Lammers (1991) for the Canyonlands area.

Table 6 presents the potential natural plant community for each of the soil types identified in the project area based on Lammers (1991:Table 4). The range site data emphasize shrubs and grasses, thus the total vegetation for any given soil type in Table 6 ranges from 60 to 100 percent. The majority of missing species are perennial and annual herbs as well as some trees such as mature pinyon-juniper. Most of the shrubs and grasses provide forage for birds and mammals year-round. Particularly important as winter forage are sagebrush, rabbitbrush, winterfat (*Eurotia lanata*), Mormon tea, blackbrush, and willow. However, the shrubs and grasses listed in Table 6 are not particularly valuable as a food resource to humans.

The grasses (Poaceae) are frequently reported in the ethnographic record as being used for construction material. "Seeds" of several of these grasses (e.g., Indian rice grass and dropseed) were gathered and ground into flour by aboriginal peoples; however, grass seeds only provide between 91 and 500 calories per hour after processing with an average of 200 calories per hour after processing and, as such, represent starvation food (Simms 1984). Such "low-ranked" resources are generally exploited from early spring through early summer when few other resources are available. *Atriplex* spp. seeds are high-ranked resources (1000 calories per hour after processing [Simms 1988]). However, the range site data suggest that *Atriplex* was relatively sparse in the area.

High-ranking food items available in the area for aboriginal exploitation would have been pine nuts, marsh-riparian resources, and annual herbs not listed in the range site data (Table 6). Pinyon sparsely grows in the Rock Outcrop-Rizno-Dry Complex today and was probably available to the prehistoric inhabitants of the area as well. Currently, salt cedar, an introduced species, has choked out natural vegetation associated with marsh-riparian zones such as cattail, sedge, dock, and bulrush (*Scirpus* spp.). Annual herbs may represent a small percentage of range land cover but because they are prolific seed producers, they are highly valuable as a food resource to humans. These would include bee plant, sunflower, goosefoot (*Chenopodium* spp.), pigweed (*Amaranthus* spp.), purslane (*Portulaca* spp.), pepper grass, and tansy mustard (*Descurainia* spp.). These resources yield 500 to 9000 calories per hour after processing (Simms 1984).

Mollusks

The National Park Service, Midwest Archeological Center, collected a sample of mollusks from site 42SA8489 during its data recovery investigations for the Needles District development. This site lies along Salt Creek near the Squaw Butte Area. The mollusk samples were analyzed by NAU as part of its ongoing effort to reconstruct the paleoenvironment of Canyonlands National Park (Mead et al. 1992). All specimens postdate 2280 ± 130 B.P. (Beta-42338).

Six taxa of terrestrial snails were identified: *Gastrocopta pellucida*, *Pupoides albilabris*,

Table 6. Expected percentage of the total annual production for characteristic taxa, by soil type.

Family Name	Plant Type GENUS/Species	Common Name	Soil Type: Rock Outcrop Rizno-Dry Complex	Rock Out-crop	Thor-ough-fare Loam	Begay Fine Sandy Loam	Ustic Torri-fluvents	Ustic Torri-fluvents, Sodic	Typic Usti-fluvents	Mido Loamy Fine Sand	Shep-pard Fine Sand
Asteraceae	*Artemisia filifolia*	Sand sagebrush	-	-	-	-	-	-	-	5	10
	Artemisia tridentata	Basin big sagebrush	-	-	-	-	15	-	-	-	-
	Chrysothamnus nauseosus	Rubber rabbitbrush	-	-	-	-	10	-	5	-	-
Chenopodiaceae	*Atriplex canescens*	Four-wing saltbush	-	-	-	10	5	-	-	10	5
	Eurotia lanata	Winterfat	-	-	-	5	-	-	-	-	-
	Sarcobatus vermiculatus	Black greasewood	-	-	30	-	-	30	-	-	-
	Suaeda sp.	Seepweed	-	-	5	-	-	5	-	-	-
Cupressaceae	*Juniperus osteosperma*	Utah juniper	5	-	-	-	-	-	-	-	-
Ephedraceae	*Ephedra nevadensis*	Mormon tea	10	-	-	10	-	-	-	5	5
Malvaceae	*Sphaeralcea* sp.	Globemallow	-	-	-	-	-	-	-	-	5
Poaceae	*Agropyron smithii*	Western wheatgrass	-	-	-	-	10	-	-	-	-
	Bouteloua gracilis	Blue grama	-	-	-	-	15	-	-	-	-
	Distichlis stricta	Inland saltgrass	-	-	-	-	-	-	10	-	-
	Hilaria jamesii	Galleta grass	5	-	5	10	-	5	-	-	-
	Muhlenbergia sp.	Sand muhly	-	-	-	-	-	-	-	5	5
	Stipa hymenoides	Indian rice grass	5	-	-	20	5	-	5	20	30
	Poa fendleriana	Mutton grass	-	-	-	-	5	-	-	-	-
	Sporobolus airoides	Alkali sacaton	-	-	10	-	-	10	35	-	-
	Sporobolus cryptandrus	Sand dropseed	-	-	-	10	-	-	-	-	10
	Sporobolus sp.	Dropseed	-	-	-	-	-	-	-	5	-
	Stipa comata	Needle-and-thread grass	-	-	-	15	5	-	-	10	-
	Sitanion hystria	Bottlebrush squirreltail	-	-	20	-	5	20	-	-	-
Polygonaceae	*Eriogonum cernuum*	Fine-branched eriogonum	-	-	-	-	-	-	-	5	5
Rosaceae	*Coleogyne ramosissima*	Blackbrush	35	-	-	-	-	-	-	-	-
Salicaceae	*Populus fremontii*	Fremont cottonwood	-	-	-	-	-	-	5	-	-
	Salix exigua	Coyote willow	-	-	-	-	-	-	15	-	-
Tamarix	*Tamarix* sp.[a]	Salt cedar	-	-	-	-	-	-	5	-	-
TOTAL PRODUCTION FOR A NORMAL YEAR (lb/acre dry weight)			350	-	750	500	1600	750	1300	600	400

FROM: Lammers 1991:Table 4.
NOTE: The percentages do not add up to 100 because only key species are listed.
[a]Introduced species.

Pupoides hordaceous, *Pupoides* sp., *Succinea* sp., and *Vallonia gracilicosta* (Mead et al. 1992:60). This assemblage suggests a streambed environment consisting of a moist seep in an open, sandy, arroyo bottom with no open or flowing water. Various grasses and sedge were probably the predominant plant taxa. Cattail, willow, and other taxa requiring more water were probably absent.

Information from the mollusk assemblage only applies to the streambed environment and is further limited in its areal applicability. Other portions of the Salt Creek drainage probably had different moisture conditions caused by local variability.

A small assemblage of snails was also recovered from a hearth at site 42SA20615 dating to 5290 ± 80 years. *Pupoides* sp., possible *Discus cronkhitei*, and at least one other taxon are present (Robert I. Birnie, personal communication 1995). These terrestrial snails indicate that conditions for the site 42SA20615 area during the mid-Holocene were similar to those just described.

Paleoenvironmental Summary

by Robert I. Birnie

Early Holocene

Regional paleoenvironmental studies (Currey 1990; Currey and James 1982; Dean et al. 1985; Euler et al. 1979; Spaulding et al. 1984; Thompson 1984) propose that the early Holocene (10,000 to 6,500 B.P.) was characterized by warmer temperatures and more effective precipitation than the late Pleistocene. Temperatures were still colder than modern conditions but there does appear to have been more effective moisture than at present. Precipitation patterns during the period were shifting towards the modern seasonal pattern. There was a gradual warming and drying trend during the early Holocene and by the end of the early Holocene (circa 6500 B.P.), temperatures were warmer with less effective precipitation than the modern conditions.

There was little geomorphic change during the early Holocene and most landforms were stable. The first of the Holocene cut and fill cycles was beginning in the upper Salt Creek area. Most likely, water was readily available year-round in Salt Creek, numerous springs, and smaller tributaries. The marsh or cienega (seep and wetland) communities in the lower Salt Creek area probably attained their maximum extent during the late Pleistocene and early Holocene.

By the end of the early Holocene, the vegetational assemblage attained a distribution and composition similar, except for pinyon pine and modern introduced species, to the historically recorded vegetational assemblage (Betancourt 1984; Mehringer 1985). Subsequent differences in the distribution of vegetation were essentially limited to vertical shifts as a response to climatic factors. At Fishmouth Cave, approximately 110 km southwest of the project area, Betancourt (1984) reports that vegetational zones shifted downward approximately 850 m during the late Pleistocene and early Holocene. Mead and Agenbroad (1992) note that this elevational depression was a minimum of 330 m in the Salt Creek drainage. Spruce, Douglas fir, and limber pine were present in the lower Salt Creek area as late as 15,000 B.P. Spruce and Douglas fir were still present as late as 10,800 B.P. (Mead and Agenbroad 1992; this report).

The late Pleistocene-early Holocene faunal assemblage was essentially the same as the modern record with the exception of Pleistocene megafauna species such as musk ox (*Symbos* spp.), horse and onager (*Equus* spp.), Harrington's mountain goat (*Oreamnos harringtoni*), camel (*Camelops* cf. *hesternus* and *Hemiauchenia* spp.), Columbian mammoth (*Mammuthus columbi*), and bison (*Bison antiquus* and *Bison* spp.) (Agenbroad and Mead 1992a; Madsen et al. 1976; Miller 1979). Schroedl (1991) proposes that Pleistocene megafauna existed in the canyons of the northern Colorado Plateau for a longer period of time than in other areas. Mead et al. (1992) and Agenbroad and Mead (1992a) also argue that the Salt Creek drainage provided a refugia during the late Pleistocene-early Holocene transition.

Middle Holocene

The Middle Holocene or Altithermal period (approximately 6500-3500 B.P.) was characterized by warmer temperatures with less effective moisture than the early or late Holocene. Eolian activity appears to have increased during this period with deposition of dune sands on landforms above the drainages. Cut and fill sequences continued in upper Salt Creek and late Pleistocene, early and mid-Holocene sediments were

beginning to be eroded from the middle reach of Salt Creek. Deposition and formation of the T3 terrace in the lower Salt Creek area was completed by approximately 4000 B.P. Marsh areas appear to have been present but were probably at their minimum extent (Agenbroad and Mead 1992a). The presence of marsh sediments and certain molluscan taxa indicates that water was probably still available on a year-round basis in the Salt Creek area.

Vegetation was similar to the modern situation, with the absence of historically introduced non-native species (e.g., cheat grass, tamarisk). Montane conifers such as spruce, Douglas fir, and limber pine were no longer present in the Squaw Butte Area and had retreated to microhabitats at higher elevations. Pinyon pine, present in the area by 5150 B.P., was recovered from pack rat middens dating to 5150 and 3990 B.P. in the middle and upper reaches of Salt Creek. Today, pinyon pine is present around Squaw Butte and in the middle and upper reaches of Salt Creek. Utah juniper is present in pack rat middens dating from 38,150 to 35,500 B.P. and is missing in the pack rat midden record at 8300 B.P. It is present in all middens dating more recent at 8300 B.P. (Mead and Agenbroad 1992; this report).

The mid-Holocene faunal assemblage was essentially the same as the modern record. Pleistocene megafauna species became extinct during the late Pleistocene and early Holocene and were not present. Bison (*Bison bison*) may have been in the area, although not in large numbers, throughout the Holocene.

Mead et al. (1992) and Agenbroad and Mead (1992a) argue that the Salt Creek drainage provided a refugia for Archaic people and animals during the Altithermal period (Antevs 1955) from approximately 8000 to 4000 B.P. The year-round availability of water would have provided habitat supporting a greater diversity of plant and animal species than in many other portions of the Colorado Plateau.

Late Holocene

Environmental conditions during the late Holocene (3500 B.P. to present) were similar to those of today with the exception of slightly cooler temperatures and more effective precipitation during the Neoglacial, approximately 3500-1800 B.P. and during the Little Ice Age, A.D. 1400-1850. Early Holocene and mid-Holocene deposits were eroded from the middle reach of Salt Creek. Cut and fill sequences were still ongoing in upper Salt Creek, and entrenchment of the T3 and T2 terraces in the lower Salt Creek area occurred. Eolian deposits may have been stabilized during this period with some pedogenesis occurring. A period of increased eolian activity may have begun around 2200 B.P. (Ahlbrandt et al. 1983; Stokes et al. 1991; Wells et al. 1990).

A small marsh is present in the northern portion of the project area today and, based on geologic and biologic evidence of previous marsh or cienega environments, it is likely that the area ". . . once supported a much larger marsh or cienega community . . ." (Mead and Agenbroad 1992:36). Marsh areas probably fluctuated in size and possibly location throughout the Holocene. The marsh areas probably had their minimum extent during the Altithermal period (Antevs 1955) and may have been larger than at present during the Neoglacial period and again during the Little Ice Age. Water was most likely available in some form (e.g., springs, seeps, streamflow) in the lower Salt Creek area throughout the year.

The vegetational assemblage was the same as the historically recorded assemblage (see vegetation and pregrazing vegetation discussions in this chapter). The cooler and more mesic conditions during the Neoglacial and the Little Ice Age may have resulted in a greater abundance of biotia. The modern vegetation assemblage may not accurately reflect the prehistoric or historically recorded vegetation in the area because of the presence of introduced species (e.g., crested wheatgrass, cheatgrass, tamarisk, and Russian thistle). Native species such as sagebrush and rabbitbrush may also be more prevalent because of overgrazing and widespread human disturbance.

The faunal assemblage was essentially the same as the modern faunal assemblage, although species not normally found in the area today such as bison, bighorn sheep, and wolves were likely present. Bison remains recovered from Arches National Park are interpreted as dating to a transitional protohistoric-historic period (Mead et al. 1992).

Reed (1993:19-21) summarizes a Late Holocene paleoenvironmental model developed by Petersen (1988) for southwestern Colorado. Based on this information, Reed argues that conditions in the lower Salt Creek area were most likely suitable for agriculture from A.D. 500 to 800 and again from A.D. 900 to 1100. The presence of a high groundwater table, as indicated by the presence of marsh deposits, and the potential for manually transporting water from Salt Creek to supplement dry water farming techniques may also have attracted Puebloan agriculturalists to the area. A series of droughts and short growing seasons between A. D. 1100 and 1300 (Petersen 1988) may have had severe limiting effects on the agricultural capabilities of the region resulting in abandonment of the area by the Anasazi (Reed 1993). The applicability of Petersen's model to the project area needs to be investigated; however, it does provide a regional model that can potentially be tested using excavation data from the vicinity of the project area.

Summary

In summary, the Squaw Butte Area had many natural resources that probably made it attractive for prehistoric occupation. One of the most important was the Cedar Mesa Formation. Various lenses within this unit provided chunks of flakeable Cedar Mesa Chert, tabular pieces of limestone that could be fashioned into pecking and pounding implements or used as-is for building stones, sandstone slabs and cobbles for milling equipment, and sediments suitable for architectural mortar. The Cedar Mesa Formation also provided rock faces for executing rock art and small overhangs suited to camping and habitation.

Sufficient water for habitation could have been obtained from Salt Creek during any season. Away from Salt Creek, water was seasonally available in tanks and depressions. The alluvial deposits in a drainage near Squaw Butte could have been used as farm lands. The Begay Fine Sandy Loam which is found mainly in the southwest side of the Salt Creek inventory parcel was also potentially arable. Finally, various plant and animal foods were available throughout the area. Among the plant foods, the most desirable were probably pine nuts, saltbush, shadscale, prickly pear cactus, and sunflower, followed by cattail, sedge, dock, and bee plant, all of which have relatively high caloric return rates compared to grasses (Simms 1988). Mormon tea, Indian rice grass, and buckwheat were probably used when other plants were not available. Many of the potentially available plants would have also provided nonfood resources such as fuel, fibers, paint, and medicinal remedies.

Previous Archeological Research

To avoid unnecessary repetition, this section focuses on information directly related to the inventory area rather than an exhaustive overview of work in the Needles District or park in general. The reader is referred to Anderson (1978) and Griffin (1984) for greater detail and such overview information.

Major archeological projects that have taken place in the Needles District are (1) the University of Utah's 1965 and 1966 reconnaissance surveys of the Needles District (Sharrock 1966), (2) the University of Utah's inventory of the proposed road from Squaw Flat to the confluence overlook (Marwitt 1970a), (3) the Midwest Archeological Center's survey of the Cave Springs area in the Needles (Hartley 1980), (4) Midwest Archeological Center's 1983 and 1984 inventory in Davis and Lavender canyons (Griffin 1984; Osborn et al. 1986), (5) Noxon and Marcus' (1985) documentation of major rock art sites, and (6) P-III Associates' inventory in the Salt Creek Pocket and Devils Lane areas (Tipps and Hewitt 1989) as part of the Canyonlands Archeological Project.

In 1988, shortly after the inventory reported in this volume, the Midwest Archeological Center began a series of projects to identify, test, and recover significant sites that could not be avoided by construction of a visitor center, new residences, utilities, and other upgraded facilities (Table 7). The work began with inventory and testing (Dominguez 1988), and later progressed to more testing and data recovery (Dominguez 1989, 1990, 1991, 1994; National Park Service 1990, 1991a, 1991b). Included in this work were testing and data recovery at several of the sites recorded by this inventory (see Table 7). More recently, Alpine Archaeological Consultants excavated one of the rockshelter sites recorded by Hartley (1980) and reevaluated by Dominguez (1988) as needing

Table 7. List of sites that have been tested or excavated in or immediately adjacent to the Squaw Butte Area.

Site Number	Inventory	Testing	Data Recovery
42SA2116	Marwitt 1970a	Dominguez 1988, 1990	Dominguez 1990 National Park Service 1991a, 1991b
42SA8487 (Shadow Shelter)	Hartley 1980		Reed 1993
42SA8488	Hartley 1980	Dominguez 1988	-
42SA8489	Hartley 1980	Dominguez 1988	Dominguez 1990 National Park Service 1990a
42SA20263 (*Soyok' manavi*)	This report	Dominguez 1991	-
42SA20286	This report	-	Dominguez 1989, 1994
42SA20309	This report	Dominguez 1988	-
42SA20436 (the Intersection Site)	Dominguez 1988	Dominguez 1990	Dominguez 1991 National Park Service 1991a, 1991b
42SA20440	Dominguez 1988	Dominguez 1990	-

further work. The site, 42SA8477, is called Shadow Shelter (Reed 1993).

Between 1983 and 1987, Nickens and Associates conducted ruins stabilization activities at nine sites in the Salt Creek Archeological District of the Needles (Metzger et al. 1989:Table 1-1). Minor excavation was conducted at one of these sites, and a larger excavation effort was undertaken at Bighorn Sheep Ruin in upper Salt Creek (Chandler 1988).

The inventories by Sharrock (1966), Marwitt (1970a), Hartley (1980), Tipps and Hewitt (1989), and the recent work by the Midwest Archeological Center (Dominguez 1988, 1989, 1990, 1991, 1994; National Park Service 1990, 1991a, 1991b) and Alpine Archaeological Consultants (Reed 1993) are most relevant to the present investigation due to spatial proximity and similarities in site types and environmental settings.

Review of the available reports for the projects noted above, records at the Utah State Historical Society (USHS), and the Canyonlands archeological base map compiled by the Midwest Archeological Center showed 12 previously recorded sites in or near the project area: 42SA1455, 42SA1513, 42SA1517, 42SA1519, and 42SA2117-42SA2124. Sites 42SA1455, 42SA1513, and 42SA1519 were recorded by Sharrock (1966) in 1965; P-III Associates relocated and rerecorded these three sites, and considerably expanded the boundaries of site 42SA1455. Definite correlations of the previously recorded sites were made through comparisons of Sharrock's site descriptions and original photographs on file at the Utah Museum of Natural History.

In 1979, Hartley (1980) and crew also recorded a site they believed to be Sharrock's site 42SA1513. Comparison with Sharrock's photos and descriptions revealed that Hartley (1980) and crew actually recorded a previously unrecorded site, not Sharrock's site 42SA1513. Our crew discovered and rerecorded both sites during this survey. Sharrock's number, 42SA1513, was retained for the original site. The site which was recorded for the first time by the Midwest Archeological Center was assigned the number 42SA20309.

The Midwest Archeological Center base map for Canyonlands shows site 42SA1517 at the juncture of the Cave Springs road and the Needles residence loop road. Field assessment of this location did not reveal any evidence of cultural material. Also, the 50-ft-high rock outcrop measuring a mile around that Sharrock noted at the site is not present at this location. It can therefore be concluded that site 42SA1517 is not in the project area.

Sites 42SA2117-42SA2124 were recorded along a road corridor surveyed by Marwitt (1970a). The Midwest Archeological Center base map for Canyonlands shows that sites 42SA2117, 42SA2118, 42SA2119, 42SA2121, 42SA2122, and 42SA2123 are in the project area; Marwitt's field map shows that sites 42SA2120 and 42SA2124 may also be in the project area. After reviewing all available data, we are quite certain that sites 42SA2121, 42SA2122, 42SA2123, and 42SA2124 are not located in the project area but are (or were) instead located along the road beyond (west of) the project area. Portions of sites 42SA2117, 42SA2118, 42SA2119, and 42SA2120 could extend into the project area. Information on the location of each site, and our reasoning for arriving at these conclusions, is elaborated below.

Sites 42SA2120-42SA2124 will be considered first. The site locations shown on Marwitt's (1970a) field map for these five sites do not match the site locations described in his report and on his site forms. For example, Marwitt describes site 42SA2119 as being west of Squaw Butte, but the site plot on his map is northeast of the butte. He describes sites 42SA2120, 42SA2121, and 42SA2122 as being in Section 25 but has them plotted in Section 19 on his field map. A thorough evaluation of Marwitt's report and site descriptions easily leads to the conclusion that the field map is incorrect and that the verbal descriptions are more accurate.

Marwitt's field map shows site 42SA2120 northeast of Squaw Butte in Section 19, but his description of the site location as "1/4 mile west of large butte [Squaw Butte] and 3/4 mile northeast of Squaw Spring" places it west of Squaw Butte in Section 25. Relative to the station numbers for sites 42SA2116-42SA2118, which are plotted *and* described as being along the road north, northeast, and northwest of Squaw Butte, this approximate location appears to be correct. Note that the described location is very close to site 42SA20276 which was recorded along the edge of the existing road during our survey.

Marwitt describes site 42SA2120 as a 50-ft-in-diameter chipped stone scatter within the proposed right-of-way. If the road was built in the corridor Marwitt surveyed, and the site was only 50 ft in diameter, the site should have either been entirely destroyed by the road or little of the site should currently remain. Site 42SA20276, which was recorded during our survey, is adjacent to the existing road and appears to be the periphery of a site that was destroyed by the road. We suspect that it could be Marwitt's site 42SA2120. If not, the two sites were probably quite close.

Marwitt's field map shows sites 42SA2121 and 42SA2122 north of Squaw Butte, but these sites appear to be located southwest of the butte. Marwitt states that site 42SA2121 is about one-quarter mile southwest of 42SA2120, at Station 909 in Section 25. This is 19 stations farther along the road than site 42SA2120. This described location corresponds perfectly with the route of the road and places the site outside of the current project area, more than a mile southwest of the location shown on Marwitt's field map. Site 42SA2122 is "about 100 ft SSW of 42 Sa 2121" at Station 910, farther outside the project area. While there are cultural remains at the locations where Marwitt plotted sites 42SA2121 and 42SA2122, they do not match his descriptions in location, site content, or site size and are not the remains Marwitt recorded as these sites; Marwitt's sites are west of the project area. Comparison of Marwitt's verbal descriptions of the locations of these two sites with the Midwest Archeological Center base map for Canyonlands suggests that one or both of these sites could have been rerecorded as site 42SA20436 by the Midwest Archeological Center.

Marwitt states that site 42SA2123 is one-quarter mile northeast of Squaw Springs at Station 928, 28 stations farther along the road than site 42SA2122, whereas site 42SA2124 is 500 ft farther, at Station 933. These described locations match the current route of the road and place these sites well west of the project area. We assume these locations are correct, particularly because there are no cultural remains at the locations Marwitt shows for sites 42SA2123 and 42SA2124 inside our project area.

In summary, sites 42SA2121-42SA2124 are not located in the project area as shown on the Midwest Archeological Center base map for Canyonlands. The reason for this error is because the Midwest Archeological Center base map was compiled from Marwitt's field map which is wrong. All of these sites are west of the project

area. Site 42SA2120 could be the same as site 42SA20276, the last vestiges of which were recorded during this survey. If not, the two sites were probably close together.

There are also problems with the plotted site locations for sites 42SA2117-42SA2119. First, Marwitt's field map shows only a small oval that supposedly contains all three of these sites plus two others (42SA2116 and 42SA2120 which we believe are located elsewhere, as described above); also, the descriptions for sites 42SA2118 and 42SA2119 do not place them within the circle shown on Marwitt's field map. From the descriptions, it does appear that all three of these sites are (were) in the road alignment north, northwest, or northeast of the butte, but these may not be the same sites we recorded north, northeast, and northwest of the butte and south of the road.

Two conditions suggest that they are not the same. First, Marwitt's site forms indicate that the sites were in the road alignment. If the road was built in the proposed alignment (the corridor Marwitt surveyed), then the sites cannot be 100-150 m south of the extant road as shown on the Midwest Archeological Center base maps. Second, if the road was built as planned, much or most of the cultural remains recorded by Marwitt would have been destroyed because Marwitt states that they were only 15-20 m in diameter; while our crew found cultural debris throughout most of the area north, northeast, and northwest of the butte and south of the extant road, none of the sites are vestiges or remnants of small sites truncated by (or even directly adjacent to the south side of) the road. The sites we found are much larger, and are either located completely off the road (42SA20251, 42SA20253, and 42SA20254) or centered well south of the road (42SA20252). For this reason, new site numbers—42SA20251, 42SA20252, 42SA20253, and 42SA20254—were assigned to the cultural remains between the north end of the butte and the south side of the road. Another problem with sites 42SA2117-42SA2124 (and with site 42SA2116 which is outside of our project area) is that these same numbers are also assigned to different sites in the Montezuma Creek area in the files of the USHS.

Chapter 3

THE ARTIFACTS

The artifact assemblage recorded during the project consists of 155 chipped stone tools, 66 miscellaneous stone and groundstone tools, and 68 sherds. Also noted were 39 cores and utilized cores. Surface debitage is estimated at more than 1,000,000 pieces. Most of these artifacts were found on sites. Isolated artifacts number only 68 items: 2 bifaces, 63 pieces of debitage, 2 tested cobbles, and 1 indeterminate metate fragment. Artifacts were found on all but one prehistoric site, a limited activity loci consisting of a petroglyph panel. Artifacts are also lacking on the Navajo component at site 42SA1661. Seventy-eight of the 80 sites (98 percent) have chipped stone artifacts. Grinding implements occur on 20 sites (25 percent). Only 13 sites (16 percent) exhibit pottery.

As noted in the first year's report of the Canyonlands Archeological Project, general artifact collections were not permitted under the contract so, with few exceptions, analyses were conducted in the field. This noncollection directive eliminated the possibility of pursuing detailed analyses and restricts this chapter to tabulations of tool and material types and presentation of limited observations.

Another limitation should also be noted. Visitors are collecting artifacts, especially tools and sherds, from the park at an alarming rate. This means that the quantity and diversity of extant surface artifacts is less than it would have been perhaps as recently as 5 or 10 years ago. Such collection has biased the data available from surface assemblages, making summaries and conclusions more tentative and preliminary than they would otherwise be in the context of an inventory. The information and conclusions presented here and elsewhere in the report should be viewed in that light until they can be confirmed or refuted with data from controlled excavations. Artifact frequencies and types for each site are provided in Appendix C.

Chipped Stone Artifacts

A wide variety of debitage, cores, expedient flake tools, and formal implements composes the chipped stone artifact assemblage; chipped stone is the most common category of artifact in the Squaw Butte Area. Within this large category, debitage predominates, distantly followed by bifaces (n=107), the most common tool type, projectile points (n=23), and modified flakes (n=17). Unifaces, scrapers, drills, and gravers occur in small numbers.

All but 2 of the 80 sites (98 percent) contain debitage; 30 sites (38 percent) contain 1 chipped stone tool only. Nineteen sites (24 percent) have two chipped stone tool types and five sites (6 percent) have more than three types. The average number of chipped stone tools is 2.8 on sites with such tools. Twenty-two sites (28 percent) have at least one core or utilized core. The majority of chipped stone artifacts are made of locally available chert from the Cedar Mesa Formation; a smaller number are fashioned of other local and nonlocal toolstone types.

Lithic Materials

As noted in the research design (Chapter 1) and the first year's report on the Canyonlands

Archeological Project (Tipps and Hewitt 1989), knowledge of lithic source locations is important to unraveling prehistoric settlement, subsistence, and trade systems, and understanding how prehistoric peoples interacted with the environment. To provide lithic source information relevant to studying these topics, we attempted, during the first year's inventory in the Salt Creek Pocket and Devils Lane areas, to identify chipped stone material types as well as their sources (Tipps and Hewitt 1989).

Because the Squaw Butte Area abuts the Salt Creek Pocket Area parcel, it provided an opportunity to evaluate and refine some of our material definitions, further identify the range of variability in certain materials, and isolate problem areas that need further research. It also provides a basis for comparison. After presenting the new information collected on the various types identified during the Salt Creek Pocket and Devil's Lane work, this section describes two new material "types," discusses the frequency of the various types, and provides comparisons, interpretations, and suggestions for additional research.

Cedar Mesa Chert

Around Squaw Butte, Cedar Mesa Chert formed in a 20- to 50-cm-thick lens sandwiched between an underlying white sandstone unit and an overlying, domed, red sandstone layer, both components of the Cedar Mesa Formation. Away from Squaw Butte, the chert lenses occasionally formed entirely within the red sandstone unit. Many cherts form by silica replacement of carbonate rocks such as limestone (Luedtke 1992:44). This appears to be the situation for the Cedar Mesa Chert because the lenses are always associated with gray to blue to purple limestone strata.

Cedar Mesa Chert available in the project area typically consists of residual deposits overlying bedrock or dune sand (Figure 14). Residual chert deposits form when the surrounding bedrock, in this case sandstone and limestone, erodes away, leaving behind the more resistant chert layer which subsequently erodes into fragments and chunks (Luedtke 1992:111). The lenticular chert beds associated with many of the residual deposits are rarely useful as toolstone sources because the chert is locked inside the bedrock with only a narrow band exposed. A notable exception is site 42SA20267 where the overlying sandstone has eroded away leaving a massive bed of red chert exposed on top of a sandstone ledge (Figure 15). This chert bed averages 12-17 cm thick but ranges up to 40 cm thick.

In the residual sources, the fragments and chunks are primarily angular to subangular with only a few rounded pieces. Most of these pieces have traveled minimal distances from their point of origin. This, the reasonably large size of the fragments to begin with, and the continued erosion of the sandstone matrix insure that a good supply of reasonably sized chunks and fragments can be found today, even after the sources have been used for perhaps as long as 10,000 years. Fragments and chunks in the residual sources typically range from 1 or 2 cm across to 10 or 20 cm across. Pieces as large as 50 cm are not uncommon and, occasionally, chunks exceed a meter across on some source area sites (Figure 16).

Cortex resulting from chert diagenesis is frequently present on fragments in the residual deposits. Because cortex is the interface between the chert and its surrounding matrices, it typically exhibits characteristics that are transitional between the two (Luedtke 1992:72). Cortex on the Cedar Mesa Chert grades between chert, sandstone, and limestone. It, therefore, consists of a smooth to highly textured and pitted, carbonate to quartzitelike, yellow to black layer. Often it is only a few millimeters thick. However, this transitional material composes almost the entirety of fragments and chunks that were subject to incomplete chertification. Such pieces are common on many of the source area sites.

The quality, luster, and texture of the chert are extremely variable. Some of the material is so full of cracks, fracture planes, dendrites, or inclusions such as quartz crystals that it is unusable, except under desperate conditions to produce flakes from small, workable chunks using a bipolar technology. (No evidence of bipolar technology was noted, however.) Other pieces have fewer and more widely spaced structural flaws, making them more suitable for flaking. In general, however, structural flaws limit the size of usable packages to no more than 20 cm across, usually less.

Figure 14. Chunks of Cedar Mesa Chert on a bedrock ridge in the Squaw Butte Area.

Another problem with some pieces is incomplete chertification resulting in textural and compositional gradations between the inner and outer sections. Such chunks typically grade from a heterogeneous carbonate or quartzitelike composition with a dull luster on the exterior to a glossy, homogeneous, and highly siliceous material on the interior. Although these gradations reduce the workability of the chunk as a whole, the interiors of the chunks can be of high quality, though of limited size. A few pieces of Cedar Mesa Chert are highly siliceous, free of fractures and inclusions, and well suited to flaking. In spite of the variation, most nodules do share a slightly grainy texture and are somewhat tough in their natural, unheat treated state.

Material quality varies greatly at most sources, and even within individual fragments and chunks, making assessment of quality and flakeability on a specific, chunk by chunk basis almost a necessity. All factors considered, Cedar Mesa Chert available in the Squaw Butte Area is considered to have an overall moderate quality, though individual pieces range from unusable or poor to excellent quality.

Dark red is the main color variety of chippable Cedar Mesa Chert at most of the lithic source sites in the Squaw Butte Area. This coloring, as well as the common yellow and reddish brown coloring, probably derives from impurities imparted by the iron-rich red beds of the Cedar Mesa Formation (see Chapter 2). Dark red chert predominates at all sources on the north, south, and east sides of Squaw Butte, as well as source sites northeast of the butte in the Salt Creek inventory parcel. On the west side of Squaw Butte is a source area, site 42SA20279, which is primarily composed of Cedar Mesa Chert in the orange, red-yellow, and yellow hues. The distinctive materials from this source are present in large quantities on neighboring sites, but their frequency radically declines with increased distance from the source. The locally unique color of the material at site 42SA20279 makes it easily identifiable and provides an ideal opportunity to study lithic procurement, transport, and use patterns in the immediate vicinity of a source area site. Such a study

Figure 15. Lenticular bed of Cedar Mesa Chert and Limestone in the Squaw Butte Area.

was beyond the scope of the present project but would be an interesting topic for future research.

Although the dark red chert is most common on all but one of the lithic source area sites, color is by no means homogeneous within a single source or even within a single fragment or chunk. Also present are red-orange, orange, yellow, reddish brown, brown, off-white, and white in descending order of frequency. Like the dark red, the reddish brown and brown varieties are usually of moderate to high quality. The red-orange, orange, and particularly the yellow varieties are of variable quality and often have a carbonate composition resulting from incomplete diagenesis. In a few instances, pieces of red Cedar Mesa Chert grade into purple, maroon, maroon with distinctive blue spots, or mottled red-blue-purple. These "varieties" are usually of moderate to high quality and suitable for chipped stone tool manufacture.

An important discovery during the Squaw Butte Area inventory are several red Cedar Mesa Chert artifacts and unmodified nodules that abruptly turn into purple chalcedony. These finds clearly indicate that the source of the purple chalcedony observed during the first year's inventory and again during the present inventory is the Cedar Mesa Formation.

Another interesting find is a piece of red-orange Cedar Mesa Chert on site 42SA20267 that abruptly turns into clear chalcedony and a piece of red Cedar Mesa Chert on site 42SA20284 that grades into white quartzite. These singular finds are too limited to infer that clear chalcedony and white quartzite are from the Cedar Mesa Formation but do indicate that further investigations are warranted.

Summerville Chalcedony

No new information was gained on the locations of the actual source area(s) used to produce the Summerville Chalcedony found in the project area. The lack of cortex on all but a few specimens and small amount of debitage from early reduction stages continue to suggest a source removed from the project area. Almost all

Figure 16. Outcrop of Cedar Mesa Chert and Limestone in the Squaw Butte Area.

specimens recorded in the Squaw Butte Area are milky white rather than clear.

Based on Baars (1983) and Berry (1975), it was previously reported that Summerville Chalcedony in the project area derives from the Late Jurassic Summerville Formation (Tipps and Hewitt 1989:84). In the area between Moab and Monticello, Utah, this formation has been recently redefined as the basal unit of the Morrison Formation, Tidwell Member (Baars 1995:65). In spite of this change, it seems appropriate to retain the Summerville Chalcedony designation because it is well ingrained in the literature.

Algalitic Chert

The algalitic chert observed in the Squaw Butte Area has the same color, texture, and range of variability as that recorded during the Salt Creek Pocket and Devils Lane Area inventories. But, algalitic chert is much more common in the Squaw Butte Area than the Salt Pocket Area,

possibly indicating that the Squaw Butte Area is closer to the source.

Few specimens with cortex were observed during the Squaw Butte Area inventory, but one small, unflaked nodule was noted on site 42SA20258. This small site has residual deposits of Cedar Mesa Chert and is adjacent to one of the largest Cedar Mesa Chert source area sites in the project area. It is not certain whether the algalitic nodule eroded out of the Cedar Mesa Formation or was brought to the site.

The Cedar Mesa Formation is a logical place to look for the source of the algalitic chert. In addition to the nodule observed above, several small, unflaked nodules were observed on a talus slope in the Devils Lane Graben (Tipps and Hewitt 1989). The steep nature of the talus slope and lack of associated cultural remains suggest that the nodules eroded out of the local bedrock. A few tiny (1-2 cm across) nodules of what appears to be the same material are tightly embedded in a vertical sandstone wall elsewhere in the Devils Lane Graben. Cedar Mesa is the only formation exposed in the Devils Lane Graben.

Besides this scant but direct evidence, the algalitic structure of the chert and its apparent nodular form suggest that it formed in a shallow sea (Luedtke 1992:29), the same origin identified for portions of the Cedar Mesa Formation (see Chapter 2). The coloring of chert is caused largely by impurities, most of which are minerals present in the area of deposition as the chert formed (Luedtke 1992:38, 65). Minerals contained in the Cedar Mesa Formation red beds are capable of producing the yellow and brown coloring typifying algalitic chert (Luedtke 1992:Table 5.1). And, finally, algalitic chert shares some important characteristics with the Cedar Mesa Chert including its highly variable quality and carbonate composition of pieces toward the yellow end of the color scale. Many formations contain highly variable cherts, so it is entirely possible that these two distinct materials come from different places in a single formation. Dapples (1979:100) notes the tendency for nodular cherts to be areally limited. If algalitic chert is from the Cedar Mesa Formation, this tendency may explain its absence from Cedar Mesa Formation toolstone sources in the Squaw Butte Area because algalitic chert appears to occur naturally in nodular form. Future investigations should be directed at identifying the source(s) of algalitic chert.

Other Materials

Additional information was obtained on the validity and source of the eight other descriptive "types" recognized on sites in the Salt Creek Pocket and Devils Lane Area inventories (Tipps and Hewitt 1989:81-87). Based on detailed field observations, most of the material assigned to five of the "types" is now believed to come from the Cedar Mesa Formation. The sources of the other three materials are still unknown and require further investigation. In addition, two new types were defined during the Squaw Butte Area inventory.

Brown Chert

The brown chert described in the first year's report is common in the Squaw Butte Area where it occurs on 10 sites. On six of these sites, pieces of brown chert grade into the dark red variety of Cedar Mesa Chert demonstrating they are the same material. There is no gradation on the other four sites, but these materials are probably either Cedar Mesa Chert or algalitic chert. Brown chert artifacts that could not be definitely attributed to either Cedar Mesa or algalitic chert were tallied in an unknown category, "brown chert." Further work will likely result in these specimens being incorporated into either the Cedar Mesa or algalitic chert category.

White Chert

White chert, another widespread material in the Salt Creek Pocket and Devils Lane Area inventories (Tipps and Hewitt 1989:86), was observed in small to moderate amounts in residual deposits on most Cedar Mesa Chert source area sites in the Squaw Butte Area. The white chert on these sites grades into the more common red varieties of Cedar Mesa Chert demonstrating that most, and perhaps all, of the white chert is from the Cedar Mesa Formation. White chert artifacts that clearly represent Cedar Mesa Chert (those that grade into obvious Cedar Mesa Chert) were so tabulated, whereas those that were uncertain (those that were completely white) remain in the uncertain "white chert" category. With further research of actual collections, it will probably be possible to ascribe these uncertain pieces to Cedar Mesa Chert.

Orange Chert

Observations in the Squaw Butte Area make it clear that the siliceous variety of orange chert recorded during the first year's inventory (see Tipps and Hewitt 1989:86) is Cedar Mesa Chert. The majority of orange chert found on Cedar Mesa Chert source area sites in the Squaw Butte Area has a carbonate composition but some is highly siliceous. All orange chert recorded in the Squaw Butte Area was called Cedar Mesa Chert.

Tan Chert

Tan chert, a minor material on 10 percent of the Salt Creek Pocket Area sites (Tipps and Hewitt 1989:86), was observed in several of the Cedar Mesa Chert source area sites in the Squaw Butte Area and is clearly another variety of Cedar Mesa Chert. All tan chert observed in the Squaw Butte Area was recorded as Cedar Mesa Chert.

Purple Chalcedony (Cedar Mesa Chalcedony)

As noted above, the crew found several artifacts of dark red Cedar Mesa Chert that abruptly turn into purple chalcedony identifying the Cedar Mesa Formation as the source of the distinctive purple chalcedony. Upon close inspection, small patches of purple chalcedony were noted on a few nodules of Cedar Mesa Chert in some source area sites indicating that this material is available in the Squaw Butte Area and was probably procured locally. Its low incidence in the source areas—rather than it being from a distant source—explains the low frequency of purple chalcedony flakes on individual sites. All purple chalcedony was recorded as Cedar Mesa Chalcedony.

Gray Chert

Gray chert is substantially more common in the Squaw Butte Area than the Salt Creek Pocket Area but the source area is still unknown. As with the Salt Creek Pocket Area materials, the gray chert observed in the Squaw Butte Area ranges from light to dark gray, is often mottled, and lacks cortex.

Gray-brown Chert and Gray Quartzite

The gray-brown chert was only found on three sites in the Squaw Butte Area. The low frequency is not surprising because gray-brown chert is also uncommon in the adjacent Salt Creek Area (Tipps and Hewitt 1989:86). This high-quality, lustrous material is variegated with patches, streaks, and dots of lighter and darker gray and brown coloring. The material is completely silicified, however, so these patches, streaks, and dots do not interfere with flake removal. All observed pieces represent late reduction stages. No additional information was obtained on the source of the gray quartzite.

Obsidian

Five pieces of semitranslucent black obsidian debitage were found on site 42SA20289. Four of the five pieces were submitted for sourcing using x-ray fluorescence; the geochemical data for all four samples match the trace element profile of the Government Mountain/Sitgreaves Peak source (Hughes 1991:2) in northern Arizona (see Appendix D). These four samples have mean hydration bands of 2.7 to 2.9 microns (Origer 1991).

Cedar Mesa Limestone

Limestone that derives from the Cedar Mesa Formation was recorded for the first time as a chipped stone material during the Squaw Butte inventory. This soft material ranges from gray to blue to purple and is always associated with the Cedar Mesa Chert. It occurs both in residual form and in beds adjacent to the chert lenses.

White Quartzite

The second material defined during the Squaw Butte inventory is fine- to medium-grained, white quartzite. This material is dominant on one site in the Squaw Butte Area and present in small amounts on about 6 percent of the sites. It is also present on sites in the Salt Creek Pocket Area but in smaller amounts (Tipps and Hewitt 1989). A piece of red Cedar Mesa Chert on site 42SA20270 grades into white quartzite suggesting the Cedar Mesa Formation as a possible source. This possibility needs to be more thoroughly investigated before any conclusions can be made.

Miscellaneous Materials

A wide variety of other materials was found in small amounts on various sites during the inventory. These materials were categorized on the site forms using descriptive labels identifying color, stone type, and other distinguishing characteristics. As more data accumulate, and laboratory analyses of collections become possible, these descriptive categories may eventually be collapsed into meaningful types. Information on these types can be obtained from the IMACS site forms on file at the park.

Discussion

As might be expected given its availability, Cedar Mesa Chert occurs on every site with chipped stone. It is the only chipped stone material on approximately 10 percent of the sites, the dominant material on another 65 percent of the sites, and one of two or more primary materials on another 21 percent of the sites (Table 8). Within the last group (21 percent), it forms the plurality 88 percent of the time; this means that Cedar Mesa Chert is outnumbered by some other material on only five sites. In each of these five cases, Cedar Mesa Chert is either present (n=2) or the second most common material (n=3). The materials which outnumber the Cedar Mesa Chert are Summerville Chalcedony (n=3), Cedar Mesa Limestone (n=1), and mottled chalcedony (n=1) from an unknown source.

The next most common materials in terms of the number of sites on which they occur are Summerville Chalcedony (present on 73 percent of the sites) and algalitic chert (present on 55 percent of the sites). It is noteworthy, however, that although these materials occur on the majority of sites, their frequency is much lower than the Cedar Mesa Chert; algalitic chert is frequently represented by only a few flakes per site. All other materials are present on less than 30 percent of the sites and they generally occur in medium to small to very small amounts.

This profile of lithic material types in the chipped stone assemblage is similar to that observed in the adjacent Salt Creek Pocket Area (Tipps and Hewitt 1989); in that area, Cedar Mesa Chert occurs on all sites with chipped stone artifacts and is the only material that constitutes the entire assemblage on a specific site. But the Squaw Butte Area does show slightly greater emphasis on Cedar Mesa Chert. Cedar Mesa Chert occurs exclusively on about 10 percent of the Squaw Butte Area sites but only 2 percent of the Salt Creek Pocket Area sites; it is outnumbered by other materials only 6 percent of the time in the Squaw Butte Area but 11 percent of the time in the Salt Creek Pocket Area. These differences

Table 8. Number and percent of sites by selected chipped stone materials and relative abundance.

Material Type	Only Material Present		Dominant Material		One of Two or More Primary Materials		Present in Medium to Small Amounts		Total	
	n	%	n	%	n	%	n	%	n	%
Cedar Mesa Chert	8	10.3	51	65.4	16 (14)[a]	20.5	3	3.8	78	100.0
Summerville Chalcedony	-	-	1	1.3	14 (2)[a]	17.9	42	53.8	57	73.1
Algalitic chert	-	-	-	-	4	5.1	39	50.0	43	55.1
Gray chert	-	-	-	-	-	-	23	29.5	23	29.5
Cedar Mesa Chalcedony	-	-	-	-	-	-	21	26.9	21	26.9
White chert[b]	-	-	-	-	1	1.3	18	23.1	19	24.4
Brown chert[b]	-	-	-	-	3	3.8	7	9.0	10	12.8
White quartzite	-	-	-	-	1	1.3	5	6.4	6	7.7
Cedar Mesa Limestone	-	-	1	1.3	-	-	2	2.6	3	3.8
Gray-brown chert	-	-	-	-	-	-	3	3.8	3	3.8
Gray quartzite	-	-	-	-	-	-	2	2.6	2	2.6
Mottled chalcedony	-	-	1	1.3	-	-	1	1.3	2	2.6
Government Mountain Obsidian	-	-	-	-	-	-	1	1.3	1	1.3

[a]Number of times material constitutes the plurality.
[b]Some or all of this material in this category is probably Cedar Mesa Chert.

surely reflect the greater concentration and availability of Cedar Mesa source area sites in the Squaw Butte Area (12.4/mi^2 versus 3.7/mi^2), and the greater availability of other materials (whose sources may be generally east) to people using the Salt Creek Pocket Area.

With Cedar Mesa Chert slightly more common in the Squaw Butte Area than the Salt Creek Pocket Area, it follows that some other materials would be less common, percentage-wise, than they are in the Salt Creek Pocket Area. One such material is Summerville Chalcedony which is dominant on 8 percent of the sites in the Salt Creek Pocket Area but only 1 percent of the sites in the Squaw Butte Area. This difference appears to represent falloff in use with increased distance from a source to the east. Two other materials, Cedar Mesa Chalcedony and white chert, are dominant on 2 percent of the sites in the Salt Creek Pocket Area but no sites in the Squaw Butte Area. While these differences are not especially pronounced, they do indicate identifiable changes in both lithic procurement activities and the characteristics of materials available in the source area sites over a relatively short distance of about 7 km.

There are also a few striking differences between the lithic profiles of the two surveys which require explanation (Table 9). Algalitic chert is present on over 55 percent of the sites in the Squaw Butte Area, but only on approximately 6 percent of the sites in the Salt Creek Pocket Area. It is a common material on about 5 percent of the sites in the Squaw Butte Area, but never amounts to more than a few pieces in the Salt Creek Pocket Area. This conspicuous difference cannot be attributed to misidentification in the field because the material is so distinctive.

In the first year's report, we (Tipps and Hewitt 1989) observed that algalitic chert is much more common in the Devils Lane Area (dominant on 13 percent of the sites and common on 10 percent of the sites) than in the Salt Creek Pocket Area (neither dominant nor common on any of the sites). The Devils Lane Area is located about 12 km west of the Squaw Butte Area, whereas the Salt Creek Pocket Area is directly east. Applying the concept of distance falloff (Renfrew 1977), the source of algalitic chert lies closer to the Devils Lane Area than the Salt Creek Pocket Area. With the Squaw Butte Area lying an average of 2-3 km closer to the Devils Lane Area and presumably the source of the algalitic chert, the increased abundance of algalitic chert could be expected. This gradation is even seen within the Salt Creek Pocket Area. Of the six sites with algalitic chert, only one is located in the east half of the parcel; the other five sites are all clustered at the west end of the parcel, closer to the presumed source. A similar explanation can be offered for the almost two-fold increase in gray chert in the Squaw Butte Area.

Table 9. Number and percent of sites that have selected chipped stone materials in the Squaw Butte and Salt Creek Pocket areas.

Material Type	Squaw Butte Area n	Squaw Butte Area %	Salt Creek Pocket Area n	Salt Creek Pocket Area %
Cedar Mesa Chert	78	100.0	99	100.0
Summerville Chalcedony	57	73.1	68	68.7
Algalitic chert	43	55.1	6	6.1
Gray chert	23	29.5	15	15.2
Cedar Mesa Chalcedony	21	26.9	31	31.3
White chert[a]	19	24.4	32	32.3
Brown chert[a]	10	12.8	43	43.3
White quartzite	6	7.7	2	2.0
Cedar Mesa Limestone	3	3.8	-	-
Gray-brown chert	3	3.8	4	4.0
Gray quartzite	2	2.6	6	6.1
Mottled chalcedony	2	2.6	-	-
Obsidian	1	1.3	1	1.0

[a]Some or all of the material in this category is probably Cedar Mesa Chert.

Other noticeable differences also exist in the number and percent of sites with white chert and brown chert in the two survey areas but these may be the result of our field method. As we learned more about the variability of Cedar Mesa Chert during the Squaw Butte inventory, we were able to attribute more pieces of brown-colored and white-colored chert to this type, leaving fewer in the uncertain and residual "brown chert" and "white chert" categories.

In summary, lithic reduction activities at the Squaw Butte sites reveal an overwhelming emphasis on locally available chipped stone materials procured from residual deposits associated with the Cedar Mesa Formation. Given the flakeability of the local material and the large number of source areas in and adjacent to the project area, it is not surprising that these local resources compose the bulk of the lithic artifacts. Materials procured at a great distance, such as obsidian, are present but rare, just as they were in the adjacent Salt Creek Pocket Area (Tipps and Hewitt 1989). Their rarity indicates that they were not the basic commodities for stone tool manufacture but probably introduced by people traveling through or temporarily residing in the project area.

The same does not appear to be true for several materials that were clearly procured outside of the project area—making them nonlocal—but which are much more common and probably available at closer distances. These materials are Summerville Chalcedony, algalitic chert, and gray chert. Without accurate sourcing information, it is difficult to identify the exact mechanisms responsible for their presence in the Squaw Butte and Salt Creek Pocket areas, but the frequency with which they occur, especially in view of the reasonable-quality materials already available in the project area, suggests that they were procured through residential or possibly logistical mobility rather than through trade mechanisms.

Future research efforts should be directed at further refining the typology presented here. An important aspect of this work should be identifying the actual sources of types such as algalitic chert, brown chert, white chert, and Summerville Chalcedony.

Projectile Points

Twenty-three projectile points were recorded on 18 sites (23 percent) (Table 10). No projectile points were recorded as isolated finds.

The 23 specimens represent seven formally recognized types: Clovis, Silver Lake or Jay, Pinto Series, Rocker Side-notched, Gypsum, Elko Corner-notched, Elko Side-notched, as well as five categories of indeterminate points. Of the 14 typeable specimens, 1 is a Paleoindian type (Figure 17), 5 are Archaic types (Figure 18), and 8 others belong to the Elko Series (Figure 19) which is usually found in Archaic and Basketmaker sites (Table 11). Two of the indeterminate points may be Paleoindian types (see Figure 18).

Clovis

The base of a Clovis point was collected from site 42SA20262 near Squaw Butte. It is made from a high-quality, nonlocal, red and purple chalcedony with small, bright red inclusions. This material appears to be Pigeon's Blood Chalcedony (Bruce D. Bradley, personal communication to Alan R. Schroedl 1990; personal observation). One source of Pigeon's Blood Chalcedony is in Floy Wash just south of Interstate 70 between Green River and Crescent Junction (Greg Nunn, personal communication 1992), approximately 85 km north of the project area.

This bifluted point has an expanding, lanceolate blade and a concave base with auricles that are only slightly rounded in plan (see Figure 17). The fragment measures 3.3 cm wide and 0.7 cm thick and has a bend break 2.2 cm above the proximal end. The bend break appears to result from use. The base and entire extent of the extant margins are heavily ground and rounded. The flutes extend the entire length of the fragment and are not invaded by retouch from the lateral margins.

After the point was fluted, a small flake was detached along each side of each flute. On one side, the two flake scars extend 12-15 mm; one of the scars is from a large, poorly controlled flake and invades the flute (see Figure 17a). The other

Table 10. Projectile point data by site.

Site Number and Name	Projectile Point Type	Material	Figure Number
42SA1455	Paleoindian?	Brown chert	18a
42SA20252	Pinto Series	Cedar Mesa Chert	18d
42SA20258	Elko Corner-notched	Cedar Mesa Chert	19a
42SA20260	Gypsum	Summerville Chalcedony	18f
42SA20262	Clovis	Pigeon's Blood Chalcedony	17
	Medium corner-notched	Gray quartzite	--
42SA20263	Elko Corner-notched	Gray-black chert	19b
(*Soyok' manavi*)	Rocker Side-notched	Gray quartzite	18e
42SA20264	Large corner-notched	Cedar Mesa Chert	--
	Indeterminate	Summerville Chalcedony	--
42SA20280	Gypsum	Summerville Chalcedony	18g
	Medium corner-notched	Brown chalcedony	--
42SA20286	Elko Corner-notched	White chert	19c
42SA20288	Elko Side-notched	Cedar Mesa Chert	19d
42SA20295	Elko Corner-notched	Summerville Chalcedony	19e
42SA20302	Elko Side-notched	Gray chert/White chalcedony	19f
42SA20304	Small corner-notched	Summerville Chalcedony	--
42SA20305	Paleoindian?	Summerville Chalcedony	18b
42SA20307	Medium corner-notched	Pink-white chert	20b
	Elko Corner-notched	Multicolored chalcedony	--
42SA20313	Large corner-notched	Cedar Mesa Chert	20a
42SA20321	Silver Lake or Jay	Dark gray chert	18c
42SA20615	Elko Corner-notched	White-maroon chalcedony	19g

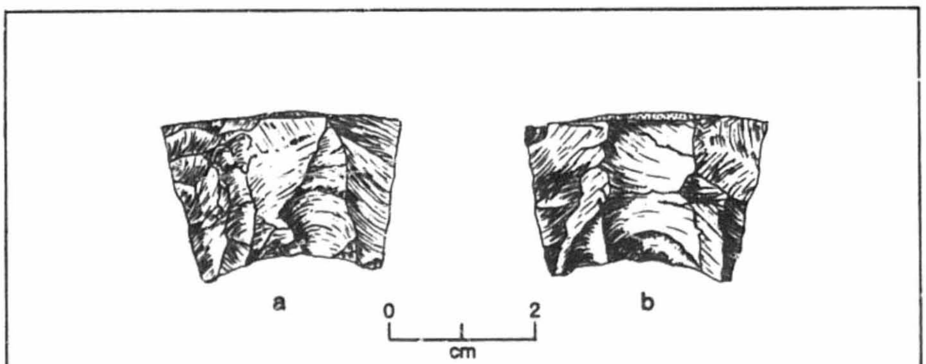

Figure 17. Both faces of the Clovis projectile point base from site 42SA20262.

scar parallels the edge of the flute. On the opposing side, the scars are shorter and parallel the flute (see Figure 17b). Such flaking was often done when the original flute was off-center or insufficiently wide to accommodate the haft (André D. La Fond, personal communication 1993). The base on both sides of the point was retouched

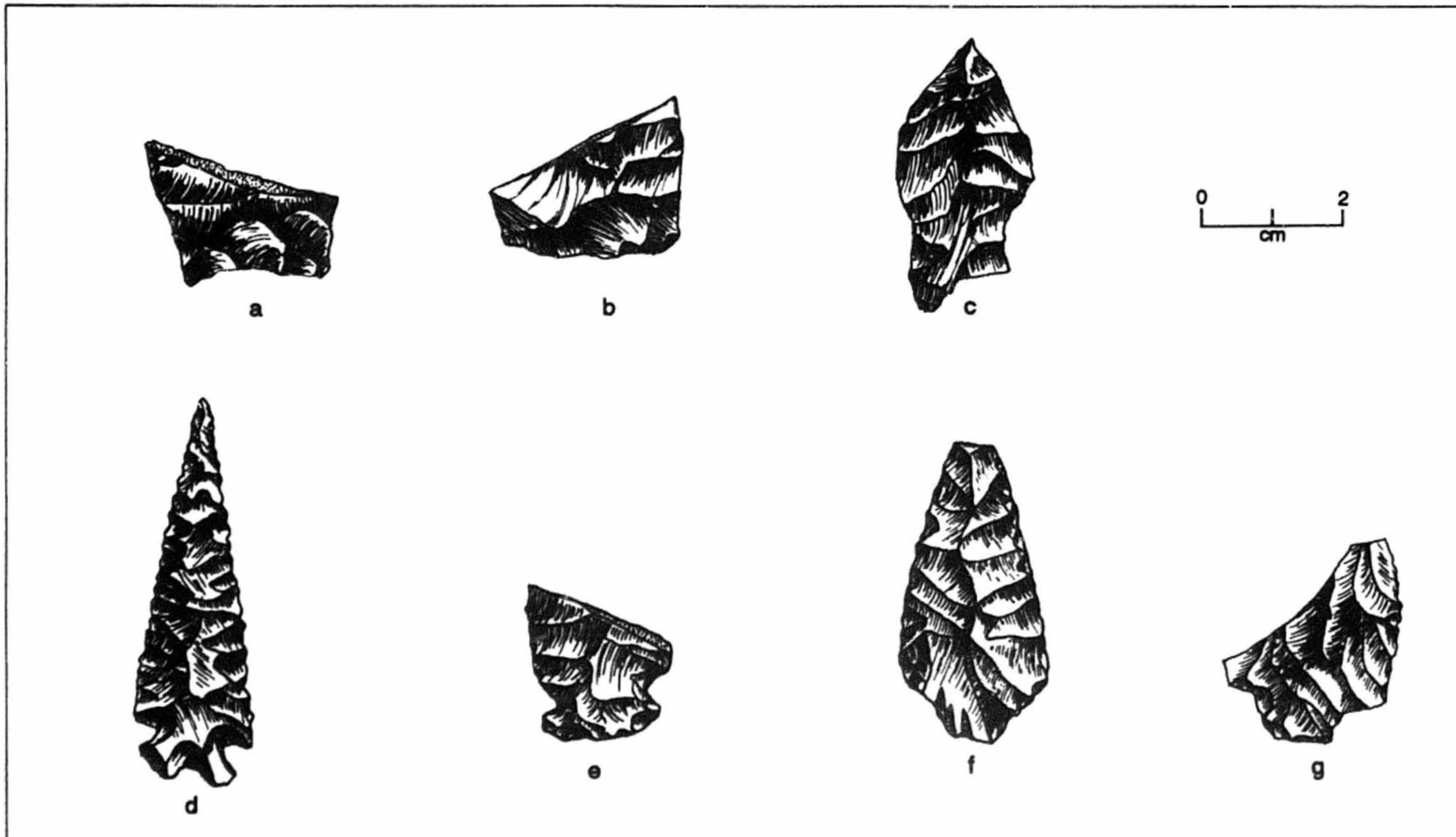

Figure 18. Selected dart points. a, Paleoindian?, site 42SA1455; b, Paleoindian?, site 42SA20305; c, Silver Lake or Jay, site 42SA20321; d, Pinto Series, site 42SA20252; e, Rocker Side-notched, *Soyok' manavi*; f, Gypsum, site 42SA20260; g, Gypsum, site 42SA20280.

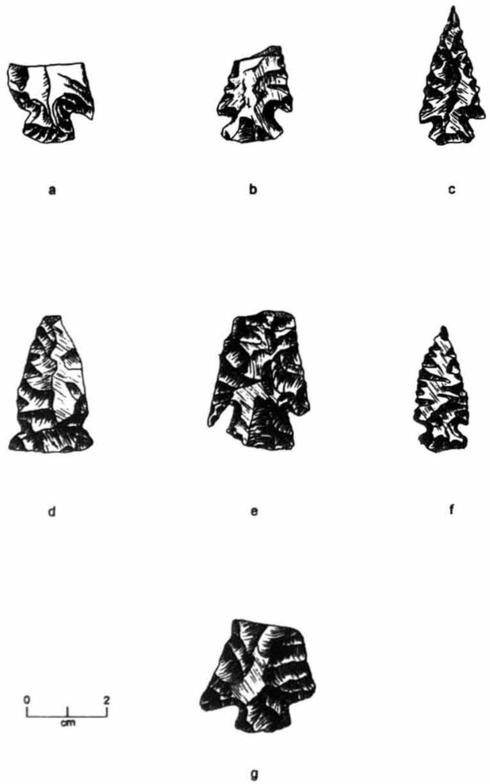

Figure 19. Selected Elko points. a, site 42SA20258; b, *Soyok' manavi*; c, site 42SA20286; d, site 42SA20288; e, site 42SA20295; f, site 42SA20302; g, site 42SA20615.

Table 11. Number of projectile points by site number and age.

Site Number and Name	Paleo-indian	Possible Paleoindian	Early Archaic	Middle Archaic	Late Archaic	Formative	Indeter-minate	Total
42SA1455	-	1	-	-	-	-	-	1
42SA20252	-	-	1	-	-	-	-	1
42SA20258	-	-	-	-	-	-	1	1
42SA20260	-	-	-	-	1	-	-	1
42SA20262	1	-	-	-	-	-	1	2
42SA20623 (*Soyok' manavi*)	-	-	-	1	-	-	1	2
42SA20264	-	-	-	-	-	-	2	2
42SA20280	-	-	-	-	1	-	1	2
42SA20286	-	-	-	-	-	-	1	1
42SA20288	-	-	-	-	-	-	1	1
42SA20295	-	-	-	-	-	-	1	1
42SA20302	-	-	-	-	-	-	1	1
42SA20304	-	-	-	-	-	1	-	1
42SA20305	-	1	-	-	-	-	-	1
42SA20307	-	-	-	-	-	-	2	2
42SA20313	-	-	-	-	-	-	1	1
42SA20321	-	-	1	-	-	-	-	1
42SA20615	-	-	-	-	-	-	1	1
Total	1	2	2	1	2	1	14	23

subsequent to basal thinning. This retouch is confined to a narrow strip along the edge.

Copeland and Fike (1988:7) report on 12 Clovis points from 11 sites/isolated finds on the Colorado Plateau in Utah. Geib and Bremer (1988) discuss a probable Clovis point from the Orange Cliffs. At least one other is known—it is from the Maze District of Canyonlands National Park (Schroedl 1991:10, 12). Of the 13 localities with Clovis materials, only one, the Lime Ridge site, has been investigated in any detail (Davis 1989; Davis and Brown 1986). This site produced no features or artifacts datable by radiocarbon. Haynes (1991 cited in Stanford 1991) recently reevaluated Clovis radiocarbon dates and suggests that the Clovis tradition dates sometime between approximately 11,200 and 10,900 years ago.

Possible Paleoindian

Two possible Paleoindian point bases were found on sites on the claypan above Salt Creek in the Salt Creek Parcel of the project area. One is from site 42SA1455; it is made from a flake of the brown chert often seen in the project area. This point fragment has a concave base with somewhat sharp auricles and an expanding, lanceolate blade exhibiting a random flaking pattern (see Figure 18a). Due to the shape of the original flake, one face of the point base is relatively flat whereas the other is convex. The base is irregular in cross section, again due to the configuration of the original flake. The thick (0.5 cm) and asymmetrical base of this tool indicates that it is unfinished and not ready for hafting. The fracture is consistent with a manufacturing error.

The longer of the two lateral margins is ground along most of its extent. Several studies have shown that lateral grinding for hafting purposes is the final step in manufacturing at least some Paleoindian point types (Callahan 1979:Figure 67; Frison and Bradley 1980:51; Judge 1973:169). Because the point is unfinished, the best explanation for this grinding is probably edge preparation prior to final retouch rather than lateral grinding prior to hafting. Although the flaking and technology are somewhat unrefined, the substantial edge preparation suggests that the knapper intended to execute controlled flaking (e.g., oblique transverse, collateral, parallel oblique) along the lateral margins.

The morphology of the point and indication that it was being set up for controlled flaking hint that it is Paleoindian. While the point could be an unfinished Folsom (Larry D. Agenbroad, personal communication 1990; Bruce D. Bradley, personal communication to Alan R. Schroedl 1990), this seems unlikely because it is too thin to flute. The point may instead represent the thinner unfluted Folsom equivalent, Midland (see Judge 1973:177, 192), or a Plano type such as Lovell Constricted (cf. Husted 1969). The point could also be a fragment of an Archaic Humboldt point (cf. Heizer and Clewlow 1968).

The second possible Paleoindian point base is from site 42SA20305. It is made from a white Summerville Chalcedony flake and exhibits a diagonal fracture that was probably precipitated by a flaw in the raw material; the point is unfinished and it appears to have been broken during manufacture. The tool has a slightly convex base, mildly convex lateral margins (see Figure 18b), and a random flaking pattern. The base is neither pressure flaked nor ground and is unsuitable for hafting in its current condition. This tool fragment is 2.8 cm wide, 0.5 cm thick, and broken 2.3 cm above the base.

The lateral margins on this implement appear to have been finely retouched and then heavily ground. Such careful and involved edge preparation would have likely been done in anticipation of controlled pressure flaking typical of late Paleoindian technology. This and the morphology of the specimen suggest that the tool may be the base of a late Paleoindian Plano point such as Milnesand (Sellards 1955).

Although they are not common, a wide variety of late Paleoindian points has been found in southeastern and central Utah (e.g., Black et al. 1982; Copeland and Webster 1983; Geib and Bremer 1988; Hunt 1953). A possible Lovell Constricted point is reported from Castle Valley (Black and Metcalf 1986:Figure 13) and a Milnesand point is known from Mesa Verde National Park (Hayes 1964). Several Folsom points has been found in the general vicinity of Canyonlands (Copeland and Fike 1988; Geib and Bremer 1988).

Silver Lake or Jay

A patinated, dark gray chert, stemmed dart point missing a corner of the base was found on site 42SA20321. The point has a large, triangular blade with excurvate margins, a wide stem with vaguely excurvate margins, and a broken but rounded, unnotched base (see Figure 18c). The stem slightly constricts just below its juncture with the blade and represents approximately one-third of the point's total length. The point measures 4.0 cm long, 2.2 cm wide, and 0.6 cm thick.

The morphology of the tool suggests that it could be a Silver Lake (cf. Amsden 1937) or Jay (cf. Irwin-Williams 1973) point. These types have different implications for cultural affiliation, age, and adaptive patterns. Silver Lake points represent the Stemmed Point Tradition (Bryan 1980) or Western Stemmed cultural tradition (Willig and Aikens 1988) in the Great Basin. The Western Stemmed cultural tradition dates between approximately 10,790 and 6,050 B.C. (Willig and Aikens 1988), though some of the point types included in the tradition extend much later; it represents the transition between what might be referred to as the Paleoindian and Archaic *periods*, both of which were probably characterized by Archaic-style lifeways (see Simms 1988).

The few Silver Lake or temporally equivalent Lake Mohave points thus far reported on the northern Colorado Plateau appear to be from surface sites in central and southern Utah (e.g., Black and Metcalf 1986; Geib and Bremer 1988; Tipps 1988). At Danger Cave in the eastern Great Basin, two Silver Lake-Lake Mohave points were recovered from an 8000-7000 B.C. context, and two were somewhat younger (Holmer 1986:95). A point very similar to the Canyonlands specimen was recovered from a stratum dated to approximately 5850 B.C. at Hogup Cave (Holmer 1986:96).

Irwin-Williams (1973, 1979) defined Jay points as the earliest materials in Oshara Tradition, a lengthy Archaic cultural tradition centered in northwestern New Mexico. In subsequent discussions, Stuart and Gauthier (1981:29-31) attribute them to late Paleoindian times based on

similarities to late Paleoindian point styles, particularly Hell Gap. Irwin-Williams believes that Jay points date between 5500 and 4800 B.C. One or two possible Jay points occur in Hunt and Tanner's (1960:Figure 4) collection from the Moab area (cf. Irwin-Williams 1973).

Determining whether the Canyonlands point is a Silver Lake or a Jay is hindered by the general noncollection nature of this survey which precluded collection of the Canyonlands specimen and the continuing lack of adequate descriptions and illustrations for the Jay style. The size of this point and the length of its stem suggest that it may most appropriately be classified as a Silver Lake point, but it is probably inappropriate to ascribe the point to either type at this time. What can be said is that the point was likely manufactured during the Early Archaic period by people who practiced a hunting and gathering lifeway.

Pinto Series

A complete Pinto (cf. Amsden 1935) point was observed on a large, probable multicomponent lithic procurement site near Squaw Butte. The point is made from local, red-orange Cedar Mesa Chert and has a triangular blade with lightly serrated, slightly excurvate margins and a bifurcate, stemmed base (see Figure 18d). It measures 5.3 cm long, 1.7 cm wide and 0.3 cm thick and has a neck width of 0.8 cm. Pinto points are common on the northern Colorado Plateau where they date between 7500 and 5000 B.C. (Holmer 1978:66; 1986:97). This places them in the Early Archaic period.

Rocker Side-notched

The base and midsection of a gray quartzite Rocker Side-notched point (cf. Holmer 1978) was found on site 42SA20263, christened as *Soyok' manavi* by Dominguez (1991). The point has shallow side notches, a convex base, and excurvate blade margins (see Figure 18e). The point is 2.0 cm wide and 1.0 cm thick and broken 2.2 cm above the base. Rocker Side-notched points are found during the Middle Archaic period on the northern Colorado Plateau where they date between 5700 and 4000 B.C. (Holmer 1978:68).

Gypsum

Two large, contracting stem points were found during the inventory. These points have large triangular blades with convex margins, wide corner notches that form shoulders, and contracting stems with convex bases (see Figure 18f-g). Both are made from Summerville Chalcedony. One is almost complete and measures 4.0 cm long, 2.0 cm wide, and 0.5 cm thick. The other is 2.3 cm wide and 0.5 cm thick and broken 3.0 cm above the base. These two points are the classic Gypsum style (cf. Harrington 1933).

Holmer (1986:105) reports that the temporal placement of Gypsum points is ". . . remarkably consistent—always between 2500 B.C. to A.D. 500," but this time span is no longer accepted. The earliest Gypsum points at Sudden Shelter occur in Stratum 15 (Holmer 1978:Table 10). A radiocarbon date taken near the top of this stratum has a tree-ring corrected age range of 3360-2880 B.C. at two sigma (Stuiver and Pearson 1993). The largest frequency of Gypsum points at the site came from Strata 18 (n=8), 20 (n=7), and 21 (n=12). These strata are bracketed by radiocarbon dates from the middle of Stratum 17 and the middle of Stratum 22. The sample from the middle of Stratum 17 has a tree-ring corrected age range of 2130-1620 B.C. at two sigma (Pearson and Stuiver 1993). The sample from Stratum 22 was run twice and produced the following calibrated age ranges: 2190-1170 B.C. and 1880-1440 B.C. (Pearson and Stuiver 1993). These data suggest a corrected date range sometime between 3500 and 1500-1000 B.C. for Gypsum points at Sudden Shelter.

Gypsum points were recovered from Unit V at Cowboy Cave (Jennings 1980) which Geib and Bungart (1989:42) have recently reinterpreted as dating between A.D. 80 and 610. Berry and Berry (1986:309-310) believe that the Gypsum points from Unit V at Cowboy Cave were upwardly displaced from Unit IV by extensive pit and cist construction and are actually older. They convincingly argue that Gypsum points do not date after approximately 1500-1000 B.C. (calibrated) on the northern Colorado Plateau.

Motivated in part by Berry and Berry's assertation regarding upward displacement of artifacts, Schroedl and Coulam (in press), two of the original Cowboy Cave project participants, recently reanalyzed the Cowboy Cave features and stratigraphy, as well as selected artifact classes. Based on this reanalysis, they conclude that ". . . Gypsum points in the Terminal Archaic strata [at Cowboy Cave] are a result of secondary deposition . . . from prehistoric pit excavations into the underlying Late Archaic strata." They strongly support Berry and Berry's (1986) argument regarding the temporal placement of Gypsum points on the northern Colorado Plateau. The above dates place them within the Late Archaic period.

Elko Series

Eight Elko points (cf. Heizer et al. 1968)—six corner-notched and two side-notched—were discovered during the inventory (see Figure 19). All eight points have triangular blades; seven have slightly convex bases. The blade margins range from straight to incurvate on the corner-notched specimens and are slightly excurvate on the side-notched examples. These points are made from red Cedar Mesa Chert (n=2), Summerville Chalcedony (n=1), gray-black chert (n=1), gray chert (n=1), white chert (n=1), and other chalcedony (n=2).

Elko points date from 6000 B.C. until A.D. 1000 on the northern Colorado Plateau, with hiatuses between 4200 and 3000 B.C., and 1400 B.C. and A.D. 200 (Holmer 1986:101-102; Figure 12). Because Elko points have been recovered from a variety of time periods and cultural contexts (Jennings 1980; Jennings and Sammons-Lohse 1981; Jennings et al. 1980; Kidder and Guernsey 1919), sites with these points have not been assigned to any particular group or time period.

Large Corner-notched

Two large corner-notched points were recorded on two different sites. One is made from dark red-brown mottled Cedar Mesa Chert. It has a long, almost rectangular blade with only slightly converging margins, deep corner notches, and a relatively straight base (Figure 20a). The crude flaking pattern created serrated margins. This point is a maximum of 0.4 cm thick, 2.1 cm wide, and 3.9 cm long, although it is missing the tip.

The other specimen consists of an unfinished, large, well-made, red Cedar Mesa Chert base and midsection from site 42SA20264. The point has only one corner notch but appears to have been broken during manufacture and discarded before the second notch was flaked. The fragment is a maximum of 3.00 cm wide and 0.75 cm thick.

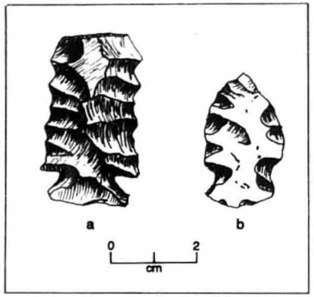

Figure 20. Selected indeterminate projectile points. a, large corner-notched, site 42SA20313; b, medium corner-notched, site 42SA20307.

Medium Corner-notched

Three medium corner-notched points were found on sites in the Squaw Butte Area. One, a pink-white chert point (see Figure 20b), measures 3.0 cm long, 1.8 cm wide, and 0.5 cm thick and has a triangular blade with markedly convex margins, wide corner notches, and a rounded base. It strongly resembles a point found on site 42SA17175 in the Salt Creek Pocket Area (Tipps and Hewitt 1989) which could be of Anasazi origin (cf. Vierra and Phagan 1984:140). Another point, made of brown banded chalcedony, is broken at the notches but possesses the same type of base. It is a maximum of 1.5 cm wide and 0.4 cm thick. The third specimen, made of gray quartzite, consists of the midsection and a small portion of the base. It measures 2.1 cm wide by a maximum of 0.3 cm thick.

Small Corner-notched

One small corner-notched projectile point was found on site 42SA20304 in the Squaw Butte Area. This Summerville Chalcedony point has a

triangular blade and oversized corner notches that make the tiny whole point appear almost stemmed. The point measures only 1.5 cm long, 0.9 cm wide, and 0.2 cm thick.

Indeterminate

One fragmentary point could not be typed, even to a descriptive category, though it appears to derive from a dart point. It is made from Summerville Chalcedony and co-occurs with an indeterminate, large corner-notched point.

Discussion

Projectile points are not common overall or on sites of any particular age in the Squaw Butte Area; most sites with surface projectile points have one such artifact and a few have two. The small size of the projectile point assemblage may suggest that hunting and other activities commonly accomplished with projectile points were not an important focus of subsistence pursuits in the project area. However, such activities may have been somewhat more important among the Archaic than the Anasazi groups—projectile points are present on approximately half of the Archaic sites but only one of the Anasazi sites.

The number of points of the various materials is not proportionate to the frequency with which the materials occur in the debitage assemblage. Cedar Mesa Chert is by far the principal material in the debitage assemblage, easily accounting for two-thirds to three-quarters of all artifacts, but only 22 percent of the points are made from this material. Summerville Chalcedony, the second most common stone type in the debitage assemblage, slightly outnumbers Cedar Mesa Chert in the point category (26 percent), whereas 11 other materials are represented by one or two specimens. There are no projectile points of the third most common material type, algalitic chert. There is a relatively greater diversity of material types in the point assemblage than the debitage assemblage.

These differences suggest that points made elsewhere of materials nonlocal to the Squaw Butte Area, and subsequently broken during use, were being replaced in the project area by tools made of Cedar Mesa Chert. Such activities are consistent with highly mobile populations following an annual round. The assemblage of typeable points is too small to reliably address whether there are any significant differences in the material types used during the various time periods represented by the points.

The percent of sites with projectile points is similar to that in the adjacent Salt Creek Pocket Area (approximately 18 percent) (Tipps and Hewitt 1989:87), implying similar emphases on activities involving projectile points. The assemblage differs from that recorded in the adjacent Salt Creek Pocket parcel by having more early styles and points (both possible Paleoindian and Early Archaic) and no Anasazi styles or points.

Material types used for projectile points differ slightly between the Salt Creek Pocket and Squaw Butte areas: the plurality of projectile points in the Salt Creek Pocket Area are made from Cedar Mesa Chert with other materials making up only 10 percent or less each. In the Squaw Butte Area, Cedar Mesa Chert and Summerville Chalcedony are codominant with small representations of other materials. These differences may reflect different access to the various raw materials.

Bifaces

A total of 107 bifaces was recorded during the Squaw Butte Area survey, 105 on sites and 2 as isolated finds. As the most common category of chipped stone tool, bifaces were found on 51 percent of the sites. Biface frequency ranges from 0 to 10 per site, but 1 is the modal category. There are an average of 2.6 bifaces per site on sites with bifaces.

Both early and late stage bifaces were recorded during the project (Figures 21 and 22; see also Figure 33e), but early stage bifaces are slightly more common. These tools may have been intended as both cutting implements and as cores that could be used later to obtain material for making expedient and small curated tools (cf. Kelly 1988). The vast majority (approximately 83 percent) are broken. Most appear to have been broken during manufacture and subsequently discarded.

One biface worthy of special note is a well-formed, algalitic chert, probable hafted knife from site 42SA20292 (see Figure 22a). This large, thin biface is described more fully in Chapter 6 and

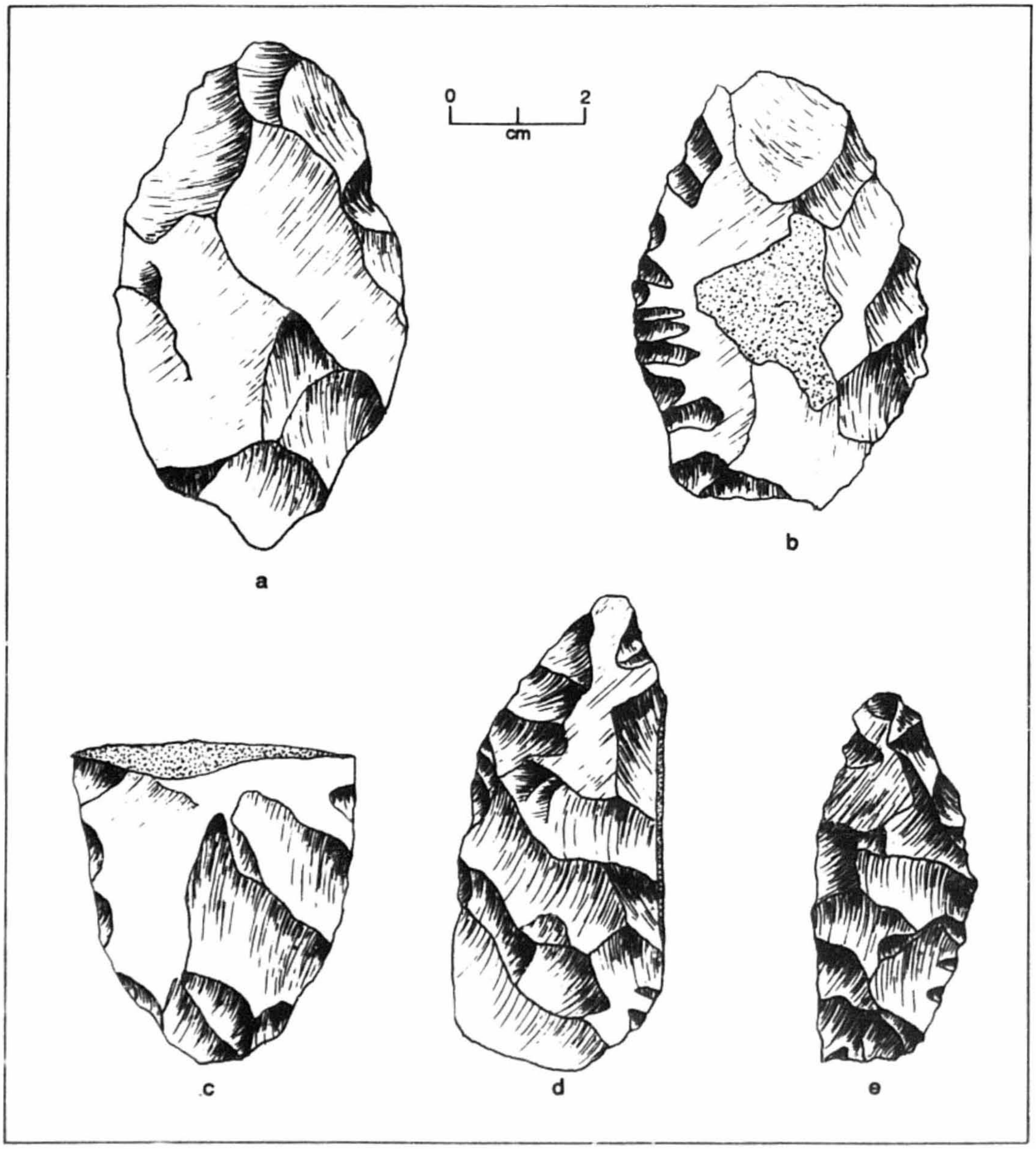

Figure 21. Selected early stage bifaces. a, site 42SA1455; b, site 42SA20317; c, site 42SA20305; d, site 42SA20261; e, site 42SA20313.

may be an Indian rice grass knife (cf. Steward 1941).

Cedar Mesa Chert is the most common material among the bifaces accounting for approximately 70 percent of the total. Summerville Chalcedony composes approximately 8 percent and algalitic chert approximately 6 percent. Fewer bifaces are made from brown chert (4 percent), white chert (3 percent), gray-brown chert (2 percent), other chert (5 percent), other chalcedony (1 percent), quartzite (1 percent), and an indeterminate material (1 percent). Excluding site

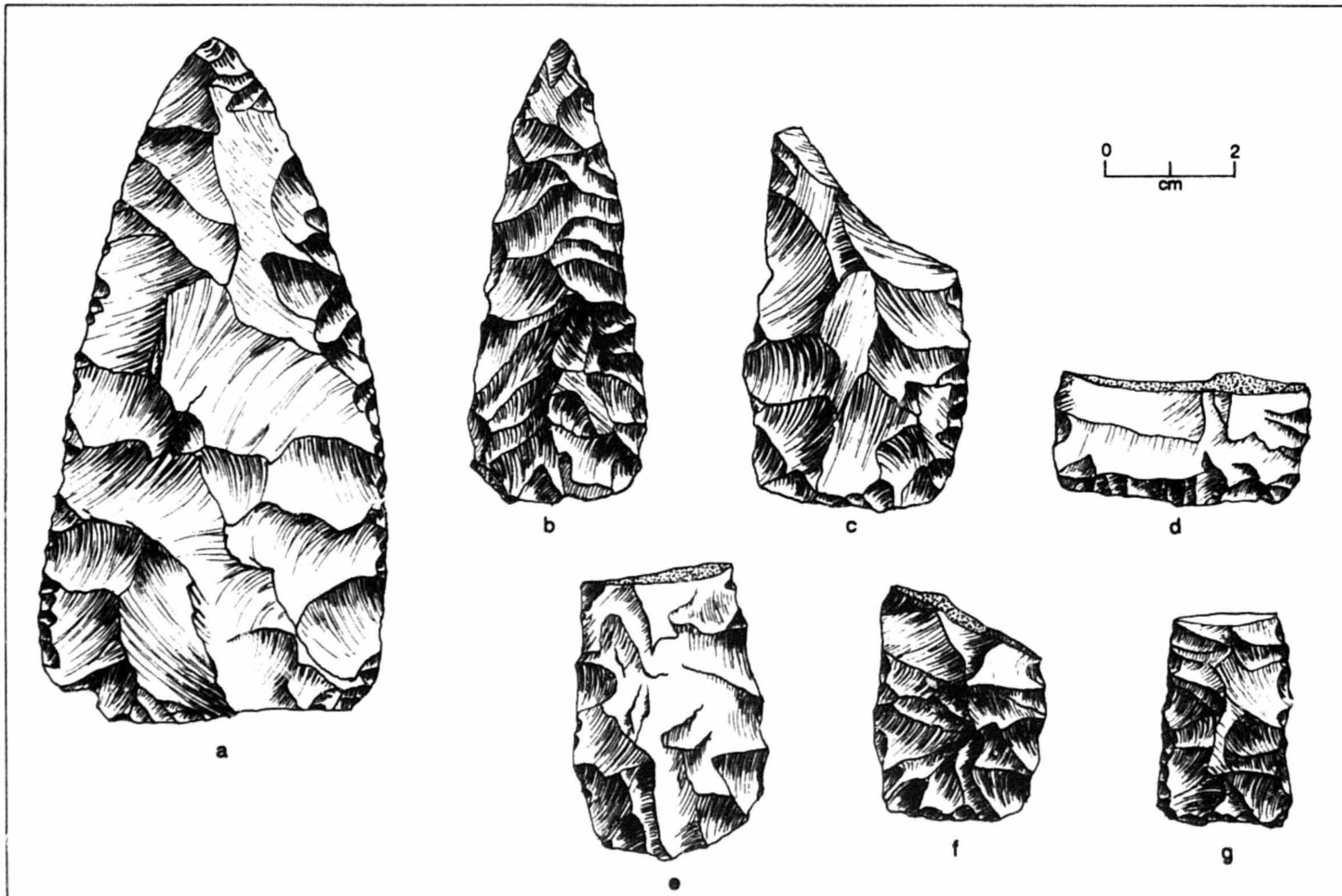

Figure 22. Selected late stage bifaces. a, site 42SA20292; b, site 42SA20294; c, site 42SA20320; d, site 42SA20307; e, site 42SA20300; f, site 42SA20286; g, 42SA20252.

42SA20615, which has Archaic and Anasazi components, bifaces are found on 7 of the 11 Archaic sites and components and only 3 of the 14 Anasazi sites and components. Average frequency of bifaces is also higher on the Archaic than the Anasazi sites ($\bar{x}$=4.0 versus $\bar{x}$=1.3).

Bifaces are found on a lower percentage of Squaw Butte Area sites than Salt Creek Pocket Area sites (51 percent versus 62 percent), but Squaw Butte Area sites with bifaces have a slightly higher average number of such tools (2.6 versus 2.1). The distribution across material types also differs from the adjacent Salt Creek Pocket Area (Tipps and Hewitt 1989); the Salt Creek Pocket Area has a substantially lower percent of bifaces made from Cedar Mesa Formation toolstone (59 percent) and a slightly higher percentage of bifaces made from Summerville Chalcedony (12 percent). These differences are probably the result of differential access to the various toolstone types.

Drills

Drills, at least the formal varieties which are more likely to be observed during an inventory, are uncommon in the Squaw Butte Area. Only one drill was found: it is the medial section of a formal flanged drill made of grainy white quartzite with multicolored speckles. The drill is from an undated site, 42SA20310.

Unifaces and Scrapers

Unifaces and scrapers are also uncommon on sites in the Squaw Butte Area: only three unifaces and three scrapers were discovered, all on separate sites. All are from undated aboriginal sites except for one uniface from an Early Formative site.

The three unifaces are expedient tools, each made from a bifacial thinning flake. All exhibit unifacial retouch or usewear along one or more margins. Most are made from Cedar Mesa Chert.

The three small end scrapers are illustrated in Figure 23. One is made from Summerville Chalcedony, exhibits fine pressure flaking, and has a lightly serrated working edge (see Figure 23a). Another specimen is made from gray chert and has unifacial flaking along the working edge (see Figure 23b). The third specimen is less formal than the other two, with only minimal retouch. It is circular in plan with a 1.5-cm-long projection that appears unworked (see Figure 23c). Usewear is evident on the circular portion of the Cedar Mesa Chert tool, opposite the projection.

Graver

A single graver was found on an undated site along the Salt Creek floodplain. It is made from a parallel-sided, secondary thinning flake of exotic chert measuring 3.7 cm long, 2.2 cm wide, and 0.9 cm thick. The graver was made by retouching one of the lateral margins into a point (Figure 24). There is also retouch on the distal end of the tool.

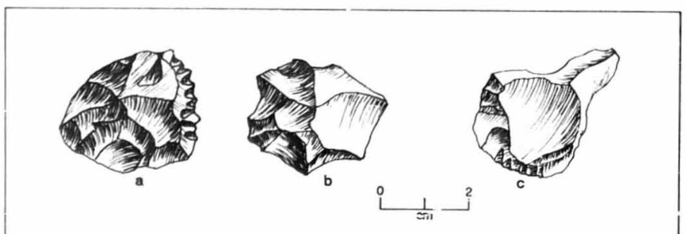

Figure 23. Scrapers. a, site 42SA20261; b, site 42SA20311; c, site 42SA20317.

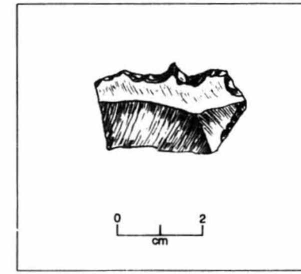

Figure 24. Graver from site 42SA1455.

Modified Flakes

Seventeen modified flakes were observed on 13 sites (16 percent) in the Squaw Butte Area. Only one modified flake was recorded on most sites, but one site had five. Of all tool categories, modified flakes is the one most likely to be underrepresented in the recorded assemblage because expedient flake tools are difficult to spot in the context of inventory. Excavations on sites in the area would likely identify a larger number of modified flakes on a higher percentage of sites.

The majority of the modified flakes are retouched, usewom, or both on one or more margins. The plurality of modified flakes are made on early stage decortication flakes; secondary and tertiary flakes were also used but are less common. Detailed description of the modified flakes from site 42SA20262 can be found in Chapter 5.

Following trends observed in the debitage and elsewhere in the tool assemblage, most of the modified flakes in the Squaw Butte Area are made of Cedar Mesa Chert (n=11), with two each made from gray chert and algalitic chert, and one each made from brown chert and gray chalcedony. The modified flakes are from Early Formative, Pueblo II-III, and undated sites.

Cores

Thirty cores were recorded on 18 sites in the Squaw Butte Area. Nine additional cores (on seven sites) show evidence of retouch or use subsequent to functioning as a core. One "utilized" core is battered, apparently from use as a hammerstone, whereas two others show wear consistent with use as a scraper. The others exhibit pressure retouch or contiguous microfracturing indicative of cutting or scraping activities.

Including both categories, there are a total of 39 cores on 22 sites (28 percent). The average number of cores on sites with cores is 1.8. Approximately half of the sites have only one core. The remaining sites have two to eight cores. Cores are approximately equally represented on sites with lithic sources and sites without. As noted above, many of the bifaces could have also served as bifacial cores—this would greatly increase the presence and frequency of cores in the Squaw Butte Area. The conservative approach used to distinguish early stage cores from tested cobbles and chunks that have "natural" flakes detached may have also biased the sample size downward. Excluding site 42SA20615, which has Archaic and Anasazi components, cores are found on 4 of the 11 Archaic sites and components and 4 of the 14 Anasazi sites and components.

Cores that were randomly flaked in various directions using multiple platforms are most common accounting for approximately 85 percent. These cores appear to have been part of a core/flake reduction trajectory where the primary purpose was to produce flakes rather than to shape the nucleus into a tool. Secondary trajectories were likely initiated on the flakes to produce end products such as projectile points and expedient flake tools. Size of the multidirectional cores varies considerably: maximum length ranges from 3 to 11 cm with an average of 7 cm; width (measured at a right angle to the length) ranges from 2 to 8 cm with an average of 5 cm, and thickness (measured perpendicular to length and width) ranges from 2 to 6 cm with an average of 4 cm. While a few of the cores are quite small (and are clearly exhausted), most are large enough to produce flakes suitable for expedient tools. A few are large enough to yield flake blanks that could be reduced into the types of chipped tools commonly found in the project area. With three exceptions, the multidirectional cores are made from local Cedar Mesa Chert (n=33) and Limestone (n=1). The exceptions include one each of algalitic chert and yellow quartzite.

Crabtree (1972:84) defines polyhedral cores as generally cylindrical cores bearing multiple blade scars. One specimen from site 42SA20252 in the Squaw Butte Area fits this definition (Figure 25a). Made from local Cedar Mesa Chert, the platform area was prepared by the removal of one large flake. This core has multiple parallel blade scars that were detached from a single end of the approximately cylindrical piece in a unidirectional fashion. The core measures approximately 5.0 cm in diameter and is approximately 4.5 cm long. The flake scars show that the core was used to produce short (1.0-4.5 cm), wide (1.3-1.5 cm) percussion blades. While the core is not as precisely formed as the pressure-derived, polyhedral cores from Mesoamerica, it clearly represents percussion blade technology, presumably undertaken to produce standardized blades.

A similar, but more finely crafted polyhedral core of Cedar Mesa Chert was collected by two looters near the Needles Outpost in the vicinity of the project area (Gary M. Popek, personal communication 1991). Unfortunately no further information is available on this artifact. These two cores, together with the two polyhedral cores recorded in the Salt Creek Pocket Area during the first year of the Canyonlands Archeological Project (Tipps and Hewitt 1989:100-101), indicate that a second, independent reduction trajectory was used to manufacture implements from the local Cedar Mesa Chert in the area.

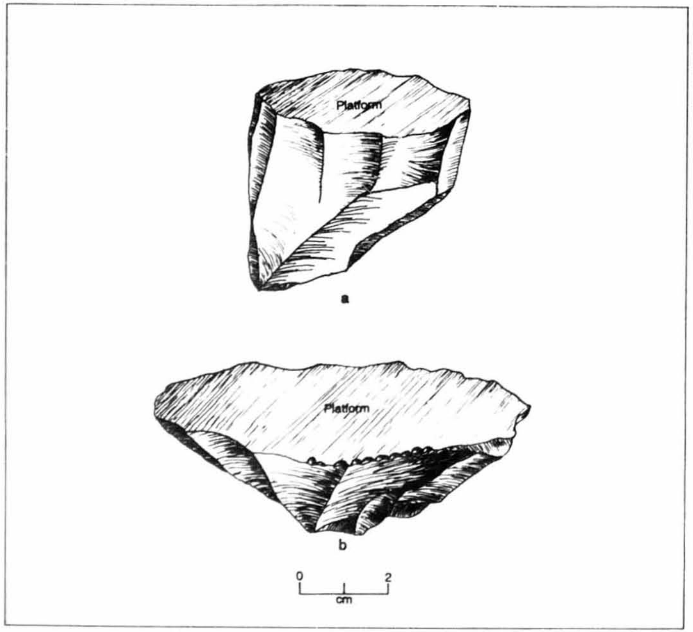

Figure 25. Selected cores. a, site 42SA20252; b, site 42SA20260.

Another core type, representing a different reduction strategy, consists of a conical nuclei that was reduced in a unidirectional fashion. Crabtree (1972:54) states that such cores are generally associated with blade technology. Two such cores, both made of local Cedar Mesa Chert, were found in the project area (see Figure 25b). Both specimens have a large, round platform created by the detachment of a single large flake. Flakes were struck from the platform in a unidirectional manner, down towards the apex (distal end) of the cone. Unlike the polyhedral cores where the detached flakes were parallel sided, flakes removed from the unidirectional cores would have converged toward the distal end. The platform on one unidirectional core is 4-5 cm in diameter; the other is 7-9 cm in diameter (see Figure 25b). Both are slightly more than 3 cm thick. The larger of the two unidirectional cores exhibits pressure retouch along a short segment of the platform margin; this retouch appears to have been subsequent to its use as a core.

The core assemblage recorded in the Squaw Butte Area is similar to that observed in the Salt Creek Pocket Area in terms of number of sites with cores, average number of cores per site with cores, and percentages of the various core types (Tipps and Hewitt 1989). Both areas have a predominance of multidirectional cores, with a minor representation of polyhedral and unidirectional conical cores. Material types are also similar between the two areas, although the Squaw Butte Area has a slightly higher percentage of Cedar Mesa Chert (and Limestone) cores (95 percent versus 85 percent), owing presumably to the greater abundance of Cedar Mesa lithic source area sites in the Squaw Butte Area. Both areas have a single core of algalitic chert and quartzite, but the Salt Creek Pocket Area has three cores each of Summerville Chalcedony and miscellaneous other cherts. This greater representation of nonlocal materials is probably the result of differential access to raw materials.

Tested Cobbles

As noted in Chapter 1, identification and recordation of tested cobbles were problematic. Some of the larger Cedar Mesa Chert lithic source area sites contained literally thousands of cobbles and nodules, many exhibiting negative flake scars. In many cases, it was impossible to distinguish between cultural and natural flake scars, and even if the distinction could be easily made, the time and manpower needed to assess each cobble was not available, nor would such an effort have been worthwhile in light of other project goals and requirements.

The assayed pieces consist of fragments and chunks of Cedar Mesa Chert that have only a few flake scars removed, evidently to inspect the quality of the material. While some could represent expedient cores used to produce flakes or flake blanks, the nature and context of the tested cobbles indicate that most were flaked to appraise material quality and flakeability. This is not surprising given the highly variable quality of Cedar Mesa Chert and the tendency for both high- and low-quality chert to lay hidden beneath the gnarly rind. The tested cobbles observed on the lithic source area sites generally contain low-quality chert and are presumably the rejects; cobbles that contained higher quality material were probably reduced into cores, flakes, and/or flake blanks for transport and use.

Tested cobbles are present on virtually all of the Cedar Mesa Chert lithic source area sites. They, and occasionally unmodified pieces of Cedar Mesa Chert, are also present on some nonsource area sites.

Lithic Debitage

Lithic debitage is the most commonly observed artifact class. Debitage is present on all but two sites: a petroglyph panel site with no artifacts and an Anasazi site with only pottery. Among the sites with debitage, those with more than 500 surface lithic artifacts are most common accounting for 36 percent. Sites with 100-500 and 25-100 lithic artifacts are approximately equal accounting for 25 percent and 23 percent, respectively. Sites with fewer than 10 lithic artifacts or no lithic artifacts are uncommon.

On the IMACS site forms, debitage data are recorded in four ordinal level categories (dominant, common, rare, not present) for four debitage types: decortication flakes, secondary flakes, tertiary flakes, and shatter. While these give a very general idea of flaking stages extant in the project area, they are not very conducive to identifying the various technologies that were used to produce tools. Flake types are too general and all-inclusive; many diagnostic types are missing. Compounding the problem, the frequency categories are not mutually exclusive, for example, there can be three common types at a site and no rare types, or two codominant types and one rare type. As a result, the IMACS data set does not provide the types of data needed to address research questions concerning differences in lithic procurement and technology through time, on various site types, or on various local and nonlocal materials, each of which bear on adaptational strategies and mobility. Addressing such questions with debitage data from the area will have to await future projects involving collection and more detailed analyses.

Table 12 presents a summary of the IMACS site form data regarding debitage. Secondary flakes account for the majority in the dominant category, tertiary flakes form the majority in the common category, and decortication flakes form the plurality in the rare category. Written descriptions on the IMACS site forms indicate that decortication and early reduction flakes are more common than these data indicate.

Although they cannot be quantified, general observations made during the inventory are that the majority of the debitage was produced using a bifacial reduction strategy—many of the flakes included in the "secondary flake" category are early and late stage bifacial thinning flakes. Also common is an expedient core-flake reduction strategy that involved reduction of expedient cores in a multidirectional fashion. This strategy seems especially visible on the lithic procurement sites though not to the exclusion of the biface reduction strategy. Though minor, a third reduction strategy is evidenced by the percussion blades on site 42SA20279. These blades range from 3.1 to 8.2 cm long, have a triangular cross section, and generally exhibit a single ridge extending the entire length of the dorsal surface. No evidence of bipolar flaking was noted but, given the abundance of chert in the project area, common sense suggests that there would have been little need for this stone-conserving, reduction technology.

Cedar Mesa Chert Debitage

Due to the IMACS site form format, no quantifiable data were collected regarding reduction strategies or stages of particular material types. However, the typical pattern is that the local Cedar Mesa materials were reduced through all stages in the project area from initial procurement and assay of chunks and fragments to final shaping of well-formed, curated tools. At least four different reduction technologies were used, bifacial, core-flake, and two types of percussion blade. The bifacial strategy is predominant: it occurs on most sites and is responsible for the bulk of the observed debitage; occasionally it is the only strategy recorded on a particular site.

Summerville Chalcedony Debitage

Summerville Chalcedony and other (rare) chalcedonies mainly emphasized middle and late stages of bifacial reduction. In referring to the Summerville Chalcedony, the site forms routinely contain statements such as "only tertiary flakes," "mostly secondary thinning flakes," "all from a bifacial technology," and "later stages than the local Cedar Mesa Chert." One site, however, stands in marked contrast. The form for site 42SA20320 states:

Table 12. Debitage abundance by type on sites with debitage.

Type	Dominant	Common	Rare	Not Present	Total
Decortication flakes	-	17	39	22	78
Secondary flakes	56	17	5	-	78
Tertiary flakes	16	51	8	3	78
Shatter	5	37	31	5	78

> It is notable that this site, in contrast to most others, shows a very high percentage of Summerville Chalcedony. *And*, the larger flakes and earlier reduction stages are represented by the Summerville Chalcedony and the dark red Cedar Mesa Chert reflects more advanced reduction stages. This is in total contrast to other sites where the Summerville Chalcedony represents the latest reduction stages and the Cedar Mesa Chert the earliest stages. On this site, the Summerville Chalcedony and algalitic chert are mainly primary and secondary thinning flakes and initial reduction flakes [emphasis in original].

This exception does not refute the general pattern described above but does indicate that patterns of lithic procurement, transport, and use were complex in the Squaw Butte Area and need to be evaluated in a more formal, quantifiable manner than is possible in the context of a non-collection inventory project.

Other Debitage

Obsidian in the project area is only represented by late stage bifacial thinning flakes. Observations regarding reduction strategies and stages on other common materials (e.g., white chert, brown chert, algalitic chert, gray chert, etc.) would likely be useful in elucidating their source and identifying whether they are from the Cedar Mesa Formation. Such observations as well as confirmation or refutation of the general trends noted above will have to await more detailed investigations involving collection and analysis.

Groundstone Artifacts

Groundstone artifacts observed during the project consist of 31 manos, 31 metates, and 1 piece of indeterminate groundstone. One metate fragment was recorded as an isolated find; the other 62 specimens were found on 20 sites (25 percent). Most of these implements are made of locally available sandstone. A few are made from quartzite, which, although uncommon, is available in the vicinity of the project area.

Manos

Thirty-one manos were observed on 15 sites (19 percent) in the Squaw Butte Area (Table 13). Approximately half of these sites have only one mano visible on the surface. The average number of manos on sites with manos is 2.1. Twenty-six of the manos are the one-hand variety, four represent the two-hand variety, and one is too fragmentary to determine type. The one- and two-hand manos typically occur on different sites but co-occur on one Anasazi site so identified by the presence of architecture and pottery. As a group, the mano assemblage is relatively well-worn suggesting substantial use.

One-hand Manos

Twenty-six one-hand manos were observed on 12 sites (15 percent) in the Squaw Butte Area. Three of the manos occur on three Archaic sites. Two are found on two Anasazi sites. Eight are located on a predominantly Archaic site with a light Anasazi component (*Soyok' manavi*). The remaining 13 were observed on 6 sites of multiple or unknown cultural affiliation.

The 26 one-hand manos are made from locally available materials. Sandstone is the most common (54 percent), followed by quartzitic sandstone (27 percent) and quartzite (19 percent). More than half of the one-hand manos (54 percent) are formally shaped by pecking and/or grinding. The shaping, however, is somewhat expedient and not indicative of a tremendous investment of labor.

Bifacially ground one-hand manos account for approximately 58 percent. Unifacially ground one-hand manos are less common at approximately 38 percent and one specimen is uncertain. Bifacially used manos may be the result of increased grinding intensity and of grinders deliberately managing the wear on the manos to extend their use-life (Adams 1993). Extending a mano's use-life might be desirable because (1) a particular mano is comfortable to use and fits a particular metate, (2) it is easier to extend a mano's

Table 13. Number and type of groundstone artifacts by site and isolated find.

Site Number and Name	Manos			Metates			Indeterminate Ground-stone	Total
	One-hand	Two-hand	Indeter-minate	Basin	Slab	Indeter-minate		
42SA1455	-	-	-	2	-	1	1	4
42SA1519	1	-	-	1	-	-	-	2
42SA20256 (Squaw Butte Cove)	1	-	-	-	-	-	-	1
42SA20262	1	-	-	-	-	-	-	1
42SA20263 (*Soyok' manavi*)	8	-	1	7	-	2	-	18
42SA20264	1	1	-	-	-	-	-	2
42SA20270	-	1	-	-	-	-	-	1
42SA20272	-	1	-	-	-	-	-	1
42SA20285	2	-	-	-	-	-	-	2
42SA20286	3	-	-	-	-	-	-	3
42SA20288	-	1	-	-	-	-	-	1
42SA20289	-	-	-	2	-	-	-	2
42SA20290	-	-	-	1	-	1	-	2
42SA20292	1	-	-	1	-	-	-	2
42SA20300	-	-	-	-	-	2	-	2
42SA20301 (Whirlwind Ridge)	1	-	-	2	1	1	-	5
42SA20305	3	-	-	-	-	2	-	5
42SA20311	-	-	-	-	-	1	-	1
42SA20312	1	-	-	-	-	-	-	1
42SA20615	3	-	-	2	-	1	-	6
IF 19	-	-	-	-	-	1	-	1
Total	26	4	1	18	1	12	1	63
Percent	41.3	6.3	1.6	28.6	1.6	19.0	1.6	100.0

use-life than to expend the energy to procure raw material and produce a suitable replacement mano, or (3) raw material for a replacement is scarce (Adams 1993:336). Also, it provides a second grinding surface that can be used without having to stop to resharpen when the first side becomes smooth and needs roughening.

Almost 74 percent of the 38 grinding surfaces present on the 26 manos are well-worn. The remainder are moderately well-worn (13 percent), minimally worn (8 percent), or indeterminate (5 percent). Approximately 30 percent of the manos have at least one pecked surface indicating that they had recently been resharpened.

Two-hand Manos

Four two-hand manos were observed on four different sites in the Squaw Butte Area. Three occur on sites with pottery and/or architecture of Anasazi origin. The fourth is from a site that lacks other diagnostics. Two of the manos are made from coarse-grained local sandstone. These two manos exhibit unifacial usewear and are

minimally to moderately worn. One was modified to a subrectangular shape by spalling; the other is unmodified and rather crudely formed.

The other two-hand manos are made from medium- to coarse-grained quartzite. One is oblong, the other subrectangular. Both have a single grinding surface that is well-worn. The grinding surface on the oblong specimen is also polished. The ends of the subrectangular specimen exhibit wear and polish consistent with use in a trough metate. The margins of both manos were deliberately shaped prior to use.

Metates

Thirty-one metates were observed on 11 sites (14 percent) and 1 isolated find in the Squaw Butte Area (see Table 13). The frequency of metates on sites with metates ranges from 1 to 9, with 2 being the modal category. The average number of metates on sites with metates is 2.7. Eighteen of the metates are the basin type, 1 is a flat (slab) type, 12 are too fragmentary to type. No trough metates were found. Like the mano assemblage, the group of metates is well-worn suggesting substantial use.

Basin Metates

Eighteen basin metates were observed on eight sites (10 percent) in the Squaw Butte Area. Three of the basin metates occur on two Archaic sites. One occurs on an Anasazi site. Seven exist on an Archaic site with a light Anasazi component (*Soyok' manavi*). The remaining seven were found on four sites of multiple or unknown cultural affiliation.

All of the basin metates are made of locally available fine- and medium-grained sandstones. Although more than one-quarter (28 percent) are formally shaped by pecking and/or spalling, the shaping is typically minimal and not indicative of a substantial investment of time and energy. Approximately 72 percent (n=13) of the basin metates are sufficiently well-worn that they have a definable oval basin (e.g., 0.3-1.0 cm deep). The remainder are moderately well-worn (n=1), are minimally worn (n=1), or have an indeterminate amount of wear (n=3).

Flat Metate

One flat metate was observed on a site with two Terminal Archaic radiocarbon dates. This specimen is made from local white sandstone and was deliberately shaped into a subrectangular form. It is well-worn from repeated use.

Indeterminate Metate Fragments

The 12 untypeable metates are all made from local sandstones. Those made from fine-grained materials form the plurality (n=6). Two others are composed of coarse-grained material and the grain-size of the remainder is unknown. Three are deliberately shaped, five are unshaped, and the remainder are uncertain. Amount of wear is approximately equally divided between minimally, moderately, and well-worn. One indeterminate metate fragment occurs on an Archaic site. The remainder were found on seven sites of multiple or indeterminate affiliation and one was an isolated find.

Discussion

For the purposes of this discussion, the large groundstone assemblage from *Soyok' manavi* is treated as Archaic even though the site appears to have a light Anasazi component. This seems reasonable given (1) our field observation that most of the site artifacts and deposits are Archaic and (2) that Steve Dominguez (personal communication 1993) reached the same conclusion based on his testing at the site.

Groundstone artifacts are slightly more common on Archaic than Anasazi sites measured in terms of frequency of sites with groundstone but this difference may not be meaningful given the small sample size. However, Archaic sites with groundstone do have a higher average number of groundstone implements on sites with groundstone ($\bar{x}$=6.5 versus $\bar{x}$=1.5), even if *Soyok' manavi* is deleted from the computations ($\bar{x}$=2.7 versus $\bar{x}$=1.5). Whether this indicates more intensive plant utilization during the Archaic period will have to await future investigations and analyses with a larger, better dated assemblage.

Although the sample is too small for statistical comparison, characteristics of manos occurring on Archaic versus Anasazi sites were examined to see if there are any discernible trends. The manos found on the Archaic sites are all the one-hand variety and primarily made from sandstone with a few from quartzite. Material grain-size favors the fine- and medium-grained stones. The manos are as likely to be shaped as unshaped, unifacial as bifacial, and whole as broken. However, the majority are well-worn from repeated, extensive use.

Manos on Anasazi sites include one- and two-hand types. They are more likely to be unifacially worn and deliberately shaped than manos found on the Archaic sites but are as likely to be whole as broken. The materials have a coarser composition than the materials used for manos on the Archaic sites and the majority (4 of 5) are made from materials more durable than the normal sandstone. The trend toward finer grained materials for manos from the Archaic sites and coarser materials for manos on the Anasazi sites may reflect differences in the food items being processed.

On a project in extreme southeastern Utah, Geib (1985:412) notes that grinders of seeds of nondomesticates chose fine- and medium-grained sandstone over coarse-grained sandstone at a rate of 3 to 1, whereas grinders of corn chose medium- and coarse-grained sandstone over fine-grained sandstone at approximately the same ratio, despite having access to the same resources.

The difference may also have to do with the durability of the cementious material binding the sandstone relative to the anticipated task. At Homol'ovi III, Fratt and Biancaniello (1993:383-386) show that sandstones with more durable cement were preferred for some groundstone implements and grinding tasks, whereas sandstones with less durable cements were preferred for others. The harder cements are presumably less subject to abrasive wear, making them more suited to certain types of grinding.

The assemblage of groundstone from the Squaw Butte Area is similar to the assemblage reported by Tipps and Hewitt (1989) for the adjacent Salt Creek Pocket Area except that the Salt Creek Pocket Area assemblage had (two) trough metates and fewer two-hand manos.

Miscellaneous Stone Artifacts

Three miscellaneous stone artifacts were discovered in the Squaw Butte Area. These consist of two hammerstones and a single polishing stone.

Hammerstones

The number of hammerstones seems remarkably low in light of the abundant lithic source area sites: only two were noted, one on an Archaic site with a light Anasazi component and one on an Anasazi site. One is made from a nodule of Cedar Mesa Chert retaining patches of cortex. This disk-shaped tool measures 6.5 cm in diameter and 3.5 cm thick and has heavily battered ridges. The second hammerstone consists of a Cedar Mesa Chert fragment measuring 9 cm long, 7 cm wide, and 7 cm thick. The margins of this piece are also battered.

Binford (1979) defines personal gear as heavily curated items carried by individuals in anticipation of future conditions or activities. In contrast, situational gear consists of items that are gathered, produced, or put into use to carry out a specific activity or task. Situational gear is expedient and generally fashioned from the readily available raw materials from the environment or one's stash of personal gear.

In areas with abundant or reasonably available suitable hammerstone material, hammerstones are logically considered situational gear. They are technologically simple and require no complex modifications before they can be put to use. Nodules could have been procured, used, and discarded in an expedient fashion, resulting in hammerstones entering the archeological record on or near source area sites proportionate to their use.

Conversely, individuals planning to visit areas lacking good hammerstone material may have incorporated hammerstones into their array of personal gear in advance, particularly if they knew that the areas contained abundant, high-quality toolstone. In this case, hammerstones might be highly curated and not left on the lithic source area sites, but instead returned to base

camps and field camps away from the project area where they were eventually discarded or lost.

Let us look at the Squaw Butte Area situation from this perspective. High-quality hammerstone material is sparsely available in the general project area. Quartzite cobbles are uncommon and may have been undesirably hard anyway. The available limestone is softer than the chert also making it less than desirable. That most of the hammerstones which do occur in the general area consist of chert nodules (see also Tipps and Hewitt 1989)—the same material as that being flaked—indicates there was a severe shortage of suitable hammerstone material. Therefore, the paucity of hammerstones in the Squaw Butte Area may suggest that the later scenario is correct—hammerstones were treated as personal gear, brought into the area, used, and taken back to field and base camps outside of the project area.

Polishing Stone

A single polishing stone was observed on an undated site in the Squaw Butte Area. The disc-shaped stone is made from a dark gray igneous material with yellow inclusions. It measures 3.5 to 4.0 cm in diameter and approximately 1.0 cm thick. The stone exhibits polish on one side.

Ceramic Artifacts

A total of 68 sherds was observed on 13 sites (16 percent) in the project area. These artifacts were documented in the field and are enumerated in Table 14. Paste color was recorded to document the presence or absence and distribution of dark paste in the project area. Although the identifications are subjective ("dark," "light," or "indeterminate"), they do provide some measure of the dark paste complex in the project area. Temper types were identified with the aid of a 20x hand lens. Type and ware names follow Colton (1955) and Breternitz et al. (1974). Interpretations are necessarily limited by the small size of the

Table 14. Frequency and type of sherds by sites and components.

	Mesa Verde						
	Gray Ware		White Ware				
Site Number and Name	Plain	Corrugated	McElmo Black-on-White	McElmo/Mesa Verde Black-on-White	Indeterminate	Indeterminate Gray Ware Corrugated	Total
42SA1519	-	1	-	-	4	-	5
42SA1661	-	8	-	1	-	-	9
42SA20263 (*Soyok' manavi*)	- -	-	-	1	-	1	
42SA20264	-	2	1	-	1	-	4
42SA20267	1	1	-	-	-	-	2
42SA20269	3	4	1	3	4	-	15
42SA20272	-	1	-	3	7	-	11
42SA20273	-	-	-	-	1	-	1
42SA20274	-	-	-	-	1	-	1
42SA20275	-	-	-	-	-	2	2
42SA20287	-	-	-	1	-	-	1
42SA20292	-	-	-	-	1	-	1
42SA20615	-	8	-	2	2	3	15
Total	4	25	2	10	22	5	68

assemblage, the small size of the sherds, the field nature of the identifications, and the lack of rims but should give an idea of the frequency and range of ceramic artifacts present in the project area.

Most of the 68 sherds documented during the inventory are indicative of occupation by peoples who used a western Mesa Verde Anasazi ceramic technology. The possible exceptions are two jar sherds with Tusayan-style corrugations that have light paste and large, angular, quartz sand temper, and three unusual corrugated sherds with light-colored rock temper. One of the three unusual sherds was collected for laboratory analysis and is discussed as item #4 in the section by Winston Hurst, below. The two corrugated jar sherds could be within the far range of variability for Kayenta gray ware although it seems unusual that gray rather than red or white wares would be introduced through what would likely be a trade context. Small percentages of Kayenta pottery have been reported by previous researchers in the Needles (Bond 1994; Tipps and Hewitt 1989:104-105).

Almost all the white ware sherds exhibit dark paste typical of Mesa Verde Anasazi occupation in the Beef Basin, Canyonlands, and Elk Ridge areas after approximately A.D. 1100 (Kramer et al. 1991:126). Temper in the white ware specimens is predominantly sherd and crushed andesite/diorite porphyry. A few sherds have just andesite/diorite porphyry (with or without rounded quartz sand) or just sherd temper. Some of the white wares are unslipped or partially slipped; others have a thin, uneven slip. Design execution is sometimes sloppy. Among the white wares, jar and bowl sherds are approximately equally represented but taking breakage into account, bowls were probably more common.

Most of the gray ware sherds exhibit light firing paste. Temper is mainly crushed rock (andesite/diorite porphyry), but a few pieces have sherd and andesite/diorite temper. As noted above, several sherds have coarse angular quartz sand temper or light-colored rock temper. All of the gray ware sherds are from jars.

As a whole, the assemblage appears to date to Pueblo III or late Pueblo II/III. Several plain gray body sherds from two sites could, in theory, date as early as Basketmaker III but may be from any subsequent period through Pueblo III. Their occurrence with corrugated styles in what appear to be sites cumulatively occupied for only a short period of time argues that they date to the same period as other sherds in the assemblage.

One of the striking characteristics about the assemblage is its small size, a total of only 68 sherds on 13 sites ($\bar{x}$=5.2). Four sites have 9-15 visible sherds but the others have 5 or less, and 1 is the modal category. On one site, eight of the sherds appear to represent one corrugated jar. The paucity of surface sherds can probably be attributed to a combination of two factors, illegal collection, especially on the easily accessible and heavily visited sites, and small assemblages to begin with. The small size of almost all sherds, the deteriorated condition of many, and the striking scarcity of aesthetically pleasing painted sherds suggest that most of the sites have been illegally surface collected. However, the assemblages may never have been very large. As early as the 1950s, before the recent wave of visitation and rampant illegal artifact collection, Rudy (1955) remarked about the small size of the ceramic assemblages on some of the sites he excavated in the Beef Basin area, a few miles to the south. He ultimately concluded that the scarcity of sherds was a result of site function/short-term occupation.

Some of the Squaw Butte Area sites are difficult to reach or in unusual places that visitors are not likely to go. In this case, the low number of sherds may primarily be the result of site function, hinting at short stays by small groups of people. On some of the larger ceramic-bearing sites with probable buried deposits (e.g., Seep Shelter and sites 42SA20274 and 42SA20615), excavation would likely uncover additional sherds. Only then will we learn whether the assemblages on such sites were large or small compared to Anasazi sites in other areas. Most likely, it will be the latter.

In summary, a small assemblage of ceramics was recorded during the inventory. The vast majority of these indicate use of the area by western Mesa Verde Anasazi people during Pueblo III or late Pueblo II/III. The ceramic artifacts provide no definitive evidence of earlier Anasazi occupation though several sherds could conceivably represent earlier Anasazi use of the area. If so, the ceramic assemblage suggests that such an occupation

would have been light and sporadic. Non-Mesa Verde pottery is limited to two corrugated body sherds which could represent the Kayenta tradition, and several unusual sherds whose origin is unknown. No Fremont, Southern Paiute, Ute, Hopi, or Navajo pottery was observed; this is not surprising because such pottery is only occasionally reported from the area (Bond 1994; Tipps and Hewitt 1989:104-105). The technology of the assemblage is representative of that found in the western portion of the Mesa Verde area after A.D. 1100. Most white ware sherds have dark paste, primarily sherd and andesite/diorite porphyry temper, often thin or incomplete slip, and sometimes sloppy designs. The service vessels have light-firing pastes and primarily crushed rock (andesite/diorite porphyry) temper.

Eighteen of the 68 sherds recorded in the field were collected for additional laboratory analysis. They are individually described and summarized by Winston Hurst in the section below.

Analysis of Collected Ceramic Artifacts

by Winston B. Hurst

Eighteen sherds from six sites have been subjected to basic analysis with the results tabulated in Table 15. All sherds were examined at a fresh break under reflected light at twenty-diameters magnification using a Bosch and Lomb binocular microscope. Paste value (lightness/darkness) was determined by using the Munsell scale with hue and chroma not recorded. Type and ware names follow Colton (1955) and Breternitz et al. (1974) with some minor modifications to accommodate variability encountered in the far western end of the Mesa Verde archeological culture area. Corrugated sherds are assigned to type on the basis of rim form and to style on the basis of corrugation morphology following Colton's Tusayan Gray Ware corrugated type series. Although the samples from any one site are small (2-7 sherds) and only one sherd can be classified beyond the ware level, we are able to derive the following conclusions from the analysis:

1. All of the site assemblages appear to represent a Pueblo III period (A.D. 1100/1150-1275±), Mesa Verde Anasazi occupation. Some of the corrugated sherds (site 42SA20264.D and site 42SA20615.C.B) exhibit styles that could occur as early as the 900s (early Pueblo II), but all of the corrugation body styles can occur in Pueblo III assemblages. In the absence of any rims, which are more temporally sensitive than body sherds, I am unable to demonstrate a pre-Pueblo III date for any of the sherds.

2. Given the small size of the samples, it is not possible to detect temporal differences among the site assemblages. They may represent a single restricted component, but this cannot be definitely determined.

3. These assemblages are representative of a distinctive dark-paste ceramic complex which is known to occur throughout the general region of the Elk Ridge Plateau. Dark-paste assemblages have been identified from the Cedar Mesa area on the south to Beef Basin and Canyonlands National Park on the north, with a continuous distribution through upper Comb Wash and the upper Cottonwood Wash drainage in between. Its distribution to the west of Elk Ridge has not yet been determined, but it is expected to extend to the Colorado River. This ceramic complex is the subject of active research by this author, Jean Akens, James Allison, Michelle Hegmon, and Owen Severance and will be fully described in the near future. As presently (and tentatively) understood, the dark-paste complex may be briefly described as follows:

a. The dark color of the paste is presumably (as yet untested) due to the use of iron-rich Triassic clays, exposed in various "red beds" around the Elk Ridge uplift.

b. Vitrification is unusually common in dark-paste ceramics, and the degree of darkness correlates with the degree of vitrification (value 5-6 for unvitrified paste, darkening to 3 or deeper with extreme vitrification). Because vitrification proceeds from the outside toward the center, it is not uncommon to see what Owen Severance has termed the "oreo cookie effect" in which the paste is lighter at the center than the edges (opposite of the widespread carbon core phenomenon common to the light-firing organic clays preferred throughout the Anasazi world).

c. During Basketmaker through mid-Pueblo II(?) times (A.D. 600-1050±[?]), dark-paste ceramics are almost entirely limited to culinary

Table 15. Ceramics from the Squaw Butte Area, Needles District, Canyonlands National Park.

Site Number	Sherd	Type	Style	Temper[a]	Paste[b]	Vitrification	Form	Paint	Comments
42SA1519	A	Mesa Verde Pueblo III white ware		1	6, 5		Jar		
	B	Mesa Verde Pueblo III white ware		1	6, 4		Jar		
	C	Mesa Verde Pueblo III white ware		1	7		Jar		
	D	Mesa Verde Pueblo III white ware		1	6, 5		Jar		Lipped rim
	E	Undifferentiated corrugated body	Moenkopi	2	8				
42SA1661	A	Undifferentiated corrugated body	Tusayan	2	8				
	B	Mesa Verde Pueblo III white ware		1	5, 3	Vitrification	Jar	Carbon	Even slip, pearly polish
42SA20264	A	Mesa Verde Pueblo III white ware		1	6		Bowl		Fine, homogeneous paste, thick wall-10 mm
	B	McElmo Black-on-white	Simple band	1	6, 5		Bowl	Carbon	Unslipped gray, fine paste, 10 mm thick
	C	Undifferentiated corrugated body	Tusayan	2	8		Jar		Fingernail indentations
	D	Undifferentiated corrugated body	Tusayan	3	7		Jar		Narrow coils, diagonally aligned indentations
42SA20269	A	Mesa Verde Pueblo III white ware		1	5, 4	Subvitrification	Bowl	Carbon	Slipped interior only
	B	Mesa Verde Pueblo III white ware		1	6		Jar	Carbon	Fine paste
	C	Mesa Verde Pueblo III white ware		1	4	Extreme vitrification	Small jar	Carbon	Bloated
	D	Mesa Verde Pueblo III white ware		1	5, 4		Small jar	Carbon	Core darkest
	E	Mesa Verde Pueblo III white ware		1	6		Jar		Even slip, polish
	F	Undifferentiated San Juan Gray Ware		2	7		Jar		Exterior spalled off
	G	Undifferentiated corrugated body	Tusayan	2	8		Jar		
42SA20287	A	Mesa Verde Pueblo III white ware		4	6, 4		Bowl	Carbon	Thin wall 5-6 mm
42SA20615	A	Undifferentiated corrugated body	Tusayan	2	8		Jar		
	B	Mesa Verde Pueblo III white ware		4	5		Bowl	Carbon	Light gray slip interior only
	C.A	Undifferentiated corrugated body	?	5	8		Jar		Unusual fine, smeared-indented corrugation, gray-dark gray crushed chert temper?
	C.B	Undifferentiated corrugated body	Tusayan	6	3		Jar		Small, square even corrugations; unsorted subrounded sand, yellow-tan matrix
	D.A	Undifferentiated corrugated body	Tusayan	7	5, 3		Jar		Black clay inclusions
	D.B	Mesa Verde Pueblo III white ware		2	5		Jar	Carbon	Thin, even slip and polish

[a]1 = Sherd and andesite/Diorite porphyry, 2 = Andesite/Diorite porphyry, 3 = Quartz sand, 4 = Sherd, 5 = Chert?, 6 = Quartz sandstone, 7 = Andesite/Diorite porphyry and clay.
[b]Gray scale value, 0 = black, 10 = white.

pottery, while the white ware pottery in the assemblages have lighter paste and were imported from points east and south. During Pueblo III times (and possibly late Pueblo II), assemblages in this area are characterized by light paste culinary ware and dark-paste, white-slipped white ware. The reasons for this reversal in the use of high-iron vs. low-iron clays in culinary vs. service pottery are as yet unknown. (Directly associated absolute dates are rare in this area. The above dates are based on stylistic cross dating and should be considered tentative.)

d. Dark-paste white ware pottery is generally tempered with potsherd (often dark and vitrified) and/or andesite/diorite porphyry, whereas dark-paste culinary pottery is tempered with andesite/diorite porphyry or one of several sandstones, apparently depending upon the availability of the former.

e. Late white ware pottery in this area tends to be less well-finished than that farther east. Bowl exteriors are often left unslipped, slips can be unevenly applied, etc. There is frequent evidence in the form of thin slips, unslipped exteriors, over-the-rim "slip-slop," etc., for conservation of the white-firing slip clay, which must have been a scarce and possibly imported commodity in this area.

f. The dark-paste complex at least overlaps with, and probably encompasses, the range of materials described by Lipe (1967) as his various "Loper Varieties" from the San Juan triangle.

4. The only really unusual sherd in the collections is Sherd A from site 42SA20615. This sherd is very distinctive in both its fine, smeared corrugation style and its chert (?) temper. This temper is reminiscent of a category observed in the Dolores Archaeological Program collections which their analysts thought to be crushed quartzite and which they considered to be an identifier of pottery from the La Plata Valley (Blinman et al. 1984:39). It is unlikely that this vessel was imported from the La Plata, but neither its age nor its cultural affiliation can be determined at this time.

In summary, all six site assemblages appear to relate to a Pueblo III period occupation by Anasazi people using a western Mesa Verdean ceramic pottery assemblage. Earlier components are possible but not demonstrable. The assemblages are representative of a "dark-paste" ceramic complex that occurs widely in the western end of the Mesa Verde culture area around the Elk Ridge uplift.

Summary and Discussion

The artifacts suggest that the project area was occupied during the early, middle, and late Archaic periods (circa 7000-1000 B.C.), and by people with a western Mesa Verde Anasazi ceramic technology during Pueblo III or late Pueblo II-III (circa A.D. 1100/1150-1275±). They provide no *definitive* evidence of occupation between circa 1000 B.C. and A.D. 1100, though certain artifacts could date to this era. For example, Elko points extend from 6000 B.C. to A.D. 1000 (Holmer 1986:101-102); the plain gray ware pottery could occur as early as the A.D. 500s (Basketmaker III) but can also be found in A.D. 1100s and 1200s assemblages. Some of the corrugated pottery could date as early as the A.D. 900s (Pueblo II) but can also occur in A.D. 1100s and 1200s assemblages (see Hurst, this chapter). However, in the absence of more temporally sensitive artifacts, it seems best to rely on other sources of information regarding occupation between 1000 B.C. and A.D. 1100. No artifacts diagnostic of post-Pueblo III use by protohistoric or historic groups such as the Ute, Paiute, Hopi, or Navajo peoples were observed. A Clovis point base and two possible Paleoindian point fragments date or could date to the Paleoindian period but do not necessarily demonstrate human use of the Squaw Butte Area during Paleoindian times. This topic is discussed in greater detail in Chapter 5.

The projectile point styles are typical of those found on the northern Colorado Plateau (Holmer 1978; Holmer and Weder 1980; Schroedl 1976) and, for the most part, consistent with that expected for the area. The ceramic assemblage is small, but representative of a local "dark-paste" complex that occurs after approximately A.D. 1100 in the western portion of the Mesa Verde Anasazi region. Exotics and tradewares are conspicuously infrequent, perhaps suggesting limited contact with people and groups beyond the Canyonlands/Beef Basin/Elk Ridge Plateau area. In contrast to early expectations (Anderson 1978;

Sharrock 1966), no Fremont pottery or other artifacts ascribable to a Fremont origin were found in the project area.

The vast majority of artifacts are fashioned from materials that outcrop and are abundantly available in the project area: Cedar Mesa Sandstone, Limestone, Chert, and Chalcedony. Artifacts manufactured from resources that lie at great distances are rare; somewhat more are made from materials whose closest sources are perhaps within a one to three day walk of the Squaw Butte Area. In contrast to the lithic artifacts, there is no indication that pottery was actually made in the project area. However, the ceramic artifacts do represent a distinctive dark-paste complex that was manufactured in the western portion of the Mesa Verde region which includes Canyonlands.

Judging from types and quantities of lithic artifacts, a primary activity at many sites was lithic reduction, specifically, the production of bifacial tools using the local Cedar Mesa material. The entire production sequence was undertaken on some sites but lithic reduction was limited to later tool production stages (e.g., final thinning, edge regularization) and tool edge rejuvenation on others. At least some of the bifacial reduction was undertaken on flake blanks removed using a core reduction strategy. Heat treatment may have been an integral part of the bifacial tool manufacturing process, at least for the common Cedar Mesa Chert material (see La Fond, Chapter 6). Core reduction and a limited core-blade technology seem to have been used for the purpose of obtaining flakes for expedient tools. Some of the resulting cores were later used as pecking and pounding tools.

The sites with evidence of intensive tool manufacture and/or maintenance tend to have unknown or Archaic temporal affiliations, but there are some exceptions to this trend, particularly one of the Early Formative sites. This is in spite of some Anasazi sites being situated on or immediately adjacent to outcrops and lag deposits of flakeable Cedar Mesa Chert. Artifact assemblages on the known Anasazi sites tend to be small and relatively diverse with a heavy emphasis on grinding equipment.

Overall, projectile points and other tools indicative of hunting and animal processing are not numerous, though they are slightly more common in Archaic than Anasazi contexts. Tools associated with plant processing are considerably more frequent. This and the presence of considerable wear on most manos and metates suggest that subsistence pursuits in the project area emphasized plant resources. The technology of the grinding tools on Archaic sites and grain-size of the raw material is consistent with processing of wild seeds. Similar grinding implements occur in Anasazi contexts alongside tools more appropriate for grinding corn. Overall, the ceramic assemblage is small but does indicate a variety of serving, mixing, cooking, and storage activities.

Some of the conclusions in this section—particularly those based on artifact quantities and diversity—should be qualified because they are based on surface artifact assemblages which have been subject to considerable collection by park visitors in recent years. Illegal collection has probably had the greatest impact on the visible overhang sites, which tend towards Anasazi affiliations, but collector's piles were also observed on a large open lithic scatter positioned on the claypan above Salt Creek, away from any seemingly interesting features that might attract a visitor.

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Chapter 4

THE FEATURES

This chapter provides a descriptive summary of the features recorded during the Squaw Butte Area inventory. It also provides some brief statements about feature function and site function/duration of occupation as reflected by the features.

A total of 59 prehistoric and historic features was discovered on 21 sites (26 percent) in the Squaw Butte Area. These features are unevenly distributed among the sites ranging from a low of 1 to a high of 20 on a multicomponent site with three overhangs, 42SA20615. Approximately half of the sites (n=11) have just a single visible feature. Four sites have two features and three sites have three features. The remaining 31 features cluster at 2 Anasazi sites: Seep Shelter (42SA20275; n=7), site 42SA1519 (n=4), and the multicomponent site 42SA20615 (n=20).

On average, the Anasazi sites and components have higher counts of visible features than sites and components of Archaic, Navajo, and unknown cultural affiliation. Feature counts on Anasazi sites and components range from 1 to 7 with an average of 3 (excluding the Anasazi component at site 42SA20615). Three rockshelter sites evincing Anasazi occupation—Seep Shelter and sites 42SA20274 and 42SA20615—have substantial natural deposition and/or cultural fill which probably obscures other, perhaps substantial, features. The remaining Anasazi sites have some potential for additional features, but these would likely be small and insubstantial.

The Archaic sites and components with visible features have 1-3 features for an average of 1.6 (excluding the Archaic components at site 42SA20615). Ethnoarcheological data on hunter-gatherer sites (e.g., Binford 1978, 1983; Gamble 1991; Jones 1993; Kroll and Price 1991) suggest a strong likelihood of additional cultural features such as hearths. The dune setting of many of these sites allows the possibility of buried features without surface indications. Two features were recorded on the sole Navajo site and others may be present.

Nineteen types of features were documented in the project area but more than half are accounted for by just four categories: unlined hearths (n=16), surface rooms (n=6), pictograph panels (n=6), and granaries (n=5). The remainder are represented by one case or just a few examples. Anasazi sites have the widest variety of feature types ranging from unlined hearths, bins, hand and toe holds, and rock art to middens, rock alignments, stone circles, granaries, and surface rooms. Features on known Archaic sites are limited to slab-lined and unlined hearths, ashy, organic-rich, cultural deposits, and rock art. A wooden structure and a woodpile were the only feature types discovered on the Navajo site.

In general, the constructed features reflect minimal to moderate investments of time and hasty construction as though they were intended for only short-term use. Despite the low investment in facilities, accumulative features such as middens and thick, ashy, organic-rich, buried cultural deposits attest that some sites were cumulatively occupied for substantial periods of time.

Feature Descriptions

Unlined Hearths

Sixteen unlined hearths were noted on nine sites in the Squaw Butte Area: one an on Early Archaic site, four on two Terminal Archaic sites, three on an Early Formative site, four on the multicomponent site 42SA20615, and four on four sites of unknown age. There are no obvious differences in the surface appearance of unlined hearths of different ages: all appear as informal circular to oval stains of ashy soil usually associated with charcoal and occasionally accompanied by burned sandstone. However, some of the stains are quite subtle and would be easy to miss or to confuse with natural staining (e.g., Dominguez 1994:33).

On the surface, the hearths range from 30 to 160 cm across with a mean size of 74 by 88 cm. Limited testing of seven of the unlined hearths (see Chapter 6) revealed that surface dimensions are often poor indicators of actual feature size; some of the hearths are up to twice as large as the surface indications; others are barely half the size. The poor correlation between surface size and actual size is because most of the sites lie in unstable dune deposits where shifting sands may differentially bury or expose cultural manifestations. Probing and the limited testing revealed 4 to 27 cm of fill in the hearths. Some of the hearths appear deflated and were likely deeper when in use. These features were probably used for a variety of purposes such as heat, light, cooking, lithic heat treatment, and pest abatement (cf. Guernsey n.d.).

On most sites, the visible hearths occur as isolated features in the open. Exceptions to this are the Early Formative site where three hearths cluster in a 1.5- by 1.6-m area and a Terminal Archaic site where two adjacent hearths lie beneath a shallow overhang. Most of the unlined hearths appear on sites with few or no other visible features.

Subsequent to the inventory, Dominguez (1991) uncovered four additional unlined hearths on one of the sites during a limited testing program. These features are evidently associated with Middle Archaic deposits at a small overhang site, *Soyok' manavi* (Steve Dominguez, personal communication 1993). This discovery supports our belief that features without surface indications are probably present on some sites.

Slab-lined Hearths

Three slab-lined hearths were found on three sites during the inventory, one each on two Terminal Archaic sites and one on an aboriginal site of unknown age. These features appear as a series of upright sandstone slabs, arranged in circular to oval patterns, that enclose light gray to black ashy fill and charcoal. They are generally larger and deeper than the unlined hearths (e.g., 0.50 by 0.50 m, 1.24 by 1.13 m, and 1.40 by 1.40 m). Average depth is 26 cm. Chapter 6 reports on testing of two of these features.

It is believed that slab-lined hearth use emphasized baking and other types of cooking instead of the generation of heat and light. This is because the slab lining would increase the heat holding capacity of the feature by confining the warmth and by absorbing heat which would radiate back into the pit.

Oblong Slab-lined Feature

One oblong, partially slab-lined feature measuring a maximum of 2.30 m long by 1.55 m wide was discovered on an Early Formative site near Squaw Butte. This feature was minimally tested (see Chapter 6) but its function remains unknown.

Smoke Blackening

Smoke blackening was observed on the ceilings of three rockshelter sites: Seep Shelter, site 42SA20615, and a site of unknown age and affiliation. Seep Shelter has localized and pronounced blackening from a fire that burned a granary and one side of a surface room. Smoke blackening on the other two sites is much lighter and more diffuse; though no firepits are evident on the surface of these two sites, this blackening appears to come from repeated campfires used to heat, light, and cook in the overhangs.

Formal Midden

One formal midden was recorded at site 42SA20615. This 14- by 6-m feature caps a long, low dune in front of the largest overhang (A) on the site. Its composition (organic-rich, dark brown-gray sand containing numerous rock slabs, burned and fire-cracked rock, charcoal, chipped stone and groundstone artifacts, and pottery) and positioning adjacent to partially buried Anasazi architecture indicate that it is a formal Anasazi trash dump. Chapter 6 reports on very limited testing of this feature.

Ashy, Organic-rich, and Buried Cultural Strata

All sites with features or artifacts, other than sites with only rock art, technically have cultural deposits but these deposits were only recorded as separate features when they met one of two criteria. The first criterion was when the cultural deposits composed a definite stratum that was visibly stained with ash, charcoal, and decomposed organic debris. Four such cases were observed in overhangs: one at *Soyok' manavi* and three at site 42SA20615. Similar deposits are probably present on two Anasazi architectural sites (Seep Shelter and site 42SA20274) as well as other sites in the project area, but they were not visible on the surface at the time of our inventory.

The cultural deposits at *Soyok' manavi* consist of very dark, organic-rich sand incorporating burned sandstone, large quantities of groundstone, debitage, and chipped stone tools, and some burned bone. They originate in a small, shallow overhang but extend beyond the protective limits of the shelter onto a sandstone platform covering a total area of at least 15 by 15 m. Testing by the Midwest Archeological Center subsequent to our inventory revealed that the deposits are primarily Middle Archaic in age, stratigraphically differentiated, and up to 1.4 m thick (Dominguez 1991; Steve Dominguez, personal communication 1993).

Of the three ashy, organic cultural strata visible on the surface at site 42SA20615, one is partially covered with indurated alluvium in the smallest overhang (B). (See Chapter 6, site 42SA20615, Feature 1, for results of limited testing of this feature.) The second is a 19-cm-thick unit of ashy sand with artifacts and burned sandstone exposed for a distance of 80 cm around the base of a masonry wall in the largest overhang (A). The third consists of dark, organic-rich, artifact-laden sediments eroding out of a sloping ridge in front of the medium-sized overhang (C) on the site. (See Chapter 6, site 42SA20615, Feature 2, for testing results on a hearth in this stratum.)

The second criterion for recording cultural deposits as a separate feature consisted of buried cultural strata fortuitously exposed on the surface regardless of whether they contained visible ash, charcoal, and decomposed organic debris. The cultural status of these buried strata was minimally defined by the presence of artifacts and/or a feature eroding out of a profile or cutbank. One buried stratum fitting this definition was observed at site 42SA20615. More detail on this feature can be found in Chapter 6 under site 42SA20615, Feature 14. Similar buried strata probably exist at a variety of the small overhang and dune sites but were not exposed on the surface.

Burial

A looted and disinterred human burial was scattered in the largest overhang (A) at site 42SA20615. Five vertebrae, four ribs, a fragmentary scapula, and several arm, leg, finger, and toe bones were observed. The pelvis and cranium were conspicuously lacking. Informants who called this site to the crew's attention enthusiastically described the human skeletal remains and they seem to be well-known among locals. Based on these conversations, it appears likely that some of the missing elements were removed by pothunters as "souvenirs."

Hand and Toe Holds

Two possible hand and toe holds were noted on an Anasazi site, 42SA20270. The best access into this site is by descending a steep (70°) slickrock slope from the open mesa top above. The possible hand and toe holds occur on this steep slope along with several natural depressions; together, they would have made traversing the steep face a little easier. The holds are about 9 cm wide and 4 cm deep, with flat to sloped bottoms.

Storage Bin

A single storage bin was located in a well-protected overhang on a small Anasazi site, 42SA20270. The bin is formed by a curved wall that encloses a circular area against the back of the overhang and an adjacent boulder of roof spall. The wall is built of wet-laid pieces of tabular and blocky, undressed, local sandstone and limestone set in a semicoursed manner, a single stone wide.

The wall ranges from one to four courses high and is a maximum of 25 cm high and 15 cm thick. Helping seal the feature, the gap between the overhang wall and the roof spall boulder is plastered to a height of 65 cm above the modern ground surface. Also, the constructed wall extends beneath the inner edge of the roof spall boulder, totally enclosing the structure on that side. Although some rubble surrounds the feature, there is no evidence that it was roofed or ever more than four courses high. The interior of the feature appears to have been leveled but is unplastered. It is a maximum of 1.35 m in diameter and has a floor area of approximately 1.4 m^2.

This feature has several characteristics typical of a granary but does not appear to have ever been roofed or completely enclosed; evidently it was accessed from the top and functioned as a bin to store foodstuffs. Today, the overhang is damp due to the presence of a seep. If this seep was present in prehistoric times, any food would have been best stored in closed ceramic containers.

Granaries

Five granaries were discovered on three Anasazi sites: three on site 42SA1519 and one each on site 42SA20271 and Seep Shelter. All five granaries are positioned on bedrock or bedrock and boulder foundations beneath natural overhangs. Each consists of a semicircular masonry wall outlining a D-shaped enclosure against the back of an overhang with the overhang forming the roof (Figure 26). The granaries range from 1.7 to 2.5 m wide and 0.9 to 1.4 m deep; floor areas vary between 1.3 and 1.9 m^2. The granaries are constructed of mostly unshaped, tabular and blocky or flagged pieces of local sandstone. One granary also incorporates undressed pieces of tabular chert and ...stone that were evidently procured from an ...e outcrop.

The granaries at site 42SA1519 are wet-laid, semi- to fully coursed, and a single stone wide. One is sufficiently well preserved to determine that it was plastered on both the interior and exterior. The other two have uncoursed, simple flagged walls which are smooth on the interior and irregular on the exterior. Both exhibit liberal use of leveler spalls to even out the sloppy construction.

The granary at site 42SA20271 is dry-laid/mudded; the interior and doorway are completely mortared but mortar is patchy on the exterior. The granary at Seep Shelter is wet-laid or dry-laid/mudded. Mortar composition and texture vary among the granaries, but all mortar is made of locally available materials. Inclusions of limestone, chert, sandstone, and sticks are common.

Three of the granaries exhibit partially or completely intact rectangular entries but all five of the granaries likely had such openings when they were in use. The entries sufficiently preserved to measure are approximately 50-60 cm high by 37-40 cm wide. Three of the granaries have intact sills composed of unshaped pieces of sandstone. Two are raised. One granary has imprints of two wooden lintels, 3 cm in diameter, which evidently supported overlying sandstone masonry. Another granary lacks a lintel because the entry extends to the overhang forming its roof. Adobe collars are present on two of the doors. These ensured a tight seal and enhanced the safety of items stored in the granary. No hatch covers or closure mechanisms were evident at any of the sites although they were probably present at one time. Interior features are also absent. The granaries were probably used to store foodstuffs; one retained a burned, 12-row corncob at the time of the inventory.

The three granaries at site 42SA1519 are positioned on a narrow ledge about 1.5 m above the bench where other site manifestations (a stone circle and artifacts) are located. They are scattered along the ledge and do not share common walls. Two of the granaries are separated by 2 m; the other is 11 m away. These granaries are visible at some distance from the site but are in a location well protected from solar radiation and heating.

Figure 26. Close-up of a granary at site 42SA1519.

The granary at site 42SA20271 lies under a hoodoo on a ledge high in the cliffs above a side canyon to Squaw Canyon Wash. Access to the site is extremely difficult. There is evidence of limited lithic procurement (from an on-site lens of Cedar Mesa Chert) and subsequent reduction, but no indication of frequent use for purposes other than storage. The ledge is visible from a great distance but, because of its secluded location behind and under the hoodoo, the granary is both hidden from view and well protected from the elements.

The granary at Seep Shelter is one of many architectural features on this Anasazi habitation site. It is located in a common area outside of any room but shares a wall with an adjacent surface room. The feature is located north of the rooms, at the back of the overhang, an ideal location in terms of avoiding solar radiation and heating (Gilman 1983:150).

Upright Slabs

Upright slabs were noted on two overhang sites with evidence of Anasazi occupation. At Seep Shelter, an upright slab is positioned on a sandstone platform against the back of the overhang. Surrounding rubble suggests that it may have been part of a cist. The other upright slab protrudes above the sediments in the large overhang (A) at site 42SA20615. Its large size (48 cm long by 9 cm wide) suggests that it may be a remnant of buried architecture.

Rubble/Rock Concentration

One rock concentration was observed at site 42SA20615. It consists of five unshaped sandstone slabs and several smaller pieces of tabular sandstone in a concentration measuring approximately 50 cm in diameter. Associated charcoal and ash are lacking. Due to its partially buried condition, the function of this feature could not be ascertained.

Rock Alignment

One rock alignment was noted in the large overhang (A) at site 42SA20615. It consists of a disordered, arc-shaped alignment of generally large, undressed sandstone slabs, blocks, and angular fragments. Courses cannot be discerned, if they were ever present. The alignment is 5 m long and ranges from 1.0 to 1.5 m wide. The positioning of this alignment adjacent to a masonry wall and parallel to, but 2-4 m away from, the back of the overhang suggests that it may have been used to enclose an open work area or room.

Wall

Abutting the end of the rock alignment at site 42SA20615 (above) is a horizontal masonry and upright slab wall that appears to partially enclose a work/use area adjacent to the back of the overhang. The feature is composed of stacked pieces of unshaped tabular, blocky, and angular sandstone. Two courses are visible above the sediments forming the shelter floor. Mortar use is uncertain. The wall encloses an area measuring approximately 2.0 by 1.3 m.

Stone Circle

One stone circle, 4 m in diameter, was discovered on the Anasazi site with three granaries, 42SA1519. This feature is composed of a ring of unshaped sandstone and limestone rock eroding out of the shallow (approximately 20 cm deep), eolian sands. Some of the stones are upright, but the majority are horizontal. Only one course of stone is visible on the surface but a few additional courses could be buried. There is no evidence that the circle had more courses than at present, although a perishable superstructure could have once been present. Mortar is lacking but given the feature's exposed location, any mortar that might have been present was probably washed away by natural erosion.

This feature is located on a bench, approximately 25 m west of the granaries, but it is not entirely isolated from other cultural remains on the site. Two bifaces, two sherds, and a small amount of chipping debris lie on the surface in the vicinity of this feature.

Similar features have been reported in a variety of locales throughout the northern Anasazi area (and beyond) (e.g., Chandler et al. 1980; Fetterman and Honeycutt 1987; Haase 1983; Honeycutt and Fetterman 1988; Schroedl 1981). The most common interpretations are as rooms and ceremonial/communication loci, but it has also been suggested that they could represent solstice observations points, defensive strongholds, or lookouts (see Honeycutt and Fetterman 1988:37). The likely function of the stone circle on site 42SA1519 is that of a room given its topographic positioning and association with other architectural features.

Masonry Surface Rooms

A total of six masonry surface rooms was located on three sites. These sites are all under overhangs displaying evidence of Anasazi occupation.

Partially Enclosed Surface Room

One partially enclosed surface room was found under a hoodoo on an Anasazi site, 42SA20264. It consists of two parallel masonry "walls" abutted to the back of a shallow overhang forming a rectangular, partially enclosed space measuring approximately 3 by 3 m. The enclosing "walls" are crudely constructed. One consists of an uncoursed jumble of dry-laid sandstone slabs, blocks, and boulders, all of which are unshaped. The other consists of protruding bedrock augmented with boulders to create an uncoursed, dry-laid "wall." Both "walls" are footed on sandstone bedrock, have masonry foundations, and are a single stone wide. The interior of the structure was deliberately modified to create a level work space. A formal entry was unnecessary because the structure is open to the front of the overhang. This structure probably functioned much like a room and was likely the location of domestic activities such as eating, sleeping, and working.

Fully Enclosed Surface Rooms

This category includes rooms that are enclosed on all sides or which appear to have been enclosed on all sides prehistorically. A total of five such rooms was recorded on two Anasazi sites: four at Seep Shelter and one at a nearby site, 42SA20274. All of these rooms are located in overhangs and on bedrock footings and are rectangular with masonry foundations. Tabular sandstone is the primary building component but most structure walls incorporate flagged sandstone and a few have sandstone blocks. With one exception, the walls of the structures are dry-laid, uncoursed to semicoursed, and a single stone wide (simple wall construction cf. Rohn 1971). They are

equally divided between flagged, biflagged, and a jumble of rocks with little order. Leveler spalls are occasionally used to fill gaps and shore up uneven stones.

The single exception is at Seep Shelter. The wall of this structure is compound with a rubble and spall core. It has semicoursed masonry that was apparently dry-laid, then mudded with a coarse-grained red mortar incorporating bits of sandstone and sticks. This structure exhibits better construction techniques (e.g., crossed joints, tied faces) and more attention to inward and outward appearance (more uniform building stones) than other structures in the project area, but would still be considered crude by most scales of comparison.

No evidence of plaster or decorative chinking was noted on any of the structures. Associated features such as bins, cists, shelves, pegs, loopholes, vents, hearths, and the like were not observed but most rooms contain sufficient sterile and cultural fill (estimated up to 25 cm) to obscure any floor features.

Room size is highly variable ranging from 6.5 to 18.0 m^2 with an average of 11.8 m^2 among the rooms complete enough to accurately measure. The shortest dimension of these rooms is 3 m, the longest, 9 m. Maximum wall height is 0.5 m, though the average is closer to 0.3 m. Available rubble suggests that the structure walls were never more than a few courses high. Most of the structures probably consisted of low enclosing walls and were unroofed except for the alcove ceiling.

All of the rooms abut a natural and/or constructed feature. Three of the rooms at Seep Shelter abut the back of the overhang and one wall of one room also abuts a granary. These three rooms form a roomblock sharing the walls which divide the block into separate rooms. Gaps in the walls hint that each room had an exterior entry. The fourth room at Seep Shelter lies near the front of the shelter and is free standing other than an abutment to the corner of the roomblock. The structure at site 42SA20274 also uses the back of an overhang as one of its walls.

Other than the dry-laid/mudded room at Seep Shelter, the rooms probably functioned as residential structures or work areas where people conducted a variety of domestic activities such as eating, sleeping, working, and storing personal belongings. The large variation in room size suggests that there were perhaps functional differences but these cannot be addressed on the basis of available data.

The more solid construction and apparent small size of the dry-laid/mudded structure at Seep Shelter suggest it may have been used for storage. The room is in poor condition and could not be precisely measured, but appears to have encompassed less than 2 m^2, with estimated dimensions of 1.2 and 1.3 m. Its position at the front of the overhang is not ideal for storage in terms of protection from solar radiation and heating (cf. Gilman 1983:150), but it may have been adequate for temporary storage.

Wood Structure

The eroded remains of what appear to be an unfinished cribbed hogan (cf. Jett and Spencer 1981) were noted on site 42SA1661 (see also Sharrock 1966). This feature is characterized by highly eroded, barkless juniper logs and debris arranged in a multisided, approximately circular configuration, approximately 3 m in diameter. Some of the log ends are crossed in a typical cribbed pattern. Average log diameter is 15-20 cm, with the longest measuring approximately 2.5 m. The logs are too weathered to definitely determine how they were cut, but they may have been sawn.

At the time of discovery, only a single layer of logs was noted. It is uncertain if the paucity of logs is because the structure was never finished, partially dismantled and moved, robbed for wood, or some combination of these. The lack of closing material and debris that usually form a ring around dismantled hogans was noticeably absent implying that the feature was never finished. Also, there was no evidence of an eastern entryway.

The National Park Service has fenced the site to protect it, but park visitors have stolen wood from the feature to build campfires in the nearby campground (Nancy J. Coulam, personal communication 1994). When we recorded the feature in 1988, it appeared much the same as described by Sharrock (1966) in 1966, suggesting that wood scavenging by park visitors is a recent phenomenon.

Woodpile Area

A woodpile area is located 10 m northeast of the wood foundation on the Navajo site, 42SA1661. It is marked by a dispersed concentration of highly weathered juniper branches, sticks, and chips covering a 3- by 5-m area. The branches and sticks are too weathered to determine how they were cut.

Rock Art Panels

One petroglyph and six pictograph panels were documented in the project area. Five of the pictograph panels occur in the large overhang (A) at site 42SA20615. The sixth is on a small Anasazi structural site, 42SA20274. The petroglyph panel composes site 42SA20268.

Rock art at the three sites appears to represent four named types: Barrier Canyon Anthropomorphic Style (Schaafsma 1971), Great Basin Curvilinear, Great Basin Representational, and Pit-and-Groove (Heizer and Baumhoff 1984). In addition, the hands motif and other elements of the so-called "Canyonlands Anasazi" Style (Noxon and Marcus 1985) were noted. All of the panels were executed on unprepared sandstone faces.

Site 42SA20268

The petroglyph panel at site 42SA20268 is located on a steeply sloping Cedar Mesa sandstone face in a well-protected overhang along the bottom of a short, deep box canyon. The overhang was formed when the drainage undercut the cliff causing a large sandstone block to tumble from the cliff wall. The block forms the platform from which the petroglyphs were executed and may figure into site interpretation as discussed below. The rock art panel is a maximum of 5.0 m long by 1.5 m high and is situated approximately 7.0 m above the canyon floor. No other sites or cultural debris were found anywhere near this feature.

The panel consists of approximately 16 dispersed, slightly repatinated petroglyphs representing anthropomorphs, zoomorphs, and geometric designs. The figures range from 4 to 35 cm across. The panel displays no apparent compositional organization but equal repatination (in light of what appears to be equal sun exposure) suggests they are all contemporaneous.

From east to west, the following are represented: an open circle containing a smaller solid circle, a counter-clockwise spiral, two small cupules or pits, a possible snake (Figure 27a) below which is another cupule, two dumbbells (horizontal lines with solid circles pecked in the middle and on each end; see Figure 27b), and a geometric form resembling the cross section of a commuter coffee mug with an expanding base (see Figure 27c). This figure has a rectangle extending above an expanding base and is decorated with geometric forms. Below this image is a circle sectioned into four triangles, two of which are solid and two of which are open but contain a faint, open circle (see Figure 27d). Continuing west are a rectangle, a solidly pecked phallic anthropomorph with a rectangular body and splayed hands and feet (see Figure 27e), two cupules, and an abstract design (see Figure 27f).

Of the known and named rock art styles previously identified in the area (Cole 1990; Noxon and Marcus 1982, 1985; Schaafsma 1971, 1980, 1986), the figures on this panel appear to most closely correspond with those of the Great Basin Curvilinear, Great Basin Representational, and the Pit-and-Groove styles (Baumhoff et al. 1958; Heizer and Baumhoff 1984; Steward 1929). Great Basin Curvilinear is typified by pecked circles, concentric circles, sectioned circles, snakes, curvilinear meanders, and other elements (Heizer and Baumhoff 1984:Table 3; Schaafsma 1971:Table 6). Spirals, rectilinear meanders, and dumbbells also occur in moderate frequency (Heizer and Baumhoff 1984:Figures 40k, 58a, 60t, 63i, 86b, Plate 15; Schaafsma 1971:Table 6).

The Great Basin Representational Style includes pecked quadrupeds, hands, feet, and anthropomorphs that are frequently horned, and which sometimes have splayed and/or oversized hands and feet (Heizer and Baumhoff 1984:Table 3, Figures 84i, 86a, 98k, 101a, 103b, 119g; Schaafsma 1971:90). The Pit-and-Groove Style consists mainly of pits ranging from 2 to 30 cm in diameter; grooves are occasionally present. One characteristic common to the three styles is that figures on the same panel lack a noticeable compositional organization.

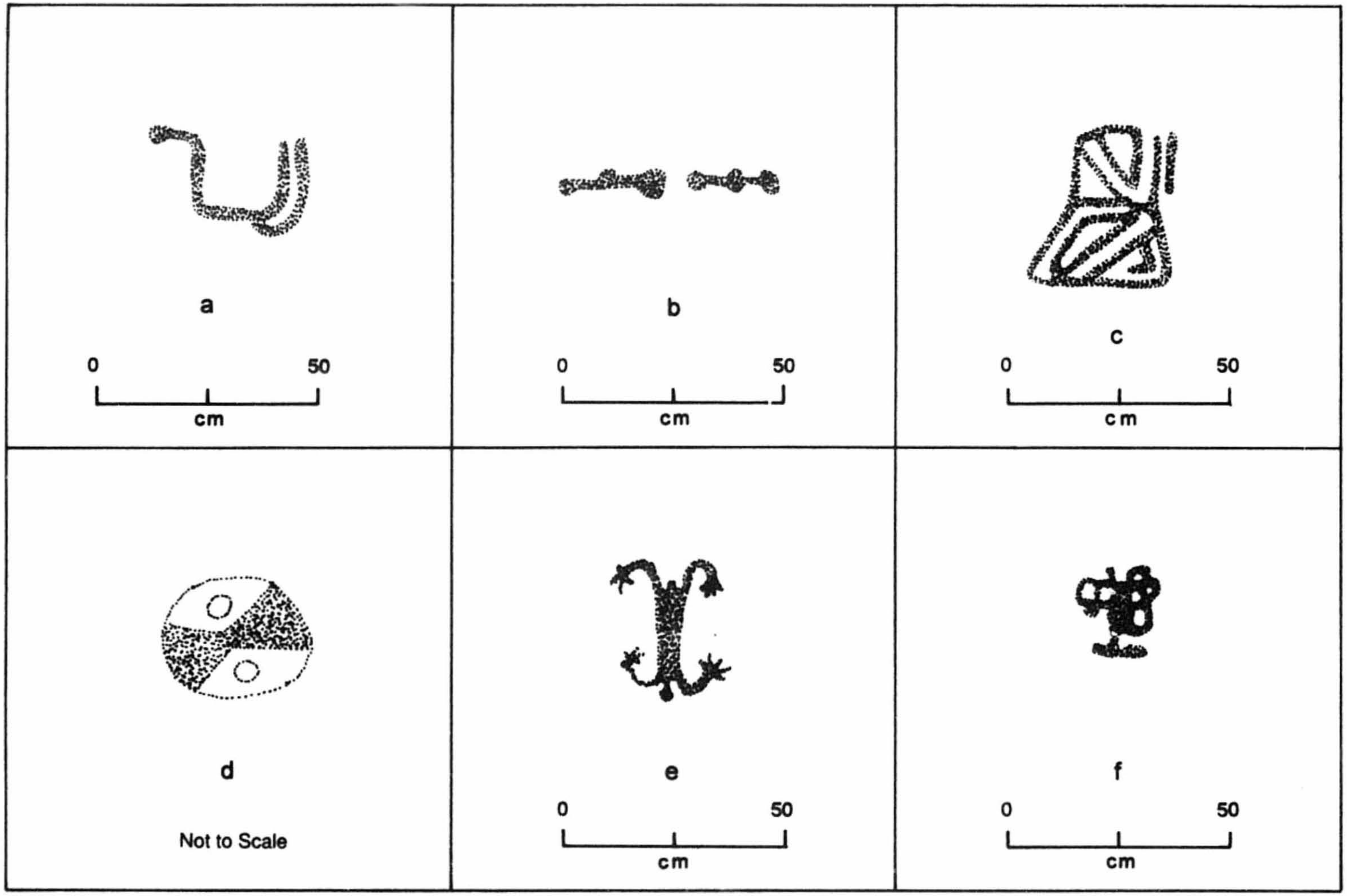

Figure 27. Selected petroglyphs at site 42SA20268.

As implied by Heizer and Baumhoff (1984: 201) and recognized by Schaafsma (1986:216-217), the curvilinear and representational traditions are not styles in the sense of having specific formal elements with delimited cultural, spatial, and temporal associations. Representational figures often co-occur with curvilinear figures and may also be elements of other formally defined styles. Perhaps this is why Cole (1990:42-58) uses the term Abstract Rock Art Tradition to refer to all such images on the northern Colorado Plateau. In any event, the co-occurrence of curvilinear and representational elements on a single panel does not represent anything unusual.

However, their co-occurrence with the Pit-and-Groove Style is problematic if all elements are contemporaneous and published dates for the three styles are accepted because the Representational and Pit-and-Groove types do not overlap in time. The Representational Style is tentatively dated between A.D. 1 and 1500 (Heizer and Baumhoff 1984:Table 9); the single cation-ratio date available for this style lies neatly within this time range (Whitley and Dorn 1987:162). Dates of 5500-500 B.C. have been suggested for the Pit-and-Groove Style (Schaafsma 1986:216). Because the figures so clearly appear to be contemporaneous, the published dates must either be inaccurate or do not apply to the area. Based on several cation-ratio studies, Dorn (1994:30) believes that the time ranges noted above are inaccurate and require revision.

Abstract rock art similar to that at site 42SA20268 is found throughout the western United States so its presence in the Squaw Butte Area holds no special significance. Although not common, curvilinear and rectilinear images have previously been recorded in Indian Creek (Castleton 1979), the Needles (Noxon and Marcus 1985:218-222), and the Maze (Hogan et al. 1975:21; Noxon and Marcus 1985:68), all of which are near the Squaw Butte Area.

Heizer and Baumhoff (1959, 1984) believe that Great Basin Curvilinear and Representational petroglyph styles were associated with hunting ritual and used to mark good locations to ambush or corral game. The setting of site 42SA20268 would be well suited to both hunting strategies. The site is located in a short box canyon, the head of which had a small seep and lush vegetation at the time of our inventory. During the wet season, standing water would have also been available in potholes near the canyon head. Game may have wandered up the canyon in search of forage and water or been deliberately driven by hunters into this natural corral. The top of the large sandstone block beneath the petroglyphs provides a perfect ambush spot where hunters could have hidden and then dispatched the unsuspecting animals as they passed by.

Site 42SA20274

The pictograph panel at site 42SA20274 lies on a soft, eroding, vertical face of Cedar Mesa Sandstone under a shallow overhang approximately 4 m above the shelter floor. It consists of nine painted white dots, 3 cm in diameter, positioned in a horizontal row 70 cm long.

Six dots are evenly spaced on the right; after a wide gap, three more are found. Dots of this sort do not appear to typify any style previously reported in the area (Cole 1990; Noxon and Marcus 1985; Schaafsma 1971, 1980) but are probably Anasazi due to their presence on an Anasazi site.

Site 42SA20615

The five pictograph panels at site 42SA20615 all occur on Cedar Mesa Formation sandstone in the largest overhang (A). Panels 1, 2, and 5 are on the vertical back wall of the shelter. Panel 3 is positioned on the ceiling. Panel 4 lies on both the overhang wall and roof. Some of the figures are quite faded making details difficult to discern with any accuracy. There are also amorphous remnants of paint that sometimes appear to mark the presence of additional pictographs; thus, it is likely that more images were originally present than those recorded and described below.

A small variety of figures from at least two general time periods make up the site 42SA20615 pictograph assemblage. The earliest figures represent the Barrier Canyon Anthropomorphic Style typified by large static anthropomorphs with tapering bodies often flanked by zoomorphs, zigzags, and other objects (Schaafsma 1971, 1986, 1988, 1990). The most recent paintings are dots, hands, and a mountain sheep, all of which are considered Anasazi following Cole (1990) and Noxon and Marcus (1985).

Munsell colors for all panels are as follows. The Barrier Canyon anthropomorphs, zoomorphs, and zigzags are dusky red (10R3/3); where they have been exposed to intense sun, they are closer to red (10R3/6). The "orange" horned Barrier Canyon anthropomorphs are reddish yellow (7.5YR6/8). The hands appear in red (10R4/6) and white (5YR8/1). The mountain sheep is also white (5YR8/1).

Panel 1

Panel 1 begins 1.3 m above the floor of the shelter and covers an area measuring 2.18 m^2 (3.20 m long by 0.68 m high). It consists of a large red Barrier Canyon anthropomorph, 11 negative white handprints, and 9 stamped stylized hands in red paint. Four other red stamped handprints may also be present. In addition, some eroded, parallel, squiggly lines on the edge of the panel could be part of a petroglyph. The anthropomorph occurs near the left side of the panel. The handprints are randomly positioned on and to the right of the humanlike figure (Figure 28).

The anthropomorph has a large, tapering body lacking appendages and a rectangular tapering head. Except for a 9- by 17-cm unpainted rectangle in the center of the chest, the figure is solidly painted and completely unadorned. It measures 61 cm high and a maximum of 31 cm wide.

The negative white handprints were made by blowing or spraying pigment around a splayed right hand (or sometimes just the fingers) placed on the overhang wall. The fingers on one hand were either bent under in a half grasp when the pigment was sprayed or the individual had short, clubbed digits. The sprayed hands measure approximately 11 by 15 cm.

The red handprints were made by painting designs on one's hand and then stamping it on the wall. These hands are approximately 7 by 15 cm across.

In an attempt to demonstrate a post-A.D. 1300 origin for Barrier Canyon rock art, Manning (1990:61-62) recently dismissed most cases of Anasazi images superimposing Barrier Canyon rock art. This panel is significant because it has an Anasazi negative white handprint clearly superimposed over a Barrier Canyon anthropomorph, unequivocally demonstrating a pre-Anasazi origin for the Barrier Canyon anthropomorph.

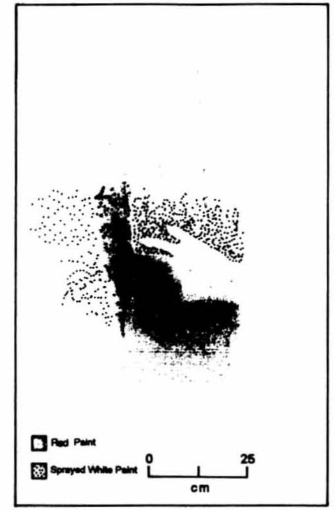

Figure 28. Selected pictographs in Panel 1 at site 42SA20615 showing Anasazi sprayed hand superimposed over a Barrier Canyon anthropomorph.

Panel 2

Panel 2 covers 1.28 m^2 (1.70 m long by 0.75 m wide) and begins 1.2 m above the modern shelter floor. It is composed of seven negative handprints sprayed in white paint, five stylized hands stamped in red paint, and some possible white paint that may represent other stamped or sprayed hands. Five white hands are grouped on the left side of the panel. The red hands are grouped on the right and two white hands are positioned on the lower right. Like Panel 1, the white figures are sprayed outlines of splayed right hands or fingers. They measure an average of 11 by 40 cm. Most of the hands have long, slender fingers but two have short, stubby fingers and one hand appears to be missing all but the lower joint of the little finger. Four of the red hands are depicted with the fingers together and one has the fingers spread apart. One right and one left hand are discernible. The stylized stamped hands cover an average area of 11 by 19 cm each.

Panel 3

Panel 3 consists of a painted and scratched bird on the ceiling of the shelter, 2.8 m above the present ground surface. Executed in white paint, it has five tail feathers and a long, extended bill or beak suggesting it may be a duck. The bird appears to be depicted in flight (Figure 29). It measures 32 cm long by 15 cm high.

Although it cannot be demonstrated with the data at hand, the zoomorph is believed to represent the Barrier Canyon Anthropomorphic Style. Birds commonly flutter around the heads of Barrier Canyon anthropomorphs and the anatomy and style of the bird resembles those on other Barrier Canyon panels (e.g., Schaafsma 1971:Figure 77). In addition, scratched embellishments are common in the Barrier Canyon images.

Panel 4

Panel 4 covers 3.87 m^2 (2.53 by 1.53 m). The lowest figure begins 1.1 m above the modern ground surface. This panel has negative impressions of 20 splayed hands, sprayed in white paint. One of the sprayed hands includes the wrist. The largest is 16 by 23 cm, the smallest 11 by 15 cm. There are also four stamped stylized hands in white paint. Depicted among these are a definite right and definite left hand with the thumb extended. The largest of the stylized stamped hands measures 11 by 16 cm and the smallest 7 by 13 cm. Finally, there are 11 white painted dots that measure 4 and 5 cm in diameter. Some of the dots are superimposed over the sprayed negative hands, but all of these elements are considered Anasazi.

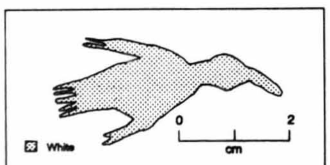

Figure 29. Panel 3 at site 42SA20615 showing probable Barrier Canyon bird in flight.

Most of the sprayed negative hands cluster in a wide band at the bottom of the panel; a few are higher in the panel and five extend onto the ceiling. The stylized stamped hands occur towards the top of the panel, below the ceiling. Figure 30 shows the two styles of hands.

Panel 5

Panel 5 is the largest, most complex, and most interesting pictograph panel at the site. It measures 9.70 m long by 1.49 m high (14.5 m^2). The bottom of the lowest figure in the panel is positioned 0.6 m above the modern ground surface. This panel contains 69 identifiable elements plus a variety of faded paint remnants that may indicate additional figures. In addition, a band of white paint was applied to the shelter roof above the panel for a distance of approximately 1 m. Patches of orange paint overlie the white but do not define any recognizable elements. Orange paint, apparently the consistency of wet clay, was also crammed into a crack between the back and ceiling of the overhang.

As recorded, Panel 5 contains 22 hands, 11 dots, 1 mountain sheep, 8 zigzags, 3 quadrupeds, 19 definite anthropomorphs, and 5 probable anthropomorphs. Approximately 80 percent of the Barrier Canyon figures and a third of the Anasazi elements are clustered on the right side of the panel which is shown in Figure 31. Here, the Barrier Canyon images are arranged in typical Barrier Canyon style format (Schaafsma 1980:61), that is, rows of large, immobile anthropomorphs flanked by quadrupeds and zigzags. The Anasazi hands and mountain sheep are superimposed on and around the Barrier Canyon figures. One dot is placed above the head of an anthropomorph.

The left side of the panel (not illustrated) has small groups and isolated occurrences of Barrier Canyon anthropomorphs, clusters of handprints, and a crescentic arrangement of dots. More specifically, left of the figures shown in Figure 31 are a row of 3 Barrier Canyon anthropomorphs, some hands, and, high on the overhang, 10 dots. Five of the dots are positioned in a horizontal row. The other five dip down in an arc so that the entire dot pattern outlines a half circle that is 1.15 m long and 0.33 m high. Farther left are a cluster of negative white hands, a line of five

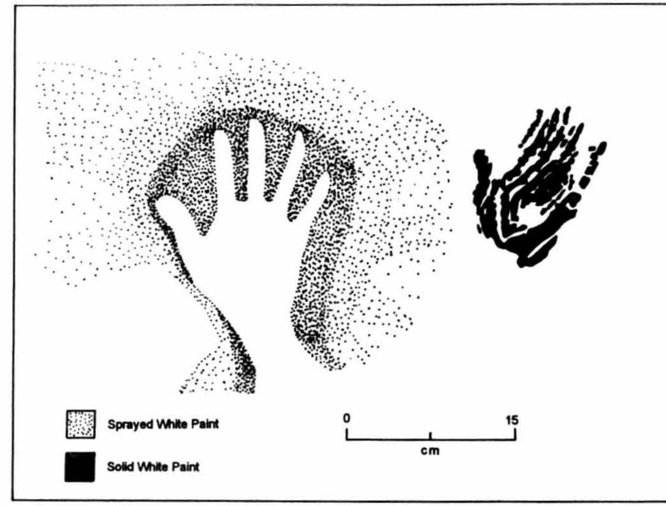

Figure 30. Close-up of sprayed and stamped handprint styles in Panel 4 at site 42SA20615.

Barrier Canyon anthropomorphs (two red and three orange; Figure 32), and, high on the shelter wall, an isolated Barrier Canyon figure. At the far left end of the panel is another isolated Barrier Canyon anthropomorph near some positive red and negative white hands.

Like Panel 1, this panel is significant because it has clear, unequivocal evidence of Anasazi images postdating Barrier Canyon images. Superpositioning includes an Anasazi negative white hand superimposed over the squiggly lines descending from the shoulder of a Barrier Canyon anthropomorph and an Anasazi mountain sheep superimposed over the torso of another Barrier Canyon figure (see Figure 31).

Anasazi Hands and Dots

The group of 22 hands includes 18 negative splayed right hands sprayed in white paint and 4 stylized hands stamped in red paint. Some of the white hands are represented only by fingers; others include the palms and one has a wrist. The actual hand outlines range from 9 to 14 cm wide and 11 to 17 cm long; the outlines of sprayed areas are, of course, larger. The dots are painted in orange and 4-5 cm in diameter.

Anasazi Mountain Sheep

The mountain sheep is executed in white. Four legs, a pair of curved horns, and possible tail are visible on the bulging body (see Figure 31). The figure is a maximum of about 30 cm long.

Barrier Canyon Anthropomorphs

Twenty-one of the 24 Barrier Canyon anthropomorphs are executed in dark red paint or dark red paint with white highlights. They have life-size tapering bodies with rounded shoulders and featureless faces. The appendages are diminutive, consisting only of squiggly lines extending from one shoulder. These 21 red figures can be divided into three groups. The first and largest group (n=11) consists of solid red figures. Among those

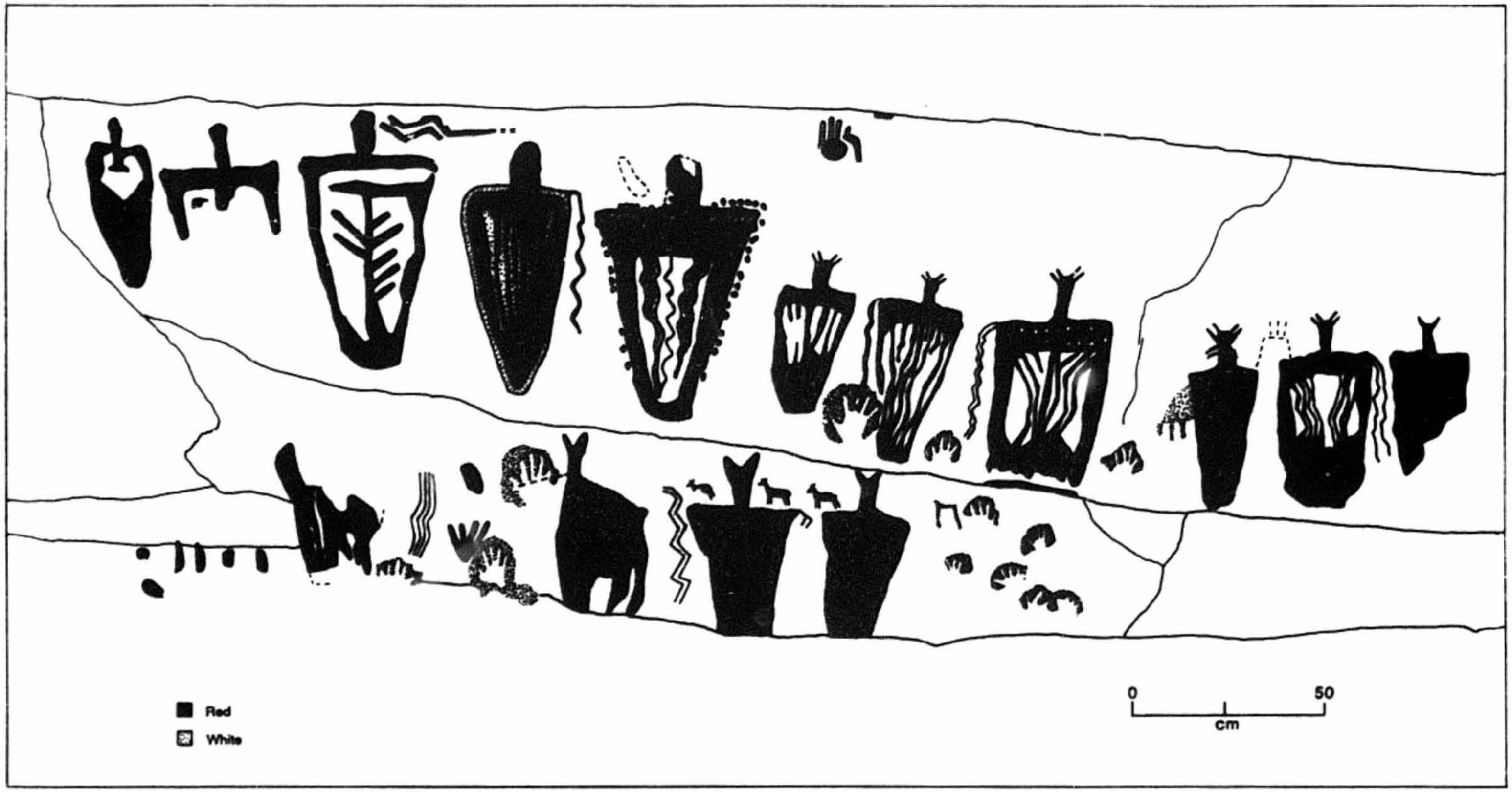

Figure 31. Right side of Panel 5 at site 42SA20615 showing Barrier Canyon anthropomorphs, zoomorphs, and zigzags, sprayed Anasazi handprints, and an Anasazi mountain sheep.

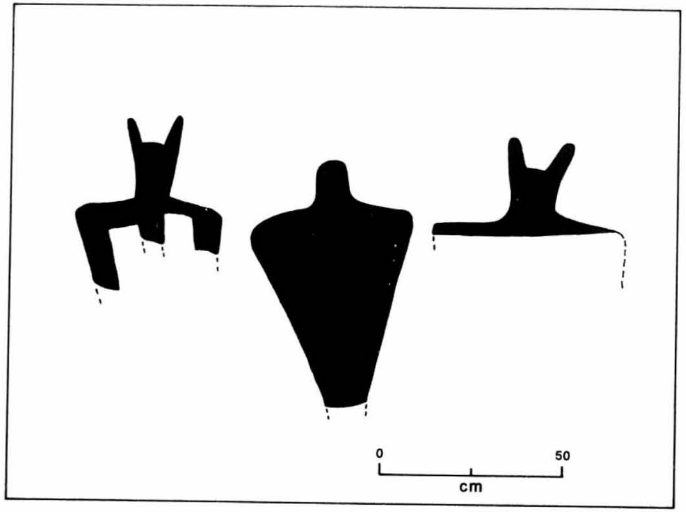

Figure 32. Selected pictographs in Panel 5 at site 42SA20615 showing three Barrier Canyon anthropomorphs, two with horns executed in orange and one without horns executed in red.

with well-preserved heads, four have horns on either side of a subrectangular or somewhat triangular head, one has two horns on each side of its head, and two others have plain, unembellished heads (see Figure 31). The single horns on three figures are wider at the base than the top, are slightly rounded at their apex, and project upwards at a steep angle somewhat like rabbit ears. Horns on the other figure are shorter and more like narrow, parallel-sided lines which project slightly sideways. One of the figures has two short squiggly lines extending from one shoulder. These solid red figures range from 49 to 61 cm high and 28 to 40 cm wide at the shoulders.

The second group consists of eight figures executed in dark red paint that have open areas inside their torsos. The interiors are decorated with red squiggly lines or a heavy red vertical central stripe (a spine?) accompanied by red ribs or squiggly lines (see Figure 31). Some of the figures have double horns on either side of their tapering heads. These horns are the short, parallel-sided variety noted above. Three figures have squiggly lines extending down from one shoulder. These anthropomorphs range from 55 to 71 cm high and 21 to 39 cm wide at the shoulders.

The third group consists of two large bichrome figures that are outlined with a wide red line and embellished with white (see Figure 31). One figure is outlined with white dots. Its interior is decorated with more white dots and wavy red lines outlined in white. This figure has a blotchy line of red pigment above one shoulder but it does not form a recognizable element. The other figure is outlined with thin white lines and has vertical red and white lines decorating its interior. These anthropomorphs have plain, subrectangular heads.

One is 81 cm high by 44 cm wide. The other is 72 cm high by 30 cm wide.

The three nonred Barrier Canyon anthropomorphs are somewhat unusual because they are executed in a thick orange mud paint, most of which has exfoliated off the shelter wall leaving only faint traces of the images. The two most visible figures appear to have solidly colored, tapering bodies that are approximately the same width as the red figures (33 cm), but much shorter (51 cm). It is not certain whether the lower torsos have weathered beyond recognition or were never depicted. Judging from the similar head and horns, the third figure was comparable size and shape. The three figures have one horn on either side of their heads but are otherwise featureless. The horns are parallel-sided lines that project upward at a steep angle above the heads (see Figure 32).

Barrier Canyon Zoomorphs

The three quadrupeds are solid red and executed in side view, facing south. Each animal has four legs and two pointed ears that make them look like coyotes. They are small, an average of 8 cm high and 11 cm long. One figure is positioned above each shoulder of a Barrier Canyon anthropomorph. Other is positioned above the shoulder of the adjacent anthropomorph (see Figure 31).

Barrier Canyon Zigzags

The eight zigzags are red and occur in two parallel pairs and one group of four. One pair has sharp zigzags and is positioned horizontally above the shoulders of two Barrier Canyon anthropomorphs. Another pair is positioned vertically between two of the humanlike forms. The group of four is positioned vertically between what appears to be remnants of two Barrier Canyon anthropomorphs (see Figure 31).

Summary and Discussion

A total of 57 prehistoric and 2 historic features was discovered in the Squaw Butte Area. These features establish that at least three different cultural groups utilized the project area: Archaic, Anasazi, and Navajo. None clearly represent other protohistoric or historic peoples or the Fremont. Archaic occupation is revealed by several panels of Barrier Canyon Anthropomorphic Style rock art at site 42SA20615. A variety of different features evince Anasazi occupation: middens with Anasazi pottery, some of the architecture, and the hands motif rock art (cf. Cole 1990; Noxon and Marcus 1985). Navajo occupation is disclosed by an unfinished hogan and, by spatial association on the same site, a woodpile area.

In general, features are sparse, occurring on only 21 sites, usually in small numbers. With the exception of three Anasazi overhang sites (Seep Shelter and sites 42SA1519 and 42SA20615), visible features are limited to no more than three. The frequency, type, and level of investment in features on the Squaw Butte Area sites suggest that the project area was normally occupied on a low-intensity, short-duration basis by all three cultural groups.

Archaic Feature Summary

Features attributable to the Archaic sites are limited to those that filled basic needs of supplying warmth, light, and energy for cooking (hearths and slab-lined hearths), and those that filled a spiritual, ritual, or communicative need (rock art). No evidence of constructed shelters was found, although some of the sites do provide natural shelter.

The feature data are insufficient to definitively identify the intensity and length of occupation during the Archaic period. There is also the substantial problem that many of the Archaic sites have a large potential for numerous buried features. For example, surface indications at Shadow Shelter (site 42SA8477), a small aceramic overhang recently excavated near the Squaw Butte Area, were limited to some debitage, a few chipped stone tools, and one mano. Subsurface investigations identified four hearths originating between 10 and 50 cm below the modern surface and yielded more than 27,000 artifacts that are believed to derive from four different components (Reed 1993). Another example is *Soyok' manavi*, a small overhang site recorded during this project and later tested by the Midwest Archeological Center (Dominguez 1991). This site had vast quantities of artifacts and a thick cultural stratum exposed on the surface but no other visible features. Limited trenching uncovered four unlined hearths.

Even though the feature data cannot precisely define the intensity or duration of occupation during the long Archaic period, they do offer a few clues. For example, the presence of thick, ashy organic cultural strata at site 42SA20615 and *Soyok' manavi* suggests intensive or repeated occupation at some locales. The multiple cultural layers and hearths at site 42SA20615 further suggest that the area was repeatedly occupied over a period of centuries during the Archaic era. Conversely, the low frequency and ephemeral nature of features at most Archaic sites suggest that occupations were usually short term and transitory.

Anasazi Feature Summary

Anasazi architecture throughout the Needles District is expedient and less regular, neat, and well executed than the classic Mesa Verde style, but both Chandler (1988:116) and Sharrock (1966:20) regard it as Mesa Verdean rather than Kayentan. The Squaw Butte Area architecture is distinctive only in its appearance of being sloppy, hastily constructed, and intended for short-term use. However, it does appear closer to the Mesa Verde than the Kayenta style.

Together, the features furnish considerable evidence that Anasazi occupation in the project area was of low intensity and short, probably seasonal, duration. Features are relatively few in number even on the sites with the largest concentrations. Constructed features are limited to those meeting the most basic Anasazi needs of living/working space, storage, and site access. Specialized and ritual features such as mealing bins, grinding rooms, and kivas are either absent or present (but completely buried) on a maximum of three sites (Seep Shelter and sites 42SA20274 and 42SA20615). There is nothing resembling room suites or architectural suites (cf. Lightfoot and Etzkorn 1993:15; Rohn 1971:31).

The architecture is also insubstantial and expedient by any standard of Anasazi measure. It reflects a minimal level of effort to produce and maintain. Living rooms consist of low, dry-laid, enclosing walls which, judging from the rubble, were never more than a few courses high. It is possible that some of the rooms had perishable brush superstructures but this seems unlikely in view of the complete lack of superstructure debris on the sites as other less substantial organic debris (e.g., corn cobs, yucca fibers, twigs) is often preserved. The granaries and storage features are somewhat more substantial than the living rooms but still do not display a great deal of effort in their construction.

Building materials consist of whatever type and shape of stone was available closest to the site: blocks, slabs, chunks, and irregular pieces of sandstone, limestone, and chert. The unmodified stones are laid in haphazard patterns with few regular courses. Liberal use of spalls is common to fill in large gaps. All of the features are dry-laid or dry-laid/mudded. Natural overhangs, outcrops, and naturally occurring boulders are utilized as or incorporated into walls whenever possible. The architecture displays almost a complete lack of attention to aesthetic qualities and outward appearance. Also, there appears to have been little concern for longevity of the features and for maintenance costs over the long run.

The frequency, types, and characteristics of the features not only suggest short-term, low-intensity use, they also imply occupation during the warm season. None of the structures exhibit characteristics of winterproofing such as substantial enclosing walls or roofs. Instead, most are open to one side and/or the top. Warm season use would coincide with the growing season for corn and fits with the clustering of Anasazi sites with features along and near a tributary to Squaw Canyon Wash; this tributary canyon contains the only plot of fine arable alluvium in the project area.

Intuitively, it makes considerable sense that the Anasazi architectural sites were seasonally used over a period of years. The features provide some hard evidence to support this interpretation. First is the presence of accumulative features such as the Anasazi midden at site 42SA20615. Seep Shelter and site 42SA20274 may also have (or have had) middens. Both sites lie in shallow overhangs in the canyon wall. As the floors of these overhangs are entirely consumed by the living and work space, trash was probably thrown over the edge of the cliff to the canyon floor below. This trash may have been flushed out of the canyon during periodic floods, lie beneath the recent deposition at the base of the cliff, or both. Other Anasazi sites with just scattered trash as opposed

to formal middens may have been occupied less frequently.

Also, the presence of granaries may indicate that the area was repeatedly occupied. Ethnographically, the Havasupai stored some of their crops in masonry granaries near their summer sites and harvest area, returning and transporting the food to the winter sites as needed (Forde 1934; Spier 1928). Crops left in the granaries also provided a food supply when they moved back to the summer sites at the end of winter (Gilman 1983:133). Gilman (1983:129) notes that such storage features can be used to supply logistical activities or help solve problems of timing and transportation in moving food from the production site to the use location.

Given the restricted extent of arable land, which would have severely limited production capacity, the small number of storage facilities, and the considerable distance to highland settlements (1-2 days walk), it seems unlikely that Squaw Butte Area farmers were using the granaries to store crops until they could be transported to highland settlements. More likely, they were being used logistically to supply summer farming parties with food, and seed for the next year's crops.

The paucity of evidence for remodeling, accretional construction, and maintenance is somewhat inconsistent with the seasonal reuse interpretation, but it may be that remodeling and accretional construction, and maintenance substantial enough to be recognized in an archeological context was unnecessary given the function of the features and their short-term use. The lack of such characteristics may also indicate that the sites were only used for a few seasons.

Navajo Feature Summary

The Navajo site has two insubstantial features: a woodpile area and a wooden structure which may have never been finished. The nature of the features plus the lack of trash suggests low-intensity use of the site for only a short period of time. The site was probably used by no more than a single family for domestic purposes.

Chapter 5

SUMMARY OF THE SITES AND ISOLATED FINDS

This chapter presents a descriptive summary of the sites and isolated finds recorded during the Squaw Butte Area inventory. Based on the artifact and feature information presented in the previous two chapters, the types, ages, and cultural affiliations of the sites are reviewed. A brief discussion of site distribution relative to the important environmental characteristics noted in Chapter 2 is also included as a vehicle for understanding how the prehistoric peoples might have utilized the Squaw Butte Area.

A total of 80 sites and 39 isolated finds (IFs) was recorded in the 878 acres composing the Squaw Butte Area. This is an average of 0.091 sites and 0.044 IFs per acre, or 58 sites and 28 IFs per mi^2. This density is quite high relative to the surrounding areas also subject to intensive inventory. It is double or more than that reported in nearby Lisbon Valley (Black et al. 1982) and the Beef Basin Planning Unit (Thompson 1979), and triple or more than that in the adjacent Salt Creek Pocket Area (Tipps and Hewitt 1989), the nearby Indian Creek Planning Unit (Thompson 1979), and White Canyon tar sands parcel (Tipps 1988). Only in the nearby Devils Lane Area within Canyonlands (Tipps and Hewitt 1989) does the density of recorded cultural resources approach that in the Squaw Butte Area. Reasons for this high density of cultural properties appear to relate to the abundance of toolstone sources and, possibly, the availability of early maturing grass seeds like dropseed and Indian rice grass.

Of the 80 sites, 79 are prehistoric, some with multiple components. One site has both a prehistoric and an historic or modern component. At a minimum, the cultural affiliation of these sites include Archaic, Anasazi, and Navajo. There is some indication that Paleoindian peoples were in the general area, if not the actual project area. There was no definitive evidence of Fremont, Ute, Paiute, or Hopi peoples.

Sites in the Squaw Butte Area are small and generally simple, consisting of artifact scatters, artifact scatters with a few features, and small architectural sites typified by a few crude masonry walls or structures. Lithic source areas are common and sometimes have associated features such as hearths or masonry structures. Rock art sites are rare. During the prehistoric era, the project area appears to have been used on a transient basis by people primarily engaged in a hunting and gathering lifeway, and on a seasonal basis by people engaged in corn horticulture. The single historic or modern site also represents a short-term occupation.

Isolated Finds

Thirty-nine isolated find locations were recorded in the project area. Most of these locations have just a single item, but a few have several and one has six. Sixty-eight different artifacts were documented at these locations. The vast majority are flakes (Table 16). Two tested cobbles, two bifaces, and an indeterminate metate fragment were also recorded. All of these items are manufactured from the raw materials which prevail throughout the project area, for example, Cedar Mesa Chert, Summerville Chalcedony, algalitic chert, and sandstone. As a group, the isolated finds indicate toolstone testing, flintknapping, and grinding activities. The catalog of isolated finds in Appendix E presents additional information on these cultural manifestations.

Table 16. Summary of isolated finds by material type.

Type	Cedar Mesa Chert	Summerville Chalcedony	Algalitic Chert	Other Chert	Sandstone	Total
Decortication flakes	10	1	1	2	-	14
Secondary flakes	16	3	1	2	-	22
Tertiary flakes	9	7	1	-	-	17
Shatter	5	4	1	-	-	10
Tested cobble	2	-	-	-	-	2
Biface	-	2	-	-	-	2
Indeterminate metate	-	-	-	-	1	1
Total	42	17	4	4	1	68

Sites

This section commences with a brief discussion of some issues regarding cultural affiliation and site types. After this is a discussion of the local occupation organized by major temporal periods and cultural groups. This discussion generally follows the chronology outlined in Chapter 1. Appendix C presents a tabular summary of selected site information.

Cultural Affiliation Considerations

The cultural affiliation and age of each site was inferred by cross dating diagnostic artifacts and features, and, when available, by radiocarbon dates. In most cases, the presence of one or two diagnostic artifacts (e.g., projectile points, sherds) or features (e.g., rock art, masonry structures), or the availability of a radiocarbon date, was considered sufficient for this purpose. This approach is admittedly liberal and can be problematic because of scavenging, curation, and site reoccupation. However, a more conservative approach would have resulted in most of the sites being categorized as undated and of unknown aboriginal affiliation—not very informative. Most of the Squaw Butte Area sites probably had few diagnostic artifacts to begin with and the already-small pool of diagnostic remains has been diminished by park visitors and other active artifact collectors. The liberal approach to assigning age and affiliation may have resulted in some misclassifications but it seems preferable to present tentative interpretations based on some educated guesses than to proffer no interpretations at all. Radiocarbon dates, projectile points, pottery, and a combination of pottery and architecture were the most commonly used markers of cultural affiliation and chronology. Age and affiliation of a few properties was determined on the basis of architecture or rock art styles alone.

All sites were evaluated for evidence of multiple components. If the diagnostic surface artifacts, features, or radiocarbon dates were indicative of more than one time period or cultural group, an additional component was identified for the site. Of the 80 sites recorded during the inventory, 4 have more than one readily identifiable component: (1) site 42SA1661 has the remains of a Navajo camp overlying a small Anasazi sherd and lithic scatter, (2) site 42SA20292 has two noncontemporaneous Terminal Archaic radiocarbon dates, (3) *Soyok' manavi* has a heavy Middle Archaic component overlain by a light Pueblo III Anasazi component, and (4) site 42SA20615 has Middle Archaic and Early Formative radiocarbon dates, Pueblo II-III pottery, and Barrier Canyon rock art which evidently dates to the Terminal Archaic period (see Chapter 7), indicating at least 4 separate components for a total of 86 identified in the project area.

Despite the often scant surface remains, many of the sites, including site 42SA20615, are believed to have more components than could be readily identified from the surface evidence. First, unauthorized artifact collection by park visitors, particularly of projectile points and pottery, has undoubtedly erased the diagnostic surface evidence of some components. Second, some components may be obscured by the deposits of later occupation(s) or naturally accumulating sediments. This problem is particularly pronounced in the shelter sites in or near the Squaw Butte Area but also affects sites in open contexts (e.g., Dominguez 1988, 1994; Reed 1993).

Third, some components probably had few or no diagnostic artifacts or features originally because of the types of activities performed. For example, procurement and early stage reduction of toolstone, a common activity in the project area, is unlikely to have left artifacts diagnostic of cultural affiliation or age. Fourth, P-III Associates' recent experience excavating numerous open lithic scatter sites (e.g., La Fond and Jones 1995; Tipps 1993; and others in preparation) has shown that some small, simple lithic scatters which have every appearance of being short-term, single occupation sites are often palimpsests of multiple occupations and components that are difficult to sort out and identify, even in the context of complete excavation. Finally, the period between approximately 1500-1000 B.C. and the introduction of pottery lacks diagnostic artifacts that can be easily recognized during a surface inventory project (see Chapter 6 for further discussion of this issue), making such components virtually impossible to identify without absolute chronometric data. In sum, we are at a substantial disadvantage when identifying components based on surface evidence.

Thus, the 86 surface-identifiable components in the Squaw Butte Area should be considered a *very* conservative estimate of those represented in the project area. A more realistic measure of prehistoric utilization—the number and frequency of occupations composing the components—cannot begin to be addressed, even on a general level, using the inventory data.

Table 17 shows the frequency of sites and recognized components by age and cultural affiliation. Well over half of the sites could not be ascribed to a particular culture or time period other than aboriginal and prehistoric based on the surface evidence. Of the remaining sites, 11 can be identified as Archaic: 2 each to the Early, Middle, and Late Archaic and 5 Terminal Archaic. Three date to the Early Formative period and one dates to the Formative period; these four sites have unknown cultural affiliations. Fourteen sites can be confidently ascribed to the Anasazi, eight to Pueblo III or late Pueblo II-III, and six to an indeterminate time period but most likely Pueblo III or late Pueblo II-III. Finally, one component represents occupation by Navajo people during the historic or modern period.

Table 17. Frequency of sites and recognized components by age and cultural affiliation.

Time Period	Archaic	Anasazi	Aboriginal	Navajo	Total
Early Archaic	2	-	-	-	2
Middle Archaic	2	-	-	-	2
Late Archaic	2	-	-	-	2
Terminal Archaic	5	-	-	-	5
Early Formative	-	-	3	-	3
Formative	-	6	1	-	7
Pueblo II-III	-	8	-	-	8
Prehistoric	-	-	56	-	56
Historic	-	-	-	1	1
Total	11	14	60	1	86
Percent	12.8	16.3	69.5	1.2	100.0

Site Type Considerations

In the earlier work in Canyonlands (Tipps and Hewitt 1989:47), we categorized all sites into descriptive types that simply summarize the setting (open or sheltered) and the extant cultural manifestations (e.g., lithic artifacts, ceramic artifacts, features). The latter category produced 10 different types for the prehistoric period: lithic source area, lithic source area with feature(s), lithic scatter, lithic scatter with feature(s), lithic source area and sherd scatter, lithic source area and sherd scatter with feature(s), sherd and lithic scatter, sherd and lithic scatter with feature(s), masonry architecture site, and feature site. The value of these site types was in conveying a basic message about the nature of the extant sites.

Recognizing that descriptive types are inadequate for addressing settlement and subsistence issues, we (Tipps and Hewitt 1989:48-52) went on to define and assign functional site types that were based upon Binford's (1980) ethnoarcheologically based model of the range of site types used by foragers and collectors. This model was not entirely satisfactory because it was developed for hunters and gatherers and some of the sites were occupied by Anasazi farmers. Some changes were made to account for this problem and, ultimately, three functional site types were recognized: limited activity sites, field camps, and habitations. Geib et al. (1986) and Geib (1989) used a similar approach on large-scale inventories in southern Utah.

Although the functional categories seemed appropriate, there were some difficulties in actual practice assigning the sites to the categories (Tipps and Hewitt 1989:48-49). In particular, it was not always possible to determine whether some Archaic sites were field camps that were repeatedly occupied over a period of years or residential bases that were seasonally occupied. Small Anasazi sites were also problematical; there were practical difficulties in distinguishing between reused camps and seasonal habitations.

Reviewing this typology for possible use on sites in the Squaw Butte Area illuminated other problems that could result in misclassification. First, when making typological assignments based on surface indications, there must be an assumption that the observed remains are representative of past activities that took place at the site. In general, this may not be warranted. First, unauthorized artifact collection by visitors can affect the frequency of observed artifacts and may also reduce assemblage diversity by selectively eliminating certain artifact classes (e.g., projectile points, bifaces, pottery).

This problem is pronounced in certain portions of Canyonlands and seems to be especially prevalent on the more visible Anasazi sites. For example, some of the large Anasazi sites in upper Salt Creek lack even a single surface artifact at the end of each visitor season (though new ones erode out each year). While Tipps and Hewitt's (1989) sites were more remote and not as seriously affected by this problem, illegal artifact collection is a definite problem in the Squaw Butte Area.

Second, local geomorphic processes also differentially affect surface manifestations on open sites. In places like the Squaw Butte Area where shifting sands repeatedly expose and rebury the cultural material, there is no guarantee that surface artifacts and features recorded at any particular point in time accurately represent the site assemblage. Representative artifact and feature samples are a prerequisite to assessing the duration of occupation as well as the type and diversity of activities at a site, and these in turn are critical considerations in most functional typologies.

Other problems include the sample size effect (Jones et al. 1983) and complicated use histories (cf. O'Connell 1987:90-91) that may or may not be evident from the site surface. Recent excavations in the uplands north of Canyonlands (Tipps 1993), the High Plateaus west of the project area (Metcalf et al. 1993), and a vast array of shallow open lithic scatters in the central Great Basin (e.g., La Fond and Jones 1995; and others in preparation) have shown that even the smallest and most simple lithic scatters may have multiple occupations dating to different time periods and cultural groups. An example of this was even encountered in the actual project area at Whirlwind Ridge (see Chapter 6). These occupations can be difficult to segregate, even in the context of excavation.

Thus, while the categories defined by Binford (1980) or by Tipps and Hewitt (1989) seem appropriate for settlement and subsistence strategies prehistoric peoples used in the project area, there are problems applying a formal or mathematical functional typology to the individual Squaw Butte Area sites. There are too many contingencies and too many unknowns that could affect individual site classifications. On the other hand, there must be some method of conveying the functional types, at least in broad terms, to gain an understanding of prehistoric settlement and subsistence strategies. In addition, the problems of misclassification are minor in the larger sense of comparing, for example, a hundred room pueblo to a small Anasazi camp consisting of a windbreak and a few artifacts in an overhang. Clearly, all of the remains in the project area are towards the more ephemeral and transient end of the scale.

To accomplish the objective of conveying an understanding of prehistoric settlement strategies without stretching the data beyond reasonable limits, the discussion begins with a presentation of the descriptive site types. This is followed by a tentative functional typology in which sites are categorized, generally following Tipps and Hewitt (1989), on an intuitive basis, taking all of the above factors into account. The typology should not be considered on a site by site basis because there are too many opportunities for misclassification, but the overall trends of the various site types should give a broad overview of how the Squaw Butte Area was utilized by prehistoric peoples.

Table 18 presents the frequency of descriptive site types by temporal period. Simple open lithic scatters are the most common site type, accounting for the majority (55.8 percent). The only other categories accounting for more than 5 percent of the total are lithic scatters with feature(s) (10.5 percent), lithic source areas (8.1 percent), and lithic source areas with feature(s) (5.8 percent). The preponderance of these ephemeral site types reveals the rather transient nature of prehistoric occupation in the Squaw Butte Area. Even the most complex and substantial of the descriptive site types, masonry architecture sites, are relatively small and few in number.

Table 19 presents the tentative functional typology by major temporal period. In this typology, limited activity sites and camps are approximately equal, about 45 percent each. The remainder were categorized as habitation sites or indeterminate. In general terms, most sites represent short-term, limited activity loci or camps relating to the procurement and reduction of Cedar Mesa Chert and the collection and processing of wild plants. A few sites appear to be seasonal habitations used by Anasazi farmers cultivating and storing crops in a tributary to Squaw Canyon Wash. There is also an isolated rock art site which may have been a hunting ambush station (see Chapter 4).

Discussion

Paleoindian

As noted in Chapter 3, one fragmentary Clovis point and two possible Paleoindian projectile point bases were recorded on three sites in the Squaw Butte Area. The geologic context of the two sites with possible Paleoindian projectile points (42SA1455 and 42SA20305) firmly establishes that they are not the result of in situ Paleoindian occupation. The age of the site with the Clovis point (see Figure 17), 42SA20262, is less certain.

Sites 42SA1455 and 42SA20305

Sites 42SA1455 and 42SA20305 lie on the well-developed claypans in the Salt Creek inventory parcel. As discussed in Chapter 2, radiocarbon dating of scattered charcoal just below the claypan surface yielded a date of 4070 ± 80 B.P. (which has a tree-ring corrected age range of 2880-2400 B.C. at two sigma [Stuiver and Pearson 1993]; see Chapters 2 and 6). This date represents the maximum possible age of occupation for sites lying on the claypan. Thus, the two sites with possible Paleoindian points (see Figure 18a-b) must be younger than circa 2880-2400 B.C. and, therefore, cannot represent in situ Paleoindian occupation.

However, the points can still impart meaningful information about Paleoindian use of the greater Canyonlands area. The possible Paleoindian point from site 42SA1455 is made from the brown chert often noted in the project area; based on its physical characteristics and its lithic profile

Table 18. Frequency of sites and components by cultural group and descriptive site type.

Cultural Group	Lithic Source Area	Lithic Source Area with Feature(s)	Lithic Scatter	Lithic Scatter with Feature(s)	Sherd and Lithic Scatter	Lithic Source Area and Sherd Scatter	Masonry Architecture Site	Masonry Architecture/ Lithic Source Area	Rock Art	Non-masonry Architecture Site	Indeterminate	Total
Archaic	2	3	1	4	-	-	-	-	-	-	1	11
Aboriginal												
Early Formative	-	-	1	2	-	-	-	-	-	-	-	3
Formative	-	-	1	-	-	-	-	-	-	-	-	1
Anasazi	-	-	-	-	4	3	4	3	-	-	-	14
Aboriginal	5	2	45	3	-	-	-	-	1	-	-	56
Navajo	-	-	-	-	-	-	-	-	-	1	-	1
Total	7	5	48	9	4	3	4	3	1	1	1	86
Percent	8.1	5.8	55.8	10.5	4.7	3.5	4.7	3.5	1.2	1.2	1.2	100.0

Table 19. Frequency of sites and components by cultural group and functional site type.

Cultural Group	Limited Activity Sites	Camps	Habitation Sites	Indeterminate	Total
Archaic	2	6	2	1	11
Aboriginal					
Early Formative	-	3	-	-	3
Formative	1	-	-	-	1
Anasazi	1	9	4	-	14
Aboriginal	36	20	-	-	56
Navajo	-	1	-	-	1
Total	40	39	6	1	86
Percent	46.5	45.3	7.0	1.2	100.0

in the Salt Creek Pocket (see Tipps and Hewitt 1989) and Squaw Butte areas (see Chapter 3), this material is believed to be local Cedar Mesa Chert or possibly a separate type available in the greater Needles area.

The possible Paleoindian point from site 42SA20305 is made from Summerville Chalcedony. This material occurs in large lag deposits near La Sal Junction, east of the project area (Tipps and Hewitt 1989:84) and north of Photographers Point; it may also be available at other locations closer to the project area. If, indeed, the two points represent unfinished Paleoindian projectiles, they add another small piece of evidence to the growing body of information signifying Paleoindian use of the greater Canyonlands area.

42SA20262

Site 42SA20262 lies near the head of a large cove, well away from the claypan adjacent to Salt Creek. The depositional context is primarily eolian sand overlying sandstone bedrock. A small amount of bedrock, covered with residual nodules of Cedar Mesa Chert, is exposed on the east end of the site. The geomorphic context of this site does not preclude the possibility of in situ Paleoindian occupation.

The site is a sparse to dense lithic scatter covering 69 m north-south by 64 m east-west. It has two distinct artifact concentrations separated by approximately 45 m, with a lighter scatter of artifacts between them. Concentration 1 lies in dune deposits at the west end of the site and measures approximately 12 m north-south by 8 m east-west. It has less than 100 artifacts visible on the surface including the Clovis point base and a utilized flake; another utilized flake was found nearby (Figure 33a). Debitage is primarily Cedar Mesa Chert representing later stages of bifacial reduction. There is also some chalcedony of unknown origin. Maximum artifact density is approximately 3 m^2.

Concentration 2 is centered around a natural deposit of Cedar Mesa Chert nodules on the sandstone outcrop at the east end of the site. Maximum artifact density is 21 m^2 with more than 500 visible artifacts. This concentration measures 12 m north-south by 2 m east-west. Reduction activities in this area emphasized the testing and initial reduction of chert nodules, with minor late stage bifacial reduction. A core, two utilized flakes (see Figure 33b-c), a fragmentary dart point (see Figure 33d), a utilized, aborted biface (see Figure 33e), and a one-hand mano were found in or adjacent to the concentration. Another modified flake (see Figure 33f) was found between the two concentrations.

Artifact Descriptions

by André D. La Fond and Betsy L. Tipps

Because of the potential importance of the site, the Clovis base (FS 1), dart point (FS 2), biface (FS 7), and four of the modified flakes (FS's 3-6) were collected for further study in a laboratory setting. The points are described in Chapter

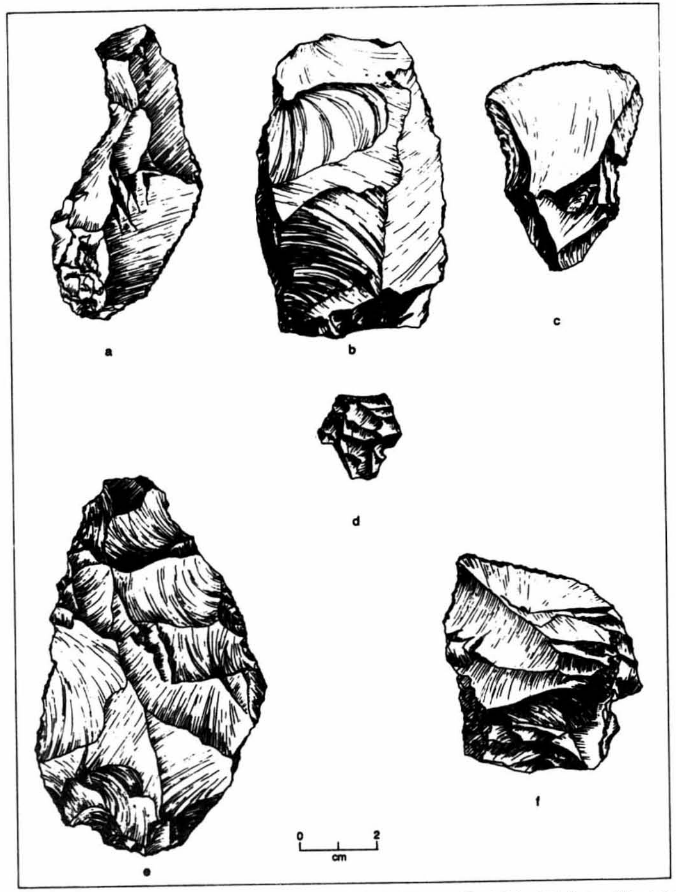

Figure 33. Selected chipped stone tools from site 42SA20262. a, utilized flake (FS 4); b, utilized flake (FS 3); c, utilized flake (FS 5); d, medium corner-notched projectile point (FS 2); e, biface (FS 7); f, modified flake (FS 6).

3. The other collected artifacts are described here; dimensions are presented in Table 20.

FS 4: FS 4, a utilized flake, was recovered several meters west of Concentration 1. It is made from a large, Cedar Mesa Chert core-face preparation flake (see Figure 33a). The flake termination overshot the core-face giving a curvature to the cross section towards the distal end and forming a steeply angled edge at the termination. Two flakes have been removed from a corner of the termination but these do not appear to be cultural. One in particular appears to have originated on the dorsal surface (not the edge) and sheared the edge. This type of fracturing does not appear to be intentional.

Under magnification, there is no evidence of usewear along any portion of the termination edge. However, both lateral margins show extensive and relatively contiguous microfracturing. The convex margin has fracturing along its entire length which is particularly pronounced along the proximal half of the tool. This edge has extensive crushing and is strongly rounded. The opposing margin has a broad concavity due to natural flake morphology. Microfracturing on this margin is primarily confined to the concavity and also consists of extensive crushing and rounding. This utilized flake may have functioned as a generalized cutting implement (convex edge) and possibly as a "shaft smoother" (concave edge).

FS 3: FS 3 is a large, rectangular, utilized flake from Concentration 2. It is made from a Cedar Mesa Chert core-flake. Differences in the glossiness between the original flake surface and the reduction scars appear to be the result of heat treatment prior to utilization.

The flake was removed from the edge of a core-face (see Figure 33b). The core edge was truncated forming a right angle lateral margin on the flake blank. This first margin was reduced by removing two edge reduction flakes on the ventral surface and two facial reduction flakes on the dorsal surface. This edge was not retouched and shows no evidence of usewear. The second lateral margin has relatively contiguous microfracturing along its entire length. Under magnification, a few of these fractures look fresh, like recent trampling and/or bag damage, but the majority of the edge is lightly crushed and rounded, and the protruding portions of the edge are well rounded indicating that this damage is from prehistoric use.

In sum, the flake scars on the first lateral margin appear to be the result of a failed attempt at bifacial reduction. A material flaw produced thickening of the ventral face toward the distal end of the flake blank and the flake removals failed to successfully thin the area. Usewear evident on the second margin indicates subsequent use as an expedient tool.

FS 5: FS 5, from Concentration 2, is another utilized flake. It is made from a large early reduction flake of Cedar Mesa Chert which, due to platform characteristics, appears to have been removed from a biface (see Figure 33c). The flake blank has a pronounced flair toward the distal end although this is not the result of intentional shaping. There is no evidence of intentional retouch or facial reduction. With the exception of the platform, all edges show extensive, relatively contiguous microfracturing consisting of weak to strong edge crushing and rounding. These characteristics are most pronounced on protruding portions of the edges. The distal edge of the tool shows the most prominent wear. However, due to the acute edge angle, it is probably not a scraper.

FS 7: FS 7 is an apparent aborted biface from Concentration 2. The blank for this Cedar Mesa Chert tool was either a large decortication

Table 20. Dimensions and weight of nonprojectile point artifacts collected from site 42SA20262.

FS No.	Length (cm)	Width (cm)	Thickness (cm)	Weight (g)
3	7.9	4.9	1.4	62.2
4	7.8	3.5	1.6	30.3
5	5.5	4.1	0.8	15.2
6	5.7	4.9	1.5	37.9
7	9.6	5.4	2.4	118.1

flake or, possibly, a naturally tabular piece of toolstone (see Figure 33e). The tool was produced primarily by unifacial reduction of the ventral surface although one facial reduction flake and a few edge reduction flakes have been removed from the dorsal surface.

Apparent usewear is present on one lateral margin, approximately in the center of the tool edge. The presence of usewear indicates that the tool was expediently utilized subsequent to the failed attempt at bifacial reduction. The edge wear consists of multiple step fractures and some edge crushing; there is little evidence of rounding. In this same area, slight matte polish and moderate high-point rounding is also evident away from the edge on one face of the tool. No striations are visible under low-power magnification.

There is little evidence of usewear on any other margin of the tool. Although step fracturing does exist elsewhere on the margin, it appears to be the result of edge preparation and/or crushing related to the flake removals (none of these areas show rounding, polish, or striations). The lack of prominent edge rounding in combination with high-point rounding and polish extending onto the face of the tool suggests that it may have functioned as a scraper.

FS 6: FS 6, a utilized flake from the area between Concentrations 1 and 2, is a large, Cedar Mesa Chert core-face preparation flake (see Figure 33f). Differences in luster between the surfaces of the tool and a nonconcoidal fracture suggest heat treatment prior to utilization.

With the possible exception of the terminal margin (discussed below), there is no evidence of retouch or facial reduction. One lateral margin exhibits contiguous microfracturing along the distal half of the edge. There is evidence of relatively weak crushing and rounding along this portion of the lateral margin. The terminal margin has an abrupt natural taper that forms a burinlike projection. This projection is truncated at an oblique angle by multiple, small step fractures. It is not clear whether the oblique truncation of the projection was originally created by removing a burin spall or if it simply resulted from use. The multiple use-related step fractures on this portion of the tool preclude a determination of the origin of the truncation. In addition to microfractures, the projection has evidence of heavy crushing and is strongly rounded. Small, contiguous microfractures continue past this projection onto the remaining lateral margin (this does not appear to be intentional retouch/shaping). The edge in this area shows only slight evidence of rounding and no evidence of crushing.

This expedient implement seems to have served multiple functions. The lateral margins appear to have been used for generalized cutting. The projection may have been used as a burin to perform relatively heavy duty incising and/or chiseling.

As an assemblage, the collected tools, other than the projectile points, represent expedient utilization of flake blanks (and, in at least one case, an aborted biface) to perform what appears to have been generalized cutting and incising/chiseling functions. However, the one apparent scraper may have been reduced with the specific intention of producing a tool to achieve that function. The strong evidence of edge crushing and rounding on all specimens except the scraping tool indicates that relatively hard materials such as wood, bone, or antler were being worked. With the exception of the apparent scraping tool, there is no evidence of use-related matte or reflective polish. No striations are visible with low-power magnification on any of the specimens. Expedient flake tools are common on Paleoindian sites (Bradley 1991; Davis 1989; Davis and Brown 1986; Frison and Bradley 1980) but none of these tools are diagnostic of the Paleoindian or any other cultural tradition.

Discussion

If the site boundaries are correctly drawn and all site manifestations represent a single occupation, then the site cannot be the result of in situ Paleoindian occupation because of the later dart point and one-hand mano. However, it is possible that the site is a palimpsest, e.g., each concentration represents a separate occupation, or there are multiple overlapping occupations. Site 42SA20262 lies close to extensive lag deposits of Cedar Mesa Chert and, as a result, the general area was heavily utilized, probably on many different occasions over a long period of time by several cultural groups.

In view of this, the important question is not whether the site represents a single in situ Paleoindian occupation but whether any part of the site represents in situ Paleoindian occupation as opposed to the point having been scavenged elsewhere and deposited at the site by later peoples (cf. Berry and Berry 1986:315). To help make this determination, the crew spent considerable time at the site looking for other definitive evidence of Paleoindian occupation such as additional points, channel flakes, distinctive flake tools, and circumstantial evidence such as flakes of the same exotic chalcedony used to make the point. After the point was discovered, one crew member recalled having seen a small late stage reduction flake of a material similar to or the same as the distinctive chalcedony used for the Clovis point base. Unfortunately, despite a concerted search, the crew was unable to relocate the flake. Since 1988, at least four separate trips have been made to the site to search for additional evidence of Paleoindian occupation but none has been found.

The question of how the point base came to be deposited at site 42SA20262 cannot be definitively resolved using available information, but the cumulative lines of evidence lean towards a scavenged specimen. First, the point was broken during use, not manufacture (see Chapter 3). This and the apparent lack of debitage from the exotic chalcedony firmly establish that the point was not manufactured at site 42SA20262. It is possible that the broken point came to the site still in the haft and was discarded during an episode of retooling. However, the apparent lack of other Paleoindian diagnostics on the site makes this possibility seem unlikely. Finally, the point base occurs on a site with artifacts that are diagnostic of later cultures and is more weathered and patinated than other artifacts on the site. Chalcedony, which was used to make the point, does tend to patinate more quickly than chert, which was used for most other site artifacts, but the point still appears more weathered than even the other chalcedony artifacts suggesting they are not contemporaneous. In sum, while an in situ Paleoindian occupation at site 42SA20262 cannot be completely dismissed at this time, the possibility seems unlikely. However, like the two possible Paleoindian points discussed above, the use of a northern Colorado Plateau toolstone for the Clovis point (see Chapter 3) indicates that Paleoindian peoples were using the general area.

Archaic

Early Archaic (7800-5100 B.C.) use of the project area is suggested by two projectile points, a Silver Lake or Jay and a Pinto, both of which occur on open lithic source area sites. These sites are in the uplands away from Salt Creek where the geomorphic conditions do not preclude the preservation and discovery of Early Archaic remains (see Chapter 2). The occurrence of Early Archaic materials comes as no surprise given the sporadic indications of local Early Archaic occupation already documented in the local literature, mainly Early Archaic projectile points such as Pinto, Humboldt, and Sand Dune Side-notched (e.g., Anderson 1978; Dominguez 1988:18, 1991:3-5[1]; National Park Service 1990:25; Tipps and Hewitt 1989:89-92).

What is perhaps surprising is that there was not more indication of Early Archaic occupation given the apparent abundance of Early Archaic sites in certain other portions of the Needles District (Tipps and Schroedl 1990). This may be the result of two factors unrelated to the actual intensity of local Early Archaic occupation—the limited presence of the appropriate age deposits in the Salt Creek inventory parcel (see Chapter 2), which accounts for approximately half of the project area, and limited visibility of appropriate age deposits in the inventory parcel near Squaw Butte. In regards to the latter, nearby excavations have clearly shown that cultural deposits of increasing age are generally in buried contexts, not exposed on the surface (Dominguez 1988; Reed 1993).

Evidence for Middle Archaic (5100-3300 B.C.) occupation of the project area consists of (1) a Rocker Side-notched projectile point which may date sometime between 5700 and 4000 B.C. (cf. Holmer 1978:68) on a lithic scatter/lithic source area site (*Soyok' manavi*) and (2) a radiocarbon date of 5290 ± 80 from a hearth exposed in profile in a buried stratum at site 42SA20615 (see Chapter 6). This date has a tree-ring corrected age range of 4330-3960 B.C. at two sigma (Stuiver and Pearson 1993). As part of the paleoenvironmental investigations, Larry Agenbroad obtained a radiocarbon date of 4510 ± 130 from an unlined hearth on an unrecorded open lithic scatter site just outside the project area (Agenbroad and Mead 1992a; Agenbroad et al. 1990:Appendix III; see also Table 2). This date,

which has a two-sigma tree-ring corrected age range of 3620-2880 B.C. (Stuiver and Pearson 1993), spans the transition from the Middle Archaic to the Late Archaic as they are defined for this project.

Echoing the cry of many researchers, Matson (1991:152) states that "Little is known about the Middle Archaic . . . on the Anasazi-occupied portions of the Colorado Plateau"[2]. He interprets the lack of intense occupation at major northern Colorado Plateau Archaic cave sites (e.g., Sudden Shelter, Cowboy Cave, Dust Devil Cave) as an indication that Altithermal conditions resulted in significantly reduced local populations. While it cannot be disputed that the major northern Colorado Plateau cave sites had less intense occupation during the Middle Archaic than during other periods, this does not necessarily mean there was a drastically reduced population.

If climatic conditions were less desirable than other periods, and most researchers agree that they were, people may have adopted a different settlement and subsistence strategy to accommodate these conditions, using sites in different, especially less intensive ways than in the preceding period, making them less obvious to archeologists. A growing number of Middle Archaic sites has been identified through cultural resources management work during the past decade (e.g., Black and Metcalf 1985; Black et al. 1982; Copeland 1986; Davis 1988; Geib and Fairley 1986; Hogan et al. 1991; Kearns 1982; Tipps 1987, 1988, 1992). Many of these are open sites or small shelters; often they appear to have been used for short periods of time, some perhaps on just a single occasion.

If indeed the climate was warmer and drier, people may have also selected site locations to help them overcome this problem, perhaps making greater use of higher altitudes (e.g., Copeland and Webster 1983; McDonald 1993; Tipps 1992) or camping closer to perennial sources (e.g., Black and Metcalf 1985; Reed and Nickens 1980). The Middle Holocene was a period of erosion rather than aggradation along watercourses so site preservation is an important consideration for sites located on erodable landforms adjacent to major watercourses. Middle Salt Creek is a local example. Agenbroad and Mead (1992b:32-33) and Mead et al. (1992:73) report that deposits of Middle Archaic age have been completely flushed out of the middle Salt Creek drainage. Away from watercourses, an increase in eolian activity may have accompanied the warmer, drier conditions (see Chapter 2), burying the by-then mostly abandoned Middle Archaic sites, again decreasing their visibility to archeologists.

The Middle Archaic sites identified in the Squaw Butte Area appear to fit this pattern. The sites are small and relatively open (there are small shallow overhangs protecting a very small portion of each site). None approach the size or scope of the major northern Colorado Plateau Early Archaic cave sites. Perhaps more importantly, all of three of the Middle Archaic sites in or adjacent to the project area are located only a few minutes walk from water sources that are perennial today and believed to have been so during the Middle Holocene (see Chapter 2).

It is also notable that the Middle Archaic feature at site 42SA20615 is buried by more than 2.5 m of dune deposits. This feature was not visible when the site was originally recorded in 1988 but had begun to erode out of a drainage cutbank in 1990 when project personnel returned to conduct additional investigations. Without ongoing erosion and this return visit, the Middle Archaic component at this site would have gone unrecognized. The Middle Archaic feature at the unrecorded site typifies the opposite problem because the site lies along a major watercourse. With the heavy rains and flooding of 1995, this feature has probably been destroyed.

Late Archaic occupation (circa 3300-1500 B.C.) of the Squaw Butte Area is revealed by the presence of two Gypsum points. As noted in Chapter 3, Gypsum points are believed to date between 3500 and 1500-1000 B.C. One occurs on a lithic source area (site 42SA20260), the other on a lithic scatter (site 42SA20280), both of which are open sites in eolian settings.

The next evidence of occupation is during the Terminal Archaic (1500 B.C.-A.D. 500). Four sites with five Terminal Archaic components were identified on the basis of radiocarbon evidence and rock art styles. Most of these sites are relatively ephemeral. They include both lithic scatters and lithic source areas with features. Chapter 6 provides the dates, site descriptions, and additional information on testing activities at three of these sites.

As a group, the Archaic sites equally occur in open and sheltered settings, normally in eolian deposits. They include lithic scatters and lithic source area sites, often accompanied by features such as unlined or slab-lined hearths, and there is one instance of rock art. In general, the Archaic sites seem to represent short-term, limited activity loci and camps primarily related to the procurement and reduction of Cedar Mesa Chert and the collection and processing of wild plant foods. Acquisition and use of animals are also indicated by the presence of hunting related tools but may have been less successful than plant gathering due to the relatively poor forage potential of most project area soils (see Chapter 6).

None of the sites appear to result from long-term or year-round occupation, although two sites, 42SA20615 and *Soyok' manavi*, seem to have extensive cultural deposits indicating repeated use over a period of years, or perhaps longer and more intensive stays. What is interesting about these two sites is that their more extensive deposits evidently date to the Middle Archaic period, possibly suggesting a different pattern of adaptation than for earlier and later Archaic periods.

Discounting for a moment the Middle Archaic portion of the Archaic period, the Squaw Butte Area appears to have been utilized by mobile hunters and gatherers who stayed for short periods of time, perhaps no more than a few weeks, in the course of their seasonal round. Foraging appears to have been the primary mode of adaptation, with most of the sites identified as camps serving as their short-term residential bases. Some of the local lithic source area sites were no doubt locations used for the procurement of Cedar Mesa Chert.

The presence of an occasional logistically organized strategy cannot be ruled out, particularly for the procurement of Cedar Mesa Chert, and especially if substantial residential bases are present in more favorable areas outside of the project area. In this case, some of the sites functionally identified as camps would be field camps, that is, the places where logistical groups maintained themselves while on procurement forays. Other than Cedar Mesa Chert, it is difficult to see what resources may have been the object of logistical forays, and, for this reason, the predominant pattern was probably a foraging strategy.

The primary seasons of occupation may have been the spring/early summer when early greens and seeds (e.g., Indian rice grass and dropseed) were available and winter stores had been depleted, and the fall around the time of the goosefoot and pinyon harvest. It is hard to imagine that people were attracted to the Squaw Butte Area by the very sparse pinyon resources as far better ones can be found in the surrounding highlands. However, annual herbs such as goosefoot may have been abundant (see Chapter 2). There is no evidence of Archaic populations wintering in the area.

The adaptive pattern for the two Middle Archaic sites was probably similar in most respects, but the more extensive deposits suggests that these two sites were longer term or reused residential bases in a forager-type adaptation or possibly residential bases in a logistically mobile, collector adaptation. The location of these sites near perennial watercourses may have encouraged reuse or longer occupation at a time when climatic conditions are inferred to have been warmer and drier.

Early Formative

Evidence for Early Formative occupation is from radiocarbon evidence alone. Three such sites were noted. Two are nondescript open lithic scatters with one or more thermal features. The third consists of a trashy, evidently aceramic stratum at site 42SA20615—an unlined hearth within the stratum produced the radiocarbon date. Chapter 6 provides the dates, site descriptions, and additional information on these sites. As noted in Chapter 6, the cultural affiliation of these sites is uncertain.

The absence of cultigens in the flotation samples (see Chapter 6) suggests that Early Formative populations in the Squaw Butte Area focused on gathering and processing wild plants and animals rather than farming, even though they were surely aware of horticulture and may have practiced it elsewhere. As in the preceding period, a transient, and probably seasonal occupation by small groups seems likely due to the ephemeral nature of the observed remains. These people may have had more substantial habitation sites in the adjacent

highlands and been visiting the relatively low-lying Squaw Butte Area for its early seeds and greens, for annual herbs that ripen in the fall, and to procure local toolstone.

A single upright slab near the tested hearth feature on site 42SA20251 may signify the presence of a pithouse which would indicate a more substantial occupation and period of residency than otherwise indicated. The same is true of the oblong, slab-lined feature at site 42SA20258 which could be a very small pitstructure.

With only three sites identified to this rather long period, occupation appears to have been rather light. Given the findings of other researchers (e.g., Hartley 1980; Sharrock 1966; Tipps and Hewitt 1989), this is probably the actual pattern though it may be exaggerated by the lack of associated ceramic remains which would make the sites easier to identify in an inventory context. Surface manifestations of these sites are almost identical to those of the preceding Archaic period and, given the complete absence of surface diagnostics, the age of these sites would have gone unknown without the limited testing program. Some of the ubiquitous undated lithic scatters found during the project probably also date to this time period.

Anasazi

Anasazi occupation is indicated by 14 sites which have Anasazi pottery and/or architecture. Eight can be confidently ascribed to Pueblo III or the generalized late Pueblo II-III period based on ceramic cross dating. The other six probably date to the same time frame although they lack temporally sensitive artifacts. The associated ceramic technology suggests a Mesa Verde affiliation in all cases.

Site types consist of small sherd and lithic scatters and small masonry architecture sites, sometimes associated with natural sources of Cedar Mesa Chert. These site are consistently associated with shallow overhangs or, occasionally, more substantial shelters. Functionally, the majority of sites appear to represent multiple activity camps. There are a few storage sites, a few habitation sites, and at least one limited activity loci.

Three Anasazi sites have architecture such as rooms, walls, and granaries, and deposits that appear to have accumulated over an extended period of time. These sites appear to represent habitations. One of these, Seep Shelter, is a small residential pueblo with four masonry rooms, one of which may have been used for storage, a granary, a possible cist, and more than 20 cm of cultural fill. Site 42SA20274 is smaller, with a single masonry enclosure, a rock art panel, and a small assemblage of artifacts, corn cobs, and corn husks. The late Anasazi component at site 42SA20615 has a wall and a rock alignment, both of which appear to have enclosed open work areas or rooms, an upright slab and a rock concentration which may represent additional architecture, and a rich midden that includes a looted and disinterred burial.

The architecture on these sites is insubstantial and reflects a low level of investment to produce and maintain. The walls are often dry-laid, never more than a few courses high, and most rooms appear to have been open to one side and/or the top. None of the structures possess characteristics of winterproofing. Feature types are limited to those meeting the most basic needs of living and working space, storage, and site access. Although somewhat intensive occupation is indicated by the depth of the cultural deposits, these sites appear to have been inhabited on a temporary basis during the warm season only. Repeated occupation may account for the accumulated deposits.

Use of these sites is consistent with seasonal farming. Two of the sites, Seep Shelter and site 42SA20274, are in deep shelters overlooking a tributary to Squaw Canyon Wash, one of the few plots of arable alluvium in the project area. The other site may also be near arable alluvium. These sites were probably inhabited by nuclear families or small groups of two to three families who migrated from a higher elevation base, annually over the course of a few years, to plant and tend crops on the arable alluvium during a period of favorable climatic conditions. The Squaw Butte Area lies at approximately 1520 m, considerably lower than that normally exploited by the Anasazi, so crops could have been planted and harvested earlier, with less risk of killing frosts than in the higher areas which presumably served as their winter homes. The ceramic technology identifies the general region of Elk Ridge Plateau as that home. More specifically, upper Salt Creek is a likely possibility.

Given the limited and marginal nature of farming pursuits in the Squaw Butte Area, it is doubtful that crops were being produced for transport to highland pueblos. The farming may have instead been used as a logistical strategy to solve short-term shortages of food resources (see Chapter 4).

Most of the multiple activity camps are characterized by sherd and lithic scatters beneath shallow overhangs. Cultural deposits are generally shallow, if present at all, suggesting short-term, ephemeral, and probably seasonal use. One such camp has a partially enclosed surface room that may have been the location of domestic activities such as eating, sleeping, and working. Another has a stone circle that may have served a similar function. The presence of abundant groundstone and occasional corn cobs at these sites suggests that grinding was a major activity. Some of the camps are spatially coincident with natural sources of Cedar Mesa Chert and may have been positioned to take advantage of this abundant resource. The multiple activity camp with the stone circle, site 42SA1519, also contains three granaries that were used to store corn. A few camps are probably related to procurement of toolstone or wild plant resources.

Two of the sites that were characterized as camps in the general functional typology are better viewed as storage sites where a few other activities incidentally took place. They may not necessarily have been used for overnight camping. Site 42SA20270 consists of a large, wet-laid storage bin tucked behind a boulder in a well-hidden crevice in the cliffs. A precarious set of hand and toe holds accesses the site from above. A difficult and probably little used route that includes ascending a chimney and scrambling over exposed slickrock gives passage from below. The site's difficult access suggests that it was not visited often, whereas its hidden location implies use to cache a store of seeds for the next year's planting while its owners were away for the winter. A two-hand mano and several flakes accompany the storage feature and attest to a limited range of other activities performed at the site.

The other probable storage site is 42SA20271. It consists of a masonry granary concealed under an overhang behind a hoodoo that is, again, very difficult to reach. A dead-end ledge extending away from the site has some natural Cedar Mesa Chert debris that appears to have been exploited on a very ephemeral, one-time basis: a core, a few flakes, and a biface tip were found in association. The primary function of this site appears to have been that of secure storage, probably over winter when its owners were away, with incidental use of a spatially coincident deposit of Cedar Mesa Chert.

At approximately 1520 m, dry farming in the Squaw Butte Area was out of the question except in selected well-watered locales. This fact was not lost upon the Anasazi. Most of the Anasazi sites are clustered adjacent to the few patches of well-watered arable alluvium in the project area, those around Squaw Canyon Wash. The deliberate settlement around this rare favorable locality demonstrates that most Anasazi were not just passing through the Squaw Butte Area on their way to somewhere else. They came for the express purpose of farming. The habitation sites, storage sites for grain, and plant processing sites are rather clearly linked to the seasonal cultivation of corn. Most sites reflecting other activities such as procurement and processing of Cedar Mesa Chert and wild plant foods are not randomly dispersed through the project area, but generally clustered near the other sites, suggesting they too are part of the same farming-inspired occupation.

Navajo

The remains of an historic or modern structure and an associated wood pile were recorded by Sharrock (1966) as a possible Navajo camp. While historic aboriginal use of the Needles District appears to have primarily been by the Ute, the round shape and cribbed nature of the structural remains suggest that the site was indeed occupied by the Navajo. Their traditional range is south of Canyonlands though their presence has been documented both ethnographically and archeologically (Hobler and Hobler 1978; Schroeder 1964) in nearby White Canyon. The small size of the site, lack of artifacts and trash, and scarcity of features indicate a short period of occupation. Fall use by a family collecting pine nuts seems to be the most reasonable explanation for the site, especially because the Squaw Butte Area is well away from places Navajo peoples typically maintained herds of sheep.

[1]Dominguez (1991:3, 5) erroneously attributes Pinto and Humboldt points to the Middle Archaic. In addition, Nancy J. Coulam (personal communication 1993), Canyonlands archeologist, has examined the reputed Pinto point from site 42SA20263 (*Soyok' manavi*) and believes that it represents an Elko Series specimen. Even if the points Dominguez (e.g., 1988:18; 1991:5) types as Pinto are dismissed, there is still scattered evidence of local Early Archaic occupation. It is assumed that the reputed Pinto points will be illustrated in forthcoming final reports which may help resolve their type status.

[2]The National Park Service (1990:8) reports that Middle Archaic sites are especially common in Canyonlands National Park but few researchers would agree with this conclusion based on analysis of their data. Two sites it specifically mentions as dating to the Middle Archaic were so designated on the basis of Pinto and Humboldt points. Most researchers consider these diagnostic of the Early Archaic. Given this and the possible typological problems mentioned in the preceding footnote, it seems reasonable to disregard this conclusion until a final report with all of the relevant information is available.

Chapter 6

THE TESTING

Several months after completing the inventory, limited testing of hearths and cultural deposits was undertaken at six of the sites recorded in the Squaw Butte Area. These six sites—Whirlwind Ridge, Squaw Butte Cove, 42SA20251, 42SA20258, 42SA20292, and 42SA20615—were chosen for testing on the basis of research priorities and a field evaluation conducted by the Rocky Mountain Regional Archeologist, Adrienne B. Anderson; the Canyonlands National Park Archeologist, Chas Cartwright; the project Principal Investigator, Alan R. Schroedl; and the author.

The six sites were selected from the larger pool of sites because they had discrete, datable features which were well preserved and clearly associated with the observed artifactual material. They were also chosen because they had one or more characteristics which suggested they could address important research issues in Canyonlands prehistory.

For all but site 42SA20615, the testing was limited to sectioning discrete features, mainly hearths, visible on the surface and collecting radiocarbon and flotation samples as well as artifacts encountered during the sectioning. The scope of testing was minimally expanded at site 42SA20615 as a means of assessing the nature and extent of deposits at this multicomponent site. Besides sampling two hearths, a small, 25- by 25-cm test probe was excavated through the deep midden deposits in front of the main shelter, and two other cultural strata were minimally investigated.

In all, nine unlined and slab-lined hearths and one oblong, slab-lined feature were sectioned. None of these features yielded faunal specimens but all yielded burned macroplant remains and most contained at least a few artifacts. Nine of these features were dated. A midden and two buried cultural units were also studied as was a deep, unlined pit exposed in one of the strata. None of these features were dated but a flotation sample was analyzed from one of the cultural strata.

Research Issues

One of the most important research problems for the Needles District is documentation and characterization of pre-Pueblo II occupation. Sharrock (1966), who conducted the baseline inventory in the Needles District, believed that the first substantial occupation was by Anasazi people beginning in Pueblo II. Sharrock (1966:63) stated: "it is doubtful that significant occupation began much before A.D. 1075." Although sites of all ages and cultural affiliations are being investigated by the project, the decision was made to focus on sites that might elucidate pre-Pueblo II occupation as they had only been recently recognized in the Needles District and, as such, were poorly understood.

Identifying sites with hearths or other discrete datable features that might date before Pueblo II (e.g., Archaic or Early Formative) was not difficult. Other than site 42SA20615, the 12 sites with visible hearths or other discrete datable features contained no evidence of Pueblo II-III occupation. However, none appeared to be especially likely candidates for Early Formative occupation either. Other than site 42SA20615, all 12 sites were aceramic with few or no diagnostic artifacts.

Related to the first research problem, another important issue is the date or dates of the ubiquitous open lithic scatter sites which account for the majority of sites in both the Squaw Butte and Salt Creek Pocket areas (Tipps and Hewitt 1989). Based on scanty surface diagnostics and a radiocarbon date from Salt Pocket Shelter, the two inventories identified at least some occupation during the Early, Middle, and Late Archaic periods, as well as during the Pueblo II-III era. It was suspected that the ubiquitous open lithic scatter sites might provide additional evidence of occupation during the sparsely represented Archaic periods, document limited activity Anasazi sites that lack ceramic artifacts, or identify occupation during time periods not already represented by the inventory data. This last possibility was especially critical.

The Squaw Butte inventory produced no concrete evidence of occupation in the 2600-year interval between 1500-1000 B.C. and A.D. 1100. Gypsum points, the only Late Archaic diagnostic artifacts observed during the inventory, do not date after 1500-1000 B.C. (see Chapter 3). The ceramic assemblage recorded during the inventory all appears to have been produced after approximately A.D. 1100 (see Chapter 3).

It seemed highly unlikely that the area had been abandoned for approximately 2600 years. Previous investigations had identified sites in that time frame throughout much of southeastern Utah (e.g., Brown 1987; Bungart and Geib 1987; Geib et al. 1987; Jennings 1966, 1980; Nickens et al. 1988; Tipps 1983, 1988), often in areas earlier thought to be devoid of such remains. And, a few kilometers away, a slab-lined hearth at site 42SA17141 in Butler Flat yielded a radiocarbon date of 2080 ± 60 B.P. (Tipps and Hewitt 1989:128) which has a tree-ring corrected age range of 340 B.C.-A.D. 70 at two standard deviations (Stuiver and Pearson 1993).

Instead of a hiatus, it was suspected that the gap, at least the portion between 1500 B.C. and the introduction of ceramics circa A.D. 400-500 (Geib 1990a; Janetski 1993), was an illusion created by the lack of mutually exclusive, inventory-visible diagnostics artifacts for these periods (see Tipps and Hewitt [1989:26] for further discussion of this issue). Elko points typify occupation during the early part of this time span, but they also occur in large numbers during the Early and Middle Archaic periods making them useless as chronological markers in the Canyonlands area (see Chapter 3). If this suspicion was correct, it seemed likely that some of the aceramic sites would date to the 2600-year time span.

Another research problem concerned the cultural affiliation(s) of sites dating to this transitional time period between the Archaic and Formative eras. Sites in this time span could result from Archaic, Basketmaker, Anasazi, or Fremont occupation.

Related to this, another critical research priority was obtaining subsistence data from the 2600-year time span. This era witnessed the transition from a hunting and gathering lifeway to one based on agriculture, an occurrence that permanently changed the nature of local prehistoric occupation. While it was certain that domesticates came into local use during the 2600-year time span, it was not known when corn was first used in the Canyonlands area, how it arrived, or what culture was responsible for its introduction. Clearly, the types of data needed to fully address these issues were not likely to come from sectioning a few hearths, but there was a possibility of obtaining chronological information pertaining to the introduction and use of corn in the area.

As noted in Chapter 2, many of the sites in the Salt Creek inventory parcel are situated in dunes overlying a claypan. A radiocarbon sample (Beta-37492) from the top few centimeters of the claypan provided a date of 4070 ± 80 B.P. which has a tree-ring corrected age range of 2880-2400 B.C. at two sigma (Stuiver and Pearson 1993). This is the minimum date of the claypan but the maximum date of potential occupation for sites overlying this surface. All sites located in dunes overlying this surface must be younger than 2880-2400 B.C. To maximize the likelihood that our sample would include sites dating to the 2600-year interval as well as sites that might bear both on the chronology of the transition from hunting and gathering to agriculture and subsistence practices in the 2600-year interval, two sites in dunes in the Salt Creek inventory parcel were selected for testing: Whirlwind Ridge (42SA20301) and site 42SA20292. Sites away from this area were also chosen to maximize any possibility of sites dating to older time periods.

The two final research problems concern subsistence strategies and bear upon the reasons for prehistoric occupation of the area. Discovery of a marsh at the north end of the Salt Creek inventory parcel led to speculations about the presence of marshes and whether marsh resources were present during prehistoric times. If present, they would likely exert a strong influence on prehistoric populations because they produce a variety of highly ranked resources (Simms 1984). Interest in this issue increased during the postfield evaluations with the paleoenvironmental contractors. They speculated that marshes similar to the one near site 42SA20292 may have been intermittently present in and around the Salt Creek inventory parcel throughout the post-4000 B.P. era (see Mead and Agenbroad, Chapter 2). The site closest to the extant marsh was chosen for testing, as was another site deemed the most likely candidate for marsh resource use based on its proximity to potential marsh locations.

One final research issue was identified as a focus of the testing program. Although not explicitly stated, Tipps and Hewitt (1989) hypothesize, based on geographic propinquity and the abundance of groundstone, that Indian rice grass was one of the major reasons for prehistoric occupation in the adjacent Salt Creek Pocket Area. We wanted to see if this explanation applied to the Squaw Butte Area and, if so, to provide more substantial evidence than the presence of appropriate tools and proximity to modern-day resources. As a result, flotation samples were processed from all tested hearths, even those that yielded insufficient carbon for dating.

The remainder of this chapter describes the tested sites including their environmental setting, surface assemblages, and features. The results of the testing relative to the research issues identified above are discussed at the end of the chapter. Metric information on the tested hearths is presented in Table 21. Radiocarbon dates derived from these features are presented in Table 22. Appendix F describes the procedures used to analyze chipped stone artifacts recovered during the testing.

Site 42SA20615

Environmental Setting

Site 42SA20615 is on a series of dissected alluvial terraces and eolian dunes which lie in front of, adjacent to, and under a series of low sandstone knobs and cliffs. The knobs and cliffs arc around the site, delimiting two of its boundaries. The dissected dunes and terraces form a series of finger ridges which trend away from the cliff line ending at a dry wash.

Three overhangs are found within the site perimeter. Shelter A, the largest, marks one edge of the site and consists of an overhang formed by a portion of the cliff line. This shelter is about 33 m long and ranges from 2 to 5 m deep. In front of Shelter A is a low mounded dune which extends most of the length of the shelter. Beyond this dune is a deep drainage and, beyond this, a long, narrow ridge ("Ridge A"), another deep drainage, and a wider ridge ("Ridge B") which slopes gradually down on the far side.

Shelter C is located at the upper end of Ridge B, where the ridge abuts the adjacent sandstone knob. It is 11 m long, 2-3 m wide, and 3 m high. On one end, the floor of the overhang is formed by a huge rock slab 7 m long and about 2 m wide. On the other, it consists of two large slabs of rock fall which overlie cultural deposits. Shelter B is located around the corner from Shelter C, at a lower elevation. This overhang lies against the sandstone knob forming the overhang for Shelter C by the drainage separating Ridges A and B. It measures 3 m long by 2 m deep. Deposits on the site are mainly brown, organic-rich eolian sands capping sterile, sandy deposits. A small deposit of indurated alluvium is found in Shelter B.

On-site vegetation consists primarily of sagebrush and greasewood with four-wing saltbush, rabbitbrush, and various grasses also common. Other taxa are Gambel oak, juniper, fleabane (*Erigeron* sp.), Wyoming paintbrush (*Castilleja* sp.), fishhook cactus, thistle (*Circium* sp.), various vines, and several riparian taxa. Because the site is near Salt Creek, site residents probably enjoyed a perennial supply of water.

Table 21. Dimensions of discrete features tested in the Squaw Butte Area.

Site Name	Site Number	Feature Number	Feature Type	Surface Dimensions Length (cm)	Surface Dimensions Width (cm)	Excavated Dimensions Length (cm)	Excavated Dimensions Width (cm)	Excavated Dimensions Depth (cm)
-	42SA20615	16	Unlined hearth	37	-	-	-	15
Whirlwind Ridge	42SA20301	1	Unlined hearth	50	60	-	-	7
Whirlwind Ridge	42SA20301	2	Unlined hearth	90	90	-	-	8
Squaw Butte Cove	42SA20256	1	Slab-lined hearth	~180	~180	~140	~140	26
-	42SA20292	1	Unlined hearth	60	80	88	91	8
-	42SA20292	2	Unlined hearth	30	90	84	78	8
-	42SA20292	3	Slab-lined hearth	90	110	124	113	36
-	42SA20258	1	Oblong, slab-lined feature	155	230	155	230	25
-	42SA20615	2	Unlined hearth	-	-	48	43	7
-	42SA20251	1	Unlined hearth	150[a]	160[a]	87[b]	48[b]	2

[a]This surface stain was caused by three adjacent unlined hearths.
[b]Represents dimensions of one hearth in larger stain.

Site Description

Site 42SA20615 is a large, multicomponent camp and habitation site with five rock art panels and a variety of other features such as hearths, architecture, a midden, and buried cultural strata. Artifacts and debris visible on the surface include 2 basin metate fragments, an indeterminate metate fragment, 3 single-hand manos, 4 bifaces, more than 500 pieces of debitage, a core, approximately 15 pieces of pottery, and scattered pieces of charcoal and burned stone. Artifact density is as high as 137 items/m^2. The site measures 70 m north-south by 170 m east-west. It has been impacted by arroyo cutting, wind erosion, and pothunting.

The rock art panels, consisting of Barrier Canyon style anthropomorphs, zoomorphs, and zigzags, and Anasazi handprints, dots, and a mountain sheep (see Figures 28 through 32), are found on the back and ceiling of Shelter A. An upright slab, rock alignment, wall, smoke blackening, and an ashy, organic-rich cultural unit are also exposed in Shelter A; a rock concentration and a midden deposit lie on the dune in front of this shelter.

A second ashy, organic-rich cultural unit is located in Shelter B, whereas a third such deposit is exposed near the top of Ridge B along with two unlined, informal hearths. Buried cultural deposits marked by a hearth and flakes eroding out of a profile are exposed on the almost-vertical side of Ridge B.

Methods

The scope of work at this site consisted of (1) evaluating the ashy, organic, cultural stratum in Shelter B (Feature 1), (2) excavating three-fourths of one of the hearths (Feature 2) eroding out of the cultural deposits on the top of Ridge B, (3) ascertaining the depth of the midden deposit (Feature 12) in front of Shelter A, and (4) evaluating and sampling the cultural stratum (Feature 14) and the hearth (Feature 16) eroding out of the face of Ridge B. A flotation sample and several artifacts were collected and analyzed from Feature 1. A flotation sample and a charcoal sample were collected and analyzed from Feature 2. Artifacts eroding from the face of Ridge B were collected and analyzed as Feature 14. Finally, charcoal and flotation samples were collected and processed from Feature 16.

Table 22. Radiocarbon dates from the Squaw Butte Area.

Site Name and Number	Feature Number	Laboratory Number	Carbon-14 Age in Radiocarbon Years B.P. ± 1 Sigma	Material Dated	Calibrated Age Range[a]
42SA20615	16	Beta-37954	5290 ± 80 years	Wood charcoal	4330-3960 B.C.
Whirlwind Ridge (42SA20301)	1	Beta-30486	2640 ± 100 years	Wood charcoal	990-430 B.C.
Whirlwind Ridge (42SA20301)	2	Beta-30487	2330 ± 90 years	Wood charcoal	760-180 B.C.
Squaw Butte Cove (42SA20256)	1	Beta-30482	2220 ± 90 years	Wood charcoal	410-40 B.C.
42SA20292	1	Beta-30485	2220 ± 70 years	Wood charcoal and burned sediment	400-60 B.C.
42SA20292	3	Beta-30484	2120 ± 60 years	Wood charcoal	360 B.C.-A.D. 10
42SA20258	1	Beta-30483	1500 ± 100 years	Wood charcoal	A.D. 380-690
42SA20615	2	Beta-30488	1360 ± 80 years	Wood charcoal and burned sediment	A.D. 550-870
42SA20251	1	Beta-30481	1170 ± 60 years	Wood charcoal	A.D. 710-1010

NOTE: Calibrated age ranges were calculated using CALIB, Version 3.0.3 (Pearson and Stuiver 1993; Stuiver and Pearson 1993; Stuiver and Reimer 1993).

[a]The calibrated age range is the adjusted range of the calibrated date(s) at two sigma.

Results

Features 1 and 15

Examination and facing up of the cutbank in Shelter B revealed that the cultural unit, Feature 1, is 22 cm thick and at least 4 m long. It ranges from light gray to black and contains debitage, charred seeds, ash, minute charcoal flecks, and decomposed organic debris. It overlies sterile orange sand; depending on location, it either forms the surface or underlies a unit of indurated, brown alluvium that was not tested.

Within Feature 1, about 12 cm above its lower edge, is a cluster of horizontal sandstone slabs which may represent a separate feature. Above one of the slabs is a concentration of ash and charcoal, possibly signifying an eroded hearth. A radiocarbon sample was collected from this concentration but not processed.

A flotation sample from Feature 1 yielded the charred remains of *Atriplex canescens*, *Celtis reticulata*, *Chenopodium* spp., and *Juniperus osteosperma*. Twenty pieces of debitage were recovered from Feature 1. A corner-notched Elko point found on the sterile underlying sand may have also come from this feature. The artifacts are discussed below.

An unlined, basin-shaped pit, Feature 15, was observed in profile after exposing a fresh face on the cutbank. Feature 15 extends through Feature 1 into the underlying sterile sediments but its level of origin relative to Feature 1 is uncertain. It measures approximately 55 cm across and 27 cm deep and contains light gray, sandy fill incorporating small pieces of tabular sandstone. It may be a hearth or roasting pit. No flotation or radiocarbon samples were taken because the feature was not excavated. The three artifacts recovered from this feature are discussed below.

Feature 2

Feature 2 is an approximately circular, unlined, basin-shaped hearth filled with light reddish brown, fine-grained eolian sand incorporating numerous charcoal flecks. This feature rests in the ashy, organic-rich cultural stratum exposed near the surface of Ridge B (Figure 34). Near the overhang, the stratum is approximately 50 cm thick and covered by approximately 50 cm of overburden. The overburden thins with increased distance from the shelter and finally disappears so that the stratum forms the site surface at the toe of the ridge. Due to heavy erosion of this stratum at the toe end of the ridge, the feature's level of origin within or stratigraphically above the cultural unit could not be ascertained.

A flotation sample from Feature 2 yielded charred macroplant remains from the following taxa: *Artemisia* spp., *Atriplex canescens*, *Celtis reticulata*, and *Juniperus osteosperma*. No artifacts were observed within the feature fill.

Feature 12

A 25- by 25-cm test probe in Feature 12 revealed that the dark cultural unit extends a minimum of 70 cm below the modern ground surface. It contains minute bits of charcoal and debitage, with pottery in the upper levels. This unit likely comprises an Anasazi midden overlying an earlier cultural stratum. The artifacts observed in the test probe were not collected and no other samples were taken.

A highly weathered screen abandoned on the midden suggests that the midden may have been extensively potted; if so, traces of such potting are no longer visible on the surface due to heavy wind action. No evidence of looting could be seen in the small test probe.

Features 14 and 16

Feature 14 is a buried cultural unit eroding out of a 2.67-m-high cutbank along one side of Ridge B (see Figure 34). After exposing a clean face, 17 flakes were observed in the profile. Most of these lie between 0.96 and 1.73 m below the modern surface suggesting an 80-cm-thick cultural unit buried by approximately 1 m of sediments. Additional flakes were eroding out of the profile 2.17 m below the modern surface probably indicating a separate, deeper cultural unit. No charcoal, staining, or distinct strata are visible in the profile, but an unlined hearth, Feature 16, was noted near the lower flakes. This feature yielded the earliest radiocarbon date of any hearth sampled during the project—5290 ± 80 B.P. (see Table 22). As exposed in the profile, this feature is 37 cm wide and 15 cm deep. A flotation sample from Feature 16 yielded *Cyperus* sp. seeds and

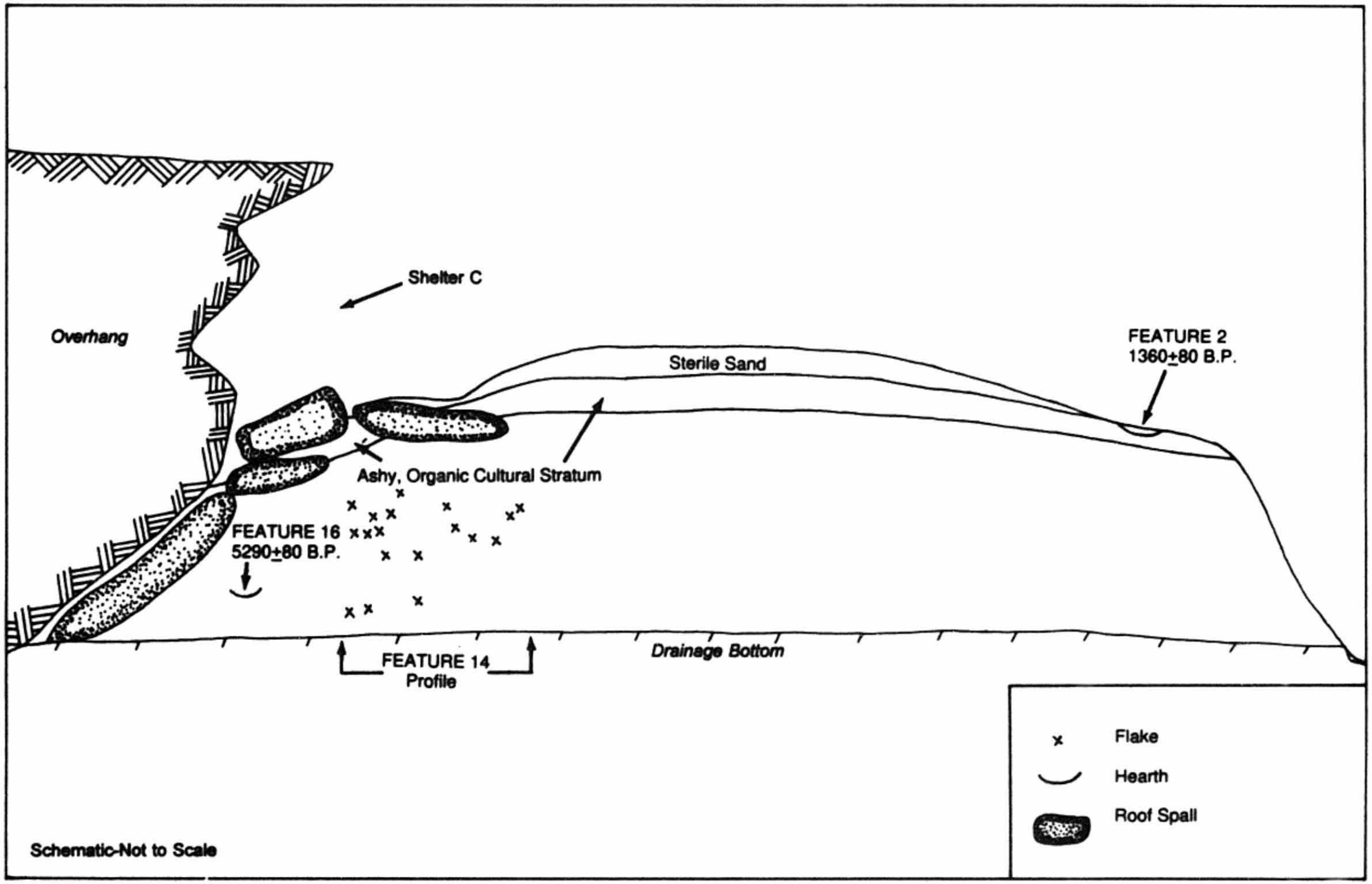

Figure 34. Schematic cross section of the deposits in front of Shelter C, site 42SA20615.

several taxa of terrestrial snails (see Chapter 2). The only noteworthy features besides the hearth and flakes are horizontal pieces of tabular sandstone at the level of the lowest flakes.

Artifacts

by André D. La Fond

A total of 36 flakes and 1 projectile point fragment was recovered during the limited testing. Twenty pieces of debitage were collected from Feature 1; the point may also come from this feature. Feature 15 yielded three pieces of debitage. Thirteen of the 17 pieces of debitage were recovered from Feature 14.

Of the 20 pieces of debitage from Feature 1, 15 are of Cedar Mesa Chert including 3 core reduction flakes, 1 early reduction flake, 1 early biface thinning flake, 4 final biface thinning/shaping flakes, 2 retouch flakes, 1 piece of angular debris, and 3 flakes of indeterminate type. In addition, one early biface thinning flake of brown chert, two retouch flakes, one of white chert and one of gray quartzite, one indeterminate flake of Summerville Chalcedony, and one early reduction flake of unknown chert were recovered from the stratum.

The Elko Corner-notched point is a proximal and midsection fragment (see Figure 19g). It is fractured in two places and one barb and the tip are truncated. The type of fracture that truncated the barb cannot be determined as the truncation appears to have been reworked. The tip was truncated by a bending fracture. In combination, these appear to be use-related fractures. The raw material incorporates three "varieties" of the Cedar Mesa material. The raw material at the base and one lateral margin of the point is Cedar Mesa Chalcedony. This grades into red-orange Cedar Mesa Chert in the central portion of the point and white Cedar Mesa Chert on the remaining lateral margin.

The debitage from Feature 15 consists of one early reduction flake, one retouch flake, and one indeterminate flake, all of Cedar Mesa Chert.

The collected debitage from Feature 14 consists of nine pieces of Cedar Mesa Chert: two core reduction flakes, three early reduction flakes, one early biface thinning flake, one final biface thinning/shaping flake, and two indeterminate flakes. In addition, one early reduction flake of other chalcedony, one core reduction flake of other chert, and two final biface thinning/shaping flakes of other chert were recovered from the unit.

As an assemblage, the debitage recovered from the site represents core reduction for the production of flake tools and/or flake blanks and bifacial tool production and maintenance.

Dating

The two noncontemporaneous dates from site 42SA20615 (see Table 22) indicate occupation during the Middle Archaic and Early Formative periods and are consistent with their stratigraphic positioning along Ridge B (see Figure 34). There is considerable cultural deposition between the levels containing the two features suggesting a good possibility for deposits dating to some or all of the following periods: Middle Archaic, Late Archaic, Terminal Archaic, and Early Formative. The cultural affiliation of the people responsible for the Early Formative hearth must be regarded as unknown because no diagnostic artifacts were seen or recovered from the cultural stratum where the hearth occurs. It is noteworthy, however, that the manos associated with the stratum are the one-hand variety. This and the lack of corn and other domesticates in the flotation sample suggest that the inhabitants were practicing a hunting and gathering lifeway.

Whirlwind Ridge

Environmental Setting

Whirlwind Ridge, site 42SA20301, lies on the north end of a sandstone ridge overlooking Salt Creek. The ridge has several levels, two small overhangs, and an uneven top surface characterized by basins, domes, and cracks. Overhang 1 is located at the base of the north end of the ridge and has a north-northeast exposure. An old meander of Salt Creek cut away the deep, sandy deposits north of the ridge leaving only a 2-m-wide strip of sand beneath this overhang; this strip of sand sits about 5 m above the surface of the adjacent terrace formed by the meander. This narrow, sandy strip evidences occupation but it is not known whether the strip was truncated to its present width before or after the occupation.

Overhang 2 is smaller, has a southwest exposure, and contains little headroom due to the thick accumulation of sandy deposits.

The ridge where the site is located is intermittently covered by deposits of eolian sand which support all on-site vegetation. The vegetation is somewhat sparse and open. The most common taxa are snakeweed, juniper, and various grasses. Also present are pinyon, Fremont barberry, sagebrush, Mormon tea, four-wing saltbush, greasewood, yucca, Indian rice grass, pepper grass, and prickly pear cactus.

Water would have been available on a perennial basis from Salt Creek, the current channel of which is about 200 m distant. A seasonal, but closer water source would have been the numerous natural basins eroded into the sandstone ridge where the site is located. These catchment basins range up to 2 m in diameter and 15 cm deep.

Site Description

On the surface, Whirlwind Ridge is represented by a medium density lithic scatter with two hearths and a variety of stone tools. Artifactual debris occurs in four main concentrations (Areas 1-4) covering approximately 84 m north-south by 78 m east-west. Area 1 is located west of the ridge and may derive from artifacts washing downslope off the ridge. It measures 48 m north-south by 8 m east-west and has 25-100 pieces of debitage with a maximum density of $13/m^2$. The primary material is Cedar Mesa Chert. Summerville Chalcedony is also common with some white chert and Cedar Mesa Chalcedony. Most of the debitage is from secondary thinning and final shaping of bifacial artifacts. There is also some shatter.

Area 2 lies on an accumulation of eolian sand in a rock-rimmed basin on top of the sandstone ridge. It measures 21 m north-south by 9 m east-west and has 100-500 pieces of debitage with a maximum density of $9/m^2$. Cedar Mesa Chert is again dominant, with some Summerville Chalcedony and algalitic chert. The debitage is mainly from secondary thinning and final shaping of bifacial tools.

Area 3 consists of Overhangs 1 and 2 and the sloping sandy deposits between them. This L-shaped area measures 12 m north-south by 33 m east-west. The artifactual assemblage consists of a biface fragment, 2 utilized cores, a one-hand mano fragment, 3 basin metate fragments, a slab metate fragment, a few tested cobbles, and 100-500 pieces of debitage; the maximum artifact density is $25/m^2$. Cedar Mesa Chert predominates. There are also algalitic, gray and white cherts and Summerville Chalcedony. Unlike the other areas, there is considerable evidence of a core reduction technology, in addition to a bifacial reduction technology emphasizing thinning and final shaping flakes. Also in Area 3 are two unlined hearths (Features 1 and 2), both of which lie in Overhang 1. Feature 1 is characterized by a light ash stain associated with five pieces of burned sandstone that may have vaguely outlined the feature. Feature 2 is a similar ash stain but with no associated stones.

Area 4 consists of a cluster of debitage and an indeterminate, moderately worn, metate fragment on the ridge top. This area measures a scant 4 m in diameter but has 100-500 pieces of debitage and a maximum artifact count of 22 $items/m^2$. The main chipped stone material is Cedar Mesa Chert. There are also Summerville Chalcedony and algalitic chert. Bifacial thinning flakes predominate.

Methods

Testing at this site consisted of excavating the northwest quarter of both hearths. One charcoal sample, two flotation samples, and several artifact lots were collected from Feature 1. Two charcoal samples, one flotation sample, and several artifact lots were collected from Feature 2.

Results

Feature 1

Feature 1 proved to be an unlined, quite shallow, vaguely basin-shaped firepit lacking oxidation. The feature has an irregular shape and contains mottled, reddish brown, fine-grained sand incorporating small bits of charcoal. Two flotation samples from the feature yielded charred macroplant remains of the following taxa: *Amaranthus* spp., *Chenopodium* spp., CRUCIFERAE, GRAMINAE, *Juniperus osteosperma*, *Portulaca oleraceae*, and *Stipa hymenoides*. Artifacts from the feature are discussed below.

Feature 2

Feature 2 is an unlined, slightly basin-shaped hearth containing mottled, brown to dark brown fine sand and charcoal (Stratum A), beneath sterile sand (Stratum B). The feature appears to have been an informally prepared, approximately circular firepit (Figure 35); it shows no evidence of hardening or oxidation such as might be expected from prolonged use. Charred macroplant remains from the single flotation sample consist of the following taxa: *Amaranthus* spp., *Juniperus osteosperma*, and *Stipa hymenoides*. A small debitage assemblage was recovered, as discussed below.

Artifacts

by André D. La Fond

A total of 39 pieces of debitage, 1 biface fragment, and 2 utilized cores was recovered from two features at this site. Feature 1 fill contained 29 flakes and 1 biface fragment; 3 flakes and a core were recovered from its surface. Feature 2 contained seven subsurface flakes and a surface core.

Feature 1 contained 24 flakes of Cedar Mesa Chert including 5 core reduction flakes, 4 early reduction flakes, 7 early biface thinning flakes, 2 final biface thinning/shaping flakes, and 6 flakes of indeterminate type. One early reduction flake of algalitic chert, one early biface thinning flake

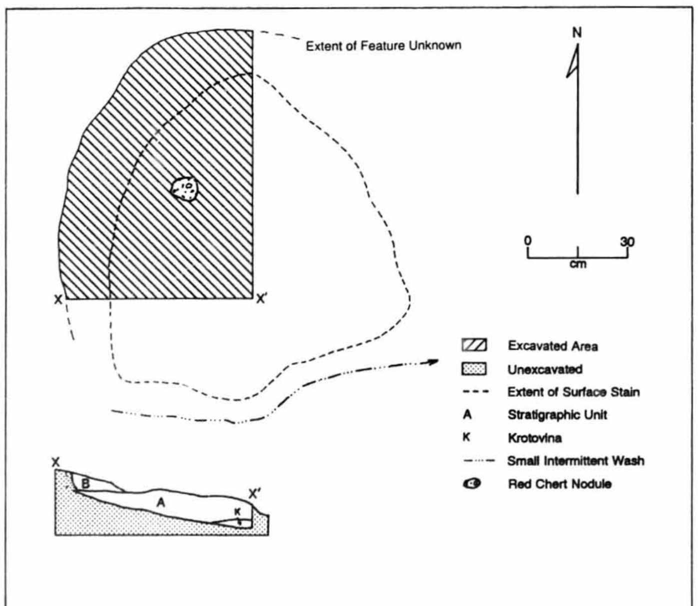

Figure 35. Plan map and profile of Feature 2, Whirlwind Ridge.

of gold chalcedony, one early reduction flake of white quartzite, and one final biface thinning/shaping flake of an unknown chalcedony were also recovered from the feature. The remaining four pieces of debitage are white chert which may represent the Cedar Mesa material. These flakes include one early reduction flake, two early biface thinning flakes, and one flake of indeterminate type.

The biface from Feature 1 is a proximal fragment of algalitic chert representing Stage 4 manufacture (cf. Callahan 1979). Under low-power magnification, there appears to be some very slight edge rounding on a few small portions of the lateral margins. However, this might be the result of edge preparation. A perverse fracture terminates the tool at its midsection. This type of fracture can result from manufacture error (Crabtree 1972). This artifact appears to represent an unsuccessful attempt at producing a refined bifacial tool.

A moderately large, multidirectional core of Cedar Mesa Chalcedony was recovered from the surface of Feature 1. The majority of the extant flake scars are too small to have resulted from removal of flakes suitable as blanks for even the smallest bifacial tools. Therefore, production of expedient flake tools is indicated at least for the last series of flake removals. Two rounded marginal projections exhibit heavy abrasion. This abrasion appears to result from utilization of the core in a scraping motion on a relatively hard material.

Feature 2 contained two early reduction flakes, one early biface thinning flake, one final biface thinning/shaping flake, and one retouch flake of Cedar Mesa Chert. In addition, one indeterminate flake of algalitic chert and one final biface thinning/shaping flake of Cedar Mesa Chalcedony were recovered from the feature.

The core from Feature 2 is a small multidirectional nuclei of Cedar Mesa Chert. The size of the flake scars indicates that the flakes removed would have been useful as blanks for only the smallest of bifacial tools (arrowhead-sized projectile points) or as expedient tools. One marginal area of the core exhibits a series of short, step-terminating flake scars which appear to have resulted from platform collapse. These failed attempts at flake removals are probably the cause of rejection of this core. However, two other marginal areas exhibit macroscopically visible crushing and microfracturing which appear to indicate utilization of the rejected core as a hammerstone. This battering is consistent with contact with a hard material.

The debitage from Feature 1 indicates a generalized set of reduction strategies with an emphasis on biface production. Although core reduction might have been accomplished to provide flake blanks for the biface production, it is also possible that the goal was to produce expedient flake tools. The debitage sample from Feature 2 appears to indicate that final bifacial reduction or, perhaps, maintenance of bifacial tools occurred nearby.

The early biface thinning flake of gold chalcedony from Feature 1 is the only piece of this extremely high-quality material recovered from the testing project. One lateral margin shows relatively extensive microfracturing. If this represents cultural usewear and not trampling or "bag wear," the small size of the artifact indicates that the implement was hafted to facilitate use.

Dating

The two radiocarbon assays from Whirlwind Ridge document occupation of the shelter during the last millennium before Christ. These dates are not contemporaneous at the 95 percent confidence level (Stuiver and Pearson 1993) but could still possibly be from a single occupation because of the old wood problem (Smiley 1985, 1994). The dates place site occupation in the Terminal Archaic period.

Squaw Butte Cove

Environmental Setting

Squaw Butte Cove, site 42SA20256, lies on the side of a Cutler Sandstone finger ridge near Squaw Butte. The general site area is characterized by a C-shaped sandstone bench which partially encloses a basin filled with orange, eolian dunes. The site lies on the bench forming the south end of the "C" and continues north into the basin inside the "C" (Figure 36). Several small drainages crosscut the basin. The basin is somewhat sheltered, not only by the surrounding rock outcrops but also by relatively tall and moderately

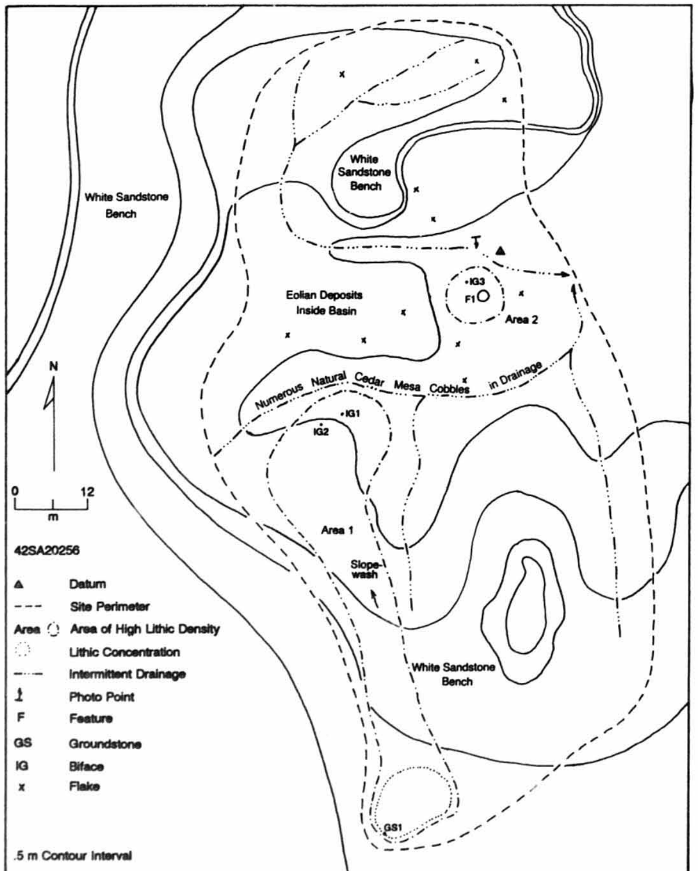

Figure 36. Plan map of Squaw Butte Cove.

dense vegetation consisting primarily of pinyon, juniper, Gambel oak, and snakeweed.

Other plant taxa present on the site are single-leaf ash, birch-leaf mountain mahogany, Mormon tea, four-wing saltbush, yucca, yellow cryptantha (*Cryptantha flava*), evening primrose (*Oenothera* sp.), prickly pear cactus, pepper grass, and various other grasses.

Squaw Butte Cove lacks an on-site water source but water would have been seasonally available in two natural catch basins eroded into the slickrock about 40 m north of the site. These basins are relatively large; one measures 5 by 7 m across and is 40 cm deep. The other is 3 m in diameter and about 30 cm deep.

Site Description

Squaw Butte Cove consists of a moderate size lithic scatter with a slab-lined hearth situated primarily in a sheltered basin or cove surrounded by outcropping sandstone. It has two discernible concentrations of artifacts with a sparse scattering of artifacts between them. The assemblage of surface artifacts is composed of a single-hand mano, 3 biface fragments, and up to 500 pieces of debitage. There is a maximum of 12 artifacts/m^2. The site measures 132 m north-south by 69 m east-west.

Area 1, the larger concentration, measures 72 m north-south by 12 m east-west. This area extends from the top of the sandstone bench forming the south end of the "C" to the north, down a slope to an intermittent east-flowing drainage that contains numerous chunks of unflaked Cedar Mesa Chert. Located within Area 1 are the single-hand mano, 2 biface fragments, and approximately 200-300 pieces of debitage which appear to have been produced using a bifacial reduction technology. The main lithic material is Cedar Mesa Chert; there are also a few pieces of Summerville Chalcedony and algalitic chert. Secondary and tertiary flakes predominate on top of the bench, but shatter and some decortication flakes are found in the drainage containing the natural chert cobbles.

Located in the basin near the toe of the east-trending drainage with the natural chert cobbles is Area 2, a discrete artifact concentration measuring approximately 9 m in diameter. This area contains a well-preserved, slab-lined hearth, a biface fragment, and 25-100 pieces of debitage. Cedar Mesa Chert is the main toolstone; there is also a small amount of Summerville Chalcedony. Debitage types are mostly secondary and tertiary flakes and shatter, with a few decortication flakes.

The slab-lined hearth, Feature 1, is marked by a circular, ashy stain outlined by two upright sandstone slabs. Some of the 16 pieces of tabular sandstone lying horizontally on and around the feature are probably other framing stones. These displaced stones cover an area measuring about 1.8 m in diameter.

Methods

Testing at Squaw Butte Cove consisted of excavating the northwest quarter of Feature 1. Three charcoal samples, three flotation samples, and one pollen sample were collected from the northwest quarter of the feature.

Results

Feature 1 is a circular, basin-shaped hearth filled with burned rock (Figure 37). The excavated portion of the hearth is lined with burned upright slabs that extend all the way to the floor of the feature. It is assumed that the remainder of the hearth is (or once was) similarly slab-lined, even though no additional slabs are visible on the surface. The unlined floor of the feature is unoxidized and simply marked by a change in coloration from the dark interior fill to the underlying, sterile, eolian sand. Because only one-quarter of the feature was excavated, exact dimensions are unknown, but extrapolating from the excavated area, the feature was approximately 1.4 m in diameter. Maximum depth is 26 cm below the modern surface.

The upper 2-8 cm of fill (Stratum B) is sterile, dark reddish brown, medium-grained, blow sand (Figure 38). Beneath this is a black unit of ash, copious charcoal, and burned rock in a compact matrix of medium-grained sand (Stratum A). The rocks occupy more space by volume than the fill and range from a few centimeters to more than 35 cm across. The majority of the rocks are sandstone, but two are unflaked chert chunks.

Three flotation samples from this feature yielded charred macroplant remains of six taxa: *Celtis reticulata*, *Chenopodium* spp., *Juniperus*

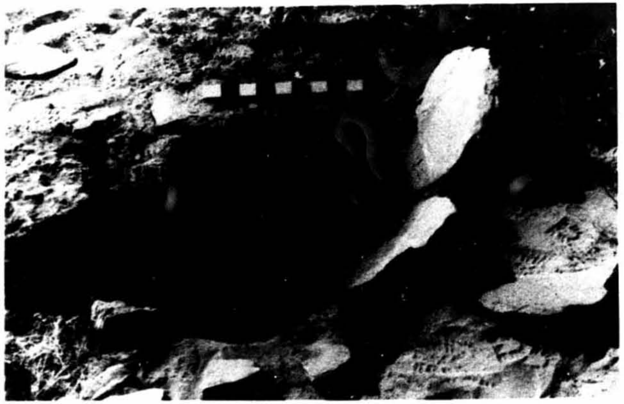

Figure 37. Slab-lined hearth at Squaw Butte Cove after excavation of the northwest quarter, looking southeast. Note the large amount of rock in the fill.

osteosperma, *Pinus edulis*, *Sphaeralcea* spp., and *Sporobolus* spp. No artifacts were recovered. The radiocarbon assay places occupation of the site sometime in the first few centuries before Christ (see Table 22). This is considered the Terminal Archaic period.

Site 42SA20292

Environmental Setting

Site 42SA20292 is located south of Salt Creek in and on a dune ridge that lies on a terrace above the current floodplain. There is a large (more than 25 m across), deep (2 m+), deflation basin near the northeast end of the ridge, within which lie most of the artifacts; this basin is surrounded by sandy slopes on the north, south, and east sides, but open to the west as the ground slopes down off the ridge top. The ridge surface south of the basin is hummocky and characterized by numerous shallow blowouts measuring up to a few meters across. Some of the blowouts are eroded approximately 25 cm to a hardpan layer, whereas others are shallower and have sandy floors. The hardpan layer is elevationally higher than the floor of the large deflation basin to the north, but its stratigraphic relationship is unknown.

Vegetation on the site ranges from moderate to sparse, with the most common taxa being rabbitbrush, greasewood, snakeweed, and various grasses. Four-wing saltbush, prickly pear cactus, and fishhook cactus are present in smaller amounts; juniper is limited to a few specimens. North of the site, in a marshy area along Salt Creek, are numerous riparian taxa including the introduced species tamarisk, as well as sedge, cattail, and grasses (see Figure 12). It is uncertain whether a marsh existed while the site was being occupied, but water and associated resources were clearly available in the immediate vicinity of the site.

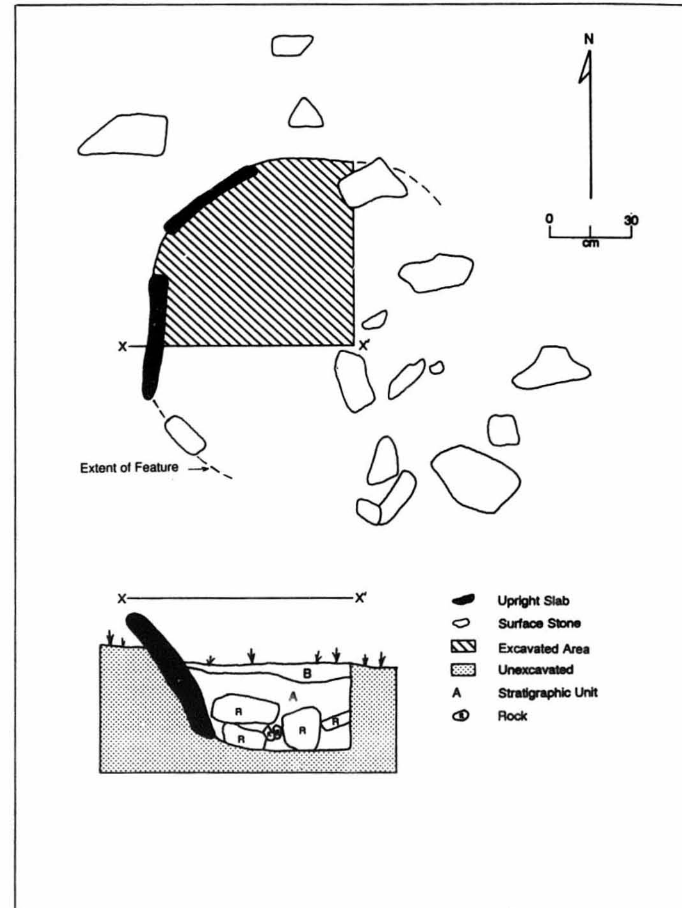

Figure 38. Plan map and profile of slab-lined hearth at Squaw Butte Cove.

Site Description

This site is a large, moderately dense (up to $10/m^2$) lithic scatter with several stone tools, three hearths, and a small burned stone scatter that could be the remains of a completely deflated fourth hearth (Figure 39). More features, including hearths, are probably buried.

The artifactual assemblage is composed of 7 bifaces, one of which was probably a hafted knife (see Figure 22a), a well-worn, one-hand mano, a well-worn basin metate fragment, a badly eroded sherd, and more than 500 pieces of debitage. The metate fragment was apparently reused as it is located in Feature 2 and appears to be a fire-cracked rock. The sherd is probably unrelated to the main site occupation as it was found in a blowout far south of the main artifact areas.

The debitage assemblage appears to represent advanced stages of core reduction with some bifacial thinning and final shaping. Most of the flakes are small to medium in size with only a few large chunks of angular shatter. Cedar Mesa Chert is the predominant material. The only other common material is Summerville Chalcedony. Rare materials are red-gold mottled chert, white chert with maroon mottling, yellow-brown chert, and algalitic chert. All material is of high quality.

The site measures 160 m northwest-southeast by 56 m northeast-southwest. Artifacts are primarily found on the north, east, and southeast slopes of the large deflation basin and continue northwest onto its floor. From there, they are washing downslope off the ridge to the northwest. Artifacts continue sporadically on the ridge top south and southeast of the large deflation basin. They lie both on the hardpan and in nondeflated areas of eolian sand between the blowouts. The distribution of artifacts on this site is clearly the result of erosional patterns. Artifacts likely continue under the dunes.

The three hearths are exposed at the north end of the site. Feature 1, an oval stain, is located on the basin floor. Feature 2, another oval stain, is located midway along the sloping side of the large deflation basin. Associated with Feature 2 are burned and fire-reddened sandstone fragments, one of which is a metate fragment. Feature 3 is a slab-lined hearth, marked by two visible upright sandstone slabs and a dark charcoal stain. This slightly oval feature is located on the south slope of the large deflation basin.

The fourth feature is a small scatter of burned sandstone bits located 4 m south of Feature 1. This burned rock scatter is not associated with stained earth but could be the remains of a completely deflated hearth.

Methods

The west half of Feature 1, the east half of Feature 2, and the southwest quarter of Feature 3 were excavated. Five flotation samples—one from Feature 1, one from Feature 2, and three from Feature 3—three carbon-14 samples—one from each feature—and one pollen sample from Feature 3 were collected during the testing. Several lots of chipped stone artifacts were recovered from the screened fill. The large biface that is probably a hafted knife was also collected.

Results

Feature 1

Feature 1 is a shallow, unlined, basin-shaped hearth with slightly sloping sides and a flat to slightly curved floor. It is probably deflated. The floor of the pit is not oxidized or hardened and is only recognized by a change in coloration from the dark interior fill to the sterile underlying sand.

The upper fill of this feature is composed of dark reddish brown, fine, eolian sand representing postoccupational deposition. Beneath this is a cultural unit of fine-grained, dark reddish brown, organically stained sand containing minute charcoal specks and a few charcoal chunks. The lowest unit is similar to the middle unit but contains less charcoal debris.

The single flotation sample from this feature yielded large amounts of charred *Juniperus osteosperma*. The artifacts are discussed below.

Feature 2

Feature 2 is a circular, basin-shaped hearth, with a sloping floor and walls. The feature is unlined indicating that the sandstone slabs lying on the surface were not part of a slab lining but simply fire-cracked rocks, presumably residue from the cooking process. The hearth appears to have

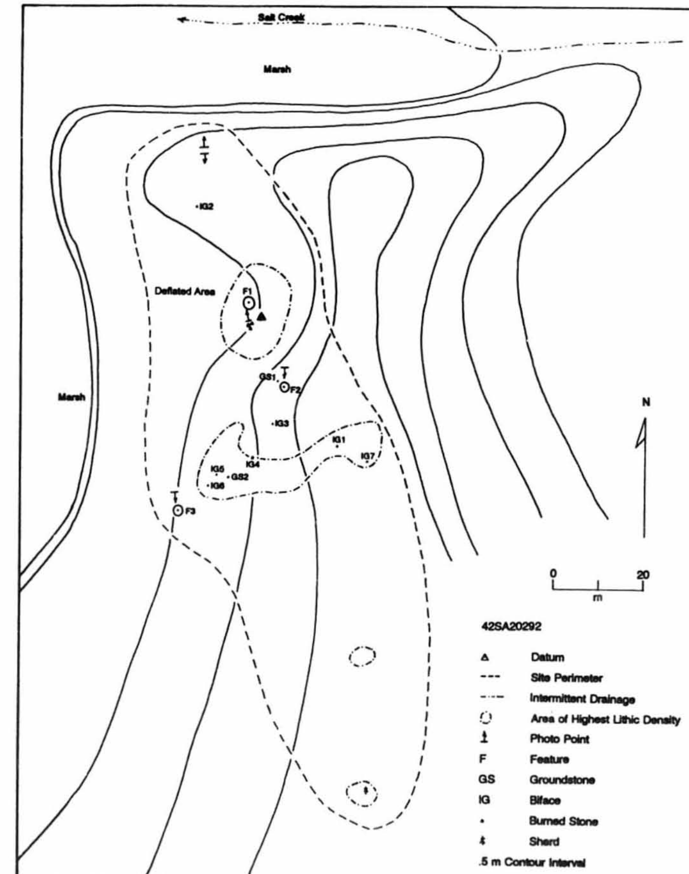

Figure 39. Plan map of site 42SA20292.

been deflated. The unoxidized floor is demarcated by a hardened surface, above which is loose sandy fill.

The fill is composed of mottled orange and brown-gray, fine-grained, eolian sand containing copious charcoal flecks and a few charcoal chunks. The majority of charcoal appears to derive from shrubs rather than trees and is probably from sagebrush.

This feature was not dated because insufficient charcoal was recovered from the tested half of the feature for regular processing. The bulk sediment sample, which contains sufficient fine charcoal for dating, will be curated for possible dating in the future.

A flotation sample from this feature yielded charred macroplant remains from five taxa: *Artemisia* spp., *Atriplex* spp., *Chenopodium* spp., CRUCIFERAE, and *Juniperus osteosperma*. Artifacts from this feature are discussed below.

Feature 3

Feature 3 is a slab-lined hearth (Figure 40). The floor of the feature is burned but not oxidized and marked by a change in coloration and sediment texture. The upper 5 cm± of fill is composed of sterile, reddish brown, postoccupational sand (Stratum C), beneath which is a brown sand with obvious organic content and some charcoal flecking (Stratum A). About midway through the lower brown unit is an ash- and charcoal-rich lens containing pieces of burned sandstone measuring 5-8 cm across (Stratum B).

Three flotation samples from this feature yielded charred seeds of *Chenopodium* spp. and *Juniperus osteosperma* macroplant remains. No artifacts were recovered.

Artifacts

by André D. La Fond

A very small sample of debitage was recovered from Features 1 and 2. The debitage sample from Feature 1 includes three final biface thinning/shaping flakes of Cedar Mesa Chalcedony, one final biface thinning/shaping flake of indeterminate chalcedony, and one indeterminate flake of white quartzite. The debitage sample from Feature 2 consists of one indeterminate flake of Cedar Mesa Chert, one final biface thinning/shaping flake of Cedar Mesa Chalcedony, and three early biface thinning flakes of indeterminate chalcedony. The combined debitage sample has limited interpretive value other than indicating that bifacial reduction was accomplished at the site using both local and nonlocal materials.

The probable hafted knife collected from the site surface (see Figure 22a) is a large Stage 5 biface (cf. Callahan 1979) of algalitic chert. This tool was carefully manufactured as evidenced by the careful thinning of the blade and the refined flaking pattern. The base has been carefully thinned and evidences slight edge rounding. In addition, a shallow notch has been worked into one corner of the base. In combination, these basal characteristics suggest that this tool might have been hafted.

Both lateral margins exhibit extensive retouch in the form of a well-executed series of small pressure flakes which extend the entire length. In addition, both lateral margins exhibit heavy edge rounding which also extends the entire length. A highly reflective, glasslike polish is associated with lateral margin edge-rounding but not with the basal margin edge rounding. The polish appears to be consistent to that referred to as "sickle sheen" or "corn polish" (Hayden 1979). As these terms imply, this form of polish is said to be associated with contact with vegetal materials. It should be noted that microfracturing is absent on all margins under low-power magnification. This tool is a maximum of 10.7 cm long, 5.4 cm wide, and 0.7 cm thick.

Dating

The radiocarbon assays from this site, one from an unlined basin hearth, the other from a slab-lined hearth, date to the last few centuries before Christ (see Table 22). These dates are contemporaneous at the 95 percent confidence level providing a pooled mean average of 2162 ± 46 B.P. for site occupation (Stuiver and Pearson 1993). This date has a tree-ring corrected age range of 370-50 B.C. at two sigma, placing it in the Terminal Archaic period.

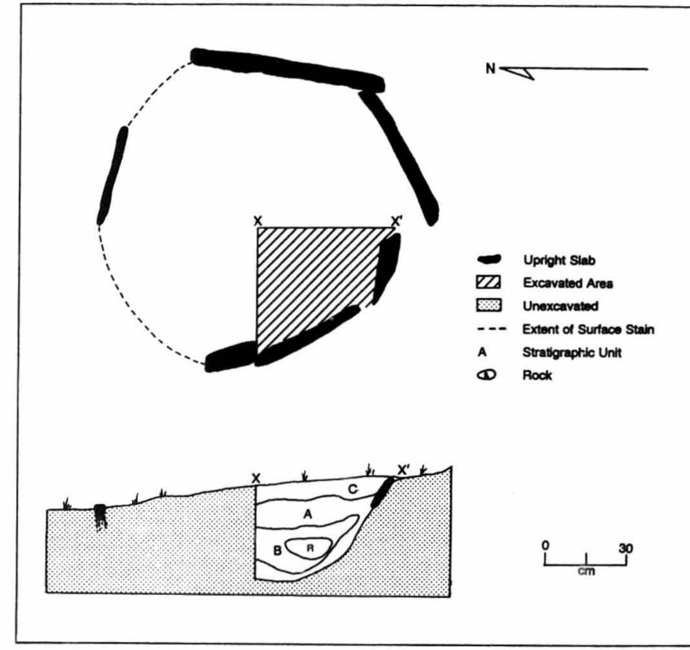

Figure 40. Plan map and profile of Feature 3, slab-lined hearth, at site 42SA20292

Site 42SA20258

Environmental Setting

This site is located near the head of a large cove in a sandy basin formed by a haystack-shaped, sandstone ridge on one side and some sandstone benches on the other. An ephemeral drainage cuts through the eastern edge of the site. Wind action has also impacted the site creating knolls and deflation basins, exposing bedrock, and leaving the tested feature atop a small, oblong island of undeflated orange sand. The site lies in a somewhat protected location.

On-site vegetation consists of Gambel oak, pinyon, and yucca. Also present are birch-leaf mountain mahogany, Mormon tea, snakeweed, pepper grass, and various other forbs and grasses. The nearest source of water would have been natural catch basins eroded into the sandstone ridge 7 m east of the site. These depressions range up to 2 m in diameter and 30 cm deep. A more distant, but perhaps more reliable water source would have been various springs in Squaw

Canyon Wash located about half a kilometer south of the site.

Site Description

The site consists of a small, discrete, dense scatter of more than 500 pieces of lithic debitage, several tools, and a partially slab-lined, oblong feature. Artifacts are concentrated (up to $59/m^2$) inside the feature, in blown-out areas in the surrounding dunes, and in the drainage along the site's eastern boundary; they are more sparsely scattered throughout the remainder of the site's 64-m north-south by 28-m east-west area.

Cedar Mesa Chert is the dominant toolstone within the debitage assemblage, with a wide variety of other materials also present: gray quartzite, brown, white, and algalitic cherts, and both Summerville and Cedar Mesa chalcedonies. Secondary thinning flakes representing a bifacial reduction strategy are predominant, with pressure flakes common, and decortication flakes and shatter rare. There are also several unflaked chunks of Cedar Mesa Chert on the site, as well as a small nodule of algalitic chert. The tool assemblage includes a large, well-made, Cedar Mesa Chert biface, a modified, brown chert flake, and the base of a corner-notched Elko point (see Figure 19a). A multidirectional Cedar Mesa Chert core was also observed.

Methods

Testing at this site consisted of excavating a 30-cm-wide trench across the northwest quadrant of the feature. The trench extended from the west edge of the feature to the approximate center and was 1.1 m long (Figure 41). Three bulk samples and two carbon samples were collected from the fill of the trench. Six artifact lots were also recovered.

Results

Feature

The slab-lined feature is oval in plan and is outlined by a double row of upright slabs at the north and northwest ends (Figure 42), and by another upright slab on the southeast side. Probing with a pin flag revealed other buried stones outlining the feature. Several horizontal stones lying in the feature and along its west side are presumably displaced framing stones.

The trench revealed a shallow pit (25 cm) with a poorly defined floor marked only by a change in color from the dark brown-gray fill to the underlying sterile orange sand. The floor of the feature, as exposed in the small trench, slopes gradually down from the framing stones and then more steeply down into a rounded basin toward the center. This lower basin has the highest concentration of charcoal and the darkest fill, possibly indicating that a fire was built in a basin-shaped pit in the center of the larger oblong feature. Burned flakes are common in the rounded basin, but not in other parts of the feature exposed in the trench. Outside of the interior basin, feature fill is composed of mottled brown sand with some charcoal chunks and bits and a few 1-2 cm burned pieces of sandstone which have a rounded, bubbly appearance (Stratum A).

A review of literature on Archaic, Anasazi, and Fremont cultures failed to locate similar features, although a 1- by 3-m slab-lined rectangle at Coffin Scatter (site 42KA2742) was tested by Northern Arizona University in the Escalante drainage system (Bungart and Geib 1987:96). A 50- by 50-cm test pit in the corner of this feature revealed a few centimeters of charcoal-stained fill underlain by sterile orange sand. Apparently, the feature was not dated nor sampled for flotation. Bungart and Geib (1987:96) are uncertain about the function of the feature but mention that "A similar feature excavated at an unreported site on Paiute Mesa had been used as a hearth during Basketmaker II (J. R. Ambler, personal communication 1982)."

Based on the small amount of testing, a definite function cannot be ascribed to the oblong feature at site 42SA20258. The fill is not consistent with its use as a hearth, roasting pit, or lithic heat treatment oven, nor is the concentration of artifacts around the interior, charcoal-filled basin. The enclosed ends further reveal it is not a slab-lined pithouse entryway. The slab lining, fill, and possible interior feature are consistent with a structure function if the interior basin and larger slab-lined feature are contemporaneous. The dimensions of the feature are small for such a function but not completely outside the range of

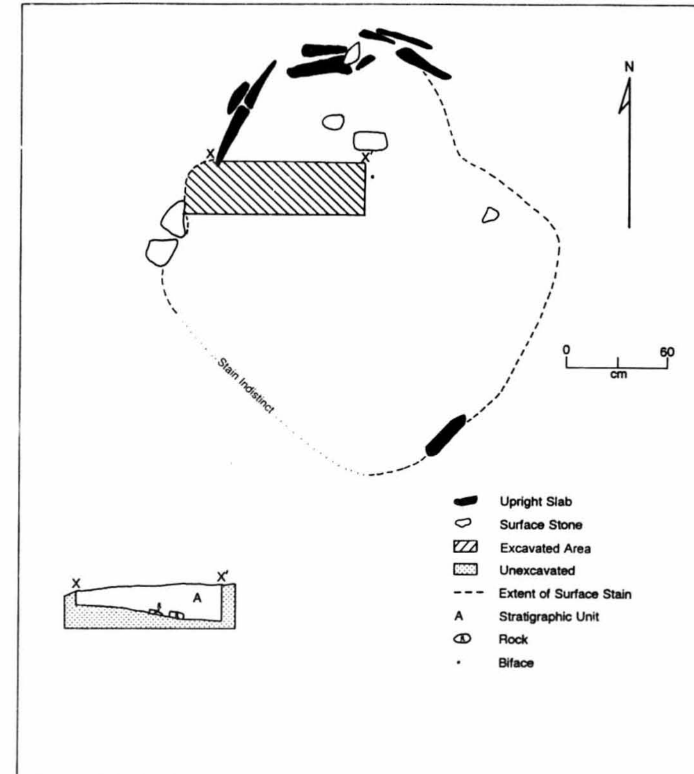

Figure 41. Plan map and profile of slab-lined feature at site 42SA20258.

others dating to a slightly earlier time period (e.g., Reed and Horn 1988; Seme and Lebo 1982). Additional investigations are needed before more conclusions can be drawn regarding this feature.

Three flotation samples from this feature contained charred remains of the following taxa: *Atriplex* spp., *Chenopodium* spp., *Descurainia pinnata*, *Phlox* spp., *Pinus edulis*, *Shepherdia* spp., and *Sporobolus* spp.

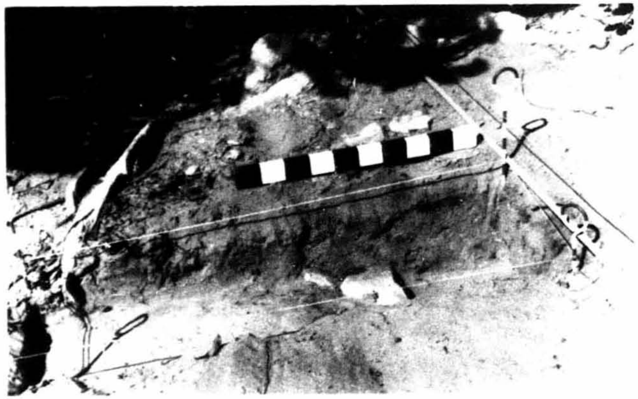

Figure 42. Slab-lined feature at site 42SA20258 after excavation of a trench in the northwest quadrant, looking northeast. Note the double slab lining and the increased slope of the feature's floor near the center.

Artifacts

by André D. La Fond

A total of 402 pieces of chipped stone debitage and 1 biface fragment was recovered from the trench through the oblong slab-lined feature. This is by far the largest sample recovered from any feature during the project. The biface fragment and 191 of the flakes are from the surface; the remainder are from the feature fill.

The biface is a proximal fragment of a relatively large Stage 4, Cedar Mesa Chert biface (cf. Callahan 1979). This tool was truncated at the midsection by a bending fracture. Bending fractures can be produced during manufacture via end shock or during use by excessive tension on the face of the blade (Crabtree 1972; Faulkner 1984). One lateral margin exhibits heavy edge rounding and microfracturing under low-power magnification which apparently represents usewear. The base of this tool has been carefully thinned by removal of a series of short narrow flakes from a single face of the artifact. This attention to basal thinning might indicate that this tool was hafted. This specimen appears to be a completed "knife-like" tool which was broken during use or rejuvenation.

Cedar Mesa Chert accounts for the majority of the debitage with 299 flakes. Twenty-two flakes are algalitic chert, 15 flakes are brown chert, 11 flakes are gray chert, 7 flakes are Summerville Chalcedony, 1 flake is Cedar Mesa Chalcedony, and 2 pieces of debitage are Cedar Mesa Limestone. The 45 remaining pieces of debitage represent at least 10 unknown varieties of chert and quartzite each of which occurs in limited quantities ($n \leq 7$ in all cases). Due to the small sample size and the unknown origin, these materials have limited interpretive value and will be subsumed under "unknown toolstones" for the purpose of this report.

The Cedar Mesa Chert sample includes 10 decortication flakes, 6 core reduction flakes, 26 early reduction flakes (indeterminate core

reduction or early biface thinning), 84 early biface thinning flakes, 82 final biface thinning/shaping flakes, 22 retouch flakes, 1 contact removal flake, 11 pieces of angular debris, and 57 flakes of indeterminate type. The sample indicates an emphasis on production and maintenance of bifacial tools. In addition, the contact removal flake is direct evidence that the bifaces were produced via a flake blank-biface reduction trajectory rather than a core-biface reduction trajectory. This would also appear to indicate that at least some of the core reduction was accomplished in order to provide flake blanks for biface production.

The algalitic chert sample includes 1 decortication flake, 13 early biface thinning flakes, 3 final biface thinning/shaping flakes, 2 retouch flakes, and 3 flakes of indeterminate type. Again, the emphasis is on the production and maintenance of bifaces. The higher frequency of early biface thinning flakes (59 percent of the algalitic chert sample) in comparison to the frequency of early biface thinning flakes in the Cedar Mesa Chert (28 percent) sample may be a reflection of raw material quality. Specifically, the algalitic chert is often very grainy and may not have been as suitable for production of refined bifacial tools. However, the presence of retouch flakes appears to indicate that some presumably crude bifaces were produced from this material at the site and subsequently utilized and maintained.

The brown chert debitage sample includes two early reduction flakes, seven early biface thinning flakes, three final biface thinning/shaping flakes, two retouch flakes, and one indeterminate flake. The debitage of the brown chert appears to represent the same type of reduction activities as indicated by the algalitic chert sample.

The gray chert debitage sample consists of five early biface thinning flakes, two final biface thinning/shaping flakes, and four flakes of indeterminate type. The emphasis of gray chert reduction at the site appears to have been late stage biface production and maintenance.

The Summerville Chalcedony debitage sample includes one early reduction flake, one early biface thinning flake, two final biface thinning/shaping flakes, two retouch flakes, and one indeterminate flake. This small sample is of limited interpretive value. However, it appears to reflect the same emphasis on bifacial reduction discussed above.

The single piece of Cedar Mesa Chalcedony is a final biface thinning/shaping flake. Both pieces of limestone are early biface thinning flakes. The presence of limestone in a debitage assemblage is unusual, particularly in light of the abundance of higher quality cherts. This material is soft and brittle, and it is generally not suitable for production of chipped stone tools. Utilization of this material in a biface reduction trajectory is particularly problematical.

The debitage sample of other toolstones includes 3 decortication flakes, 1 core reduction flake, 3 early reduction flakes, 16 early biface thinning flakes, 8 final biface thinning/shaping flakes, 2 retouch flakes, and 12 flakes of indeterminate type. The variety of toolstones represented by these flakes indicates a relatively wide range of access to toolstones.

Dating

The radiocarbon assay from this site suggests site occupation during the middle of the first millennium A.D. (see Table 22). The affiliation of the site inhabitants is uncertain because neither the testing nor the inventory produced culturally diagnostic artifacts. The date represents Early Formative occupation.

Site 42SA20251

Environmental Setting

Site 42SA20251 is located in an area characterized by sandstone benches and dunes. It extends from the north edge of a sandstone bench, down a short slope onto a lower level of dunes. The site area is generally open and exposed, though the bench provides some shelter for the lower, dune portion of the site.

The bench is composed of barren sandstone, intermittently covered with a few pockets of red, eolian sand. The lower portion is mainly undulating dune deposits with a few sandstone outcrops. The most common taxa on the site are juniper, pinyon, snakeweed, yucca, and various grasses. Also present are serviceberry, Gambel oak, birchleaf mountain mahogany, sagebrush, Mormon tea, four-wing saltbush, Fremont barberry, blackbrush, Indian rice grass, yellow cryptantha, Wyoming paintbrush, red penstemon (*Penstemon* sp.), prickly pear cactus, and hedgehog cactus. Large portions of the dunes are stabilized with cryptobiotic soil.

The nearest source of water would have been the numerous depressions in the sandstone bench on the south end of the site. A more reliable source of water would have been one or more springs in Squaw Canyon Wash.

Site Description

Site 42SA20251 consists of a large, sparse to moderately dense scatter of debitage and a large charcoal stain associated with some burned sandstone slabs. Flakes are most common on the sandstone bench at the south end of the site but continue to the north onto the dunes and rock outcrops below the bench. In the latter area, debitage is primarily exposed in pockets among the dunes with their distribution very much a consequence of drainage and deflation patterns. The site extends 105 m north-south by 110 m east-west, and has 100-500 pieces of debitage exposed on the surface and a maximum artifact density of 6/m^2.

Most of the debitage consists of secondary thinning flakes with a few pressure flakes and a limited amount of shatter. The debitage is generally small, with individual pieces being less than 3 cm long. Cedar Mesa Chert is the most common material, but a wide variety of other types are present in small quantities including quartzite, chalcedony, and various other cherts. The only tool observed on the site is a brown chert thinning flake that is unifacially worked on one edge. No ceramic artifacts or diagnostic stone tools were exposed on the site at the time of the inventory or testing.

The stain is located near the base of the northeast face of a moderately sloping dune, about 65 cm below its crest. It is characterized by dark gray to black ashy fill with visible charcoal chunks. The stain measures approximately 150 cm north-south by 160 cm east-west but has indistinct edges due to erosion and mottling with the surrounding sterile orange sand. Scattered in an arc across the northeast side of the stain are five large and numerous smaller pieces of burned sandstone. These stones appear too small for framing stones and their function is unknown. One flake was observed in the immediate vicinity of the feature.

Methods

Due to the large size of the feature and limitations of the project to minor testing, only the southwest quarter of the stain was excavated. As soon as excavation began, it became clear that the large stain actually encompasses several hearths whose upper fill had coalesced into a single surface stain. The southwest quarter of the stain contains a small hearth, Feature 1, which was excavated in its entirety, and the edges of two other hearths (Features 2 and 3), only the tops of which were exposed.

One charcoal sample and three flotation samples were collected from Feature 1. No samples were collected from Features 2 and 3 because these features were not excavated.

Results

Excavation of the southwest corner of the stain revealed portions of three hearths, all of which appear to be significantly deflated because they are only a few centimeters deep. Feature 1 is located entirely within the southwest quarter, whereas only the edges of Features 2 and 3 protrude into the excavated area. No artifacts or faunal remains were found during the testing.

Feature 1

Feature 1 is oval in plan, basin-shaped in profile (Figure 43). The floor and walls are unoxidized and appear to have been formed by scooping out an informal pit in the sterile orange sand. The loose, mottled fill is dark gray to black, is ashy, and contains numerous large chunks of wood indicating that trees rather than shrubs were being burned. A few small pieces of burned sandstone less than 5 cm across were present in the fill.

The three flotation samples from Feature 1 collectively yielded remnants of the following plant taxa: *Chenopodium* spp., CRUCIFERAE, GRAMINAE, *Juniperus osteosperma*, *Pinus edulis*, and *Sporobolus* spp.

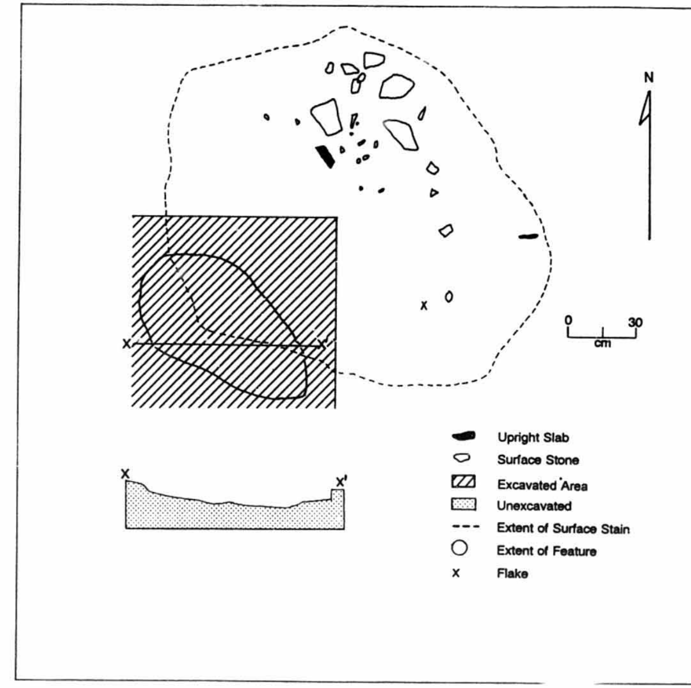

Figure 43. Plan map of Feature 1 and the large surface stain at site 42SA20251.

Features 2 and 3

Few details are available on Features 2 and 3 because only the outer edges were exposed during the testing. These features appear to be similar to Feature 1—shallow basins scooped out of the sterile orange sand—but their sizes and shapes are unknown. Because only one-quarter of the large stain was excavated, additional features may also be present.

Dating

A radiocarbon sample from Feature 1 produced a date in the latter portion of the first millennium A.D., 710-1010 (see Table 22). While this date occurs during the Pueblo I-II time frame, there is no corroborating evidence to verify that the site results from Anasazi occupation.

Macrobotanical Remains

by Nancy J. Coulam

Twenty flotation samples from six sites, Whirlwind Ridge, Squaw Butte Cove, 42SA20251, 42SA20258, 42SA20292, and 42SA20615, were analyzed to provide information about prehistoric human utilization of plant resources in the project area. The 20 flotation samples represent 11 different cultural features including unlined hearths, slab-lined hearths, a cultural stratum, and an oblong, slab-lined feature. (Five of the features had replicate samples analyzed.) The distribution of the samples by feature and site is given in Table 23.

Results

Diversity

Charred plants identified in the 20 flotation samples are presented in Table 24. As shown in this table, a total of 18 plant taxa from 13 plant families were identified. (Several unidentifiable plants were also present in the samples.) The number of identifiable plant taxa per flotation sample ranges from 1 to 8. When identifiable plant taxa from replicate samples from the same provenience are combined, the number of taxa *per provenience* ranges from 1 to 11. Figure 44 shows the diversity of plant taxa recovered from the features dating to two different time periods, portions of the Late/Terminal Archaic (990 B.C.-A.D. 10) and the Early Formative (A.D. 380-1010). (Three samples from three proveniences, site 42SA20292, Feature 2, and site 42SA20615, Features 1 and 16, are not included in this figure.) The figure shows a slight trend from a lower diversity of plant taxa ca. 990 B.C.-A.D. 10 to a higher diversity ca. A.D. 380-1060.

Features

The only deviations from the low diversity of taxa in the earlier samples are the seven plant taxa recovered from a slab-lined hearth from Squaw Butte Cove dated 410-40 B.C. and the 11 taxa recovered from the unlined hearth dated 990-430 B.C. from Whirlwind Ridge. Could there be differences in diversity due to type of features? Only one other slab-lined hearth was analyzed. This hearth was dated 360 B.C.-A.D. 10 and contained only two taxa: *Chenopodium* spp. and *Juniperus osteosperma*. These two taxa were also recovered from the slab-lined hearth at Squaw Butte Cove. Thus, slab-lined hearths contained both a high and low diversity of plant taxa and this range was within the range recovered from unlined hearths. Unlined hearths contained from 1 to 11 plant taxa with a median of 4.5 and a mean of 5.0. Two other types of cultural features were analyzed: an oblong feature which contained seven taxa and a cultural stratum which contained four taxa. Thus, diversity of plant taxa did not correlate with type of feature.

Ubiquitous Plants

The number of samples in which a particular taxon occurs is a *ubiquity count* and ubiquity is used to quantify the degree to which particular plants were utilized in the past. It is assumed that the higher the ubiquity, the more likely the plant was utilized as a prehistoric resource. The justification for this assumption is that plants are preserved in archeological sites primarily through carbonization, and carbonization occurs most often as a result of cooking accidents and fuel use. Hence ubiquity provides an approximate measure of the plants most often used, parched, or cooked over a fire and of plants used for fuel.

From the 20 Canyonlands flotation samples, plants with the highest ubiquity are *Juniperus osteosperma*, *Chenopodium* spp., *Pinus edulis*, and *Sporobolus* spp. These plants are present in 7-13 of the samples; thus, these plants were most likely prehistoric resources preserved through fuel use or cooking accidents.

The most ubiquitous plants are also the most ubiquitous noncharred plant remains. While not listed in Table 24, the presence of the uncharred ubiquitous plants in all the samples indicates that vegetation surrounding the sites in the past was similar to that of the present. This raises the question of whether the four ubiquitous plants were prehistoric resources or whether they were incorporated in the sites through natural processes.

Given known ethnobotanical uses of all four ubiquitous plants, it is likely that all four were important prehistoric plant resources. The two woody plants, *Juniperus osteosperma* and *Pinus edulis*, were undoubtedly utilized as fuel and

Table 23. Provenience of flotation samples from tested sites in the Squaw Butte Area.

Site Number	Site Name	Feature Number	Bulk Sample Number	Feature Type	Calibrated Age Range[a]
42SA20251	-	1	1	Unlined hearth	A.D. 710-1010
		1	2	Unlined hearth	
		1	3	Unlined hearth	
42SA20256	Squaw Butte Cove	1	1	Slab-lined hearth	410-40 B.C.
		1	2	Slab-lined hearth	
		1	3	Slab-lined hearth	
42SA20258	-	1	1	Oblong, slab-lined feature	A.D. 380-690
		1	2	Oblong, slab-lined feature	
		1	3	Oblong, slab-lined feature	
42SA20292	-	1	4	Unlined hearth	400-60 B.C.
		2	5	Unlined hearth	
		3	1	Slab-lined hearth	360 B.C.-A.D. 10
		3	2	Slab-lined hearth	
		3	3	Slab-lined hearth	
42SA20301	Whirlwind Ridge	1	2	Unlined hearth	990-430 B.C.
		1	3	Unlined hearth	
		2	1	Unlined hearth	760-180 B.C.
42SA20615	-	1	1	Cultural stratum	-
		2	2	Unlined hearth	A.D. 550-870
		16	3	Unlined hearth	4330-3960 B.C.

[a]The calibrated age range is the adjusted range of the calibrated date(s) at two sigma.

preserved due to incomplete combustion. Additionally, the presence of burned pinyon cones in site 42SA20258, Feature 1, and burned pinyon nuts in Squaw Butte Cove, Feature 1, and site 42SA20292, Feature 1, suggests that pinyon nuts were being roasted and consumed by the inhabitants of these sites. The tree-ring corrected age of these samples are A.D. 380-690, 410-40 B.C., and 400-60 B.C., respectively.

Charred (and uncharred) seeds from two non-woody plants were also ubiquitous: *Chenopodium* spp. and *Sporobolus* spp. Seeds of both *Chenopodium* spp. and *Sporobolus* spp. were staples of the prehistoric diet of the region and the presence of uncharred seeds of these plants reinforces the conclusion that the present vegetation is similar to that of the past and that prehistoric gathering and plant food utilization emphasized local resources.

Rare Plants

The 14 plant taxa with ubiquity counts of only 1-3 were most likely introduced to the sites through natural processes. However, all of the rare plants have known ethnobotanical uses (e.g., Harrington 1967) and some may have been brought into the sites as resources. For example, *Celtis reticulata* was only recovered from three samples: Feature 1 in site 42SA20258 (BS 3) and Features 1 (BS 1) and 2 (BS 2) in site 42SA20615. Though rare in the Canyonlands' flotation samples, it was widely utilized for its edible fruits and it was probably brought into sites

Table 24. Macroplant remains present in bulk flotation samples from tested sites in the Squaw Butte Area.

Scientific Name	Common Name	Ubiquity	42SA20251 Feature 1			Squaw Butte Cove Feature 1			42SA20258 Feature 1		
			1[a]	2	3	1	2	3	1	2	3
Amaranthus spp.	Pigweed	2	-	-	-	-	-	-	-	-	-
Artemisia spp.	Sagebrush	2	-	-	-	-	-	-	-	-	-
Atriplex canescens	Four-wing saltbush	2	-	-	-	-	-	-	-	-	-
Atriplex spp.	Shadscale, saltbush	2	-	-	-	-	-	-	-	1	-
Celtis reticulata	Netleaf hackberry	3	-	-	-	-	-	3	-	-	-
Chenopodium spp.	Goosefoot	9	3	-	-	-	-	15	-	2	3
CRUCIFERAE	Mustard family	3	-	1	-	-	-	-	-	-	-
Cyperus sp.	Sedge	1	-	-	-	-	-	-	-	-	-
Descurainia pinnata	Pinnate tansymustard	1	-	-	-	-	-	-	-	1	-
GRAMINEAE	Grass family	2	1	-	-	-	-	-	-	-	-
Juniperus osteosperma	Utah juniper	13	-	10	-	20	3	7	-	-	-
Phlox spp.	Phlox	1	-	-	-	-	-	-	-	1	-
Pinus edulis	Pinyon	7	1	1	-	5	5	15	6	2	-
Portulaca oleraceae	Purslane	2	-	-	-	-	-	-	-	-	-
Shepherdia spp.	Buffaloberry	1	-	-	-	-	-	-	-	1	-
Sphaeralcea spp.	Globemallow	1	-	-	-	1	-	-	-	-	-
Sporobolus spp.	Dropseed	7	80	208	24	20	3	2	4	-	-
Stipa hymenoides	Indian rice grass	3	-	-	-	-	-	-	-	-	-
Indeterminate		2	-	-	-	-	-	1	-	-	-
Total N taxa		18	4	4	1	4	3	6	2	6	1

[a]Bulk Sample (BS) number.

Table 24. Macroplant remains present in bulk flotation samples from tested sites in the Squaw Butte Area (continued).

Scientific Name	Common Name	Ubiquity	42SA20292 Feature 1	42SA20292 Feature 2	42SA20292 Feature 3			Whirlwind Ridge Feature 1		Whirlwind Ridge Feature 2	42SA20615 Feature 1	42SA20615 Feature 2	42SA20615 Feature 16
			4	5	1	2	3	2	3	1	1	2	1
Amaranthus spp.	Pigweed	2	-	-	-	-	-	-	1	9	-	-	-
Artemisia spp.	Sagebrush	2	-	5	-	-	-	-	-	-	-	2	-
Atriplex canescens	Four-wing saltbush	2	-	-	-	-	-	-	-	-	2	2	-
Atriplex spp.	Shadscale, saltbush	2	-	3	-	-	-	-	-	-	-	-	-
Celtis reticulata	Netleaf hackberry	3	-	-	-	-	-	-	-	-	10	5	-
Chenopodium spp.	Goosefoot	9	-	3	1	2	-	-	2	-	5	-	-
CRUCIFERAE	Mustard family	3	-	1	-	-	-	-	1	-	-	-	-
Cyperus sp.	Sedge	1	-	-	-	-	-	-	-	-	-	-	1
Descurainia pinnata	Pinnate tansymustard	1	-	-	-	-	-	-	-	-	-	-	-
GRAMINEAE	Grass family	2	-	-	-	-	-	-	1	-	-	-	-
Juniperus osteosperma	Utah juniper	13	800	5	1	-	1	23	21	272	1	2	-
Phlox spp.	Phlox	1	-	-	-	-	-	-	-	-	-	-	-
Pinus edulis	Pinyon	7	-	-	-	-	-	-	-	-	-	-	-
Portulaca oleraceae	Purslane	2	-	-	-	-	-	1	1	-	-	-	-
Shepherdia spp.	Buffaloberry	1	-	-	-	-	-	-	-	-	-	-	-
Sphaeralcea spp.	Globemallow	1	-	-	-	-	-	-	-	-	-	-	-
Sporobolus spp.	Dropseed	7	-	-	-	-	-	-	-	-	-	-	-
Stipa hymenoides	Indian rice grass	3	-	-	-	-	-	18	34	12	-	-	-
Indeterminate		2	-	-	-	-	-	-	1	-	-	-	-
Total N taxa		18	1	5	2	1	1	3	8	3	4	4	-

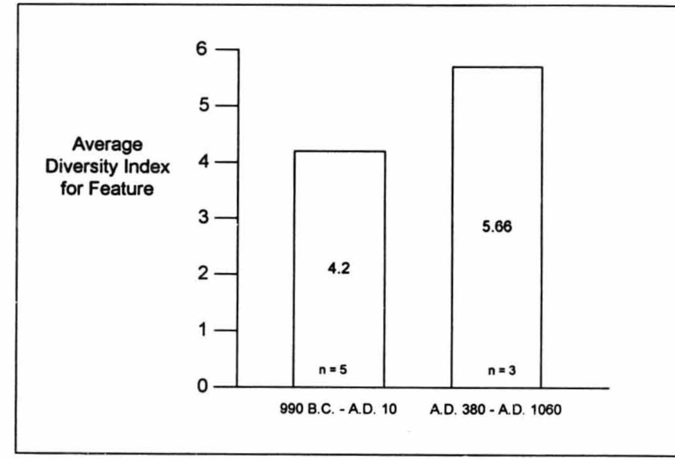

Figure 44. Diversity of plant taxa in features by two time periods.

42SA20258 and 42SA20615 as an edible resource.

Likewise, seeds of *Stipa hymenoides* (formerly *Oryzopsis hymenoides*) were widely utilized prehistorically and ethnohistorically and it is likely that this plant was burned in Features 1 and 2 from Whirlwind Ridge during food processing.

Discussion

Juniperus osteosperma, *Chenopodium* spp., *Pinus edulis*, and *Sporobolus* spp. were consistently utilized as resources by the prehistoric inhabitants of Canyonlands. *Chenopodium* spp., *Pinus edulis*, and *Sporobolus* spp. were probably collected near the sites and utilized as edible resources, while *Juniperus osteosperma* and *Pinus edulis* were probably utilized as fuel.

While the 14 other plants have known ethnobotanical uses, their low ubiquity counts indicate they were probably part of the natural composition of the sites. Exceptions to this may be *Stipa hymenoides* and *Celtis reticulata* which were widely utilized prehistoric and ethnohistoric edible resources. These plants were probably imported to Whirlwind Ridge, Squaw Butte Cove, and site 42SA20615 as edible resources.

While these plants appear to have been utilized resources, a surprising result was the absence of cultivated plants such as *Zea maize*, *Phaseolus vulgaris*, and *Cucurbita pepo*. While cultivated plants would not be expected from Archaic proveniences such as Feature 1 from Whirlwind Ridge, they are expected from the more recent Basketmaker- or Pueblo-age proveniences such as those at sites 42SA20251 and 42SA20615. It could be argued that the absence of cultivated plants is the result of sampling error; however, seven samples were processed from Early Formative proveniences from sites 42SA20251, 42SA20258, and 42SA20615. In addition, 11 samples were processed from proveniences falling within the Terminal Archaic or Basketmaker time ranges; i.e., samples from Squaw Butte Cove, Whirlwind Ridge, and site 42SA20292. If in fact the hallmark of Basketmaker is the presence of agriculture, then it is possible that the absence of cultivated plants indicates an Archaic cultural affiliation for these sites.

Archeobotanically, the Late and Terminal Archaic are the most poorly sampled cultural periods on the northern Colorado Plateau, but, given the present data base (e.g., Coulam 1988), it appears that the lowest diversity of utilized plants occurred during these periods. In the Canyonlands' data presented here, the greatest number of plant taxa from any one provenience came from a Terminal Archaic unlined hearth dated 990-430 B.C. This hearth contained 11 different taxa. However, other Terminal Archaic (or possibly Basketmaker) features contained relatively few taxa; the diversity of taxa generally increased only after A.D. 400. This result agrees with that reported from most of the Southwest.

Throughout the Southwest, it has been documented that along with an increasing reliance on maize agriculture from Basketmaker to Late Pueblo times, there was an increased utilization of wild plants and animals (Gasser 1982). While archeological research in Canyonlands has been limited and there is as yet no additional documentation for such diversification, there is evidence from nearby Glen Canyon that diversification of plant resources occurred. Data from Fry and Hall (1975) and Fry (1977) suggest use of an increasing number of plants in the later Pueblo periods.

Flotation Summary

In summary, the cultural affiliation of these sites cannot be addressed solely with flotation data; however, the absence of cultivated plants is suggestive of an Archaic cultural affiliation for all but the most recent sites. As with other Terminal Archaic archeobotanical data, the diversity of plants was fairly low and a slight increase in diversity occurred through time. Flotation of the Terminal Archaic samples from Canyonlands provides additional data that the low diversity of utilized plants in the Terminal Archaic may indeed be accurate and not simply sampling error. Certainly, the addition of these samples to the archeobotanical data base is an important contribution to the Canyonlands Project.

The ubiquity counts presented here indicate that at least four plants were commonly utilized by the prehistoric occupants of Canyonlands: *Juniperus osteosperma*, *Chenopodium* spp., *Pinus edulis*, and *Sporobolus* spp. These plants were apparently utilized from the Terminal Archaic to Pueblo times. Additional plants appear to have been utilized at particular sites or particular time periods; e.g., seeds of *Stipa hymenoides* were apparently eaten between 990 and 180 B.C. at Whirlwind Ridge. *Celtis reticulata* was probably eaten at two sites: Squaw Butte Cove during 410-40 B.C. and at site 42SA20615 from A.D. 550 to 870.

Artifacts

by André D. La Fond

As previously implied, the debitage sample from the project is small and, therefore, has limited interpretive value. However, some tentative conclusions can be drawn from the assemblage.

Material Types

Debitage type frequencies by raw material are provided in Table 25. Confirming observations made during inventory (see Chapter 3), Cedar Mesa Chert is the most common material type in the assemblage accounting for 72.9 percent (n=366) of the recovered debitage. Other previously identified toolstones (see Chapter 3) show up in limited quantities: algalitic chert 5.0 percent (n=25), brown chert 3.4 percent (n=17), gray and gray-brown chert 2.4 percent (n=12), Summerville Chalcedony 1.8 percent (n=9), Cedar Mesa Chalcedony 1.2 percent (n=6), and Cedar Mesa Limestone 0.4 percent (n=2). Other cherts, quartzites, and chalcedonies which have not been formally recognized in this or previous reports (e.g., Sharrock 1966; Tipps and Hewitt 1989) account for the remaining 13.1 percent (n=66). Some of these may represent variations of the recognized types. None of these occur in sufficient quantities to warrant identification of new types at this time.

With the exception of Cedar Mesa Chert, Chalcedony, and Limestone, the exact locations of sources of the recovered materials are unknown. The limited size of the assemblage recovered from the testing is not sufficient to determine the direction and distance to the sources of the other materials but it appears as though none of these materials is available in the immediate vicinity of the sites. Specifically, the debitage types

Table 25. Debitage type by raw material from tested sites in the Squaw Butte Area.

Material Type	Decorti-cation	Core Reduction	Early Reduction	Early Biface Thinning	Final Biface Thinning/ Shaping	Retouch	Bipolar	Contact Removal	Notching	Pot Lid	Angular Debris/ Shatter	Indeter-minate/ Other	Total
Chert													
Cedar Mesa	10	20	37	99	90	26	-	1	-	-	12	71	366
Algalitic	1	-	2	13	3	2	-	-	-	-	-	4	25
Brown	-	-	2	8	4	2	-	-	-	-	-	1	17
White	-	-	1	3	-	1	-	-	-	-	-	2	7
Gray	-	-	-	2	2	-	-	-	-	-	-	1	5
Gray-brown	-	-	-	3	-	-	-	-	-	-	-	3	6
Other	3	2	4	12	9	1	-	-	-	-	-	11	42
Chalcedony													
Summerville	-	-	1	2	2	2	-	-	-	-	-	2	9
Cedar Mesa	-	-	-	-	6	-	-	-	-	-	-	-	6
Other	-	-	1	5	2	-	-	-	-	-	-	-	8
Quartzite													
Gray	-	-	-	1	1	1	-	-	-	-	-	-	3
White	-	-	1	-	-	-	-	-	-	-	-	1	2
Purple	-	-	1	-	-	-	-	-	-	-	-	-	1
Other	-	-	-	1	-	1	-	-	-	-	-	1	3
Limestone													
Cedar Mesa	-	-	-	2	-	-	-	-	-	-	-	-	2
Total	14	22	50	151	119	36	0	1	0	0	12	97	502

NOTE: This table includes 15 pieces of debitage from site 42SA1455 that were recovered during limited testing of a stain which proved to be natural. Although the unsuccessful testing is not documented in this report, the artifacts are included in this table and the final summary discussion.

The 15 pieces of debitage were recovered in the vicinity of the natural stain. Ten of these are Cedar Mesa Chert. Algalitic chert, brown chert, white chert, purple quartzite, and Summerville Chalcedony each account for one piece. Four pieces of Cedar Mesa Chert are core reduction flakes, five pieces are biface thinning flakes, and one is indeterminate. The algalitic chert and purple quartzite specimens are early reduction flakes. The Summerville Chalcedony item is an early biface thinning flake. The brown chert debitage is a final biface thinning/shaping flake. The white chert item is an indeterminate flake type.

emphasize later stages of lithic reduction. No angular debris/shatter, no core reduction flakes, and only one decortication flake of algalitic chert were recovered from the other material types.

Except for the gray chert, all of these materials occur on sites in both inventory parcels. All of the gray chert was recovered from a single site (42SA20258) in the Squaw Butte inventory parcel. A source to the west or south of the project area might be weakly indicated, but this is merely speculative at this point in time.

As noted in Chapter 3, Cedar Mesa Chalcedony derives from the Cedar Mesa Formation which outcrops throughout the project area, but its availability appears to be limited to patches within larger Cedar Mesa Chert nodules. The sample of Cedar Mesa Chalcedony is extremely small. However, the fact that all flakes of this material are final biface thinning/shaping flakes indicates that this material was not procured near any of the sites on which it occurs and that this toolstone was transported to the sites in the form of later stage bifaces. Only one flake of this material was recovered from the Squaw Butte inventory parcel. This flake was recovered from site 42SA20258 which has the largest debitage sample (n=402) and the most diverse representation of material types. The remaining five pieces are from small debitage samples in the Salt Creek inventory parcel: site 42SA20292 (total debitage n=10; Cedar Mesa Chalcedony n=4) and Whirlwind Ridge (total debitage n=39; Cedar Mesa Chalcedony n=1). This might weakly suggest a toolstone source to the east or north of the project area. Although this is also merely speculative at this point, it is consistent with observations from inventories in the Salt Creek Pocket and Squaw Butte areas (see Table 9).

Reduction Strategies

The debitage type frequencies clearly indicate that the major emphasis of lithic reduction at the sites was the production and maintenance of bifacial tools with a lesser representation of core reduction. There is no definitive evidence that flintknapping activities included the production of projectile points. Specifically, no notching flakes were recovered. However, this does not rule out the possibility that projectile points were manufactured on these sites. Most notching flakes would be too small to be recovered by a one-quarter-inch mesh screen. In addition, experiments by the analyst indicate that they often shatter on removal and their thin cross sections would make them particularly subject to postdepositional breakage.

The presence of one contact removal flake in debitage recovered from site 42SA20258 is definite evidence that at least some portion of the bifacial reductions were executed on flake blanks. Therefore, some portion of the core reduction flakes from this site (and probably other sites in the project area) were produced while attempting to manufacture flakes suitable for use as blanks. However, this does not rule out the reduction of cores on these sites for the specific purpose of manufacturing flakes suitable for use as expedient tools. Given the relatively poor quality of much of the Cedar Mesa Chert represented in the debitage recovered during the project and the abundance of outcrops of this toolstone in the area, it is probable that utilization of the material for production of expedient tools did occur (cf. Andrefsky 1994).

In addition, the relatively small flake scars on one of the two cores from Whirlwind Ridge indicate core reduction for the specific purpose of obtaining expedient flakes for tools.

Bipolar flakes are absent in the debitage assemblages. Bipolar reduction is a technique which allows for the reduction of small pieces of toolstone (Forsman 1975). Under certain conditions, the presence of bipolar flakes can represent conservation of toolstone via scavenging and further reducing broken and/or worn and discarded tools (Skinner n.d.). It is not surprising that there is no indication of this behavior in the debitage assemblages given the ubiquitous occurrence of Cedar Mesa Chert in the project area.

Heat Treatment

Only seven flakes meet the strictest criterion for determining heat treatment of toolstone, that is, dull, preheat treatment flake scars succeeded by glossy, postheat treatment scars on a single artifact. These seven flakes include five core reduction flakes of Cedar Mesa Chert (one each from Whirlwind Ridge and sites 42SA1455 and 42SA20258, and two from site 42SA20615). The two remaining specimens are early biface thinning flakes of Cedar Mesa Chert and white chert (both

from site 42SA20258). Using this conservative approach of identifying heat treatment, the lack of heat treated flakes representing later stages of reduction is as expected. As reduction progresses, it is less likely that any dull preheat treatment surface will remain. However, the presence of heat treated core reduction flakes is somewhat unusual and will be discussed below.

To get a more accurate and less conservative indication of heat treatment occurrence, the Cedar Mesa Chert artifacts were compared to samples of Cedar Mesa Chert that had been experimentally heat treated for this purpose (see Appendix G). On the basis of luster, 61 percent of the Cedar Mesa Chert has been heat treated (total: n=366; heat treated: n=225). The frequencies of heat treated specimens by debitage type are presented in Table 26. The relatively high frequency of heat treated debitage is apparently a reflection of the emphasis on bifacial reduction. Most Cedar Mesa Chert is a relatively grainy, tough material in its natural state. Refined reduction involving soft hammer percussion and/or pressure flaking would be difficult without heat treatment of the toolstone.

Using this less conservative approach to identifying heat treatment, the number and percent of heat treated flakes dramatically increases for later stages. The higher percentages of heat treated toolstone from later reduction stages probably reflect risk reduction. Although toolstone becomes easier to flake after heat treatment, it also becomes more brittle (Domanski and Webb 1992). Heat treated toolstone is, therefore, more prone to manufacture related breakage than toolstone in its natural state. Experiments by the analyst indicate that earlier stages of reduction which involve the removal of relatively large masses of toolstone and require the application of greater force are more likely to succeed without breakage on less brittle, natural toolstone than on heat treated toolstone. Therefore, less risk is involved by heat treating the stone later in the manufacturing process.

The presence of some heat treated decortication and core reduction flakes is somewhat unusual for two reasons. First, it is difficult to effectively control the rate of temperature increase and decrease in large masses of toolstone (Luedtke 1992). As a result, larger, thicker masses of toolstone such as cores are more prone to thermal failure (crazing, pot lidding, and macrofracturing) than are smaller, thinner pieces such as flake blanks or preforms. Second, due to the increased brittleness of heat treated toolstone, flakes detached from a heat treated core are more likely to break on detachment and become unsuitably small for utilization as blanks. However, flakes removed from heat treated nuclei have sharper, although less durable, edges than those removed from natural nuclei (Luedtke 1992). Therefore, flakes removed from heat treated nuclei may be better suited for utilization as expedient tools for certain tasks. This might explain the heat

Table 26. Frequency of heat treated Cedar Mesa Chert by debitage type.

Debitage Type	Total Debitage	Total Heat Treated Debitage	% Heat Treated
Decortication	10	2	20
Core reduction	20	12	60
Early reduction	37	21	57
Early biface thinning	99	56	57
Final biface thinning/Shaping	90	76	84
Retouch	26	23	88
Contact removal	1	1	100
Angular debris/Shatter	12	2	17
Indeterminate/Other	71	32	45
Total	366	225	

treatment of cores as evidenced in the debitage recovered from the project. However, heat treatment of cores in order to gain better control of the toolstone for production of flakes suitable for biface blanks cannot be ruled out.

No pot lid "flakes" were recovered during the project. In addition, no toolstone with crazing or macrothermal fractures were recovered. Therefore, there is no direct evidence of heat treatment of toolstone having been conducted at these sites. However, successful heat treatment will not produce these features. Therefore, the possibility of heat treatment having occurred at these sites cannot be ruled out.

Artifact Summary

In summary, core reduction and biface reduction of Cedar Mesa Chert represent the primary lithic reduction activities at the sites. Heat treatment was an integral factor in the reduction of this toolstone. All other toolstones, including Cedar Mesa Chalcedony and Summervillle Chalcedony, were only a minor factor in the reduction activities at the sites. The emphasis on later stages of bifacial reduction in these other toolstones indicates that these materials were transported to the sites in the form of relatively refined bifacial tools.

Summary and Discussion

Limited testing was undertaken at six sites in the Squaw Butte Area. Testing focused on sampling features for radiocarbon dates and flotation samples. Four of the tested sites are open lithic scatters situated in predominantly dune environments. The two other sites—Whirlwind Ridge and 42SA20615—are associated with shallow overhangs. A total of 11 features was tested at these 6 sites. Three additional features were evaluated and minimally investigated at site 42SA20615: two cultural strata and an unlined pit. The sites and features were selected for testing based on the belief that they would provide information relevant to the research issues discussed at the beginning of the chapter. They represent a large percentage of the sites in the project area with radiocarbon-datable surface features.

Except for site 42SA20615, the sites are typified by debitage scatters with one to three unlined and/or slab-lined surface hearths and occasional chipped stone or groundstone tools; only one outlying and probably intrusive sherd was noted on one of the sites. These sites have every indication of having been used for relatively short periods of time. Site 42SA20615 is a much larger, more complex site with a variety of features and artifacts that evince occupation on numerous occasions from at least the Middle Archaic through the Pueblo II-III period.

The 11 features tested during the project include 7 unlined hearths, 2 slab-lined hearths, an oblong, slab-lined feature, and a midden. The unlined hearths are circular to oval in plan view, are basin shaped in profile, and range from 48 by 43 cm to 88 by 91 cm across. Most are less than 10 cm deep but probably deflated. The buried unlined hearth at site 42SA20615 is 15 cm deep. The two slab-lined hearths are much larger than the unlined features, 124 by 113 cm and 140 cm in diameter. Depths are 36 cm and 26 cm, respectively. Neither feature has a slab-lined bottom, although one is full of burned rock. The unlined hearths were probably general-purpose features used for cooking, heating, lighting, and pest abatement. The slab-lined features may have had a more specialized purpose, that of roasting or baking. Neither slab-lined hearth was accompanied by visible piles of thermally altered rock from previous use or cleaning.

The oblong feature is 155 by 230 cm in plan and partially outlined by a double row of upright slabs. It contained a small interior pit that resembled an unlined basin-shaped hearth. Otherwise, the fill was lightly stained. This feature could be a small structure. Finally, a small test probe confirmed the presence of a cultural midden at site 42SA20615. In the sampled area, this midden has up to 70 cm of cultural fill consisting of Anasazi remains overlying apparently aceramic deposits.

At least one flotation sample, but often replicate samples, was collected from each of the tested features except the midden. One or more samples were analyzed from each feature. Radiocarbon samples were taken from all features with sufficient organic remains; these samples consist of charcoal or burned sediment because no other organic materials were encountered (e.g., corn). Nine of the collected samples have been processed as of this writing. The others will be

curated for possible future analysis. Artifacts encountered during the testing were collected but are generally few in number and are not necessarily representative of the larger site assemblages. No bone was discovered. The remainder of this discussion addresses the research issues presented at the beginning of this chapter.

Chronology

Radiocarbon dates from the Squaw Butte Area add to the growing body of evidence soundly refuting Sharrock's (1966) notion that there was no prehistoric occupation in the Needles District prior to A.D. 1075. The radiocarbon record from the six tested sites, although intermittent, spans a relatively long period—from approximately 4300 B.C. to A.D. 1000. The majority of dates cluster in the last millennium B.C. and all but one cluster in the two millennia straddling the transition to the Christian era (Figure 45).

None of the tested sites produced corroborating evidence for the Early Archaic, but the Middle Archaic is represented by a calibrated date of 4330-3960 B.C. from the deeply buried unlined hearth at site 42SA20615. This feature was not visible when the site was originally recorded nor when it was later tested, attesting to the visibility problems that may exist with Middle Archaic sites. The remainder of the dates document Terminal Archaic and Early Formative occupation. The absence of dates from Pueblo II-III is not because such sites are lacking in the study area; it is because we tried—and were apparently successful—at focusing the testing on earlier sites.

The small assemblage of Squaw Butte dates, when combined with other recent dates from excavation projects in or near the project area (Dominguez 1994; National Park Service 1990; Reed 1993; Tipps and Hewitt 1989), suggests that the ubiquitous, nondiagnostic open lithic scatters may represent several different time periods and cultural groups. If the available dates are any indication, some of the open lithic scatters may date to the as yet poorly documented Archaic period, others may be later, aceramic, limited activity sites used by Formative peoples, but many date to the two millennia that straddle the transition into the Christian era.

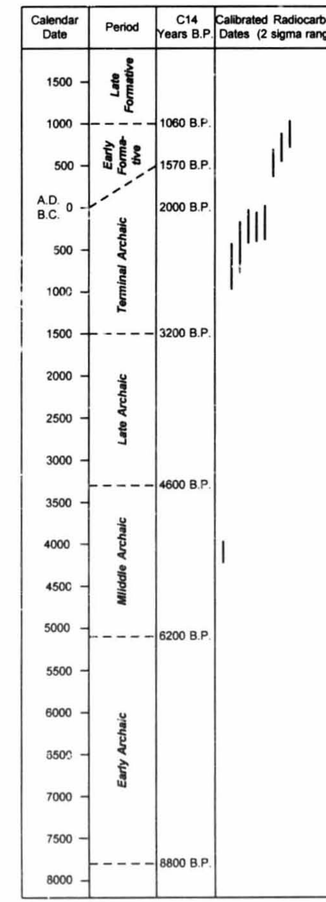

Figure 45. Distribution of Squaw Butte Area radiocarbon dates by temporal period.

As noted at the beginning of the chapter, the inventory data documented occupation of the Squaw Butte Area during the Early, Middle, and Late Archaic periods and again during Pueblo II-III but failed to indicate human presence during the 2600-year period between approximately 1500-1000 B.C. and A.D. 1100. It was suspected that this gap in the local chronological sequence did not represent a hiatus, at least for the period from 1500 B.C. until circa A.D. 400-500, but rather was due to the lack of diagnostic traits likely to be visible during surface inventory. In fact, this is the case. Eight of the Squaw Butte dates document occupation during this time period.

Some of the sites were expected to date to the 2600-year interval, but it came as somewhat of a surprise that all but one did. Clearly, some cultural or natural process or a combination of factors precipitated this pattern.

In the Orange Cliffs area a short distance southwest of Canyonlands, Bungart (1990) undertook a similar testing program which, radiometrically, produced similar results. His tree-ring corrected radiocarbon dates range from 1870-1130 B.C. to A.D. 420-660 at two sigma (Table 27), with the majority concentrating in the millennia just before and just after Christ. Based on his suite of dates, Bungart (1990:68) concludes that there was ". . . a substantial increase in occupation . . . between 3200 and 1500 years [circa 1500 B.C.-A.D. 550] BP . . . " which was ". . . fostered by a combination of environmental factors," i.e., more mesic climatic conditions and the recent availability of pinyon. Subscribing to Berry and Berry (1986:319), Bungart (1990:59) implies that migration and expansion of Great Basin populations are responsible for increasing population levels and, hence, the concentration of dates.

While I agree with Bungart (1990) that climatic conditions ameliorated, it is hard to believe that populations migrating from the eastern Great Basin are responsible for the Terminal Archaic occupation in the Squaw Butte Area. No diagnostic Great Basin artifacts of this time period were observed in the Squaw Butte Area. Bungart does not identify any in the Orange Cliffs sites either. In addition, the Squaw Butte sites lack even a few pieces of eastern Great Basin obsidian. If people came from the Great Basin, obsidian should be present because obsidian is a very desirable and often transported resource that is common on many eastern Great Basin sites (e.g., Nelson and Holmes 1979). Four of the five pieces of obsidian discovered during the Squaw Butte Area inventory were sourced and all are from northern

Table 27. Radiocarbon dates from the Orange Cliffs, Utah.

Site Number	Feature Number	Laboratory Number	Carbon-14 Age in Radiocarbon Years B.P. ± 1 Sigma	Calibrated Age Range[a]
42GA3086	2	Beta-32025	3230 ± 140 years	1870-1130 B.C.
42GA3205	2	Beta-27897	3240 ± 60 years	1670-1400 B.C.
42GA3206	2	Beta-32026	2950 ± 100 years	1420-870 B.C.
42GA3084	1	Beta-31185	2850 ± 70 years	1250-830 B.C.
42GA3205	1	Beta-28322	2670 ± 90 years	1010-550 B.C.
42GA3202	4	Beta-31189	2530 ± 70 years	820-410 B.C.
42GA3199	1	Beta-31187	2160 ± 90 years	400 B.C.-A.D. 50
42GA3048	1	Beta-16268	1850 ± 140 years	170 B.C.-A.D. 540
42GA3035	2	Beta-28770	1650 ± 100 years	A.D. 150-630
42GA3082	1	Beta-28769	1570 ± 100 years	A.D. 250-660
42GA3199	2	Beta-31188	1520 ± 60 years	A.D. 420-660

SOURCE: Bungart 1990:Table 6.4.

NOTE: Calibrated age ranges were calculated using CALIB, Version 3.0.3 (Pearson and Stuiver 1993; Stuiver and Pearson 1993; Stuiver and Reimer 1993).

[a]The calibrated age range is the adjusted range of the calibrated date(s) at two sigma.

Arizona (see Chapter 3). The toolstone on sites that precede the Terminal Archaic is essentially the same as in the Terminal Archaic—locally available material from the greater Canyonlands area.

Regarding changing climatic conditions, the period of greater frequency of radiocarbon dates coincides with the Neoglacial dating approximately 3500-1800 B.P. (circa 1900 B.C.-A.D. 300). This era was characterized by cooler temperatures and more effective moisture (Currey and James 1982), probably leading to improved spring flow and increased yields of upland plant resources such as grasses, which in turn allowed larger and more diverse animal populations (see Chapter 2). This may have made the area more attractive for hunter-gatherers, allowing either in situ population growth or expansion from other areas.

It is appropriate to discuss whether the clustering of sites in the millennia surrounding the transition into the Christian era is the result of local geomorphic conditions, cultural processes, or both. The paleoenvironmental research conducted as part of the project (see Chapter 2) revealed that the surface deposits in much of the Salt Creek inventory parcel date after 2880-2400 B.C., with the overlying dunes younger still. Therefore, the ages of sites that could potentially be present are restricted in approximately half of the project area. This phenomenon may have had some effect on the range of dates, but it cannot be the complete cause of the observed pattern.

First, most of the sites in the cluster are not located in the part of the project area constrained by these geomorphic conditions—they lie in areas that could have deposits of any age. Second, other areas of southern Utah show a similar proliferation of radiocarbon dates at the same time (e.g., Agenbroad et al. 1989; Bungart 1990; Geib and Bungart 1989; Geib et al. 1987; Horn 1990; Tipps 1983, 1992; Tipps and Hewitt 1989; Vetter 1989) suggesting that the Squaw Butte situation is part of a larger cultural pattern. Thus, while geomorphic conditions probably reduced the chances of finding earlier sites, they do not appear to be responsible for the clustering of dates in the millennia around the time of Christ.

Cultural Affiliation

Seven sites and components dated by eight radiocarbon assays provide the opportunity to assess cultural affiliation in the transitional era between the Archaic and Formative periods. Four of these date to the Terminal Archaic period defined for this project (1500 B.C.-A.D. 500). As noted in Chapter 1 and in the report of the first year's work (Tipps and Hewitt 1989:25-26), this period can include sites of Archaic, Basketmaker, or nacent Fremont affiliation. Three sites date to the Early Formative period (A.D. 500-1000).

The four components with Terminal Archaic dates lack associated artifacts that might help identify the cultural affiliation of their inhabitants. Their dates are in the Basketmaker II time frame, but no Basketmaker II diagnostics or traits were discovered on these sites. In addition, the flotation samples demonstrate a hunting and gathering subsistence strategy, not the maize-dependent lifeway recently argued for Basketmaker II (Chisholm and Matson 1994; Matson 1991). Nearby Shadow Shelter (Reed 1993), Sandy Ridge (Richens and Talbot 1989), and the Down Wash site (Horn 1990) in the Maze District of Canyonlands exhibit the same temporal/subsistence pattern: dates in the Basketmaker II time frame but a forager subsistence pattern. They also lack artifacts exclusively diagnostic of Basketmaker II.

This seems to be a common occurrence on much of the northern Colorado Plateau outside of the core Basketmaker areas as they are known today (Matson 1991). Some researchers consider such sites Archaic (e.g., Schroedl 1992b, Tipps 1983, 1992), others consider them Basketmaker II (e.g., Geib [1990b] and Nickens et al. [1988] commenting on Tipps 1983; Horn 1990), and still others list the cultural affiliation as unknown (Reed 1993; Richens and Talbot 1989). A different, but equally difficult and related problem is whether to call preceramic horticultural groups in this same area Basketmaker II or something else (e.g., Berry and Berry 1976).

The reason for the varying interpretations seems to stem from differences in opinion about what constitutes Basketmaker II, that is, whether it is a stage, a constellation of traits, a time period, a lifeway, an ethnic group, a geographic area, or some combination of the above. Kidder (1927a, 1927b) defined Basketmaker II as the agricultural, atlatl-using, nonpottery-making stage of the Pueblo tradition in the northern Southwest In the Pecos model of Puebloan cultural development, Basketmaker II was viewed as a transitional stage between Archaic hunter-gatherers and more sedentary, horticulturally dependent, Basketmaker III populations.

Matson (1991:xii, 123) defines Basketmaker II as the ". . . earliest widely recognized agricultural culture on the Colorado Plateau . . ." and goes on to make it clear that he views Basketmaker II as ". . . a stage rather than a cultural or ethnic group . . .," which he correctly notes fits well with Kidder's (1927a, 1927b) use of the term in the Pecos classification. Matson (1991:123) reports that "A unitary aspect of the Basketmaker II is the reliance on maize horticulture . . ." and believes, based on the work of Matson and Chisholm (1991), that ". . . one has to assume maize dependency for all Basketmaker II until someone comes up with a convincing counter-example . . ." (Matson 1991:101). If a counter-example were found, Matson (1991:101) would question if it was, indeed, Basketmaker II.

Geib et al. (1986:12) emphasize an assemblage of artifacts in their definition of Basketmaker II as ". . . an assemblage of cultural materials distinct from earlier Archaic remains. . . ." The assemblage of cultural remains they refer to is evidently that described by Kidder and Guernsey (1919) and Guernsey and Kidder (1921). In a later publication, Geib (1990b:265) views Basketmaker II as the early horticultural period in his reference to ". . . the Basketmaker II period, the start of the horticultural lifeway. . . ." Presumably within a certain geographic area, Geib (1990b:275) also considers it just a period when he suggests that

> . . . the 2445 ± 85 B.P. date [with a two sigma calibrated age of 800-370 B.C.; Pearson and Stuiver 1993] from Captains Alcove . . . is not Archaic, as suggested by Tipps (1983:156-158), but rather represents an unrecognized BMII occupation.

This is despite the associated deposits lacking Basketmaker II diagnostic artifacts and evidence of a horticultural lifeway (Tipps 1983).

Smiley (1985:10) seems to emphasize lifeways when he defines Basketmaker II as the aceramic peoples

> . . . of the northern Southwest, organized in small groups, cultivating Mexican-derived domesticated plants, using dry caves and rockshelters as storage facilities and marking their stewardship of such facilities by placing their dead within them in comparatively rich funerary context.

Janetski (1993:241) defines Basketmaker broadly—as the ". . . beginnings of the use of corn and horticultural strategies."

The stage or lifeways definitions seem to be the most appropriate from the standpoint of understanding culture change, diversity, and process, but these are the most difficult to apply in actual practice. As archeologists, we must often identify cultural affiliation based on a radiocarbon date or a few diagnostic artifacts. In doing so, we assume that the dates or artifacts are associated with a particular lifeway. In many cases, this is a perfectly acceptable approach that helps us understand lifeways at incompletely excavated sites or sites only documented at the inventory level. However, the situation is complicated for Basketmaker II because many material traits that accompany the Basketmaker II lifeway are not uniquely Basketmaker II, but also found in Archaic or later Pueblo contexts, e.g., slab-lined cists, one-hand manos, atlatls, Elko-style projectile points, and coiled baskets with two-rod-and-bundle foundations and noninterlocking stitches (Fairley et al. 1994:100; Janetski 1993:226). In addition, traits that exclusively accompany the Basketmaker II lifeway are often perishable, and, thus, unlikely to be found in most sites, especially in the context of inventory. Matson's (1991:78-80, 105-109) recent identification of several nonperishable Basketmaker II artifacts is promising, but more work needs to be done to verify their unique

Basketmaker II status and document how common they are and in what contexts they occur.

The lack of common, easily identifiable, mutually exclusive, diagnostic traits to distinguish Basketmaker II sites and separate them from Archaic sites may not be so much of a problem in areas like Black Mesa, Marsh Pass, Cedar Mesa, and Grand Gulch, for example, where there have been numerous investigations (e.g., Bearden 1984; Dohm 1988, 1994; Guernsey and Kidder 1921; Kidder and Guernsey 1919; Lipe 1978; Lipe and Matson 1971; Matson 1991; Matson and Lipe 1978; Smiley 1984, 1993, 1994; Webster and Hays-Gilpin 1994), including extensive excavation projects, and much is known about physical manifestations that accompanied the Basketmaker II lifeway. But this is not necessarily the case in the more peripheral areas where extensive excavation data and knowledge of local Basketmaker II manifestations (if they occur) are lacking. Accurately distinguishing between Archaic and Basketmaker II sites such areas can be difficult to impossible on many sites (see Fairley et al. 1994:99-100; Richens and Talbot 1989:83-87, and Tipps and Hewitt 1989:25-26). And, using material traits that are not proven to be solely Basketmaker II to identify sites as Basketmaker II in such areas could lead to incorrect conclusions.

Likewise, assigning sites as Basketmaker II on the basis of radiocarbon dates will probably yield acceptable results in areas known to have exclusive Basketmaker II occupation during a particular time period. But using a radiocarbon date or dates to identify Basketmaker II sites in areas where two populations with different economies (one horticulturally based and presumably Basketmaker II and one forager based and presumably Archaic) overlap in space and time can be problematic. There appears to have been just such a situation in the lower Glen Canyon drainage system just a few miles across the Colorado River from Cedar Mesa, and still inside the geographical range of later Anasazi. Here, hunter-gatherer populations were residing at Horse Canyon Rockshelter between 1100 B.C. and A.D. 100 (Schroedl 1992b), at Sunny Beaches between A.D. 1 and 430 (Geib and Bungart 1989), and at Casa del Fuego between A.D. 430 and 540 (Tipps 1992).

Identification of Basketmaker II sites based solely on radiocarbon evidence would also be suspect in areas where agriculture was adopted on a gradual basis. Based on a review of recent data, Janetski (1993) concludes that the area north of the Anasazi was typified by a gradual shift from an Archaic hunting and gathering lifeway to a Formative agricultural lifeway between approximately the fifth century B.C. and A.D. 500. He sees continuity between the Archaic and later Fremont cultures and argues that a Basketmaker II-like culture preceded the Fremont in this region. This

> . . . Basketmaker II-like strategy . . . included pithouse architecture, storage in bell-shaped pits, and the use of corn [and] was in place well to the north of the traditional Anasazi region at a time contemporary with the Basketmaker II of the Southwest . . . [Janetski 1993:240].

The appearance and use of corn in this area appear to have been more gradual and spotty than that described by Matson (1991) for the Cedar Mesa situation, making it particularly difficult, especially in the context of an inventory, to determine whether a site was produced by maize-dependent people.

In sum, when we are working away from known Basketmaker II core areas and in locations lacking the benefit of substantial excavation-derived knowledge, we need to be very careful when applying the Basketmaker II label with all of its associated interpretive baggage lest we identify non-Basketmaker II sites as Basketmaker II, generate erroneous interpretations, and ultimately dilute the communicative value of the Basketmaker II label. This issue has always been relevant for the Basketmaker II situation in much of Utah but is even more so given Matson's (1991:123, 310-311) and Chisholm and Matson's (1994) assertions that Basketmaker II were not hunter-gatherers supplementing their diet with corn, but corn-dependent farmers by as early as 500 B.C. This difference in subsistence strategies has major ramifications for other aspects of prehistoric society including settlement patterns, mobility, and social organization.

Lipe (1994:339) has recognized the difficult problem of how to define Basketmaker II and has asked researchers to consider whether Basketmaker II is the ". . . most appropriate rubric for considering all of the prepottery but maize-growing manifestations in the northern Southwest."

Because Basketmaker II people, by definition, grew corn, first, and most importantly, we should make sure that a site was occupied by maize-producing people before applying the Basketmaker II label. This is clearly difficult in the context of single sites and inventory level investigations, but if pollen or flotation data are available, the presence of corn or other domesticates is a sure means of verification. Site location near arable land or known Basketmaker II sites or communities can also provide some circumstantial evidence. Another problem is that not all sites or site types produced by prepottery, maize-growing populations of the Pueblo tradition will contain evidence of domesticates. On Cedar Mesa, for example, Basketmaker II campsites are believed to have been used for nonagricultural subsistence activities such as collecting Indian rice grass, harvesting pine nuts, and hunting (Matson 1991:89). Further characterization of such sites in core Basketmaker II areas—with an emphasis on how they differ from similar age Archaic sites—may be useful in this regard. In the meantime, we can continue to make a best guess of whether a site was inhabited by Archaic foragers, ancestral Fremont, or maize-dependent Basketmakers, or use a generic term, such as Preformative (Geib et al. 1987) or Preceramic (Fairley et al. 1994), that lacks implications about cultural association.

It also seems appropriate to reserve the Basketmaker II label for manifestations that typify the Basketmaker II lifeway as defined by the recent work of Matson (1991), Matson and Chisholm (1991), Chisholm and Matson (1994), and others. The meaning of Basketmaker II has been too transformed and has too many implications for other applications. Basketmaker II is no longer viewed as a transitional lifeway between the Archaic and Formative, but as a maize-dependent, fully Formative phenomenon (Chisholm and Matson 1994:250). As noted above, a culture with a maize-based economy will differ in many respects from one based on foraging supplemented by horticulture. As such, we should probably consider some other term to denote sites representing a more transitional lifeway.

I now return to the cultural affiliation of the Terminal Archaic period Canyonlands sites, which was the point of this long discussion. The Terminal Archaic-age remains thus far discovered in Canyonlands do not appear to typify the same stage, lifeway, cultural expression, or adaptation now thought to characterize Basketmaker II. From all indications, the site inhabitants were practicing a hunting and gathering strategy. Were these people growing corn in or near the project area but evidence of such use was lacking in our samples because of sampling error? This seems unlikely because none of the sites are positioned near arable land. In addition, dry-farming would have been difficult unless climatic conditions were more favorable than at present because the average annual precipitation is well below the commonly accepted minimum of 30 cm (see Chapter 2). Also, the sites appear to be short-term camps rather than seasonally occupied base camps inhabited by people tending crops.

Were they growing corn elsewhere but making residential or logistical forays into the low-lying Squaw Butte Area on a seasonal basis? Perhaps, but such a scenario is hard to support at present because there are no known clusters of Basketmaker II habitation sites in the immediate area and long distance logistic travel to forage in the Squaw Butte Area seems unlikely. Also, certain taxa in the flotation samples are harvested at the same time as corn. From an energetic perspective, such foraging would not be expected at the time of the corn harvest if horticultural endeavors were successful.

If, however, the site inhabitants' commitment to horticulture was less substantial or farming was marginal overall or from year to year, foraging activities in the Squaw Butte Area would make more sense. However, such a hunting and gathering subsistence strategy supplemented by horticulture does not appear to be consistent with that now defined for Basketmaker II (Chisholm and Matson 1994; Matson 1991; Matson and Chisholm 1991). The available information is not sufficient to determine whether the inhabitants of the Terminal Archaic period sites grew corn elsewhere or at other times, but the fact they appear to have been collecting wild resources at the time of the corn harvest in portions of the project area lacking arable soil suggests that maize was not their mainstay.

In sum, the Squaw Butte Terminal Archaic period sites give no indication of the Basketmaker II lifeway and cannot be demonstrably associated with maize-growing peoples. If future work in the area shows a substantial Basketmaker II occupation or identifies that such sites are within the range of variation for the annual Basketmaker II lifecycle, a reassessment may be in order. In the meantime, an Archaic affiliation seems most appropriate for the four sites and components.

Next I would like to focus attention on the three sites with Early Formative dates. Cultural affiliation assignments at these sites were also difficult. Dates from these sites place them in the Basketmaker III-early Pueblo II periods of the Anasazi sequence, but there is no evidence from the sites themselves to indicate they are, in fact, Anasazi.

A heavy middle Pueblo II-late Pueblo III Anasazi occupation is well documented in the Needles District (e.g., Bond 1994; Firor 1986a, 1986b, 1988; Gaunt and Eininger 1987; Griffin 1984; Nickens and Associates 1985; Sharrock 1966; Thompson 1979; Tipps and Hewitt 1989), but evidence of earlier Anasazi occupation is rather slim: Tipps and Hewitt (1989:136) report on a few Basketmaker III-Pueblo I sites in the Butler Flat and Devils Lane areas, a few kilometers west of the Squaw Butte Area, and several Pueblo I ceramic types have been discovered by P-III Associates in upper Salt Creek.[2] No specimens definitively predating middle Pueblo II were noted in a recent analysis of 950 sherds illegally collected and later turned in by park visitors (Bond 1994). From all indications, local Early Formative Anasazi occupation was light.

The Early Formative sites documented by this project and by Tipps and Hewitt (1989) do not fit the general model of pre-A.D. 1000 Anasazi, e.g., a serious commitment to maize-bean-squash horticulture, turkey husbandry, ceramic technology, pithouse villages, community structures, and, later, multiroom pueblos, etc. If the site inhabitants were Anasazi, they were practicing a different lifestyle than typical Anasazi of the same time period.

Other researchers have postulated a Formative period Fremont occupation in the Needles District (Anderson 1978; Griffin 1984; Schaafsma 1971). However, there is even less definitive evidence that the Fremont utilized the greater project area. Sharrock (1966:20), reporting on a large-scale reconnaissance inventory of the Needles, states that "No sites which are distinctively affiliated with the Fremont culture were recorded. No Fremont pottery or other portable artifacts and no Fremont architectural styles or techniques were noted." All subsequent work in the Needles District has failed to document cultural elements diagnostic of the Fremont.[3]

The only exception is rock art motifs that Sharrock (1966) considers of Fremont style. Sharrock was puzzled by the Fremont rock art because it consistently occurs on sites that are otherwise "identifiable as Mesa Verde [Anasazi]." Because he assumed that the "Fremont" rock art was contemporaneous with the Anasazi occupation—and this was a reasonable assumption given the then-current state of knowledge on the Fremont—Sharrock could not find a satisfactory explanation for its presence. He speculated that the motifs were made by Fremont men incorporated into the local Anasazi culture or were borrowed from the Fremont by the Mesa Verdeans. Later researchers have also considered some of the same rock art Fremont (Noxon and Marcus 1982; Schaafsma 1971) but never provided a good explanation for its presence. I will return to this issue later.

Although definitive evidence for Fremont use of the area is lacking, recent Fremont research may be useful in understanding the local Early Formative adaptation. In 1970, Marwitt (1970b) examined ceramic and architectural variability and identified five Fremont variants. He believed that the San Rafael variant—the one closest to the project area—dated from approximately A.D. 750 to 1240 and was coeval with Anasazi occupation in nearby areas. Based on a large inventory project and a review of data collected during the subsequent 15 years, Black and Metcalf (1985:13-15) proposed a chronology for the San Rafael area; this chronology considerably expanded the proposed time depth for the local Fremont culture.

The earliest period, the "Proto-Formative," dates from A.D. 150 to 700 and is seen as a time of increasing sedentism when hunting and gathering pursuits were gradually supplemented by horticulture, especially corn. Diagnostic artifacts include Elko and Rose Spring projectile points and, late in the phase, Emery Gray pottery. Black and Metcalf (1985) view this phase as nascent Fremont. Schroedl (1992a) objects to the use of "Proto-Formative" for a phase name and proposes the "Escalante Phase" instead. Believing that the local culture is not "Fremont" until the introduction of pottery circa A.D. 400, he considers the Escalante Phase an Archaic expression.

Black and Metcalf's (1985) succeeding Muddy Creek Phase dates from A.D. 700 to 1000 and is typified by ". . . a variety of dwelling structures other than those of surface coursed-masonry construction, undecorated gray ware vessels, and Rose Spring arrow points" and, again, increasing sedentism. Settlements were small and dispersed (Metcalf et al. 1993).

Although Black and Metcalf's (1985) phase sequence was based on incomplete data, the diagnostic traits and temporal spans appear to have been borne out by more recent work, at least in general outline. Casa del Fuego (Tipps 1992), Horse Canyon Rockshelter, Stratum 3 (Schroedl 1992b), and Sunny Beaches (Geib and Bungart 1989) are examples of the early phase. These sites are aceramic, have dart and arrow points or just arrow points, and lack corn. Casa del Fuego has a shallow, burned pithouse which has a tree-ring corrected age range of A.D. 430-540 (average of two contemporaneous wood dates).

Cultural manifestations possibly representing the latter part of the early phase include components of the Muddy Creek site (42EM1887) along Interstate 70 (Gundy et al. 1990; Quinn et al. 1991), various dry shelters in the Escalante River Basin (Geib 1990a), and several components at open sites along Highway 10 (Metcalf et al. 1993). The Muddy Creek site dates from approximately A.D. 220 to 1100+ and has multiple pit-structures, dart and arrow points, a few sherds, and evidence of corn (Janetski 1993:232-233; Quinn et al. 1991:Tables 3.3.1 and 3.3.2). The Escalante River Basin sites have ceramics and abundant evidence of corn utilization. They show a continuous record of occupation from approximately A.D. 200 to 900 (Geib 1990a). While the Black and Metcalf (1985) chronology will surely be revised with the recent work along Interstate 70, all available evidence suggests a long record of continuous local occupation extending from the Archaic through the latest Fremont period, and gradual transition into the Formative lifeway (Janetski 1993).

Regarding Fremont adaptation, Simms (1986:206) has suggested that the Fremont may have

> . . . employed a variable strategy, necessarily becoming mobile during portions of a year, during a year of horticultural shortfall or during several successive years of inadequate horticultural production. In years of horticultural shortfall, groups, or portion of groups may have . . . fissioned, becoming hunter-gatherers with a relatively mobile settlement pattern, and locating sites without concern for horticultural potential. If this was the case, many smaller, short-term and special-use sites would have resulted from the activities of Fremont (in terms of material culture) hunter-gatherers. . . .

So how is this relevant to the three Early Formative sites in the Squaw Butte Area? The limited evidence from the Squaw Butte Area suggests the local pattern of Early Formative adaptation resembles that proposed by Simms (1986) for the Fremont. People who produced these sites may have been participating in a larger pattern of Archaic to Formative transition that covered much of central Utah and particularly the area north of the Colorado River. Does that make them Fremont? Anasazi? Something else? Does it really matter which label we use? It does because of the cultural baggage attached to the Anasazi and Fremont designations (see Madsen 1982, for example). But I would argue that explicating and understanding lifeways is more important than

whether they were Anasazi, Fremont, or something else. Cultural boundaries, if they exist at all, were fluid and changeable through time.

Cultural affiliation of sites must be assigned using a constellation of traits, artifacts, and lifeways in addition to absolute chronometric dates. While the sites may have been inhabited by Anasazi people, their lifestyle was more akin to what archeologists define as Fremont rather than Anasazi groups of the same time period. It is apparent that the general Anasazi sequence of the Four Corners area cannot be uncritically applied to the Canyonlands area for all cultural periods.

Now I return to the anomalous association of the "Fremont" rock art motifs and Pueblo II-III Mesa Verde Anasazi sites noted by Sharrock (1966:20). As noted in Chapter 1, most of the rock art motifs identified by Sharrock (1966) as Fremont have now been attributed to other cultures. To my knowledge, however, no one has argued a different affiliation for the horned dancer motif and solid evidence regarding the cultural affiliation of the Faces Motif is still lacking. If future work shows that the Canyonlands area was sporadically and lightly used by Fremont or other non-Anasazi people during the Early Formative, we should be open to the possibility that they produced this rock art. In this case, the rock art would predate the Pueblo II-III Anasazi occupation recorded by Sharrock and help explain the occurrence of "Fremont" rock art on otherwise Anasazi sites.

If this is so, why did Sharrock not recognize the earlier occupation? If the Early Formative sites tested during this project are any indication of what such sites might look like, they would be easy to overlook because they appear no different than the hundreds of other open lithic scatters that date to a variety of time periods. In shelters and overhangs, where the "Fremont" style rock art generally occurs, traces of such ephemeral sites could easily be mixed with or buried by later Anasazi occupation, and difficult to identify in any case, if they predate the arrival of ceramics or were special use sites where ceramic artifacts were not used.

The Squaw Butte Area investigations do not shed light on the identity of the rock art artists other than to call attention to one possibility that has not been previously considered. Fortunately, with recent advances in rock art dating, we may be able to resolve this issue when samples and funding become available.

Subsistence

As noted earlier in this chapter, evaluating subsistence patterns was one of the research goals of the testing program. Specifically, we were attempting to characterize subsistence patterns through flotation analysis and determine whether marsh resources, corn, or Indian rice grass formed significant components of the local diet.

A diet-breadth model (Simms 1984) was also applied to the flotation data. This model predicts that resources will be incorporated into the optimal diet according to their caloric rate of return (i.e., ranking), not their overall abundance in the natural environment (Bettinger 1991; Kelly 1995). The highest ranked resources are included first and will be taken whenever encountered. If rarely encountered, such resources will constitute only a small amount of the diet. If the availability of a highly ranked resource declines and search time is increased, diet breadth is increased to compensate. Thus, inclusion of a resource in the diet is dependent on the relative abundance of other higher ranked resources. Increased diet breadth reflects decreased abundance of higher ranked resources relative to consumer needs. This model cannot account for resources harvested or excluded for nonenergetic reasons but does provide a framework for developing hypotheses about and understanding prehistoric subsistence strategies.

The flotation analysis failed to show evidence of domesticates during any time period represented in the testing sample. Instead, the small assemblage of plant remains revealed a foraging lifeway that apparently focused on high ranking wild plant resources, regardless of their abundance in the natural environment. Goosefoot, pinyon, and dropseed were consistently used as edible resources, and there is some evidence for use of Indian rice grass and hackberry. No faunal remains were recovered from the tested features.

Of the 18 plant taxa identified in the flotation samples, 11 are high to moderately highly ranked (Simms 1984), with only 6 lower ranking resources (e.g., sagebrush, grass, dropseed, Indian rice grass, juniper, and globemallow), all of which are generally abundant in the natural environment.

Among the lower ranking resources, juniper, dropseed, and Indian rice grass occur in the most number of samples and in the greatest amounts. For juniper, this may be because it was used for fuel. For dropseed and Indian rice grass, it may be because they are the earliest seeds available in the late spring and early summer and, relative to other plant resources available at that time, they are relatively highly ranked. Effective exploitation of Indian rice grass must be properly timed because of its narrow window of availability, but it can be stored for long periods of time, thus increasing the popularity of its use beyond that expected based on its energetic return (Simms 1984:153).

Many of the higher ranked resources such as goosefoot, atriplex, and pinyon are available in the fall, and a fall occupation seems to be clearly indicated for the component associated with Feature 2 at site 42SA20292. A mix of spring/early summer and fall resources, which do not mature at the same time, occur in the samples from Squaw Butte Cove, site 42SA20258, and site 42SA20251. The presence of burned pinyon cones suggests that the spring/early summer taxa (tansy mustard, phlox, buffaloberry, and dropseed) at site 42SA20258 were incorporated as natural seed rain during a fall occupation when resources such as goosefoot, atriplex, and pinyon were being collected. This or the opposite may be true for Squaw Butte Cove, which has pinyon, a fall resource, and dropseed and hackberry, both spring resources. Two other possibilities are use of the site during multiple seasons or the high-ranking fall plants may have been stored resources that were being consumed when people were using the site during the spring/early summer.

Dropseed has a spring and a late summer flowering and can be available in September before the ripening of pinyon nuts. However, it seems unlikely that dropseed would have been harvested as a food resource in the late summer when other higher ranking plants are available. Given this and the extremely low counts of fall resources at site 42SA20251, it is possible that the site was occupied in the early summer while dropseed was being collected.

The lack of faunal remains is not anticipated under the diet-breadth model because most faunal resources rank well above most plant resources (Kelly 1995; Simms 1984). This may relate to the forage potential of area soils. Under pregrazing soil conditions, the Squaw Butte Area has a very poor rating for wetland wildlife habitat that might have supported animals like ducks, geese, mink, and beaver (Lammers 1991:Table 6). The situation improves only slightly for openland habitat which supports cottontail. Woodland and rangeland habitat, which support deer, antelope, sage grouse, and coyote, are rated as poor or worse for all project area soil types except Thoroughfare Loam, which is rated only fair.

Also, the lack of faunal remains in flotation samples does not automatically exclude hunting and animal procurement from the local subsistence pattern. Preservation may be a problem in the open sites we tested. In addition, animal processing and cooking techniques may not have resulted in residue in the features and deposits outside the features were not excavated. Excavations at Shadow Shelter produced more than 120 animal bone fragments but not one of the specimens was recovered from feature fill (Reed 1993). At least some hunting activities are inferred for the project area because of the diet-breadth model and because hunting equipment occurs on some sites.

There was less direct evidence of Indian rice grass use than anticipated based on the findings of Tipps and Hewitt (1989) in the adjacent Salt Creek Pocket Area and the range site data for the Squaw Butte Area. The range site data (Lammers 1991) indicate that under natural, pregrazing conditions, certain project area soils have some of the highest potential Indian rice grass productivity of any soil identified in a 1.8-million-acre study parcel encompassing portions of Grand and San Juan counties—100-160 lbs/acre. These soils, Thoroughfare Loam, Begay Fine Sandy Loam, Mido Fine Sand Loam, and Sheppard Fine Sand, cover approximately 35 percent of the project area. Only one site, Whirlwind Ridge, yielded Indian rice grass, but it occurs in both features, which are noncontemporaneous and apparently the result of separate occupations. Indirect evidence of Indian rice grass use also occurs in the form of a probable Indian rice grass knife recovered from site 42SA20292 (see Chapter 6).

There was no indication of marsh resource use despite several resources commonly available in marshes (e.g., ducks, cattails) being more highly ranked than any of the resources recovered from the Squaw Butte Area flotation samples. Their absence may indicate that the marshes had contracted or dried out. Or, scheduling conflicts may have forced prehistoric peoples to choose lower ranked resources. Cattail pollen, for example, has a high rate of return, but a narrow period of harvestability (from early to mid-July in central and western Utah) (Simms 1984).

In sum, the flotation results from the tested sites document seasonal use of the project area by people practicing a foraging lifeway. This does not discount the possibility that some of the site inhabitants were aware of domesticated crops or used them at other times or places. Prehistoric peoples adapted their subsistence strategies to account for population growth, changing environmental conditions, variable resource availability, or other events and stresses (e.g., Metcalf et al. 1993; Simms 1986). It just means that the testing and flotation analyses produced no evidence of domestic crops in the pre-A.D. 1000 period. Reed's (1993) work at Shadow Shelter and Horn's (1990) excavation at the Down Wash site produced a similar pattern of plant utilization; no domesticates were recovered from the deposits dating to several centuries around the transition to the Christian era. It should be noted that Squaw Butte Area populations were farming in selected portions of the project area sometime after A.D. 1100 (during Pueblo II-III), but no sites of that age were tested during the project.

The assemblage of plant macrofossils suggests warm season use during the spring, summer, and fall months. Plant taxa recovered from the two features at Whirlwind Ridge imply spring use of the project area to harvest early ripening seeds and greens. The later sites yielded taxa that ripen in the fall or a mixture of spring/summer and fall plants that are not available at the same time. These may co-occur because of natural seed rain, storage, or reuse of the sites during more than one season.

With the exception of the earliest unlined hearth at Whirlwind Ridge, which has a high diversity of plant taxa, the Terminal Archaic features generally contain fewer taxa than the Early Formative features. This corresponds to a major trend observed throughout the Southwest (Gasser 1982) and may indicate decreased abundance of the higher ranking resources in the later period. The unusually high diversity of plant taxa (n=11) in the early hearth at Whirlwind Ridge may be related to the timing of the occupation in the spring when early resources were just becoming available. Following assumptions of the diet-breadth model, a diverse diet is predicted because the availability of high-ranking resources was limited.

Final Statement

Despite the limited amount of excavation and the ephemeral nature of the sites, the Squaw Butte testing contributes significantly to the understanding of Canyonlands' prehistory. It documents occupation during the Middle Archaic, which is still poorly known across the northern Colorado Plateau, and the Terminal Archaic and Early Formative periods, which are all but unknown in the park. Locally, these latter two periods are very difficult to recognize from surface evidence and, indeed, without the testing and subsequent radiocarbon dating, these occupations would have gone unrecognized.

The testing also shows that the area was used by people practicing a hunting and gathering lifeway, with an emphasis on plant resources. This lifeway was apparently being practiced as late as A.D. 710-1010, in contrast to surrounding areas that have much earlier evidence of horticulture (e.g., Brew 1946; Geib 1990a; Gundy et al. 1990; Janetski 1993; Jennings 1980; Matson 1991; Wilde and Newman 1989). Arable land in the general project area has a limited extent and a patchy distribution, and few portions of the actual project area are suitable for horticulture. This may be one factor in the lack of domesticates in the flotation samples—other areas of Canyonlands with more suitable soils (e.g., upper Salt Creek) show more intensive horticulture than that revealed by the inventory data in the Squaw Butte Area and probably supported corn-producers at an earlier date.

[1]Bungart's (1990) dates have been recalibrated using Stuiver and Reimer (1993) to make them consistent with the dates presented in this report.

[2]The purported Pueblo I pottery illustrated by Osborn et al. (1986:138-140, Appendix A) in nearby Lavender Canyon appears to be misidentified and is therefore discounted as evidence of Pueblo I occupation. For example, a sherd identified as Cortez Black-on-white is clearly a Pueblo II-III type, probably McElmo Black-on-white.

[3]The purported Emery Gray pottery reported by Osborn et al. (1986:138-140, Appendix A) in nearby Lavender Canyon must be rejected pending further analysis. The classification appears to have been made on the basis of an artifact sketch (Osborn et al. 1986:ix) after the fieldwork was completed, not on the technological attributes which distinguish the various corrugated types.

Chapter 7

BARRIER CANYON ROCK ART DATING

Barrier Canyon rock art in the Canyonlands area has long captured the interest and imagination of researchers and visitors alike. The age and cultural affiliation of the rock art are of great interest to the visiting public and, from a scientific perspective, essential to its use as a vehicle for understanding past human behavior. Thus, one of the specific research issues outlined in our original proposal for the Canyonlands Archeological Project concerned rock art dating (P-III Associates, Inc. 1984) as did our research design for the first year's field investigations (Tipps and Hewitt 1989:32). Funding for this work became available in 1987 and our contract was modified (National Park Service 1987) to allow us to attempt to date the Barrier Canyon Anthropomorphic Style rock art.

The age and cultural affiliation of this dramatic rock art style have been the subject of considerable interest for decades with proposals ranging from mere speculation to informed, well-reasoned approximations. Barrier Canyon Anthropomorphic Style rock art has, at one time or another, been attributed to every prehistoric culture known to occupy the northern Colorado Plateau with the exception of Paleoindian (e.g., Grant 1967:117; Gunnerson 1969:68, 158-159; Schaafsma 1971:128-135, 1980:61, 70, 1988:18; Schroedl 1977:262-263, 1989:17), and even to a protohistoric or historic people (Manning 1990:76).

Schroedl and Schaafsma have offered the most commonly accepted theories. In her early work, Schaafsma (1971:128-135, 1980:61, 70) hypothesized that Barrier Canyon rock art was made by pre-Fremont hunter-gatherers between 500 B.C. and A.D. 500. This suggestion was based on superpositioning, panel subject matter (e.g., lack of bow and arrow depictions), and stylistic similarities with an Archaic rock art style found in the Pecos River region of west Texas. The Pecos River Style is now believed to date to at least 2000 B.C. (Shafer 1986:142).

Following Schroedl (1977:262-263), who used the similarity between Barrier Canyon anthropomorphs and indirectly dated, unfired clay figurines from Cowboy Cave (Jennings 1980) to posit an earlier Archaic origin, Schaafsma (1988:18) revised her dating for the style to 2000 B.C.-A.D. 1. More recently, Schroedl hypothesized that Barrier Canyon rock art could be as much as 6000-8000 years old.

> . . . At . . . Cowboy Cave, clay figurines of human form were found with tapering torsos lacking arms, identical in shape to the body forms of Barrier Canyon pictographs. In fact, one of the figurines had a series of parallel lines down the torso similar to those found on many of the Barrier Canyon anthropomorphs. These figurines were found in a layer dated to about 6000 years old. . . .
>
> . . . The date of the analogous clay figurines . . . suggests that Barrier Canyon rock art . . .

> could . . . [date] as early as 6000 to 8000 years ago . . . [Schroedl 1989:17].

As both authors recognize, these are only best guess approximations.

Within the framework of the contract and our research design, we made a concerted effort throughout our multiyear Canyonlands Archeological Project to find means of ascertaining the age and cultural affiliation of Barrier Canyon rock art.

The Barrier Canyon Anthropomorphic Style

Barrier Canyon Anthropomorphic Style rock art is typified by large static, ghostlike anthropomorphs, usually portrayed in front view with elongate bodies that either lack or have diminutive appendages. Figures with arms often hold elements that have been interpreted as serpents or plants such as wild grasses (Schaafsma 1971:69, 1980:64; Schroedl 1989:16). Normally, gender is not depicted.

While almost all figures are elongate, their shapes vary. The most common form in the Canyonlands area is a long tapering body with rounded shoulders and very infrequent lower appendages; the bottoms of these figures usually terminate in a rounded arc, horizontal line, or point (see Figures 28 and 31; Cole 1990:Plates 18-19, 21, 23; Noxon and Marcus 1982:Figure 105). Figures with shorter tapering bodies and more pointed, wide shoulders are also common (see Figure 31; Noxon and Marcus 1982:Figure 105); they usually lack lower appendages but tend to be more elaborately decorated than those in the first group. A third common body style is an elongate, slender rectangle or tapering rectangle. These figures often have short legs and feet (see Cole 1990:Plate 21; Noxon and Marcus 1982:Figures 94, 114; Schaafsma 1990:Figures 4 and 6).

Heads vary from rounded with little constriction for the neck, to bucket shaped with no separate neck, to flattened ovals with pronounced necks. Unpainted circles depicting hollow, staring eyes constitute the only common facial feature. Mouths are sometimes illustrated. When present, head adornment is generally simple and common only in the form of antenna and horns that occur alone, in pairs, or triplets on either side of the head. Other less frequent head decorations consist of crowns composed of short lines or dots and plantlike images.

Solid figures with no interior decoration are the most common. Torsos of some figures are highly decorated with geometric and anthropometric elements including dots, animals, small mummylike forms, spirals, and straight, wavy, or zigzag lines, sometimes arranged in broad bands; a few appear to depict ribs, spines, or intestines in x-ray mode.

Single Barrier Canyon anthropomorphs may occur in isolation. Normally, however, these large to larger-than-life-size figures appear in rows or groups surrounded by small human images, naturalistic renderings of animated zoomorphs that appear to represent mountain sheep, birds, dogs, and snakes, and occasional abstract designs consisting of zigzags, dots, and circles. The smaller humans are sometimes static, resembling the large forms, but are often animated and depicted in side view. Unlike the static forms, these animated images frequently have appendages and are often holding implements such as spears. Barrier Canyon rock art is usually compositional and symmetrical. Cole (1990:76-77) believes it sometimes relates a story.

The vast majority of Barrier Canyon rock art occurs as pictographs. However, some panels consist entirely of outlined or solidly pecked forms (e.g., Cole 1990:71; Manning 1990:44; Tipps and Hewitt 1989:109-111). In addition, the painted images often have incised, abraded, and pecked details (e.g., eyes, mouths, outlines) that occur as part of the original artwork or as later embellishments. Most Barrier Canyon images were executed on unmodified sandstone walls. Sometimes, however, the rock face was smoothed or painted before the artisans made the figures (Noxon and Marcus 1982:43).

The painted figures are normally dusky or dark red with frequent buff or white embellishments, and occasional green, blue, bluish gray, black, or yellow highlights (Cole 1990:71; Gunnerson 1969:158; Noxon and Marcus 1982:112; Schroedl 1989:16; Tipps and Hewitt 1989:109). Buff, orange, black, black-red, and black-red-buff figures have also been reported in the Canyonlands area (Brunsman 1986; Noxon and Marcus 1982:204; Tipps and Hewitt 1989:108-111; this report). Some figures are purple but this appears to be the result of the red figures being exposed to intense sunlight. Cook et al. (1990) report that pigment colors may alter with age due to oxidation, solar radiation, and exposure to differing moisture regimes, etc.

The characteristic dusky or dark red color of the majority of figures suggests that they were painted using ochre-based (iron oxide or hydrous iron oxide) paint. Indeed, the red pigment on a spall from the Flying Rug Barrier Canyon panel in the Needles District consists of hematite with a small amount of calcite (Swayze 1994).

Because the reflective properties of ochres vary with the state of oxidation and reduction, among other things, the present colors do not necessarily reflect the original colors when the figures were painted. The red figures may have originally been applied in yellow, orange, or brown (cf. Bednarik 1994:70).

Barrier Canyon Style rock art is believed to extend from the North Rim of Grand Canyon northeast in a broad band across much of eastern Utah into western Colorado (Cole 1990:Map 4). Thus far, it appears to be most common in the Canyonlands area of southeast Utah (Manning 1990:Figure 3).

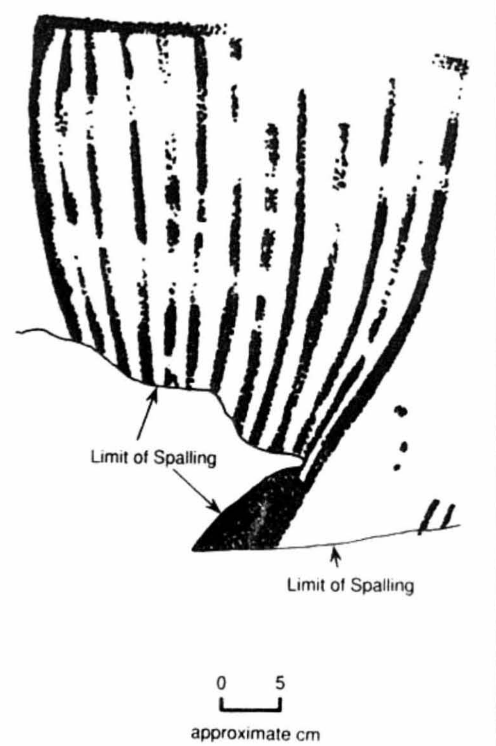

Figure 46. Barrier Canyon anthropomorph at Salt Pocket Shelter. Note that the drawing has been revised since publication in Tipps and Hewitt (1989:Figure 34) based on a subsequent field check.

Project History and Methods

Our first opportunity to address the age and cultural affiliation of the Barrier Canyon Anthropomorphic Style came in 1985 when we discovered Salt Pocket Shelter (42SA17092), a small overhang site with a simple Barrier Canyon anthropomorph (Figure 46)[1] and dark, ashy, artifact-rich cultural deposits that could conceivably be coeval with the rock art (Tipps and Hewitt 1989:122-133). If we could demonstrate that the site was single component, and that the rock art and deposits were contemporaneous, then a date on the deposits could be applied to the rock art.

We obtained authorization to excavate a 1- by 1-m unit at the site in 1986. The test pit contained up to 26 cm of unstratified cultural fill and an unlined hearth that provided a radiocarbon date of 3340 ± 100 years (Table 28). This date has a tree-ring calibrated age range of 1880-1410 B.C. at two sigma (Pearson and Stuiver 1993).

Based on an unauthorized and inaccurate personal communication from one of our crew members, Schaafsma (1990:215) erroneously reports that ". . . there was a convincing association between the fill and the rock art . . ." (and hence the date) at Salt Pocket Shelter. Actually, the artifactual assemblage hints at an Early Archaic component in addition to Late Archaic materials so it is uncertain that the dated hearth and rock art are contemporaneous. In view of this, we concluded that "the association is certainly suggestive, but will be stronger if . . . other sites . . . yield similar dates" (Tipps and Hewitt 1989:133).

Table 28. Radiocarbon dates that potentially apply to Barrier Canyon Style rock art.

Site Name and Number	Material Dated	Laboratory Number	Carbon-14 Age in Radiocarbon Years B.P. ± 1 Sigma	Carbon-13 Delta Value	Calibrated Age Range[a]
Salt Pocket Shelter (42SA17092)[b]	Charcoal	Beta-21209	3340 ± 100 years	-	1880-1410 B.C.
42SA20615-1a[c]	Paint	AA9178	lost on mass spectrometer	-	-
42SA20615-2a[c]	Paint	AA9179	2710 ± 75 years	-21.1	1010-780 B.C.
Great Gallery (42WN418-2a)[c]	Paint	AA8625	3400 ± 65 years	-26.1	1880-1520 B.C.
Great Gallery (42WN418-2d)[c]	Unpainted sandstone host rock	AA9177	4010 ± 55 years	-25.7	2850-2360 B.C.
Dubinky Well (42GR382-1a)[c]	Paint	AA9116	2100 ± 50 years	-23.6	340 B.C.-A.D. 10
Dubinky Well (42GR382-1f)[c]	Unpainted sandstone host rock	AA9236	2565 ± 115 years	-22.7	830-415 B.C.
Rochester Creek[d]	Charcoal	Beta-7717	1990 ± 70 years	-	170 B.C.-A.D. 200
42WN766[e]	Charcoal	Beta-75861	2660 ± 80 years	-25.0	980-560 B.C.
Harvest Scene (42WN665)[e]	Charcoal	Beta-64818	1860 ± 50 years	-	A.D. 70-320

NOTE: Calibrated ages and age ranges were calculated using CALIB, Version 3.0.3 (Pearson and Stuiver 1993; Stuiver and Pearson 1993; Stuiver and Reimer 1993).

[a]The calibrated age range is the adjusted range of the calibrated date(s) at two sigma.

[b]Dating information is from Tipps and Hewitt (1989).

[c]Dating information is from Rowe (1993).

[d]Dating information is from Loendorf (1985).

[e]Dating information is from Canyonlands archeologist, Nancy J. Coulam (personal communication 1995).

The Claflin-Emerson Expedition apparently encountered a similar problem of uncertain association when they excavated at Horseshoe Shelter, a small site in Horseshoe Canyon with Barrier Canyon rock art and cultural fill. Evidence from the fill suggested

> . . . that there may have been a nonceramic occupation of the site prior to its occupation by Fremont and/or Mesa Verde Pueblo II-III peoples. On the other hand, there may have been only two occupations, Fremont and Mesa Verde, or even a single mixed component . . . [Gunnerson 1969:68].

The temporal placement and cultural affiliation of the Barrier Canyon artists were not clarified by the Salt Pocket Shelter test excavation.

Spatial and contextual associations between features, deposits, and/or artifacts and nearby rock art panels may imply contemporaneity, but temporal associations of this kind will always be suspect unless the pattern occurs repeatedly or special circumstances exist (e.g., the tools or paint drops actually used to create the rock art are recovered from dated contexts [e.g., Clottes 1994:3; Loendorf 1985, 1990]; or deposits burying or containing spalled fragments of rock art can be dated to obtain a minimum age [e.g., Clottes 1994; Cole 1988; Francis 1989; Kirkland and Newcomb 1967; Loendorf 1985; Morwood 1989; Tucker 1989; Walker 1989]). Shelter and overhang sites—the most common place for such associations—are particularly suspect because they are often used repeatedly through time. Even if features, artifacts, and deposits at a site are from a single occupation, it is still hard to prove that they are contemporaneous with extant rock art (e.g., Geib and Fairley 1992). Clearly, the most convincing data on rock art age will come from dating the panels themselves.

While several calibrated or numerical dating techniques have been attempted (e.g., Bard 1979; Dorn 1994; Dorn and Whitley 1984; Francis et al. 1993; Loendorf 1991; van der Merwe et al. 1987; Whitley and Loendorf 1994), there is still no generally accepted, foolproof technique of measuring the absolute age of rock art. However, one promising technique is accelerator mass spectrometry (AMS) which requires only minute amounts of organic carbon (1 mg) for dating (Hedges and Gowlett 1986). Dorn (1994) and Francis et al. (1993) have used AMS carbon-14 techniques to date trace levels of organic matter incorporated into accreting varnish on petroglyphs and believe that it successfully estimates the rock art's minimum radiocarbon age. AMS can also be used to date pictographs providing the paint included an organic component supplying the radioisotope carbon-14 (e.g., Chaffee et al. 1994; Clottes 1994; Geib and Fairley 1992; Lorblanchet et al. 1990; van der Merwe et al. 1987).

AMS dating has a strong advantage over conventional radiocarbon analysis in that dating can be performed on minute amounts of organic carbon. This was an important consideration because National Park Service policy precludes collection of paint directly from intact pictographs and only trace amounts of paint are likely to be available on sandstone spalls from Barrier Canyon panels.

Barrier Canyon rock art appears to have been executed using at least two different techniques. One evidently involved coloring the stone with a lump of pigment much like a crayon; because the pigment was probably inorganic (e.g., hematite, manganese oxide, etc.), it is doubtful that figures created in such a fashion would contain organic carbon related to the date of their manufacture. This may be the reason that no organic binder was identified in the sample of red pigment recently tested from the Flying Rug Barrier Canyon panel (see above). To date, the "color-crayon" technique has only been observed on the red figures.

The other method involved the use of paint consisting of ground pigment suspended in a liquid medium. The paint appears to have been applied with fingers, brushes, and occasionally by blow-spraying (Noxon and Marcus 1982:256). While the pigment in such paint was likely inorganic, aboriginal peoples are believed to have used organic binders such as animal fat, vegetable oil, blood, urine, or egg white to mix paint (Grant 1967:14; Loy et al. 1990; Rudner 1982; Sanger and Meighan 1990:26; Watchman 1993a). Therefore, we thought there was a good chance of

directly dating the rock art if we could locate samples that had been painted rather than colored.

We began looking for and soliciting fragments of rock that had spalled off of Barrier Canyon figures to use for dating. The first sample became available in the fall of 1987 when a Canyonlands ranger, Gary Cox, discovered a chunk of painted sandstone that had spalled off a Barrier Canyon anthropomorph at the Great Gallery (site 42WN418). This site lies in Horseshoe Canyon, northwest of the Maze District in extreme northeastern Wayne County.

In the United States, AMS dating of rock art paint had been tried one time prior to our inquiry and the results were negative because the sample contained no organic carbon. This raised concerns about wasting accelerator time on nonproductive samples. As a result, Beta Analytic and the AMS facility in Zurich required that the paint on our samples be pretested to guarantee the presence of organic carbon (Murray Tamers, personal communication 1987). We were also concerned about the potential for contamination (cf. van der Merwe et al. 1987) by organic and/or inorganic carbon in the sandstone. Beta Analytic advised that the paint would have to be *completely* separated from the sandstone host rock to avoid contamination and potential overestimation of the age (Murray Tamers, personal communication 1987, 1988).

At the time, these two requirements presented an insurmountable problem. We knew of no procedures for cleanly separating the faint traces of paint from the sandstone and, even if we had, the amount of paint on the sandstone was insufficient for available organic content tests.

We began soliciting additional samples in hopes of finding one with a better preserved paint. Julie Howard, then Bureau of Land Management (BLM) archeologist, Grand Resource Area, sent us a sample from Dubinky Well (site 42GR382) in January of 1988. This site is situated in the Island-in-the-Sky uplands north of the park in southwestern Grand County. Gary Cox returned to the Great Gallery in May of 1989 and discovered additional pieces that had spalled off of the panel. None of these pieces retained sufficient paint for the available techniques so we continued to store the samples with the hope that improved techniques would eventually allow the paint to be dated. In the meantime, we kept looking for samples with thicker coats of preserved paint. A site with such samples, 42SA20615, was found during the Squaw Butte inventory reported in this volume.

The site 42SA20615 samples were sufficiently large for the required analyses but we were unable to process them because the fees charged to private consulting firms for the dating and analysis exceeded available funding in our contract. Fortunately, government agencies engaged in research efforts could obtain such analysis and dating at minimal expense. A contract modification was initiated to delete this task from our contract and transfer it to the National Park Service. All samples were subsequently turned over to Canyonlands National Park.

The most serious technical difficulty in directly dating pictograph paint has been in isolating and extracting the organic binder without also incorporating carbon from other sources such as modern organics, atmospheric carbon dioxide, the rock substrate, or carbon-containing mineral overcoatings such as calcium oxalate and calcite that might be present in the paint (e.g., Whitley and Loendorf 1994). This is extremely important. Because such minute amounts of carbon are dated, the effects of any contamination are pronounced (Chaffee et al. 1994).

Chemist Marvin Rowe and his colleagues at Texas A&M University have been experimenting with direct dating of rock art for several years and have developed a procedure that selectively isolates the organic carbon from rock art paint (Russ et al. 1990, 1991, 1992). Briefly, this method uses high vacuum techniques and low temperature, low pressure, oxygen plasma to oxidize the organic component in the paint and collect the carbon as gaseous carbon dioxide (CO_2) which can then be dated using AMS carbon-14 techniques. This method makes it possible to extract organic materials from any type of pigment that contains preserved organic binders (not just charcoal pictographs). It also overcomes problems of possible contamination from inorganic carbon in the host rock and subsequent mineral overcoatings. Rowe and colleagues have had good success with this technique in some areas (Chaffee et al. 1994). However, in the Canyonlands area, there have been some problems with contamination from an organic component in the host rock.

Nancy J. Coulam, Canyonlands archeologist, submitted four of the samples (two from site 42SA20615 and one each from the Great Gallery and Dubinky Well) to chemist Marvin Rowe at Texas A&M University for initial processing. As noted previously, the site 42SA20615 samples consisted of pure pigment that had spalled off of Barrier Canyon figures. The samples from Dubinky Well and the Great Gallery consisted of faded traces of paint on sandstone spalls. After initial processing, the Dubinky Well and Great Gallery samples contained a large amount of sandstone debris (Rowe 1993:1). Rowe was concerned that the sandstone might contaminate the samples so he processed additional samples from the bare rock adjacent to the paintings on both the Great Gallery and Dubinky Well specimens as controls. These two control samples along with the four samples from the paint were dated at the Facility for Radioisotope Dating at the University of Arizona.

Since the submission of the original specimens, Dr. Coulam has continued to search for, collect, and date samples relevant to dating the Barrier Canyon rock art style. As part of this ongoing effort, she has recently dated features on two sites with Barrier Canyon rock art—the Harvest Scene (42WN665) and site 42WN766. Neither date is on the rock art itself, but both add to the growing body of potentially relevant information, much like that provided by Salt Pocket Shelter.

The Sites and Dating Information

Site 42SA20615

As discussed previously in this report, site 42SA20615 is a multicomponent site that was intermittently inhabited from as early as circa 4000 B.C. until A.D. 1100-1275± (see Chapters 4 and 6). It has five rock art panels consisting mainly of Barrier Canyon Style anthropomorphs, zoomorphs, and zigzags, as well as dots, mountain sheep, and sprayed and stamped hands considered to be Anasazi (see Chapter 4 for a complete description). Anasazi pictographs overlie some of the Barrier Canyon figures at the site, but not those sampled for dating.

As noted in Chapter 4, the last few bits of thick mud paint or slip remaining on the orange horned Barrier Canyon anthropomorphs in Panel 5 were rapidly chipping off the shelter wall. Pieces of this exfoliating paint were collected from two of the figures for analysis. One sample (FS 5) is from the orange horned figure on the left in Figure 32; the other (FS 6) is from the orange horned figure on the right in Figure 32. Sometime after the samples were transferred to the National Park Service, they were renumbered as 42SA20615-1a and 42SA20615-2a so it is not certain which sample is from which figure. This may not be important, however, because everything about the two figures suggests they are contemporaneous.

One sample yielded a date of 2710 ± 75 years B.P. (see Table 28). Unfortunately, the other sample (AA-9178) was lost during graphite preparation at the University of Arizona when air was accidentally let into the CO_2 from the sample (Chaffee et al. 1993:71; Rowe 1993:1).

Inadvertent incorporation of older or younger carbon into a sample is a concern with AMS dating due to the minute amount of carbon being dated. Before placing faith in a date, one must know precisely what is being dated and the potential for contamination. The sample from site 42SA20615 consisted of pure paint; when viewed under an optical microscope, it showed no sign of any other material (Chaffee et al. 1994:71). Therefore, contamination from carbon in the sandstone should not be a concern. Rowe (1993:1-2, personal communication 1994) confirms that there is no reason to suspect contamination from this source.

Other sources of visible contamination were lacking. The pictographs showed no outward evidence of fungus, mold, lichen, water stains, mineral accretions, fecal or other organic matter, bird or insect activity, smoke blackening, or overpainting. And, they are well protected from surface runoff. Therefore, it seems reasonable to accept the date at face value and conclude that Barrier Canyon artists painted the orange horned images at site 42SA20615 sometime between circa 1000 and 800 B.C.

The Great Gallery

The Great Galley in Horseshoe Canyon in the Maze is a shallow, north-facing rockshelter with numerous Barrier Canyon anthropomorphs and quadrupeds, mainly arranged in groups or rows for a distance of approximately 30 m along the shelter wall (Gunnerson 1969:65-67; Malouf 1941; Schaafsma 1971:75, Figures 72-74, Plates 34-36). This site is the type locality of Barrier Canyon Anthropomorphic Style rock art. Unlike site 42SA20615, the Great Gallery is devoid of prehistoric cultural remains other than rock art.

The painted rock sample from the Great Gallery was found 3 m from the back of the shelter at the location shown in Figure 47. It had a solid red design and refit to the lower portion of the small red anthropomorph noted in Figure 47 (Gary Cox, personal communication to Alan R. Schroedl 1987).

The pictograph fragment sampled for paint had no visible contamination from smoke blackening, plant growth, animal matter, water, or carbonate, but the sample did contain relatively large amounts of sandstone after extraction from the rock (Rowe 1993:1). This sample yielded a date of 3400 ± 65 (see Table 28). The unpainted sandstone control sample from the Great Gallery contained sufficient carbon to produce high levels of CO_2 and a date of 4010 ± 55 years B.P. (see Table 28). Therefore, the date of 3400 ± 65 years obtained on the paint is probably too old, having been contaminated by organic carbon in the sandstone host rock. There is no way to assess how much too old the date is; although the amount of sandstone contamination was high, it is uncertain how much it affected the date (Marvin Rowe, personal communication 1994). However, it is probably safe to tentatively use the date as a maximum date range and conclude that the sampled figure at the Great Gallery was painted after 1900 B.C. (Rowe 1993:2). Referring to this sample and the one from Dubinky Well, which is discussed below, Chaffee et al. (1993:71) state, ". . . presumably the pictograph dates obtained can be taken as upper limits on their ages."

Dubinky Well

Dubinky Well in the Island-in-the-Sky is a large, north-facing overhang with Barrier Canyon rock art and evidence of occupation consisting of cists excavated into an indurated alluvial deposit, groundstone tools, a few flakes, and a yucca fiber bundle (Brunsman 1986; Delling and Delling 1963). Rock art at the site is composed of seven Barrier Canyon anthropomorphs: four executed in black, one in black-red-buff, and two in red only (Figure 48). Remnants of a black and red indeterminate and deteriorated image were also noted. The sample from this site was a large sandstone spall painted with parallel red stripes. There is only one red striped figure on the panel (the anthropomorph, the fourth from the left in Figure 48) so it must have come from that figure.

Like the Great Gallery sample, the Dubinky Well sample contained large amounts of sandstone (Rowe 1993:1). Given that the unpainted sandstone control sample from the site dates older than the pictograph sample (see Table 28), the paint date of 2100 ± 50 is probably too old. There was no visible evidence of other contamination from the common sources discussed for the previous sites. Using the paint date as a maximum limiting age (cf. Chaffee et al. 1993:71), the red striped figure at the site would appear to date sometime around or after the turn of the millennium.

Other Sites

As noted earlier, radiocarbon dates are available from two features that lie beneath Barrier Canyon rock art panels in the Maze District of Canyonlands. The first site, 42WN766, is a long overhang that harbors a Barrier Canyon pictograph panel and a diverse artifact scatter (Cox 1994). This site is believed to have a single prehistoric component (Nancy J. Coulam, personal communication 1995).

Cox (1994:1-2) describes the rock art panel as follows:

> The panel is crowded with figures. A row of four, tiny, Barrier Canyon style anthropomorphs, hovers directly above four plantlike forms growing up out of three rectangular clusters of dots. A zoomorph consisting of

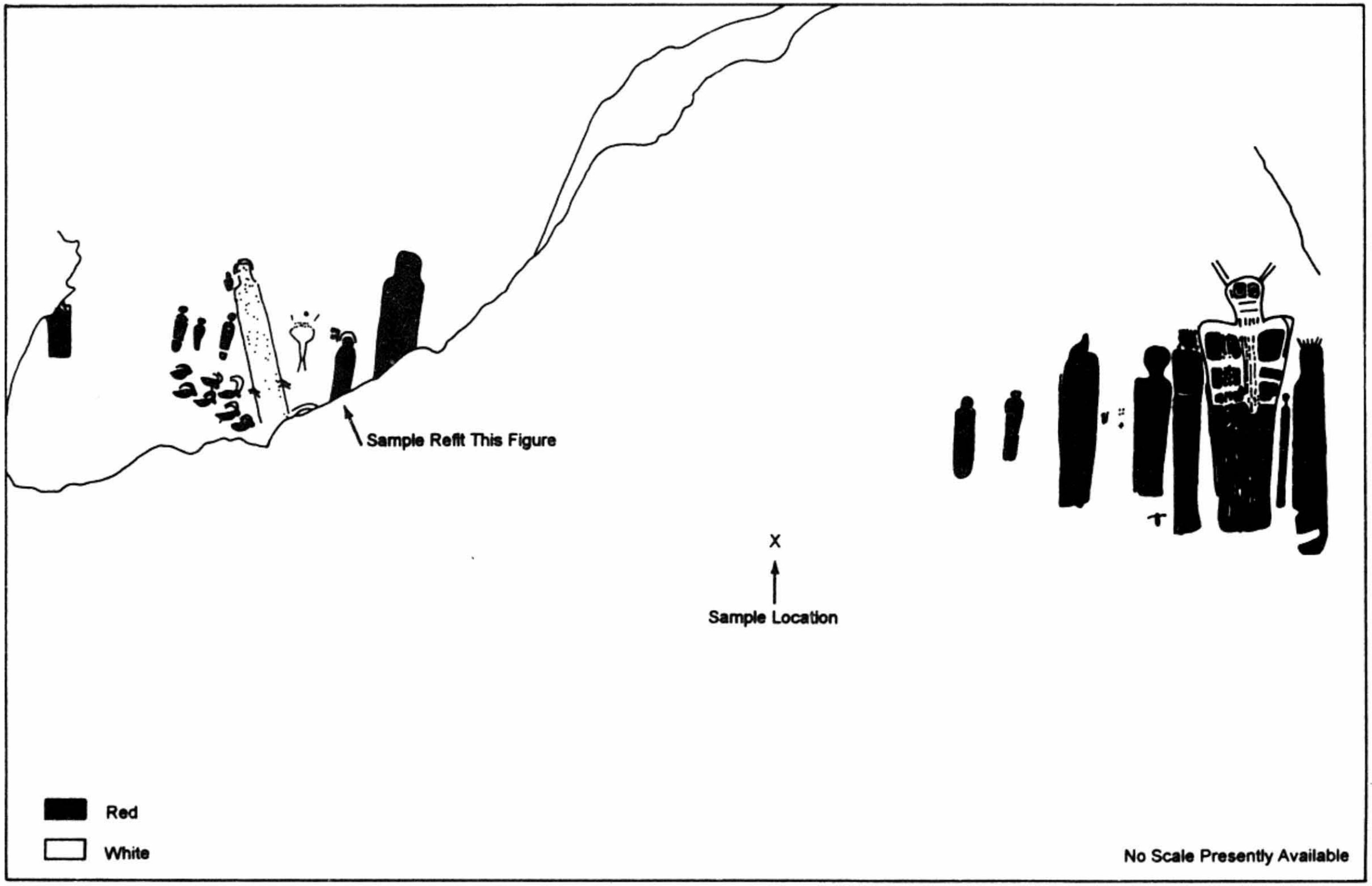

Figure 47. Portion of the Great Gallery rock art panel, site 42WN418, showing the sample location and the figure it came from. Redrafted from Noxon and Marcus (1982:Figure 105).

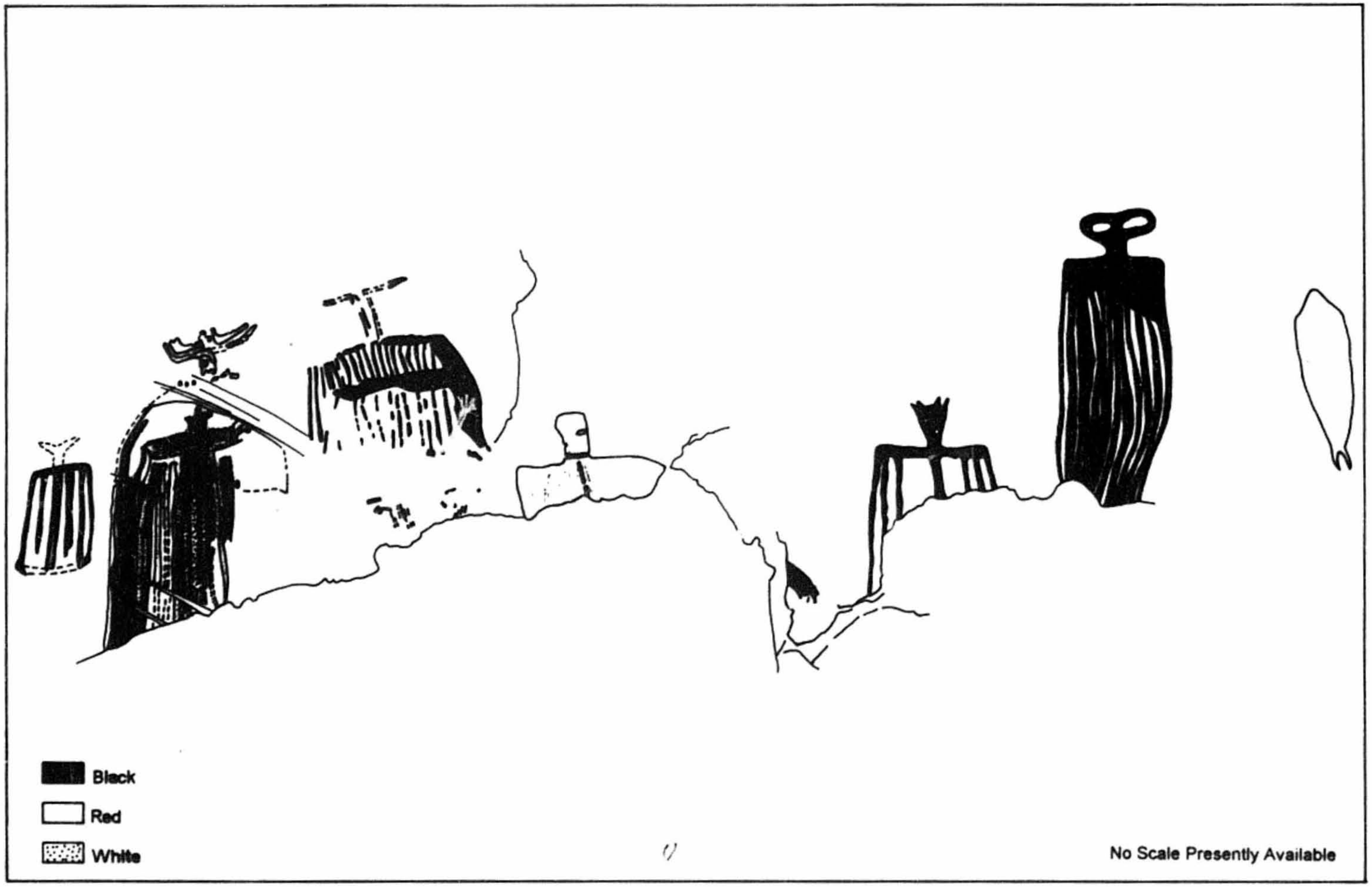

Figure 48. Pictographs at Dubinky Well, site 42GR382.

fingerprint sized dots is superimposed over a cucumber shaped ghost figure.

A radiocarbon date of 2660 ± 80 (Beta-75861) was obtained from an ash stain directly in front of the panel (Nancy J. Coulam, personal communication 1995).

The second site is the famous Harvest Scene (42WN665) or Bird Site (Schaafsma 1994) which Schaafsma (1971) used in her original definition of the Barrier Canyon rock art style. This site includes numerous life-size and larger-than-life-size anthropomorphs, often with wavy lines at their sides, small animals, flying birds and/or insects, and figures which appear to hold wild grasses. Some of the anthropomorphs are believed to either be stooped or carrying burden baskets and they hold objects that have been interpreted as tools (Castleton 1979:290-291; Schaafsma 1994:77). Most of the figures are painted but several are pecked (Castleton 1979:290-291). A radiocarbon date of 1860 ± 50 (Beta-64818) was recovered from a large slab-lined hearth in front of the panel (Nancy J. Coulam, personal communication 1995).

The association between the dates and the rock art at these two sites is suggestive, but by no means definitive. It will be stronger if similar dates from better contexts are obtained at other sites.

Discussion

Barring some unexpected and heretofore unidentified problem with the plasma technique or contamination by modern organics, the date of 1010-780 B.C. probably provides a realistic estimate of the time period when the orange Barrier Canyon figures were painted at site 42SA20615. This date places the Barrier Canyon Style squarely in the Terminal Archaic period.

Though less certain than the site 42SA20615 evidence, other available data support this general temporal placement. The Great Gallery paint date of 1880-1410 B.C. is within a millennium (500-900 years older) of the site 42SA20615 date and, if it is too old because of contamination from organic carbon in the sandstone, the actual dates could be closer, lending more support to a first millennium B.C. time frame for the rock art.

The Salt Pocket Shelter hearth date (1880-1410 B.C.) is equally earlier than the site 42SA20615 date, but if the Salt Pocket Shelter date suffers from the old wood problem (Smiley 1985, 1994), the dates may be relatively contemporaneous. If we accept the site 42SA20615 date plus the Great Gallery date as an outside maximum age of the Great Gallery figure, together they lend support to the association between the Salt Pocket Shelter date and the Barrier Canyon anthropomorph at that site.

Finally, the hearth date from site 42WN766 is statistically the same as the site 42SA20615 paint date at the 95 percent confidence level (Stuiver and Pearson 1993), lending credibility to the feature date-rock art association at this site as well. If old wood is a problem at site 42WN766, then the 42WN766 panel might be slightly younger than the site 42SA20615 panel. However, this difference should not be sufficient to reject the potential applicability of the 42WN766 date at the coarse level of chronological resolution at which we are working.

Together these four dates—the evidence from site 42SA20615 combined with the more tenuous evidence from Salt Pocket Shelter, site 42WN766, and the Great Gallery—suggest that the dated figures on these four sites were painted during the first or first and second millennia B.C.

With the limited dating evidence at hand, there is no way to accurately estimate the longevity of the style and, if it was protracted, whether these dates apply to the beginning, middle, or end of its maximum time span. However, given these four dates which potentially apply to the Barrier Canyon Style, the first and second millennium B.C. may represent the period of florescence when the majority of the rock art was produced.

The Dubinky Well paint date diverges from the other four dates—it is several hundred years later (340 B.C.-A.D. 10). In reality, this difference could be greater because the sample was evidently contaminated by older organic carbon in the sandstone. In light of the other four dates, this date will be more convincing when and if it can be confirmed through replicate analyses and dating of additional Barrier Canyon panels. However, it is obviously inappropriate to reject the date on the

grounds that it diverges from expectations at this early juncture.

In the meantime, we do not have to look far for other evidence that tentatively corroborates the validity of the late Dubinky paint date. Without modifying the date to account for organic carbon contamination, independent evidence indicates that Dubinky Well was inhabited during the period indicated by the AMS date on the rock art paint. Six highly eroded circular cists are excavated in the alluvial hardpan on the shelter floor. Such cists are believed to date between circa 500 B.C. and A.D. 1 in southeastern Utah (Lipe 1970:100-101; Matson 1991:122-124).

Tentative support for the late date also comes from limited salvage work at the Rochester Creek site in central Utah (Smith 1980). This predominantly petroglyph site has one red, Barrier Canyon anthropomorph that was exposed by pothunters digging along the cliff wall sometime after 1979. The pothunters also exposed a hearth.

In 1984, Loendorf (1985) profiled the pothole, sampled the hearth, and collected a small assemblage of artifacts—including a mano with a faint layer of red pigment adhering to it—from the soil the pothunters removed. The hearth provided a radiocarbon date of 1990 ± 70 B.P. which has a tree-ring corrected age range of 170 B.C.-A.D. 200 at two sigma (Stuiver and Pearson 1993). Based on this radiocarbon date from a feature in soil that covered the pictograph and the ochre-stained mano that may have been used to prepare the paint for its production, Loendorf (1985:8) concludes that the red figure was painted around "the time of Christ." The Rochester Creek date is statistically the same as the Dubinky paint date at the 95 percent confidence level (Stuiver and Pearson 1993).

The date of A.D. 70-320 from the Harvest Scene feature is slightly younger than the Rochester hearth and Dubinky paint dates. This may suggest that all three dates could be reasonably valid approximate estimates of when the Barrier Canyon figures were painted at those sites.

Let us assume for the purposes of argument that these three dates do represent the maximum age of or are older than the images. If so, they may well be giving us an indication of the style's longevity or showing that later people added to, embellished, refreshed, or emulated earlier Barrier Canyon figures for spiritual or other reasons. Ethnography and previous rock art research tells us that each of these scenarios is possible.

An example of a long-lived rock art style is provided by the Dinwoody petroglyphs found in the Wind River and the upper Bighorn River drainages of western Wyoming (Gebhard 1969; Gebhard and Cahn 1950, 1954; see also Tipps and Schroedl 1985). Recent AMS and cation-ratio dating suggests that it persisted from at least 6800 to 300 B.P. and was concurrent with other totally distinct styles (Francis 1994:39; Francis et al. 1993:731-732). Throughout its long history, the style evolved through time (see Gebhard 1969).

Without explicitly saying so, Cole (1990:70-72) implies that the Barrier Canyon Anthropomorphic Style was long-lived by her claims that it overlapped with the Glen Canyon Linear Style (Turner 1971), the San Juan Anthropomorphic Style (Schaafsma 1980), and Fremont rock art. Glen Canyon Linear is tentatively dated between 1000 B.C. and A.D. 500. The San Juan Anthropomorphic Style may date between 100 B.C. and A.D. 750. Fremont rock art is believed to date between A.D. 400 and 1350 (see Cole 1990:60, 109; Geib and Fairley 1992; Schaafsma 1980:109).

Australian literature contains numerous references to aboriginal custodians adding to, retouching, repainting, and renewing rock art images, apparently over considerable periods of time (e.g., Bowdler 1988; Elkin 1931; Layton 1992:17-26; Mowaljarlai et al. 1988; Utemara and Vinnicombe 1992; Walsh 1992; Watchman 1992). The best known examples are from the Kimberley area of western Australia though other examples are known (e.g., Watchman 1992).

In the Kimberley, aborigines tell of *Wandjini*, spirits that inhabited the land and created everything (Utemara and Vinnicombe 1992:25). When their time on earth came to an end, the *Wandjini* transformed into spectacular rock art images where their spirits still live (Crawford 1973:108). Placation of these spirits is of considerable importance to the aborigines because the *Wandjini* have great powers to send torrential rains, death, and destruction, but also to provide needed rain, an adequate food supply, and life itself (Crawford 1973:116). Retouching, repainting, and renewing the *Wandjini* images are part of the placation process.

. . . Art in the Kimberley is perceived as a tangible inheritance from the spiritual past for which the Aboriginal people have been charged with clear social responsibilities. They believe that for the intrinsic power of the image to remain effective, it must be cyclically renewed in the same way that nature is cyclically renewed. Life cannot be stagnated by study and preservation. Life moves in a never-ending cycle, and interruption of that cycle may result in chaos and death . . . Aboriginal priorities lie with the spiritual power of the ancestral painting which, in order to remain powerful and meaningful to present and future generations, need to be spiritually recharged and freshened by repainting . . . [Mowaljarlai et al. 1988:693].

Ethnographic accounts from the Kimberley district emphasize the association of retouch with adequate rain (Walsh 1992:50; Welch 1993:15). They also note the importance of retouch in ensuring an adequate food supply (Love 1930:7).

> Where *Wandjina* made snakes or yams or honey or crocodiles, he painted them there. When we wanted to have plenty [of] yams or crocodiles, we would go back to that place and paint them again. . . . [Utemara and Vinnicombe 1992:25].

In the Kimberley case, the paintings were normally repainted just as they were, but sometimes, when the images were faded, the aborigines put in their ". . . own ideas of what had been there before" (Mowaljarlai et al. 1988:692). The long history of renewing the images has resulted in the addition of new motifs and noticeable stylistic shifts (e.g., Clarke and Randolph 1992:18), some of which are perhaps best considered emulations of an earlier style. An aborigine from the Kimberley district reports:

> In some cases entire panels have been repainted, first obliterating the original panel under a background coating of white paint, and then repainting *similar but not identical* subject matter on top of the original paintings. One investigator identified paint up to 5 mm thick, with over 40 distinct layers in places . . . [Mowaljarlai et al. 1988:693; emphasis added].

Confirming this archeologically, a researcher reports:

> . . . In most cases, a bright white pigment (huntite) was spread over the faded image, and then the figure was repainted. With repetitious repainting over time some of these paintings have become 1 cm thick . . . [Welch 1993:15].

Aborigines in the Kimberley are not concerned about stylistic shifts or modifications to the images because it is the process of renewing the figures and interceding with the spiritual authorities, not the product, that is important (Ward 1992:33).

Modern aboriginal modification of earlier rock art is not limited to the Australian continent. In northeastern Utah, modern Ute peoples are still adding to existing rock art (Blaine Phillips, personal communication 1987). Similar activities appear to have occurred in the past. Francis et. al (1993:731) document such a case in Montana. Schaafsma (1988:8) reports on another in Arizona: at Shaman's Gallery, there were ". . . numerous painting episodes . . . Designs

were frequently painted on top of previously existing ones, and old figures were added to or renewed."

There is ample evidence that Barrier Canyon images were also modified prehistorically through embellishments and renewal (Cole 1990:79-82; Noxon and Marcus 1982:141, 184; Schaafsma 1988:8; Steven J. Manning, personal communication 1994; personal observation). Noxon and Marcus (1982:153) suggest Anasazi emulation of the Barrier Canyon Anthropomorphic Style and it is possible that the style inadvertently evolved through repainting of similar figures after obliterating the earlier work with mud.

> Some Barrier Canyon Style figures have been covered by mud. . . . In some instances, individual painted elements have been mudded over; in other cases, entire panel surfaces appear to have been covered with mud. . . . New images have been placed over mud in a few instances . . . [Cole 1990:81].

Some Barrier Canyon Style figures have been painted on mudded surfaces.

Evidence to support these or other scenarios is equivocal at Dubinky Well. There is no *obvious* evidence of modification, repainting, or renewal but the figures are highly weathered, so later applications of paint may not be visible. Two of the anthropomorphs have unusual polychrome decorations and atypical L-shaped antennae that depart from standard Barrier Canyon characteristics. Could these represent a long standing tradition evolving through time or emulation of the original style by the original artists, their descendants, or a people of a different, and perhaps later, cultural group?

These questions cannot be addressed with the data at hand but they do point out the need and some potential directions for further research. First, we to need to reexamine the definition of the Barrier Canyon Anthropomorphic Style. Schaafsma's (1971:65-82) original definition was based on less than 20 sites. Now there are potentially 155 or more known sites with Barrier Canyon Anthropomorphic Style rock art (Manning 1990:74). There is considerable diversity within this large group of rock art sites and upon close examination, it may be possible to isolate geographic or stylistic differences that have temporal significance. Such information will be critical in analyzing and interpreting additional absolute dates as they become available and placing the rock art in its proper cultural perspective.

Already, Schaafsma (1988, 1990) has posited the existence of a Barrier Canyon variant along the North Rim of Grand Canyon. This variant (as represented by Shaman's Gallery and a few other sites) shares many characteristics with the Canyonlands area Barrier Canyon style, but almost as many differences including, among others, more elongate body forms, narrower shoulders, round heads, large legs and phalli, extreme crowding and overpainting of the figures, and more frequent use of yellow paint (Schaafsma 1990:227-228). The age and cultural relationship of this variant relative to the classic Canyonlands Barrier Canyon images is unknown.

Even in the Canyonlands area, there may also be more than one temporally distinct type or evolution of the style through time. Note the three distinct body styles described in the introduction. Also, method of execution (e.g., painted, "color-crayoned," solidly pecked, outlined by pecking) and color may be important. The occurrence of white Barrier Canyon figures superimposed over weathered and faded red Barrier Canyon figures, among other things, led Manning (1990:59) to propose that Barrier Canyon figures with white paint postdate those without it.

All substances used for white clay pigment poorly bond with rock faces and are, therefore, subject to more rapid exfoliation and deterioration than most other pigments. Ochre-based pigments such as hematite are the most long-lived because of their ability ". . . to penetrate sandstone pores, or to become chemically or physically bonded . . ." (Bednarik 1994:70) to the rock. These pigment characteristics might provide independent evidence that white figures and embellishments are among the youngest of the preserved Barrier Canyon figures. However, it does not mean that white pigment was not used in older Barrier Canyon figures. It may have simply eroded beyond recognition. The poor bonding characteristics of white paint may have implications regarding the nature and breadth of the preserved rock art assemblage, especially if particular types of figures were executed solely in white. However, if white or other fugitive pigment composed only a small element of a figure largely executed in more long-lasting pigment, it should be possible to identify its former presence by consistent gaps in figures of other colors (Bednarik 1994:70-71; Welch 1990:111-112).

Subject matter may also be important in isolating styles or substyles that have temporal significance. Manning (1990:70-72, 74-75) claims to have found Barrier Canyon rock art with bow and arrow depictions and mounted horseman. These claims are hard to accept without better justifications of how and why they represent the Barrier Canyon Anthropomorphic Style and clear, scaled illustrations showing the figures in the context of the entire rock art panel. If verified, however, such panels might provide the very type of information needed to demonstrate the presence of multiple, perhaps temporally segregated styles within the group of rock art we now call the Barrier Canyon Anthropomorphic Style.

Second, we need to carefully look for evidence of evolution of the style through time, repainting, and modification. Each of these characteristics has a potential to provide insights on the longevity of the style and how the images may have functioned as part of a dynamic living culture. Reference to the work of Australian researchers, who have already considered and researched many of these types of issues, should be of considerable help in providing theoretical and methodological frameworks.

Third, while hypotheses and conclusions based on preliminary and tentative dating information may provide a starting point for further research, they require confirmation through replicate analyses and additional cases. Therefore, we need to be alert to dating opportunities, especially those that may be lost because of weathering, erosion, vandalism, and theft.

For example, when site 42SA20615 was recorded in 1988, the thick mud pigment on the orange horned Barrier Canyon figures was rapidly exfoliating from the shelter wall. Today, nothing is left but staining. When Dubinky Well was recorded in 1963 (Delling and Delling 1963), a large piece of a Barrier Canyon figure had spalled off the panel and was lying on the floor of the shelter. This fragment was not present when the site was rerecorded by the BLM in 1986 (Brunsman 1986).

Dating opportunities need not be limited to pigment spalling from panels or testing of features and deposits presumably associated with the images. Dating opportunities may exist in museum holdings. The 1930 Claflin-Emerson Expedition collected a rather large, oblong piece of modeled red pigment during their excavations at Cottonwood Cave (site SR 16-6), a reputed Basketmaker II site (Gunnerson 1969:47, 57, Figure 39f). This site has several Barrier Canyon anthropomorphs (Gunnerson 1969:56; Manning 1981) executed in what appears to be the same red pigment. If the presence of an organic binder can be confirmed through nondestructive reflectance spectroscopy, for example, and permission from the Peabody Museum can be obtained for destructive analysis, there will be another opportunity for dating the Barrier Canyon style.

Finally, we need to be alert to advances in rock art dating and new techniques that overcome weaknesses of earlier methods as well as techniques that approach the problem differently and, therefore, provide an independent means of dating the figures. An example of the latter is represented by the recent work of Alan Watchman (Watchman 1990, 1993b; Watchman and Lessard 1993). Noting that pictographs can only be directly radiocarbon dated when they contain preserved organic binders and that many paintings lack these constituents, he believes that the best approach is to date carbon-bearing substances in laminae that have accumulated both beneath and on top of the pictograph (Watchman 1993b:40). Watchman uses a focused laser beam to convert carbon-bearing substances in individual laminae into CO_2 which can subsequently be dated using the AMS carbon-14 method. The ability to sample and date individual laminae is critical, especially if the laminae developed over a protracted period of time; dating of an entire accretion would result in an average age for all carbon in the accreted deposit. Watchman advocates the dating of laminae above and below the paint layer, not only to provide minimum and maximum dates for the rock art, but also to ensure reliability of the dates by checking their internal consistency.

Dr. Nancy J. Coulam, the Canyonlands archeologist, is currently working with the U.S. Geological Survey Office in Denver to identify the pigment in various Barrier Canyon rock art panels (using nondestructive reflectance spectroscopy). If organic binders are rare or lacking in most Barrier Canyon paints, Watchman's approach may be well suited for future dating attempts. Accretionary deposits of the type dated by Watchman are known to exist at rock art in the park (e.g., Chaffee et al. 1994:769).

Conclusion

In sum, three AMS and four conventional radiocarbon dates relevant to ascertaining the age of Barrier Canyon Anthropomorphic Style rock art were presented and evaluated. While most of these dates are tentative for one reason or another (e.g., single-sample AMS dates, dates that could be contaminated by old carbon, and inconclusive associations), there are too many coincidental and squarely overlapping dates to completely dismiss all this evidence.

All seven dates cluster in a 2200-year time frame between approximately 1900 B.C. and A.D. 300 despite their being from widely scattered sites, a variety of contexts, and two organic mediums. This suggests that the problems of possible contamination of the AMS paint dates are not on the order of thousands of years but more likely a few hundred years. Considering where we started, with dating based only on stylistic evidence and superpositioning, I think this is an acceptable level of resolution from which we may begin additional research. Like any interpretation based on few dates and tentative evidence, it will probably require revision when the next batch of dates becomes available, but, in the meantime, we may have narrowed the range of possible ages from that proposed on stylistic evidence alone (Schroedl 1989).

One AMS date on pigment and three more tenuous dates (two conventional radiocarbon dates on features possibly associated with Barrier Canyon rock art and one AMS paint date that may be too old because it was contaminated by older organic carbon in the sandstone host rock) are clustered during the first and second millennium B.C., suggesting that this could have been a major period of production for the Barrier Canyon style. These dates are in accord with archeological inference based on style, subject matter, and superpositioning.

Another AMS paint date is several hundred years more recent than the aforementioned dates and may be more recent still because of contamination from organic carbon in the sandstone. Without correction for this contamination, this date almost perfectly overlaps with other dating evidence from the site, as well as a hearth date believed to be associated with Barrier Canyon rock art at another site. It is slightly earlier than a hearth date from a third site that also has Barrier Canyon rock art. These overlaps and similarities may suggest that alteration of the date by old carbon was not substantial. If this is the case, or the correct date is even later, it raises questions regarding the style's longevity and whether the later people emulated, added to, or modified earlier rock paintings. Detailed studies of what should actually be included in the Barrier Canyon Anthropomorphic Style coupled with additional attempts at absolute dating may shed light on these issues. With additional research and more dating information, we should eventually be able to confirm, refine, or reject the dates and ideas proposed here and be better equipped to elucidate how rock art can help us understand past human behavior.

NOTES:

[1]In a recent article on the age of Barrier Canyon Anthropomorphic Style rock art, Manning (1990:44) states that the figure at Salt Pocket Shelter resembles the Chihuahuan Polychrome Abstract Style more than it does the Barrier Canyon style. This suggestion is untenable.

As defined by Schaafsma (1972:61-71, 1980:49-55, 1992:43-46), the Chihuahuan Polychrome Abstract Style is characterized by multicolored paintings of informal abstract designs such as series of *short*, closely spaced, *parallel lines* and zigzags. The parallel lines are freestanding or joined to form "rakes." Circles, ovals, sunbursts, dots, and dot designs are also depicted as are few stick-figure humans. Elements are haphazardly arranged and generally independent of the others in the panel. The designs may be executed in any of the following colors: yellow, red, orange, black, and white.

Manning presumably believes that the Salt Pocket Shelter figure is one of the "rake" designs common in the Chihuahuan Polychrome Style but the design does not match Schaafsma's description. The descending lines are neither short nor parallel but, instead, long and radically converging forming a tapered figure. Close examination of the Chihuahuan panels illustrated by Schaafsma (1972:Figures 53-57, 1980:Figures 29-31) and Cole (1990:Plates 6, 8-9, 1993:9.4-9.6) reveals that most of the lines are indeed parallel as Schaafsma described, a few actually expand (e.g., see Schaafsma 1980:Figure 31), but none radically converge like the Salt Pocket Shelter to form a tapered figure. Tapered figures are, however, characteristic of Barrier Canyon anthropomorphs (e.g., see Figure 29; Noxon and Marcus 1982:Figure 81; Schaafsma 1980:Figures 42, 44).

Close reexamination of the Salt Pocket Shelter panel on May 7, 1994, by Alan R. Schroedl and Nancy J. Coulam provided additional convincing evidence that the figure represents the Barrier Canyon Anthropomorphic Style and not the Chihuahuan Style. Although not noticed originally, the vertical lines converge into a faded wide red horizontal line at the base of the figure. Figure 34 from Tipps and Hewitt (1989) has been revised to reflect this new information and is included here as Figure 46. Chihuahuan Style "rakes" do not terminate in solid lines on both the upper and lower ends because they would not be classifiable as "rakes," but Barrier Canyon anthropomorphs do. (As an aside, also note that the horizontal pecked line described by Manning could not be located during the close reinspection, nor could any other natural or cultural pecking).

The figure is also of the wrong proportions for a Chihuahuan Polychrome "rake." Most of the "rakes" illustrated by Schaafsma (1972:Figures 53-55, 57, 1980:Figures 29, 31) and Cole (1990:Plate 9, 1993:9.4-9.6) are wider than they are tall owing to the short length of the vertical lines. The figure at Salt Pocket Shelter is much taller than it is wide. This is atypical of Chihuahuan Polychrome "rakes," but characteristic of Barrier Canyon anthropomorphs. The sizing and proportions of the Salt Pocket figure are within the range expected for a Barrier Canyon anthropomorph.

The absence of a head may be one reason Manning considers the figure a Chihuahuan Polychrome design rather than a Barrier Canyon anthropomorph, but not all Barrier Canyon anthropomorphs have heads (Schaafsma 1988:17). Reinspection of the figure in May of 1994 failed to reveal traces of a head. It was clear, however, that the upper right and center portion of the figure, including the expected location for a head, was more highly eroded than the surrounding area. Any paint originally present in this area would have weathered away.

In sum, after considering all the evidence, the figure clearly and unequivocally represents a Barrier Canyon anthropomorph, not a Chihuahuan Polychrome abstract element. The original assessment reported in Tipps and Hewitt (1989:124), that the figure is a Barrier Canyon anthropomorph, is correct.

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Chapter 8

SUMMARY AND CONCLUSIONS

The archeological investigations documented in this report were conducted as part of the Canyonlands Archeological Project, a multiyear cultural resource study being conducted by P-III Associates, Inc., for the National Park Service, Rocky Mountain Region. These investigations were part of a larger, multiyear, multidisciplinary endeavor that also included ruins stabilization, rock art investigations, historic site studies, data recovery investigations, and paleoenvironmental reconstruction. This project builds and expands on the results of P-III Associates' investigations in the nearby Salt Creek Pocket and Devils Lane areas (Tipps and Hewitt 1989) as well as those of other previous researchers (e.g., Hartley 1980; Marwitt 1970a; Rudy 1955; Sharrock 1966), and incorporates, as appropriate, the results of the paleoenvironmental studies conducted by Northern Arizona University.

One aspect of the investigations involved intensive pedestrian inventory of two parcels covering a total of 878 acres in the Squaw Butte Area of the Needles District. The inventory resulted in the discovery and documentation of 76 previously unrecorded sites. Four sites previously documented by Sharrock (1966) were rerecorded to modern standards bringing the total to 80 properties. With the single exception of a modern or historic Navajo camp, the sites date to the prehistoric period and were occupied by Archaic, Anasazi, and unknown aboriginal peoples. A total of 86 components was identified on the sites, although many more are probably present than could be ascertained from the surface evidence. Simple open lithic scatters, some with one to several features, represent the majority of sites. Lithic source areas, sherd and lithic scatters, and small masonry architecture sites occur less frequently and there is one isolated rock art panel. In general, most sites are rather ephemeral attesting to the transient nature of local occupation.

Features are relatively sparse, occurring on only one-third of the sites, usually in small numbers. With the exception of three Anasazi sites, visible features are limited to no more than three per site. Most features reflect neither extensive construction effort nor prolonged periods of use. Approximately one-quarter of the 59 recorded features are unlined hearths. Ephemeral surface rooms, pictograph panels, and granaries are the next most common feature types but are represented by six or fewer examples, each. Slab-lined hearths, bins, rock alignments, walls, stone circles, and middens are examples of uncommon types occurring on only one or two sites.

The artifactual assemblage is largely composed of debitage, although 221 stone tools, 39 cores and utilized cores, and 68 sherds were also recorded. The stone tool assemblage is relatively diverse but many tool types are represented by just a few examples. The most common tools are bifaces, distantly followed by manos, metates, projectile points, and modified flakes. A few scrapers, unifaces, drills, hammerstones, and other tool types were found. The vast majority of artifacts are fashioned from raw materials that outcrop and are abundantly available in the project area. However, there is no indication of local pottery manufacture. Instead, this appears to have been accomplished elsewhere, presumably in the Elk Ridge Plateau highlands south of the project area (see Chapter 3).

A second component of the project was limited testing of features at six of the recorded sites. This work was undertaken to obtain chronological and subsistence information on the pre-Pueblo II occupation. Nine unlined and slab-lined hearths, an oblong slab-lined feature, and a midden were tested. Three additional features—two cultural strata and an unlined pit exposed in one of the strata—were minimally investigated. Radiocarbon dating was undertaken on samples of burned wood from nine of the features. The calibrated dates range in age from 4330-3960 B.C. to A.D. 710-1010 but cluster in the few centuries around the time of Christ. Twenty flotation samples from 11 of the features yielded 18 different plant taxa from 13 families, all of which are available in the natural environment of the project area today. A surprising result was the complete absence of cultivated plants such as corn, beans, and squash, even in samples that date to the Basketmaker II and III and Pueblo I time periods. Evidence of faunal utilization was also lacking in the flotation samples.

The third and final aspect of the project was the ongoing research concerning the age and cultural affiliation of the Barrier Canyon rock art style. Although additional work on this topic remains to be done, research on this topic has sufficiently progressed that the time has come to present the current results.

The remainder of this chapter reviews what was learned through the Squaw Butte Area investigations relative to the research issues presented in Chapter 1. For the most part, the succeeding discussions represent a summary and review. More detailed information and justifications for the conclusions can be found in the various chapters.

Chronology and Cultural Affiliation

Results of investigations concerning the local chronology support the conclusions of Tipps and Hewitt (1989) that the general area was inhabited during most, if not all major periods of prehistoric human habitation. Although there is much we still do not know, we may safely discard the earlier interpretations that Canyonlands was devoid of occupation prior to the Pueblo II time period.

Although well over half of the sites could not be ascribed to a particular culture or time period other than aboriginal and prehistoric, 11 sites can be identified as Archaic: 2 each to the Early, Middle, and Late Archaic and 5 to the Terminal Archaic. Three sites date to the Early Formative period and one to the more general Formative period; their cultural affiliations are presently unknown. Fourteen sites were created by the Anasazi. Eight date to Pueblo III or late Pueblo II-III. The exact age of the other six could not be determined from the surface evidence although they appear to be the same age. Finally, one component represents occupation by Navajo people during historic or modern times. Paleoindian artifacts were also discovered in the project area but do not appear to be the result of actual occupation.

One fragmentary Clovis point and two possible Paleoindian projectile point bases were recorded on three sites in the Squaw Butte Area. The geologic context of the latter two artifacts firmly establishes they are not the result of in situ Paleoindian occupation. However, both specimens are made from local materials indicating Paleoindian use of the general area, if not the actual project area.

The depositional context in the vicinity of the Clovis point base does not preclude in situ occupation but the cumulative lines of other evidence suggest that it is a scavenged specimen. First, the site has artifacts diagnostic of a much later period and appears to lack other diagnostic Paleoindian artifacts. Second, the point was broken during use, not manufacture. This and the lack of debitage of the exotic material used for the point establish that it was not made at the site. While the point could have been discarded during a retooling episode, this seems unlikely in the absence of other diagnostic Paleoindian artifacts. Finally, the point is more weathered than other site artifacts. The Clovis base is made from a material believed to be Pigeon's Blood Chalcedony; this material is available in Floy Wash, near Interstate 70, north of the project area. If the raw material for the point was procured from Floy Wash, it at least indicates regional manufacture and use for the Clovis specimen.

Early Archaic occupation was identified at two sites on the basis of projectile point styles.

The small number of Early Archaic sites accords with Tipps and Hewitt's (1989) findings in the nearby Salt Creek Pocket and Devils Lane areas, but as noted later in this research domain, this paucity may, in part, reflect the ages of deposits preserved and exposed in the project area. Early Archaic sites are much more common in portions of the Needles District that have large remnants of intact Early Holocene deposits (Tipps and Schroedl 1990).

The Middle Archaic is documented by a Rocker Side-notched projectile point on one site and a radiocarbon date of 4330-3960 B.C. (two sigma calibrated age range) from an unlined hearth on another site. Another Middle Archaic radiocarbon date (3620-2880 B.C., two sigma calibrated age range) was obtained by the paleoenvironmental contractors from an unlined hearth on a site just outside the project area. The discovery and documentation of Middle Archaic sites are important contributions of the project because the Middle Archaic period is still poorly understood. Future research efforts should be directed at more thorough investigations of these three sites. Late Archaic occupation is suggested at two sites on the basis of Gypsum points. Gypsum points are believed to date between 4000 and 1500-1000 B.C.

The inventory produced no evidence of occupation during the Terminal Archaic (1500 B.C.-A.D. 500) but the testing program documented four components at three sites dating to this time period. In addition, studies of the age and cultural affiliation of Barrier Canyon rock art (see Chapter 7 and discussion below) suggest that this style may date to the Terminal Archaic period so an additional component was identified as Terminal Archaic on this basis. Accumulation of evidence from this period is particularly important to understanding the nature of the transition into the Formative lifeway and the introduction of a horticultural economy.

Based on Sharrock's (1966) reconnaissance inventory, it was widely held that Canyonlands was not occupied during the Early Formative period. This view was modified by the findings of Tipps and Hewitt (1989) and the Squaw Butte Area investigations provide further evidence of occupation during this period. Thus far, it appears that Early Formative occupation was sporadic and light. However, if sites from this time period lack diagnostic surface artifacts, as did the three Early Formative sites discovered in the Squaw Butte Area, they may be difficult to distinguish from earlier Archaic sites and, thus, underrepresented in our sample relative to the actual frequency of their occurrence.

A relatively substantial Mesa Verde Anasazi occupation is indicated on the basis of ceramic styles, architecture, and rock art. Overall, the ceramic assemblage dates the occupation to Pueblo III or late Pueblo II-III. Several plain gray body sherds could date any time between Basketmaker III and Pueblo III. However, their occurrence with corrugated styles in what appear to be sites cumulatively occupied for only a short period of time argues they date to the same period as other sherds in the assemblage. The small nature of the ceramic assemblages and the scarcity of painted types (mostly due to illegal artifact collection by visitors) precluded more precise dating.

Finally, one site dates to historic or modern times. This site contains a circular wooden structure that may be the remains of an unfinished cribbed hogan suggesting that the site's inhabitants were Navajo. While Protohistoric and historic aboriginal occupation of the area may have primarily been by Ute or Paiute people, Navajo use of the greater Needles area is also documented. For example, Hunt (1953) reports on Navajo pottery at a site near La Sal and Pierson (1980) notes the presence of a collapsed hogan in Ruin Park. Navajo use of the La Sal Mountain area is documented by archeological evidence, historical records, and oral history (Correll 1971). Use of the area continues today (Beth E. King, personal communication, 1994).

As was the case at the conclusion of Tipps and Hewitt's (1989) investigations, data concerning many parts of the chronology are still sketchy and more work needs to be done to fill in the details. It is certain, however, that there was occupation during all major periods of the Archaic, and at least a light Early Formative occupation in addition to the better known Late Formative occupation by the Mesa Verde Anasazi. Late Prehistoric or Protohistoric occupation by Numic speakers has also been identified in the immediate area (Reed 1993).

Available information is not yet sufficient to determine whether the Needles District was continuously inhabited, though there is evidence of occupation during every major phase and period with the possible exception of Paleoindian. However, there is sufficient evidence to establish occupation between approximately 3000 and 2000 B.P. (circa 1250 B.C.-A.D. 50) when Berry and Berry (1986) propose large-scale abandonment of the Colorado Plateau. Using the two sigma calibrated age ranges, five of the Squaw Butte Area dates lie within the circa 1250 B.C.-A.D. 50 low point in the radiocarbon record noted by Schroedl (1976:68-69) for the northern Colorado Plateau, even if they are affected by the old wood problem (Smiley 1985, 1994). These dates add to the growing corpus of evidence for occupation in the greater Canyonlands area during this time period (e.g., Bungart 1990; Horn 1990; Metcalf et al. 1993; Osborn 1994; Reed 1993; Tipps 1992; Tipps and Hewitt 1989; Vetter 1989). Accumulation of this evidence is particularly significant because the existence of a hiatus is an important factor in determining whether there was cultural continuity between the Archaic and later horticultural peoples (e.g., Berry and Berry 1986).

Referring to their conclusion that their radiocarbon bar charts accurately represent temporal patterning of the Southwestern Archaic, Berry and Berry (1986:311) observe: "If we are wrong, this will be demonstrated by subsequent work." It now seems that a sufficient amount of subsequent work is available to revise our thinking concerning the abandonment proposed for the circa 1250 B.C.-A.D. 50 period. Counting this project and P-III Associates' work in Island-in-the-Sky (in prep.), there are eight recent projects conducted in or near Canyonlands National Park that have produced a total of 22 radiocarbon dates with two sigma calibrated age ranges in the circa 1250 B.C.-A.D. 50 time period. Only four of these dates are eliminated if 200 years are subtracted to account for potential old wood problems (cf. Smiley 1985, 1994). Also, if the dates of 1900 B.C.-A.D. 300 proposed for the Barrier Canyon rock art style are correct (see Chapter 7 and below), there is even more evidence of occupation at this time. Rather than a regional hiatus or partial population abandonment, much of the circa 1250 B.C.-A.D. 50 period now appears to have been a time of moderate, if not intensive occupation.

The work by Schroedl (1976) and Berry and Berry (1986) was done when there were substantially fewer radiocarbon dates than at present and when most of the available dates were from rockshelter sites where occupation during earlier and latter periods is well represented. Most of the dates referred to above are from open sites or sites with small, shallow overhangs. This implies major changes in settlement patterns from preceding periods and is a topic begging for attention during future research. If settlement strategies during the circa 1250 B.C.-A.D. 50 period emphasized small open sites, the early focus on excavating rockshelters may have given the inaccurate impression of a hiatus. As demonstrated by the Squaw Butte Area investigations, another factor that may have caused the appearance of an abandonment or low density of sites is the paucity of mutually exclusive diagnostic artifacts that can help identify open sites belonging to this time period.

The next research issue concerns the dates of the ubiquitous open lithic scatters which are so common in the project area and adjacent portions of the Needles District. The radiocarbon dates from the Squaw Butte Area and other sites in the immediate vicinity (Dominguez 1994; National Park Service 1990; Reed 1993; Tipps and Hewitt 1989) suggest they result from occupation by several cultural groups during multiple time periods. If the available dates are any indication, some of the open lithic scatters date to various portions of the Archaic period, whereas others may be aceramic sites used by Formative peoples. Reed's (1993) recent identification of a Late Prehistoric or Protohistoric component at Shadow Shelter suggests some could even be later sites occupied by Numic speakers. However, the majority may date to the two millennia that straddle the transition into the Christian era. This discovery is particularly important to understanding the local chronology because sites from portions of this period are often difficult to recognize in the context of an inventory and are thus likely to be overlooked, leading to false impressions of abandonment or declining population, as noted above. In addition, the recognition and study of sites from this period is especially important to evaluating competing hypotheses regarding the local introduction of agriculture and the initiation of the Formative lifeway (Berry 1982; Berry and Berry 1986; Irwin-Williams 1973; Matson 1991).

Paleoenvironmental investigations were undertaken not only to reconstruct the environmental conditions during the various periods of prehistoric occupation, but to ascertain how geomorphic processes might have affected the preservation and discovery of sites dating to each major time period. The inventory parcel near Squaw Butte is typified by shallow soils and exposed sandstone bedrock intermittently covered with sheet sand, dunes, and lag deposits of Cedar Mesa Chert. The depositional setting allows the possibility of Holocene deposits of any age in this area (see Birnie, Chapter 2) but recent archeological investigations have shown that cultural deposits of increasing age are likely to be buried (Dominguez 1988; Reed 1993), at least in sheltered settings such as overhangs. This area appears to have been an erosional landscape throughout the Holocene; thus, deposits of varying ages may occur on the same surface (see Birnie, Chapter 2).

In the inventory parcel near lower Salt Creek, there are three alluvial terraces (T1-T3), intermittently covered with eolian sands of varying depth (Agenbroad and Mead 1992b; Mead et al. 1992). The upper terrace (T3) covers most of this parcel, whereas the lower two terraces (T1 and T2) are confined to selected near-channel positions along Salt Creek. Radiocarbon dating of scattered charcoal collected near the surface of T3 yielded a two sigma calibrated age range of 2880-2400 B.C., with the overlying dunes younger still. Thus, the ages of sites that could potentially be present on the surface of this terrace or the overlying dunes are restricted to the Late Archaic and subsequent periods. The depth and age range of the T3 terrace were not investigated but, based on the configuration of the floodplain, the positioning of bedrock thresholds, and various other topographic barriers, Birnie (Chapter 2) suggests there is potential for in situ deposits of late Pleistocene to early Holocene age, as well as mid-Holocene deposits consisting of reworked late Pleistocene and early Holocene-age sediments flushed from the middle and upper reaches of the Salt Creek drainage. If this reconstruction is correct, mid-Holocene and earlier cultural manifestations are likely to be deeply buried and have low archeological visibility. The most likely location for surface exposures of mid-Holocene and earlier deposits would be along the edge of the terrace where Salt Creek has exposed a deep profile.

In summary, while geomorphic conditions do not preclude the preservation and surface visibility of sites from all major periods of human habitation recognized in the region, they are more conducive to the preservation and discovery of sites dating to the Late Archaic and later periods. And indeed, this is exactly what the inventory and testing showed. Surface-visible Early Archaic sites are few in number and restricted to erosional surfaces in the vicinity of Squaw Butte. The few Middle Archaic sites also occur on erosional surfaces near Squaw Butte as well as in deep exposures of T3 terrace deposits near Salt Creek. Sites of later periods occur throughout the project area but do appear to be positioned relative to critical environmental variables as discussed later in the section entitled Environmental Adaptation.

Cultural affiliation is the next major topic in the research design. Four cultural components on three sites have dates during the Terminal Archaic period defined for this project (1500 B.C.-A.D. 500). As noted in Chapter 1 and the first report of the Canyonlands Archeological Project (Tipps and Hewitt 1989), this period can include sites of Archaic, Basketmaker II, or nacent Fremont affiliation. The four sites and components lack artifacts diagnostic of any of these cultural phenomena but flotation samples from hearths on the sites demonstrate a hunting and gathering economy. A similar situation was encountered at the nearby Shadow Shelter (Reed 1993) and at the Down Wash site in the Maze District of Canyonlands (Horn 1990).

In the absence of culturally diagnostic traits, past researchers working outside of core Basketmaker II areas have considered such sites Archaic, Basketmaker II, or of unknown cultural affiliation. The reason for these varied interpretations is because researchers may define Basketmaker II as a stage, a group of artifacts, a time period, a lifeway, an ethnic group, a geographic area, or some combination of the above. Depending on which traits are present at a particular site, and which definition a researcher uses, the interpretation may differ.

In Chapter 6, it is argued that the Basketmaker II label should be reserved for sites created by preceramic Puebloan people who were demonstrably engaged in maize horticulture and which typify the Basketmaker II lifeway as defined by the recent work of Matson (1991), Chisholm and Matson (1994), and others. The latter requirement is especially important because the original definition of Basketmaker II (cf. Kidder 1927a, 1927b) as intermediate between Archaic hunter-gatherers and more sedentary Basketmaker III horticulturalists has been significantly modified by recent research. It now refers to preceramic corn-dependent Puebloan people and is considered a Formative phenomenon (Chisholm and Matson 1994:250).

The Terminal Archaic-age sites thus far discovered in Canyonlands do not typify the same stage, lifeway, cultural expression, or adaptation described by Matson (1991) for Basketmaker II. These ephemeral sites are located away from arable land in an area lower than that normally inhabited by southeastern Utah Basketmakers and they display a hunting and gathering economy. While they could possibly represent Basketmaker II camps associated with hunting or wild plant procurement, this scenario is hard to support given the scarcity of known Basketmaker II habitations in the area (e.g., see Pierson 1980; Thompson 1979). In addition, while the flotation results are limited and will be stronger when and if additional samples are processed, available information suggests that some of the recovered plant taxa are harvested at the same time as corn. Although these taxa can often be procured from disturbed areas around corn fields, there is no evidence to suggest this type of procurement was being practiced. From the perspective of optimal foraging, full-time farmers would not abandon ripe corn fields to instead forage for these plant taxa. Based on these lines of evidence, it is provisionally argued that the sites are best considered of Archaic affiliation (see Chapter 6).

Fremont cultural affiliation was the next research issue. Not one shred of evidence was found to indicate any sort of occupation by people who had Fremont material culture, but neither can Fremont use of the project area be completely ruled out based on the available information. Three sites occupied during the Early Formative period (circa A.D. 500-1000) lack any visible diagnostic artifacts that might aid in determining their cultural affiliation. The sites appear to be aceramic, and flotation studies of hearth contents revealed a complete absence of cultigens (see Coulam, Chapter 6). These sites do not fit the settlement and subsistence patterns which typify analogous age Anasazi but are instead more consistent with those of the San Rafael Fremont of the same period (Black and Metcalf 1985). This does not necessarily mean that the sites were occupied by people archeologists identify as Fremont. Early Formative-age Anasazi sites have been found in the Needles District (Tipps and Hewitt 1989) and it is also possible that people of both cultural traditions sporadically used the area during the Early Formative era. More research is clearly needed to ascertain the identity of the Early Formative inhabitants. We may also need to rethink and expand our view of adaptive strategies for the frontier Anasazi of this time period.

The final research priority in the chronology domain was ascertaining the age and cultural affiliation of Barrier Canyon Anthropomorphic Style rock art. Research on this topic began in 1985 with the dating of a hearth at a small overhang site containing a single Barrier Canyon anthropomorph (Tipps and Hewitt 1989). The hearth provided a two sigma calibrated age range of 1880-1410 B.C. but the results were inconclusive due to the uncertain nature of the association between the hearth and the rock art panel. Over the next few years, several samples of actual rock art became available for dating: painted sandstone spalls from Barrier Canyon panels at the Great Gallery in the Maze District and Dubinky Well in the Island-in-the-Sky uplands, and pure paint samples spalled from two Barrier Canyon figures at site 42SA20615 in the Squaw Butte Area.

Researchers at Texas A&M University extracted the organic carbon from the paint using the plasma technique (Russ et al. 1990, 1991, 1992). After extraction, the Great Gallery and Dubinky Well samples contained large amounts of sandstone. As a precaution against possible contamination, background samples of the unpainted sandstone were subjected to the same extraction technique and used as controls. The paint and control samples were subsequently dated using AMS at the Facility for Radioisotope Dating at the University of Arizona. The unpainted sandstone samples from the Great Gallery and Dubinky Well were older than the respective paint dates causing Rowe (1993) to conclude that the paint dates could be too old, but taken as upper limits on their ages. One of the samples from site 42SA20615 samples was lost during processing.

As a result of this work, previous investigations by Loendorf (1985), and the radiocarbon dating of features on two sites with Barrier Canyon rock art by Dr. Nancy J. Coulam, Canyonlands Archeologist, there are now three AMS and four conventional radiocarbon dates relevant to ascertaining the age of the Barrier Canyon rock art style. While most of these dates are tentative for one reason or another (e.g., single-sample AMS dates, dates that could be contaminated by old carbon, and inconclusive associations), there are too many coincidental and squarely overlapping dates to completely dismiss all this evidence. All seven dates cluster in a 2200-year time frame between approximately 1900 B.C. and A.D. 300, despite their being from widely scattered sites, a variety of contexts, and two organic mediums. This suggests that the problems of possible contamination of the AMS paint dates are not on the order of thousands of years, but more likely a few hundred years. Considering that previous dating was based on stylistic evidence and superpositioning alone, this is an acceptable level of resolution for some initial observations.

One AMS date on pigment and three more tenuous dates are clustered during the first and second millennium B.C. suggesting that this could have been a major period of production for the Barrier Canyon Anthropomorphic Style. These dates are in accord with archeological inference based on style, subject matter, and superpositioning (Schaafsma 1971, 1980, 1988). Another AMS paint date is several hundred years more recent and may be younger still because of contamination from organic carbon in the sandstone. Without correction for this possible contamination, this date almost perfectly overlaps with other dating evidence from the site, as well as a hearth believed to be associated with Barrier Canyon rock art at another site. It is slightly earlier than a hearth date at a third site with Barrier Canyon rock art.

These overlaps and similarities may suggest that alteration of the date by old carbon was not substantial. If this is the case, or the correct date is even later, it raises questions regarding the longevity of the style, and whether later people emulated, added to, modified, or refreshed earlier rock paintings. Longevity of rock art styles has been reported in other archeological contexts (Francis 1994; Francis et al. 1993) and there are many ethnographic examples of rock art modification by later peoples, some over considerable periods of time (e.g., Bowdler 1988; Elkin 1931; Layton 1992; Mowaljarlai et al. 1988; Utemara and Vinnicombe 1992; Walsh 1992; Watchman 1992; Blaine Phillips, personal communication 1987).

In sum, available evidence suggests that the Barrier Canyon rock art style dates to the period between approximately 1900 B.C. and A.D. 300. It now seems less likely that Schroedl's (1989) suggestion regarding the antiquity of Barrier Canyon Style rock art is correct. Instead of being contemporaneous with analogous Early Archaic figurines (Coulam and Schroedl in press), it is possible that the prehistoric discovery of old figurines in sites such as Cowboy Cave (Jennings 1980) spawned the Barrier Canyon Anthropomorphic Style. In retrospect, the proposed dates should not come as a surprise. They accord with Schaafsma's (1971, 1980) suggested dates based on stylistic evidence. Also, a rock art style as common as Barrier Canyon should correlate with a period of high occupational intensity as revealed by independent lines of evidence, and the radiocarbon record shows a noticeable increase in dates at about the same time.

One other point that seems obvious but in definite need of additional investigation concerns the cultural affiliation of the style's makers. Much of the proposed period of manufacture overlaps with the Basketmaker II *period* (circa 500 B.C.-A.D. 400), as defined in the Four Corners area (Matson 1991:Figure 2.42), yet the style mainly occurs around the western, northwestern, and northern peripheries of the core area typifying the Basketmaker II lifeway (see Cole 1990:Map 4) and, thus far, appears to be most common in the Canyonlands area (Manning 1990:Figure 3). If the proposed dates are correct, the relatively non-coincident spatial distribution of Barrier Canyon Style rock art and known sites exhibiting a

Basketmaker II lifeway suggests they could be the remains of two separate but contemporaneous cultural traditions occupying adjacent portions of southeastern Utah at that time. This is not a new suggestion (e.g., Geib and Bungart 1989; Tipps 1992) but does provide a separate line of evidence supporting the earlier arguments as well as an indication of the spatial extent of the non-Basketmaker II cultural tradition.

Based on stylistic grounds, Schaafsma (1971) convincingly argued a hunting and gathering lifeway for the Barrier Canyon artists, and this interpretation seems as appropriate today as it was when written, almost 25 years ago. Schaafsma's interpretation, coupled with the discovery that analogous age inhabitants in the core Barrier Canyon rock art area (see Chapter 6) had a hunting and gathering economy, argues an indigenous, Archaic age affiliation for the Barrier Canyon artists.

Settlement Patterns

Research issues identified for the settlement pattern domain concerned the types of settlement patterns practiced in the project area, whether occupation was seasonal or year-round, and if the latter, during what season(s). The Archaic sites include lithic scatters and lithic source areas sites, often accompanied by features such as unlined or slab-lined hearths, and there is one instance of rock art. There is no evidence of constructed shelters, although some of the sites occur in overhangs that provide natural shelter.

None of the sites appear to result from long-term or year-round occupation, although the Middle Archaic components at two sites have extensive deposits indicating repeated use or perhaps more intensive stays. Discounting these two sites, Archaic hunter-gatherers appear to have used the project area for short periods of time, perhaps no more than a few weeks, during the course of their seasonal round. The primary mode of adaptation is inferred to be foraging, with most of the sites representing short-term residential bases or locations involved in the collection and processing of Cedar Mesa Chert and various wild plant foods such as Indian rice grass, dropseed, prickly pear cactus, pinyon, saltbush, and goosefoot. Acquisition and use of animal resources is also indicated by the presence of hunting related implements. The primary seasons of occupation may have been the spring/early summer when early greens and seeds were available and winter stores had been depleted, and again around the time of the goosefoot harvest.

The adaptive pattern for the two Middle Archaic sites was probably similar in most respects, but the more extensive deposits suggest that these two sites were longer term or reused residential bases in a forager adaptation or possibly residential bases in a logistically mobile collector adaptation. The location of the sites near perennial water sources may have encouraged reuse or made longer term occupation possible at a time when climatic conditions are inferred to have been warmer and drier than during preceding and succeeding periods.

Anasazi sites are small sherd and lithic scatters and small masonry architecture sites, sometimes associated with natural sources of Cedar Mesa Chert. Features on these sites are relatively few in number and limited to those meeting the most basic Anasazi needs of defining living/working space (e.g., stone circles, rock alignments, ephemeral surface rooms), providing storage (e.g., granaries and storage bins), and allowing site access (e.g., hand and toe holds). Specialized and ritual features such as mealing bins, grinding rooms, and kivas were not encountered, although there is a possibility for a few such features to be buried at the three largest Anasazi sites.

The limited amount of architecture is expedient and insubstantial, reflecting a minimal level of effort to produce and maintain. Living rooms consist of low, dry-laid enclosing walls which were never more than a few courses high and probably never roofed. The granaries are somewhat more substantial than the living rooms but still do not display a great deal of effort in their construction. Building materials consist of whatever type and shape of stone was immediately available and structures often incorporate natural overhangs, outcrops, and large boulders as walls. The frequency, types, and characteristics of the features not only suggest short-term and seasonal low-intensity use, but also occupation during a warm season.

Tipps and Hewitt (1989) report that Anasazi occupation in the adjacent Salt Creek Pocket and Devils Lane areas was primarily initiated by Anasazi farmers from adjacent highlands who came on a short-term, intermittent basis to hunt, gather wild plant foods, and collect nonfood resources such as toolstone. Most sites were considered to be camps. They also suggest that some of the sites were stopover points for groups of Anasazi on their way to seasonal farmsteads along the Green and Colorado rivers. Though not important in their project area, Tipps and Hewitt (1989) believe that limited horticulture was practiced somewhere in the general vicinity based on the presence of two highly deteriorated possible granaries, two trough metates, and two two-hand manos. These interpretations are consistent with the ephemeral nature of their sites, the minimal evidence of horticulture, and the general paucity of arable land in their project area.

Anasazi settlement patterns in the Squaw Butte Area accord with certain aspects of Tipps and Hewitt's (1989) model but show a wider range of variability than was present in their project area. Like the adjacent Salt Creek Pocket and Devils Lane areas, Anasazi occupation in the Squaw Butte Area was not year-round but instead timed to take advantage of certain subsistence resources available at selected times throughout the year. Some activities were directed at procurement of wild plant and animal foods and the collection and processing of Cedar Mesa Chert, much like the Salt Creek Pocket and Devils Lane areas. However, the few small pockets of arable land were apparently more attractive than the wild plant and animal foods, resulting in an expanded settlement pattern that involved some additional site types, reduced mobility, and longer periods of occupation.

Specifically, at least some sites were farmsteads that were inhabited seasonally over a period of a few years. Several storage facilities and corn processing sites were established in support of this occupation. The habitation and storage sites were probably used by small groups of Anasazi farmers taking advantage of the long and early growing season at the project area's relatively low elevation. The dark paste ceramic assemblages affiliate these site inhabitants with the Elk Ridge Plateau highlands (see Hurst, Chapter 3), supporting Tipps and Hewitt's (1989) suggestion that Anasazi occupation of the lower Salt Creek lowlands was initiated from year-round pueblos in that area.

Tipps and Hewitt's (1989) suggestion that some of the sites in the adjacent Salt Creek Pocket and Devils Lane areas were stopover points for Anasazi traveling to and from summer farmsteads is probably correct, although the locations of at least some of the farmsteads are now known to be isolated patches of arable alluvium in adjacent parts of the Needles District.

In Binford's (1979, 1980) forager-collector model, the Anasazi settlement pattern in the Squaw Butte Area technically displays aspects of both forager and collector adaptations but is closest to the collector end of the continuum. The Anasazi practiced a seasonally mobile strategy of moving their residental base to the resource zone they planned to exploit. But once there, they followed a collector strategy, procuring resources and moving them to their residential bases for immediate processing and consumption, or for storage for future use. Considering the limited extent of arable land which would have severely limited production capacity, the small number of storage facilities, and the long and arduous trip to their presumed highland homes, it seems unlikely that the crops were being transported to highland pueblos. Instead, they were probably being used to supply the summer farming party with food and provide seed for next year's crops.

Environmental Adaptation

Studies of the Squaw Butte Area environment revealed many natural resources that probably made the area attractive for prehistoric occupation. One of the most important resources was the Cedar Mesa Formation. This unit contains nodules of Cedar Mesa Chert suitable for chipped stone tool manufacture, tabular limestone that could be fashioned into pecking and pounding tools, or used as-is for building stones, and sandstone that could be used for milling equipment and building material without modification. It also provided shelter from the elements in the form of small overhangs and numerous vertical faces suitable for the execution of rock art.

The project area is relatively well watered in that it is bisected and bordered by two perennial drainages. In locations removed from these drainages, water could have been obtained, at least during the rainy seasons, from natural tanks and depressions in sandstone outcrops. The dearth of arable land in the project area appears to have been a major deterrent to intensive Anasazi occupation, but the small patches of arable land appear to have been utilized and were therefore an important factor in prehistoric settlement and site location.

Finally, various plants and animals were available throughout the project area. Among the most desirable were probably pine nuts, saltbush, shadscale, prickly pear cactus, and sunflower, followed by cattail, sedge, dock, and bee plant, all of which have relatively high caloric return rates compared to grasses (Simms 1988). Many of the potentially available plants would have also provided nonfood resources such as fuel, fibers, paint, and medicinal remedies.

The density of sites in the Squaw Butte Area is significantly higher than that of most surrounding areas that have also been intensively inventoried, even the adjacent Salt Creek Pocket Area inventoried during the first year of the Canyonlands Archeological Project (Tipps and Hewitt 1989). One possible reason for the larger concentration of sites in the Squaw Butte Area is the higher density of lithic source area sites. Another is probably the presence of a small patch of arable alluvium, a resource that was lacking in the Salt Creek Pocket Area. Anasazi sites in the Squaw Butte Area are concentrated in the vicinity of the few arable alluvial soils.

A third reason for the higher density of sites may be the availability of water, a key resource in the relatively low-lying desert environment, particularly in the spring, summer, and fall. The shape and positioning of the Squaw Butte Area relative to two perennial drainages would have made water more readily accessible than in the Salt Creek Pocket Area. Also, the Squaw Butte Area has a higher concentration and more even distribution of rocky outcrops. Not only would these outcrops have provided shelter from the hot summer sun, perhaps more importantly, their numerous pothole reservoirs would have provided water during wet periods in the spring and summer months. The greater density and more even distribution of rocky outcrops and, hence, water sources may partially account for the higher concentration of sites. Tipps and Hewitt (1989) also observed a strong correlation between sites and rocky outcrops in the Salt Creek Pocket Area.

Another factor in the differing site densities may relate to topography. In contrast to the vast open expanses of waterless homogenous sand sheets that characterize much of the Salt Creek Pocket Area, the Squaw Butte Area has a diversity of clayplans, alluvial terraces, and rocky outcrops, in addition to small sand sheets. This diversity of environmental settings translates into a much wider assemblage of soil types that provided more varied and perhaps more desirable plant resources for consumption as well as animal forage. More than 90 percent of the Salt Creek Pocket Area is covered with Sheppard Fine Sand or Rock Outcrop-Rizno-Dry Complex soils. Under presumed natural conditions and the modern climatic regime, both have a low annual plant productivity and Indian rice grass is the primary plant of human interest (Lammers 1991; see also Table 6). As noted in Chapter 6, Indian rice grass is relatively low ranked and will mainly be taken when higher ranking plants are not available. These two soil types also have a poor to very poor rating for wildlife habitat (Lammers 1991:Table 6). A much wider variety of soils occur in the Squaw Butte Area, some with much higher total annual plant productivity. These soils support a more diverse assemblage of plant life, including several highly ranked resources such as saltbush, and are rated slightly better for the production of animal forage.

The next research issue in this domain concerned the extent and nature of Cedar Mesa Chert utilization. Cedar Mesa Chert occurs on every site with chipped stone. It is the only material on approximately 10 percent of the sites, the dominant material on another 65 percent, and one of two or more primary materials on another 21 percent. The widespread intensity of utilization suggests that procurement and processing of Cedar Mesa Chert was an important activity during all major periods of occupation.

Procurement of Cedar Mesa Chert appears to have been accomplished using a combination of strategies (cf. Elston and Raven 1992b). The unique spatial coincidence of food, water, shelter, some arable land, and toolstone in the Squaw Butte Area invited a residential procurement strategy. Indeed, several camps and habitations are on or adjacent to Cedar Mesa Chert sources. Some of the larger sites lie in overhangs removed from the sources. Residents of these sites probably obtained the toolstone using a diurnal collection strategy. It is also possible that groups moving through the area procured toolstone based on an encounter strategy. However, long distance logistical procurement seems unlikely during any period given the regional abundance of other high-quality toolstone sources and the variable quality of the Cedar Mesa material. All Cedar Mesa Chert procurement appears to have been accomplished by simply picking up nodules from the lag deposits. There was no evidence of mining or quarrying the material from in situ seams.

The types and quantities of lithic artifacts indicate that bifaces and bifacial tools were the primary products of the lithic reduction activities, although expedient flake tools were also manufactured. A contact removal flake in the assemblage from a tested site (see La Fond, Chapter 6), as well as detachment scars and the morphology of biface cross sections, indicates that some, if not most of the bifacial tools were manufactured from flake blanks. It is also possible that bifacial tools were manufactured using a core-blank trajectory, although direct evidence of this strategy was not observed during the inventory level recording or analysis of the small assemblage recovered by the testing.

Several different flake-core strategies were used to obtain flake blanks to make the expedient and formal tools. The most common appears to have been the removal of flakes from multidirectional cores. Two other less common strategies were the production of parallel sided "blades" from polyhedral cores and converging "blades" from unidirectional conical cores. Secondary trajectories, mainly involving a bifacial reduction technology, were then initiated on some of the flakes to produce the desired products (e.g., bifaces, projectile points, drills, flake tools, etc.). The highly variable nature of Cedar Mesa Chert may have imposed certain constraints that affected which lithic reduction strategy was used.

Heat treatment appears to have been an integral part of the bifacial tool manufacturing process (see La Fond, Chapter 6 and Appendix G) and given its frequency of occurrence, must have taken place in the project area. No specific heat treatment pits were observed during the inventory, although it is possible that some heat treatment was accomplished in regular hearths. Future investigations should be directed at further identifying the frequency of heat treatment and searching for heat treatment facilities as these have implications for site function and possibly, the duration of occupation.

The entire biface production sequence (from toolstone procurement to final flaking) was undertaken on some sites, but lithic reduction was limited to later tool production stages and tool edge rejuvenation on others. Because of high transport costs, toolstone is usually processed to varying degrees before it is transported away from the source and this appears to be the case in the Squaw Butte Area. In general, the earliest lithic reduction stages are confined to source area sites, although these sites often have evidence of intermediate and late stage reduction. Lithic artifacts on sites away from the sources generally have later stage debitage and more refined bifaces.

Anasazi use of the Cedar Mesa material appears to have been mainly directed at fulfilling immediate tool needs. Chipped stone artifact assemblages on the demonstrable Anasazi sites tend to be small and relatively diverse, with a heavier emphasis on grinding equipment than chipped stone tools. However, Anasazi use of some of the nondiagnostic quarry sites is also likely. The abundance and availability of Cedar Mesa Chert is clearly not a major impetus for Anasazi occupation of the Squaw Butte Area, although its availability may have influenced use of this area over an otherwise analagous area.

In the case of the Archaic sites, the availability of Cedar Mesa Chert may have been an important reason for scheduling foraging activities in the Squaw Butte Area. Much of the lithic processing appears to have been directed at replacing broken tools and gearing up with bifaces before leaving the area. Kelly (1988) has suggested that biface reduction strategies are primarily economic adaptations of mobile hunter-gatherers. Large bifaces can perform cutting and chopping tasks, be

reduced into other tools forms, or serve as bifacial cores that supply material for making expedient and small curated tools. As such, they are highly efficient for mobile foragers who need to limit weight yet have sufficient toolstone for anticipated tasks until they reach the next raw material source. By nature, they are curated items of personal gear (see Binford 1979). Because lithic sources are typically patchy, mobile foragers are expected to "gear up" with new tools whenever they encounter a high-quality lithic source. Such retooling should result in broken tools entering the archeological record at or near procurement site. These tools are likely to be manufactured from nonlocal materials encountered during other parts of the group's seasonal round. Lithic activities at or near the sources should include the production of tool forms desired for transport.

A large part of the lithic reduction effort in the Squaw Butte Area appears to have been directed at producing bifaces for transport out of the project area. The vast majority (approximately 83 percent) of the discarded bifaces are broken and most appear to have been broken during manufacture. If the bifaces were being manufactured for local use, the biface assemblage should instead contain a higher percentage of complete specimens and more examples of use-related fractures. Also, there is a relatively greater diversity of material types, including nonlocal materials, in the project point assemblage than in the debitage or biface assemblages. These points were probably manufactured by mobile foragers during other aspects of their annual round and discarded during retooling episodes in the Squaw Butte Area.

As noted in Chapter 3, the vast majority of lithic artifacts are local materials from the Cedar Mesa Formation. The only other common material is Summerville Chalcedony which is available north and east of the project area. Its presence indicates that inhabitants of the Squaw Butte Area sites included areas to the north and east in their annual range, of which the Squaw Butte Area was probably only a tiny fraction. The Anasazi sites seem to have a lower representation of this material than the non-Anasazi sites suggesting that Anasazi populations were less mobile and had less access to this high-quality material. The different sizes, shapes, and positioning of each group's annual territory probably explain the differences in the frequency of tools from various local and nonlocal materials between the adjacent Squaw Butte and Salt Creek Pocket areas.

Another research issue for this project was verification and refinement of the preliminary classification of chipped stone raw material types proposed by Tipps and Hewitt (1989). Correct identification of local versus nonlocal materials is a prerequisite to examining other more interesting aspects of prehistoric occupation. The nature and range of variability of the local Cedar Mesa material were carefully examined on the 17 lithic source area sites identified in the project area. In the project area, Cedar Mesa Chert typically consists of residual deposits of angular to subangular fragments and chunks overlying bedrock or dune sand. These chunks typically range from 1 to 20 cm across. Pieces up to 50 cm across are common, and, occasionally, chunks exceed a meter in diameter. The quality, luster, texture, and color of this material are extremely variable between and across sources, and even within individual nodules and chunks. Cracks, fracture planes, inclusions, and both textural and compositional gradations are common. These flaws limit the size of usable chunks to 20 cm and usually less. Dark red is the primary color in the Squaw Butte Area but yellow and reddish brown are also common, and one source has orange, red-yellow and yellow material. Also present are red-orange, brown, off-white, white, purple, maroon, and mottled red-blue-purple.

Based on detailed studies of the local material, three of the "types" identified by Tipps and Hewitt (1989)—orange chert, tan chert, and purple chalcedony—were collapsed into the Cedar Mesa Chert category. Most, if not all specimens in the brown chert and white chert categories are also this local material, as is limestone, identified as a chipped stone material for the first time during the Squaw Butte Area investigations.

The distinctive yellow and brown algalitic chert identified by Tipps and Hewitt (1989) is also believed to be from the Cedar Mesa Formation (see Chapter 3) though its actual source is removed from the project area. This suggested origin is based on the presence of a small, unflaked nodule on one Cedar Mesa Chert source area site and the discovery of small algalitic chert chunks on a talus slope in Devils Lane where

Cedar Mesa is the only exposed formation (Tipps and Hewitt 1989:85). The structure and nodular form of algalitic chert are consistent with the shallow sea conditions under which the Cedar Mesa Formation developed. In addition, minerals in the Cedar Mesa Formation are capable of producing the distinctive yellow and brown coloring. Finally, algalitic chert shares many characteristics with Cedar Mesa Chert including its variable quality and carbonate composition of pieces toward the yellow end of the color scale.

No changes were proposed to the Summerville Chalcedony category noted by Tipps and Hewitt (1989:84), although the formation supplying the material has recently been redefined as the basal unit of the Morrison Formation, Tidwell Member (Baars 1995:65). This material is nonlocal and, from all indications, appears to have been procured from sources north and east of the project area.

The frequencies of other material types reported by Tipps and Hewitt (1989:85-87) are still too small to determine whether they are variations of Cedar Mesa Chert, some other type, or whether they are even valid types. The same is true for a new type identified during the Squaw Butte Area investigations: fine- to medium-grained white quartzite. In sum, revisions to the earlier classification scheme make it clear that there was an even greater emphasis on the locally available chipped stone material than previously considered. Summerville Chalcedony is the only nonlocal material of any frequency, and known sources are within a day or two's walk of the project area.

The remaining research topics in this domain all concern subsistence. In the adjacent Salt Creek Pocket and Devils Lane areas, Tipps and Hewitt (1989) observed that the Anasazi were primarily practicing a hunting and gathering subsistence strategy much like their Archaic predecessors. This conclusion was based on the paucity of arable land, the small and ephemeral nature of the Anasazi sites, the presence of hunting implements, and low frequency of material traits normally associated with an agricultural lifeway (e.g., summer farmsteads or fieldhouses, granaries, two-hand manos, trough metates, etc.). As discussed earlier in the context of settlement strategies, Anasazi subsistence practices were more diversified in the Squaw Butte Area owing to the more diverse array of appropriate resources, in particular, arable land. While some Anasazi subsistence activities were undoubtedly geared toward wild plant and animal foods, particularly in the period between corn planting and harvest, most subsistence pursuits were geared toward growing corn. Evidence to support this conclusion includes the occurrence of several farmsteads, granaries, and other storage features adjacent to the few plots of arable land in the project area. In addition, some of the nearby plant processing sites display corn grinding equipment such as two-hand manos and actual corn cobs. Projectile points and other hunting paraphernalia are only minimally present.

In sum, work in the Squaw Butte Area allowed better definition of the range of Anasazi subsistence practices in the arid lowlands of lower Salt Creek. Farming appears to have been the preferred subsistence activity when the necessary water and arable land were available. However, such areas are of limited size and patchy distribution. Outside these favorable locales, procurement of wild resources was the focus.

The next research issue concerns the relative importance of hunted versus gathered resources among the various groups that inhabited the project area. No direct evidence of faunal resource use (bone) was obtained during the testing. While this lack could result from the limited nature or context of the testing, projectile points and other tools indicative of hunting and animal processing are limited on all project area sites. In addition, the range site data rate most Squaw Butte Area soils as very poor for wetland wildlife habitat that might have supported animals such as duck, geese, mink, and beaver (Lammers 1991:Table 6). Woodland and rangeland habitat, which provide forage for animals such as deer, antelope, sage grouse, and coyote are rated very poor to poor for all but one project area soil, and only fair for that exception. Openland habitat, commonly used by cottontails, is rated very poor to fair. While hunting is predicted by the diet-breadth model (Simms 1984), the low frequency of hunting related tools and relatively marginal nature of animal habitat suggests that hunting was not the major focus of any cultural group that inhabited the project area.

Implements used for plant processing are relatively common during all major periods of occupation and also tend to exhibit considerable

evidence of use-wear. These findings suggest that subsistence pursuits in the project area emphasized the collection and processing of plant resources. The technology of the grinding tools on Archaic sites and grain-size of the raw material is consistent with the processing of wild seeds. Similar grinding implements occur in Anasazi contexts alongside tools more appropriate for corn grinding.

The final research priority established for the project concerned the local timing of the transition from a hunting and gathering lifeway to one based on agriculture. Numerous features that date to what has been established as the early horticultural period in adjacent parts of southern and central Utah were tested during the project but no evidence of cultigens was found. The first period for which corn use can be firmly established is Pueblo III or late Pueblo II-III. A slightly burned ear of 12-row corn was observed in a granary at one site, a fragmentary cob was found near an overhang harboring a small sherd and lithic scatter, and a small corn cob and some corn husks were noted in the fill of a structure at an Anasazi site near Squaw Butte.

The Squaw Butte Area investigations do not contribute any early dates for the local arrival of corn. What they do indicate is local peoples were practicing a hunting and gathering lifeway during the Basketmaker II period, continuing as late as A.D. 710-1010. This does not discount the possibility that some of these people were aware of cultigens or grew them at other times or places; it is just that the Squaw Butte Area investigations produced no such evidence.

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Appendix A

LEGAL LOCATIONS AND MAPS OF THE SQUAW BUTTE AREA

by Gary M. Popek

Distribution Limited To:

National Park Service
Canyonlands National Park
Moab, Utah

National Park Service
Midwest Archeological Center
Lincoln, Nebraska

Appendix B

CORRELATION OF TEMPORARY FIELD NUMBERS AND PERMANENT SMITHSONIAN SITE NUMBERS

Table B-1. Correlation of temporary field numbers and permanent Smithsonian site numbers.

Temporary Number	Permanent Smithsonian Number	Temporary Number	Permanent Smithsonian Number
4-1	42SA20251	4-41	42SA20291
4-2	42SA20252	4-42	42SA20292
4-3	42SA20253	4-43	42SA20293
4-4	42SA20254	4-44	42SA20294
4-5	42SA20255	4-45	42SA20295
4-6	42SA20256	4-46	42SA20296
4-7	42SA20257	4-47	42SA20297
4-8	42SA20258	4-48	42SA20298
4-9	42SA20259	4-49	42SA1455[a]
4-10	42SA20260	4-50	42SA20299
4-11	42SA20261	4-51	42SA20300
4-12	42SA20262	4-52	42SA20301
4-13	42SA1519[a]	4-53	42SA20302
4-14	42SA20264	4-54	42SA20303
4-15	42SA20265	4-55	42SA20304
4-16	42SA20266	4-56	42SA20305
4-17	42SA20267	4-57	42SA20306
4-18	42SA20268	4-58	42SA20307
4-19	42SA20269	4-59	42SA20308
4-20	42SA20270	4-60	42SA1513[a]
4-21	42SA20271	4-61	42SA20309
4-22	42SA20272	4-62	42SA20310
4-23	42SA20273	4-63	42SA20311
4-24	42SA20274	4-64	42SA20312
4-25	42SA20275	4-65	42SA20313
4-26	42SA20276	4-66	42SA20314
4-27	42SA20277	4-67	42SA20315
4-28	42SA20278	4-68	42SA20316
4-29	42SA20279	4-69	42SA20317
4-30	42SA20280	4-70	42SA20318
4-31	42SA20281	4-71	42SA20319
4-32	42SA20282	4-72	42SA20320
4-33	42SA20283	4-73	42SA20321
4-34	42SA20284	4-74	42SA20322
4-35	42SA20285	4-75	42SA20323
4-36	42SA20286	4-76	42SA20324
4-37	42SA20287	4-77	42SA20325
4-38	42SA20288	4-78	42SA1661[a]
4-39	42SA20289	4-79	42SA20263
4-40	42SA20290	4-80	42SA20615

[a] This site was previously recorded.

Appendix C

TABULAR SITE DATA

Table C-1. Location of each site by inventory area and geographic location.

Site Number	Inventory Area	Geographic Location
42SA1455	Squaw Butte Area	Squaw Butte Uplands
42SA1513	Squaw Butte Area	Squaw Butte Uplands
42SA1519	Squaw Butte Area	Squaw Butte Uplands
42SA1661	Squaw Butte Area	Squaw Butte Uplands
42SA20251	Squaw Butte Area	Squaw Butte Uplands
42SA20252	Squaw Butte Area	Squaw Butte Uplands
42SA20253	Squaw Butte Area	Squaw Butte Uplands
42SA20254	Squaw Butte Area	Squaw Butte Uplands
42SA20255	Squaw Butte Area	Squaw Butte Uplands
42SA20256	Squaw Butte Area	Squaw Butte Uplands
42SA20257	Squaw Butte Area	Squaw Butte Uplands
42SA20258	Squaw Butte Area	Squaw Butte Uplands
42SA20259	Squaw Butte Area	Squaw Butte Uplands
42SA20260	Squaw Butte Area	Squaw Butte Uplands
42SA20261	Squaw Butte Area	Squaw Butte Uplands
42SA20262	Squaw Butte Area	Squaw Butte Uplands
42SA20263	Squaw Butte Area	Squaw Butte Uplands
42SA20264	Squaw Butte Area	Squaw Butte Uplands
42SA20265	Squaw Butte Area	Squaw Butte Uplands
42SA20266	Squaw Butte Area	Squaw Butte Uplands
42SA20267	Squaw Butte Area	Squaw Butte Uplands
42SA20268	Squaw Butte Area	Squaw Butte Uplands
42SA20269	Squaw Butte Area	Squaw Butte Uplands
42SA20270	Squaw Butte Area	Squaw Butte Uplands
42SA20271	Squaw Butte Area	Squaw Butte Uplands
42SA20272	Squaw Butte Area	Squaw Butte Uplands
42SA20273	Squaw Butte Area	Squaw Butte Uplands
42SA20274	Squaw Butte Area	Squaw Butte Uplands
42SA20275	Squaw Butte Area	Squaw Butte Uplands
42SA20276	Squaw Butte Area	Squaw Butte Uplands
42SA20277	Squaw Butte Area	Squaw Butte Uplands
42SA20278	Squaw Butte Area	Squaw Butte Uplands
42SA20279	Squaw Butte Area	Squaw Butte Uplands
42SA20280	Squaw Butte Area	Squaw Butte Uplands
42SA20281	Squaw Butte Area	Squaw Butte Uplands
42SA20282	Squaw Butte Area	Lower Salt Creek Canyon
42SA20283	Squaw Butte Area	Squaw Butte Uplands
42SA20284	Squaw Butte Area	Lower Salt Creek Canyon
42SA20285	Squaw Butte Area	Lower Salt Creek Canyon
42SA20286	Squaw Butte Area	Lower Salt Creek Canyon
42SA20287	Squaw Butte Area	Squaw Butte Uplands
42SA20288	Squaw Butte Area	Squaw Butte Uplands
42SA20289	Squaw Butte Area	Squaw Butte Uplands
42SA20290	Squaw Butte Area	Squaw Butte Uplands
42SA20291	Squaw Butte Area	Squaw Butte Uplands
42SA20292	Squaw Butte Area	Lower Salt Creek Canyon

Table C-1. Location of each site by inventory area and geographic location (continued).

Site Number	Inventory Area	Geographic Location
42SA20293	Squaw Butte Area	Lower Salt Creek Canyon
42SA20294	Squaw Butte Area	Lower Salt Creek Canyon
42SA20295	Squaw Butte Area	Lower Salt Creek Canyon
42SA20296	Squaw Butte Area	Squaw Butte Uplands
42SA20297	Squaw Butte Area	Squaw Butte Uplands
42SA20298	Squaw Butte Area	Squaw Butte Uplands
42SA20299	Squaw Butte Area	Squaw Butte Uplands
42SA20300	Squaw Butte Area	Squaw Butte Uplands
42SA20301	Squaw Butte Area	Lower Salt Creek Canyon
42SA20302	Squaw Butte Area	Squaw Butte Uplands
42SA20303	Squaw Butte Area	Squaw Butte Uplands
42SA20304	Squaw Butte Area	Squaw Butte Uplands
42SA20305	Squaw Butte Area	Lower Salt Creek Canyon
42SA20306	Squaw Butte Area	Squaw Butte Uplands
42SA20307	Squaw Butte Area	Squaw Butte Uplands
42SA20308	Squaw Butte Area	Squaw Butte Uplands
42SA20309	Squaw Butte Area	Squaw Butte Uplands
42SA20310	Squaw Butte Area	Squaw Butte Uplands
42SA20311	Squaw Butte Area	Lower Salt Creek Canyon
42SA20312	Squaw Butte Area	Squaw Butte Uplands
42SA20313	Squaw Butte Area	Squaw Butte Uplands
42SA20314	Squaw Butte Area	Squaw Butte Uplands
42SA20315	Squaw Butte Area	Squaw Butte Uplands
42SA20316	Squaw Butte Area	Squaw Butte Uplands
42SA20317	Squaw Butte Area	Squaw Butte Uplands
42SA20318	Squaw Butte Area	Squaw Butte Uplands
42SA20319	Squaw Butte Area	Squaw Butte Uplands
42SA20320	Squaw Butte Area	Squaw Butte Uplands
42SA20321	Squaw Butte Area	Squaw Butte Uplands
42SA20322	Squaw Butte Area	Squaw Butte Uplands
42SA20323	Squaw Butte Area	Squaw Butte Uplands
42SA20324	Squaw Butte Area	Squaw Butte Uplands
42SA20325	Squaw Butte Area	Squaw Butte Uplands
42SA20615	Squaw Butte Area	Squaw Butte Uplands

Table C-2. List of sites and their cultural affiliation and age.

Site Number	Number of Identifiable Occupations	Cultural Affiliation	Age
42SA1455	1[a]	Aboriginal	Prehistoric
42SA1513	1	Aboriginal	Prehistoric
42SA1519	1	Anasazi	Pueblo II-III
42SA1661	2	Anasazi/Navajo	Pueblo II-III/Historic or modern
42SA20251	1	Aboriginal	Early Formative
42SA20252	1[a]	Archaic	Early Archaic
42SA20253	1	Aboriginal	Prehistoric
42SA20254	1	Aboriginal	Prehistoric
42SA20255	1	Aboriginal	Prehistoric
42SA20256	1	Archaic	Terminal Archaic
42SA20257	1	Aboriginal	Prehistoric
42SA20258	1	Aboriginal	Early Formative
42SA20259	1	Aboriginal	Prehistoric
42SA20260	1[a]	Archaic	Late Archaic
42SA20261	1	Aboriginal	Prehistoric
42SA20262	1	Aboriginal	Prehistoric
42SA20263	2	Archaic/Anasazi	Middle Archaic/Formative
42SA20264	1	Anasazi	Pueblo II-III
42SA20265	1	Aboriginal	Prehistoric
42SA20266	1	Aboriginal	Prehistoric
42SA20267	1	Anasazi	Pueblo II-III
42SA20268	1	Aboriginal	Prehistoric
42SA20269	1	Anasazi	Pueblo II-III
42SA20270	1	Anasazi	Formative
42SA20271	1	Anasazi	Formative
42SA20272	1	Anasazi	Pueblo II-III
42SA20273	1	Anasazi	Pueblo II-III
42SA20274	1	Anasazi	Formative
42SA20275	1	Anasazi	Pueblo II-III
42SA20276	1	Aboriginal	Prehistoric
42SA20277	1	Aboriginal	Prehistoric
42SA20278	1	Aboriginal	Prehistoric
42SA20279	1	Aboriginal	Prehistoric
42SA20280	1	Archaic	Late Archaic
42SA20281	1[a]	Aboriginal	Prehistoric
42SA20282	1	Aboriginal	Prehistoric
42SA20283	1	Aboriginal	Prehistoric
42SA20284	1	Aboriginal	Prehistoric
42SA20285	1	Aboriginal	Prehistoric
42SA20286	1	Aboriginal	Prehistoric
42SA20287	1	Anasazi	Pueblo II-III
42SA20288	1	Aboriginal	Prehistoric
42SA20289	1	Aboriginal	Prehistoric
42SA20290	1	Aboriginal	Prehistoric
42SA20291	1	Aboriginal	Prehistoric

Table C-2. List of sites and their cultural affiliation and age (continued).

Site Number	Number of Identifiable Occupations	Cultural Affiliation	Age
42SA20292	1	Archaic	Terminal Archaic
42SA20293	1	Aboriginal	Prehistoric
42SA20294	1	Aboriginal	Prehistoric
42SA20295	1	Aboriginal	Prehistoric
42SA20296	1	Aboriginal	Prehistoric
42SA20297	1	Aboriginal	Prehistoric
42SA20298	1	Aboriginal	Prehistoric
42SA20299	1	Aboriginal	Prehistoric
42SA20300	1	Aboriginal	Prehistoric
42SA20301	2	Archaic	Terminal Archaic
42SA20302	1	Aboriginal	Prehistoric
42SA20303	1	Aboriginal	Prehistoric
42SA20304	1	Aboriginal	Formative
42SA20305	1[a]	Aboriginal	Prehistoric
42SA20306	1	Aboriginal	Prehistoric
42SA20307	1	Aboriginal	Prehistoric
42SA20308	1	Aboriginal	Prehistoric
42SA20309	1	Aboriginal	Prehistoric
42SA20310	1	Aboriginal	Prehistoric
42SA20311	1	Aboriginal	Prehistoric
42SA20312	1	Aboriginal	Prehistoric
42SA20313	1	Aboriginal	Prehistoric
42SA20314	1	Aboriginal	Prehistoric
42SA20315	1	Aboriginal	Prehistoric
42SA20316	1	Aboriginal	Prehistoric
42SA20317	1	Aboriginal	Prehistoric
42SA20318	1	Aboriginal	Prehistoric
42SA20319	1	Aboriginal	Prehistoric
42SA20320	1	Aboriginal	Prehistoric
42SA20321	1	Archaic	Early Archaic
42SA20322	1	Aboriginal	Prehistoric
42SA20323	1	Aboriginal	Prehistoric
42SA20324	1	Aboriginal	Prehistoric
42SA20325	1	Aboriginal	Prehistoric
42SA20615	4[a]	Archaic/Archaic/ Aboriginal/Anasazi	Middle Archaic/Terminal Archaic/Early Formative/ Pueblo II-III

[a]Additional components or multiple occupations are probably present.

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Table C-3. List of sites and their descriptive site types.

Site Number	Component Number	Site Setting	Descriptive Site Type
42SA1455	1	Open	Lithic scatter
42SA1513	1	Shelter	Lithic scatter
42SA1519	1	Shelter	Masonry architecture/Lithic source area
42SA1661	1	Open	Sherd and lithic scatter
42SA1661	2	Open	Features without artifacts
42SA20251	1	Open	Lithic scatter with features
42SA20252	1	Open	Lithic source area with feature
42SA20253	1	Open	Lithic scatter with feature
42SA20254	1	Open	Lithic scatter
42SA20255	1	Open	Lithic source area with feature
42SA20256	1	Open	Lithic source area with feature
42SA20257	1	Open	Lithic scatter
42SA20258	1	Open	Lithic scatter with feature
42SA20259	1	Open	Lithic scatter
42SA20260	1	Open	Lithic source area
42SA20261	1	Open	Lithic scatter
42SA20262	1	Open	Lithic source area
42SA20263	1	Shelter	Lithic source area with feature
42SA20263	2	Shelter	Lithic source area and sherd scatter
42SA20264	1	Shelter	Masonry architecture/Lithic source area
42SA20265	1	Open	Lithic scatter
42SA20266	1	Shelter	Lithic scatter
42SA20267	1	Shelter	Lithic source area and sherd scatter
42SA20268	1	Shelter	Features without artifacts
42SA20269	1	Shelter	Lithic source area and sherd scatter
42SA20270	1	Shelter	Masonry architecture
42SA20271	1	Shelter	Masonry architecture/Lithic source area
42SA20272	1	Shelter	Sherd and lithic scatter
42SA20273	1	Open	Sherd and lithic scatter
42SA20274	1	Shelter	Masonry architecture
42SA20275	1	Shelter	Masonry architecture
42SA20276	1	Open	Lithic scatter
42SA20277	1	Open	Lithic scatter
42SA20278	1	Open	Lithic scatter
42SA20279	1	Open	Lithic source area
42SA20280	1	Open	Lithic scatter
42SA20281	1	Open	Lithic source area with feature
42SA20282	1	Open	Lithic scatter
42SA20283	1	Open	Lithic scatter
42SA20284	1	Open	Lithic scatter
42SA20285	1	Open	Lithic scatter
42SA20286	1	Open	Lithic scatter with feature
42SA20287	1	Open	Sherd and lithic scatter
42SA20288	1	Open	Lithic scatter
42SA20289	1	Open	Lithic scatter

Table C-3. List of sites and their descriptive site types (continued).

Site Number	Component Number	Site Setting	Descriptive Site Type
42SA20290	1	Open	Lithic scatter
42SA20291	1	Open	Lithic scatter
42SA20292	1	Open	Sherd and lithic scatter with features
42SA20293	1	Open	Lithic scatter
42SA20294	1	Open	Lithic scatter
42SA20295	1	Open	Lithic scatter
42SA20296	1	Open	Lithic scatter
42SA20297	1	Open	Lithic scatter
42SA20298	1	Shelter	Lithic scatter
42SA20299	1	Open	Lithic scatter
42SA20300	1	Open	Lithic scatter
42SA20301	1	Shelter	Lithic scatter with feature
42SA20301	2	Shelter	Lithic scatter with feature
42SA20302	1	Shelter	Lithic scatter
42SA20303	1	Shelter	Lithic scatter
42SA20304	1	Shelter	Lithic scatter
42SA20305	1	Open	Lithic scatter
42SA20306	1	Open	Lithic source area
42SA20307	1	Open	Lithic scatter
42SA20308	1	Shelter	Lithic scatter
42SA20309	1	Shelter	Lithic scatter
42SA20310	1	Shelter	Lithic scatter
42SA20311	1	Shelter	Lithic scatter with features
42SA20312	1	Open	Lithic scatter
42SA20313	1	Open	Lithic scatter
42SA20314	1	Shelter	Lithic scatter
42SA20315	1	Shelter	Lithic scatter
42SA20316	1	Open	Lithic scatter
42SA20317	1	Open	Lithic scatter
42SA20318	1	Shelter	Lithic scatter
42SA20319	1	Shelter	Lithic scatter
42SA20320	1	Open	Lithic scatter
42SA20321	1	Open	Lithic source area
42SA20322	1	Open	Lithic source area
42SA20323	1	Open	Lithic source area
42SA20324	1	Shelter	Lithic scatter
42SA20325	1	Open	Lithic scatter
42SA20615	1	Shelter	Lithic scatter with features
42SA20615	2	Shelter	Features without artifacts (?)
42SA20615	3	Shelter	Lithic scatter with features
42SA20615	4	Shelter	Masonry architecture

C-4. Number and type of artifacts on prehistoric sites and components.

Site Number	Projectile Points	Bifaces	Drills	Unifaces	Scrapers	Gravers	Modified Flakes	Cores	Utilized Cores
42SA1455	1	7	.	.	.	1	1	2	2
42SA1513	.	1	.	.	.	.	.	1	.
42SA1519	.	2	.	.	.	.	.	.	.
42SA1661	.	.	.	.	.	.	.	.	.
42SA20251	.	.	.	1	.	.	.	.	.
42SA20252	1	10	.	.	.	.	.	8	.
42SA20253	.	2	.	.	.	.	.	.	.
42SA20254	.	1	.	.	.	.	.	.	.
42SA20255	.	1	.	.	.	.	.	.	.
42SA20256	.	3	.	.	.	.	.	.	.
42SA20257	.	1	.	.	.	.	.	.	.
42SA20258	1	1	.	.	.	.	1	.	1
42SA20259	.	1	.	.	.	.	.	.	.
42SA20260	1	3	.	.	.	.	.	1	1
42SA20261	.	1	.	.	1	.	1	.	.
42SA20262	2	1	.	.	.	.	5	1	.
42SA20263	2	2	.	.	.	.	.	2	.
42SA20264	2	.	.	.	.	.	.	.	.
42SA20265	.	.	.	.	.	.	.	.	.
42SA20266	.	.	.	.	.	.	1	.	.
42SA20267	.	1	.	.	.	.	.	2	.
42SA20268	.	.	.	.	.	.	.	.	.
42SA20269	.	.	.	.	.	.	1	.	1
42SA20270	.	.	.	.	.	.	.	.	.
42SA20271	.	1	.	.	.	.	.	1	.
42SA20272	.	.	.	.	.	.	.	1	.
42SA20273	.	.	.	.	.	.	.	.	.
42SA20274	.	.	.	.	.	.	.	.	.
42SA20275	.	.	.	.	.	.	.	.	.
42SA20276	.	1	.	.	.	.	1	.	.
42SA20277	.	.	.	.	.	.	.	.	.
42SA20278	.	.	.	.	.	.	.	.	.
42SA20279	.	.	.	.	.	.	.	3	.
42SA20280	2	.	.	.	.	.	.	.	.
42SA20281	.	1	.	.	.	.	.	.	.
42SA20282	.	.	.	.	.	.	.	.	.
42SA20283	.	.	.	.	.	.	.	.	.
42SA20284	.	.	.	.	.	.	.	.	.
42SA20285	.	2	.	.	.	.	.	.	.
42SA20286	1	10	.	.	.	.	.	1	1
42SA20287	.	.	.	.	.	.	1	.	.
42SA20288	1	.	.	.	.	.	.	.	.
42SA20289	.	2	.	1	.	.	.	1	.
42SA20290	.	.	.	.	.	.	1	.	.
42SA20291	.	.	.	.	.	.	.	.	.
42SA20292	.	7	.	.	.	.	.	.	.
42SA20293	.	1	.	.	.	.	.	1	.
42SA20294	.	2	.	.	.	.	.	.	.
42SA20295	1	.	.	.	.	.	.	.	.
42SA20296	.	1	.	.	.	.	.	.	.
42SA20297	.	3	.	.	.	.	.	.	.
42SA20298	.	.	.	.	.	.	.	.	.
42SA20299	.	1	.	.	.	.	.	.	.
42SA20300	.	2	.	.	.	.	1	.	.
42SA20301	.	1	.	.	.	.	.	.	2
42SA20302	1	1	.	.	.	.	.	.	.
42SA20303	.	.	.	.	.	.	.	.	.

C-4. Number and type of artifacts on prehistoric sites and components (continued).

Site Number	Projectile Points	Bifaces	Drills	Unifaces	Scrapers	Gravers	Modified Flakes	Cores	Utilized Cores
42SA20304	1	.	.	.	.	.	.	.	.
42SA20305	1	10	.	.	.	.	.	.	1
42SA20306	.	.	.	.	.	.	.	.	.
42SA20307	2	5	.	.	.	.	.	1	.
42SA20308	.	.	.	.	.	.	.	1	.
42SA20309	.	.	.	.	.	.	.	.	.
42SA20310	.	.	1	.	.	.	.	.	.
42SA20311	.	.	.	.	1	.	.	1	.
42SA20312	.	.	.	.	.	.	.	.	.
42SA20313	1	1	.	.	.	.	.	.	.
42SA20314	.	.	.	.	.	.	.	1	.
42SA20315	.	2	.	.	.	.	.	.	.
42SA20316	.	.	.	.	.	.	1	.	.
42SA20317	.	3	.	.	1	.	1	.	.
42SA20318	.	.	.	.	.	.	.	.	.
42SA20319	.	.	.	.	.	.	.	.	.
42SA20320	.	2	.	1	.	.	1	.	.
42SA20321	1	2	.	.	.	.	.	.	.
42SA20322	.	.	.	.	.	.	.	.	.
42SA20323	.	1	.	.	.	.	.	.	.
42SA20324	.	.	.	.	.	.	.	.	.
42SA20325	.	1	.	.	.	.	.	.	.
42SA20615	1	4	.	.	.	.	.	1	.
Total	23	105	1	3	3	1	17	30	
Percent	6.9	31.5	0.3	0.9	0.9	0.3	5.1	9.0	2.7

C-4. Number and type of artifacts on prehistoric sites and components (continued).

Site Number	Blades	Hammerstones	Manos	Metates	Indeterminate Groundstone	Polishing Stones	Sherds	Total
42SA1455	.	.	.	3	1	1	.	19
42SA1513	.	.	.	.	.	.	.	2
42SA1519	.	.	1	1	.	.	5	9
42SA1661	.	.	.	.	.	.	9	9
42SA20251	.	.	.	.	.	.	.	1
42SA20252	.	.	.	.	.	.	.	19
42SA20253	.	.	.	.	.	.	.	2
42SA20254	.	.	.	.	.	.	.	1
42SA20255	.	.	.	.	.	.	.	1
42SA20256	.	.	1	.	.	.	.	4
42SA20257	.	.	.	.	.	.	.	1
42SA20258	.	.	.	.	.	.	.	4
42SA20259	.	.	.	.	.	.	.	1
42SA20260	.	.	.	.	.	.	.	6
42SA20261	.	.	.	.	.	.	.	3
42SA20262	.	.	1	.	.	.	.	10
42SA20263	.	1	9	9	.	.	1	26
42SA20264	.	.	2	.	.	.	4	8
42SA20265	.	.	.	.	.	.	.	0
42SA20266	.	.	.	.	.	.	.	1
42SA20267	.	.	.	.	.	.	2	5
42SA20268	.	.	.	.	.	.	.	0
42SA20269	.	.	.	.	.	.	15	17
42SA20270	.	.	1	.	.	.	.	1
42SA20271	.	.	.	.	.	.	.	2
42SA20272	.	.	1	.	.	.	11	13
42SA20273	.	.	.	.	.	.	1	1
42SA20274	.	1	.	.	.	.	1	2
42SA20275	.	.	.	.	.	.	2	2
42SA20276	.	.	.	.	.	.	.	2
42SA20277	.	.	.	.	.	.	.	0
42SA20278	.	.	.	.	.	.	.	0
42SA20279	8	.	.	.	.	.	.	11
42SA20280	.	.	.	.	.	.	.	2
42SA20281	.	.	.	.	.	.	.	1
42SA20282	.	.	.	.	.	.	.	0
42SA20283	.	.	.	.	.	.	.	0
42SA20284	.	.	.	.	.	.	.	0
42SA20285	.	.	2	.	.	.	.	4
42SA20286	.	.	3	.	.	.	.	16
42SA20287	.	.	.	.	.	.	1	2
42SA20288	.	.	1	.	.	.	.	2
42SA20289	.	.	.	2	.	.	.	6
42SA20290	.	.	.	2	.	.	.	3
42SA20291	.	.	.	.	.	.	.	0
42SA20292	.	.	1	1	.	.	1	10
42SA20293	.	.	.	.	.	.	.	2
42SA20294	.	.	.	.	.	.	.	2
42SA20295	.	.	.	.	.	.	.	1
42SA20296	.	.	.	.	.	.	.	1
42SA20297	.	.	.	.	.	.	.	3
42SA20298	.	.	.	.	.	.	.	0
42SA20299	.	.	.	.	.	.	.	1
42SA20300	.	.	.	2	.	.	.	5
42SA20301	.	.	1	4	.	.	.	8
42SA20302	.	.	.	.	.	.	.	2
42SA20303	.	.	.	.	.	.	.	0

C-4. Number and type of artifacts on prehistoric sites and components (continued).

Site Number	Blades	Hammerstones	Manos	Metates	Indeterminate Groundstone	Polishing Stones	Sherds	Total
42SA20304	.	.	.	.	.	.	.	1
42SA20305	.	.	3	2	.	.	.	17
42SA20306	.	.	.	.	.	.	.	0
42SA20307	.	.	.	.	.	.	.	8
42SA20308	.	.	.	.	.	.	.	1
42SA20309	.	.	.	.	.	.	.	0
42SA20310	.	.	.	.	.	.	.	1
42SA20311	.	.	.	1	.	.	.	3
42SA20312	.	.	1	.	.	.	.	1
42SA20313	.	.	.	.	.	.	.	2
42SA20314	.	.	.	.	.	.	.	1
42SA20315	.	.	.	.	.	.	.	2
42SA20316	.	.	.	.	.	.	.	1
42SA20317	.	.	.	.	.	.	.	5
42SA20318	.	.	.	.	.	.	.	0
42SA20319	.	.	.	.	.	.	.	0
42SA20320	.	.	.	.	.	.	.	4
42SA20321	.	.	.	.	.	.	.	3
42SA20322	.	.	.	.	.	.	.	0
42SA20323	.	.	.	.	.	.	.	1
42SA20324	.	.	.	.	.	.	.	0
42SA20325	.	.	.	.	.	.	.	1
42SA20615	.	.	3	3	.	.	15	27
Total	8	2	31	30	1	1	68	333
Percent	2.4	0.6	9.3	9.0	0.3	0.3	20.4	100.0

Table C-5. Number and type of features on prehistoric sites.

Site Number	Hearths	Oblong Slab-lined Features	Occurrences of Smoke Blackening	Formal Middens	Cultural Strata[a]	Burials	Picto-graph Panels	Petro-glyph Panels	Hand and Toe Holds	Storage Bins	Grana-ries
42SA1455	.	.	.	.	.	.	.	.	.	.	.
42SA1513	.	.	.	.	.	.	.	.	.	.	.
42SA1519	.	.	.	.	.	.	.	.	.	.	3
42SA1661	.	.	.	.	.	.	.	.	.	.	.
42SA20251	3	.	.	.	.	.	.	.	.	.	.
42SA20252	1	.	.	.	.	.	.	.	.	.	.
42SA20253	1	.	.	.	.	.	.	.	.	.	.
42SA20254	.	.	.	.	.	.	.	.	.	.	.
42SA20255	1	.	.	.	.	.	.	.	.	.	.
42SA20256	1	.	.	.	.	.	.	.	.	.	.
42SA20257	.	.	.	.	.	.	.	.	.	.	.
42SA20258	.	1	.	.	.	.	.	.	.	.	.
42SA20259	.	.	.	.	.	.	.	.	.	.	.
42SA20260	.	.	.	.	.	.	.	.	.	.	.
42SA20261	.	.	.	.	.	.	.	.	.	.	.
42SA20262	.	.	.	.	.	.	.	.	.	.	.
42SA20263	.	.	.	.	1	.	.	.	.	.	.
42SA20264	.	.	.	.	.	.	.	.	.	.	.
42SA20265	.	.	.	.	.	.	.	.	.	.	.
42SA20266	.	.	.	.	.	.	.	.	.	.	.
42SA20267	.	.	.	.	.	.	.	.	.	.	.
42SA20268	.	.	.	.	.	.	.	1	.	.	.
42SA20269	.	.	.	.	.	.	.	.	.	.	.
42SA20270	.	.	.	.	.	.	.	.	2	1	.
42SA20271	.	.	.	.	.	.	.	.	.	.	1
42SA20272	.	.	.	.	.	.	.	.	.	.	.
42SA20273	.	.	.	.	.	.	.	.	.	.	.
42SA20274	.	.	.	.	.	.	1	.	.	.	.
42SA20275	.	.	1	.	.	.	.	.	.	.	1
42SA20276	.	.	.	.	.	.	.	.	.	.	.

Table C-5. Number and type of features on prehistoric sites (continued).

Site Number	Hearths	Oblong Slab-lined Features	Occurrences of Smoke Blackening	Formal Middens	Cultural Strata[a]	Burials	Picto-graph Panels	Petro-glyph Panels	Hand and Toe Holds	Storage Bins	Grana-ries
42SA20277	.	.	.	.	.	.	.	.	.	.	.
42SA20278	.	.	.	.	.	.	.	.	.	.	.
42SA20279	.	.	.	.	.	.	.	.	.	.	.
42SA20280	.	.	.	.	.	.	.	.	.	.	.
42SA20281	1	.	.	.	.	.	.	.	.	.	.
42SA20282	.	.	.	.	.	.	.	.	.	.	.
42SA20283	.	.	.	.	.	.	.	.	.	.	.
42SA20284	.	.	.	.	.	.	.	.	.	.	.
42SA20285	.	.	.	.	.	.	.	.	.	.	.
42SA20286	1	.	.	.	.	.	.	.	.	.	.
42SA20287	.	.	.	.	.	.	.	.	.	.	.
42SA20288	.	.	.	.	.	.	.	.	.	.	.
42SA20289	.	.	.	.	.	.	.	.	.	.	.
42SA20290	.	.	.	.	.	.	.	.	.	.	.
42SA20291	.	.	.	.	.	.	.	.	.	.	.
42SA20292	3	.	.	.	.	.	.	.	.	.	.
42SA20293	.	.	.	.	.	.	.	.	.	.	.
42SA20294	.	.	.	.	.	.	.	.	.	.	.
42SA20295	.	.	.	.	.	.	.	.	.	.	.
42SA20296	.	.	.	.	.	.	.	.	.	.	.
42SA20297	.	.	.	.	.	.	.	.	.	.	.
42SA20298	.	.	.	.	.	.	.	.	.	.	.
42SA20299	.	.	.	.	.	.	.	.	.	.	.
42SA20300	.	.	.	.	.	.	.	.	.	.	.
42SA20301	2	.	.	.	.	.	.	.	.	.	.
42SA20302	.	.	.	.	.	.	.	.	.	.	.
42SA20303	.	.	.	.	.	.	.	.	.	.	.
42SA20304	.	.	.	.	.	.	.	.	.	.	.
42SA20305	.	.	.	.	.	.	.	.	.	.	.
42SA20306	.	.	.	.	.	.	.	.	.	.	.

Table C-5. Number and type of features on prehistoric sites (continued).

Site Number	Hearths	Oblong Slab-lined Features	Occurrences of Smoke Blackening	Formal Middens	Cultural Strata[a]	Burials	Picto-graph Panels	Petro-glyph Panels	Hand and Toe Holds	Storage Bins	Grana-ries
42SA20307	.	.	.	.	.	.	.	.	.	.	.
42SA20308	.	.	.	.	.	.	.	.	.	.	.
42SA20309	.	.	.	.	.	.	.	.	.	.	.
42SA20310	.	.	.	.	.	.	.	.	.	.	.
42SA20311	1	.	1	.	.	.	.	.	.	.	.
42SA20312	.	.	.	.	.	.	.	.	.	.	.
42SA20313	.	.	.	.	.	.	.	.	.	.	.
42SA20314	.	.	.	.	.	.	.	.	.	.	.
42SA20315	.	.	.	.	.	.	.	.	.	.	.
42SA20316	.	.	.	.	.	.	.	.	.	.	.
42SA20317	.	.	.	.	.	.	.	.	.	.	.
42SA20318	.	.	.	.	.	.	.	.	.	.	.
42SA20319	.	.	.	.	.	.	.	.	.	.	.
42SA20320	.	.	.	.	.	.	.	.	.	.	.
42SA20321	.	.	.	.	.	.	.	.	.	.	.
42SA20322	.	.	.	.	.	.	.	.	.	.	.
42SA20323	.	.	.	.	.	.	.	.	.	.	.
42SA20324	.	.	.	.	.	.	.	.	.	.	.
42SA20325	.	.	.	.	.	.	.	.	.	.	.
42SA20615	4	1	1	1	4	1	5	.	.	.	.
Total	19	1	3	1	5	1	6	1	2	1	5
Percent	32.2	1.7	5.1	1.7	8.5	1.7	10.2	1.7	3.4	1.7	8.5

Table C-5. Number and type of features on prehistoric sites (continued).

Site Number	Upright Slabs	Rubble/ Rock Concentrations	Rock Alignments	Walls	Stone Circles	Surface Rooms	Wood Structures	Woodpile Areas	Total
42SA1455	.	.	.	.	.	.	.	.	0
42SA1513	.	.	.	.	.	.	.	.	0
42SA1519	.	.	.	.	1	.	.	.	4
42SA1661	.	.	.	.	.	.	1	1	2
42SA20251	.	.	.	.	.	.	.	.	3
42SA20252	.	.	.	.	.	.	.	.	1
42SA20253	.	.	.	.	.	.	.	.	1
42SA20254	.	.	.	.	.	.	.	.	0
42SA20255	.	.	.	.	.	.	.	.	1
42SA20256	.	.	.	.	.	.	.	.	1
42SA20257	.	.	.	.	.	.	.	.	0
42SA20258	.	.	.	.	.	.	.	.	1
42SA20259	.	.	.	.	.	.	.	.	0
42SA20260	.	.	.	.	.	.	.	.	0
42SA20261	.	.	.	.	.	.	.	.	0
42SA20262	.	.	.	.	.	.	.	.	0
42SA20263	.	.	.	.	.	.	.	.	1
42SA20264	.	.	.	.	.	1	.	.	1
42SA20265	.	.	.	.	.	.	.	.	0
42SA20266	.	.	.	.	.	.	.	.	0
42SA20267	.	.	.	.	.	.	.	.	0
42SA20268	.	.	.	.	.	.	.	.	1
42SA20269	.	.	.	.	.	.	.	.	0
42SA20270	.	.	.	.	.	.	.	.	3
42SA20271	.	.	.	.	.	.	.	.	1
42SA20272	.	.	.	.	.	.	.	.	0
42SA20273	.	.	.	.	.	.	.	.	0
42SA20274	.	.	.	.	.	1	.	.	2
42SA20275	1	.	.	.	.	4	.	.	7
42SA20276	.	.	.	.	.	.	.	.	0

Table C-5. Number and type of features on prehistoric sites (continued).

Site Number	Upright Slabs	Rubble/ Rock Concentrations	Rock Alignments	Walls	Stone Circles	Surface Rooms	Wood Structures	Woodpile Areas	Total
42SA20277	.	.	.	.	.	.	.	.	0
42SA20278	.	.	.	.	.	.	.	.	0
42SA20279	.	.	.	.	.	.	.	.	0
42SA20280	.	.	.	.	.	.	.	.	0
42SA20281	.	.	.	.	.	.	.	.	1
42SA20282	.	.	.	.	.	.	.	.	0
42SA20283	.	.	.	.	.	.	.	.	0
42SA20284	.	.	.	.	.	.	.	.	0
42SA20285	.	.	.	.	.	.	.	.	0
42SA20286	.	.	.	.	.	.	.	.	1
42SA20287	.	.	.	.	.	.	.	.	0
42SA20288	.	.	.	.	.	.	.	.	0
42SA20289	.	.	.	.	.	.	.	.	0
42SA20290	.	.	.	.	.	.	.	.	0
42SA20291	.	.	.	.	.	.	.	.	0
42SA20292	.	.	.	.	.	.	.	.	3
42SA20293	.	.	.	.	.	.	.	.	0
42SA20294	.	.	.	.	.	.	.	.	0
42SA20295	.	.	.	.	.	.	.	.	0
42SA20296	.	.	.	.	.	.	.	.	0
42SA20297	.	.	.	.	.	.	.	.	0
42SA20298	.	.	.	.	.	.	.	.	0
42SA20299	.	.	.	.	.	.	.	.	0
42SA20300	.	.	.	.	.	.	.	.	0
42SA20301	.	.	.	.	.	.	.	.	2
42SA20302	.	.	.	.	.	.	.	.	0
42SA20303	.	.	.	.	.	.	.	.	0
42SA20304	.	.	.	.	.	.	.	.	0
42SA20305	.	.	.	.	.	.	.	.	0
42SA20306	.	.	.	.	.	.	.	.	0

Table C-5. Number and type of features on prehistoric sites (continued).

Site Number	Upright Slabs	Rubble/ Rock Concentrations	Rock Alignments	Walls	Stone Circles	Surface Rooms	Wood Structures	Woodpile Areas	Total
42SA20307	.	.	.	.	.	.	.	.	0
42SA20308	.	.	.	.	.	.	.	.	0
42SA20309	.	.	.	.	.	.	.	.	0
42SA20310	.	.	.	.	.	.	.	.	0
42SA20311	.	.	.	.	.	.	.	.	2
42SA20312	.	.	.	.	.	.	.	.	0
42SA20313	.	.	.	.	.	.	.	.	0
42SA20314	.	.	.	.	.	.	.	.	0
42SA20315	.	.	.	.	.	.	.	.	0
42SA20316	.	.	.	.	.	.	.	.	0
42SA20317	.	.	.	.	.	.	.	.	0
42SA20318	.	.	.	.	.	.	.	.	0
42SA20319	.	.	.	.	.	.	.	.	0
42SA20320	.	.	.	.	.	.	.	.	0
42SA20321	.	.	.	.	.	.	.	.	0
42SA20322	.	.	.	.	.	.	.	.	0
42SA20323	.	.	.	.	.	.	.	.	0
42SA20324	.	.	.	.	.	.	.	.	0
42SA20325	.	.	.	.	.	.	.	.	0
42SA20615	1	1	1	1	.	.	.	.	20
Total	2	1	1	1	1	6	1	1	59
Percent	3.4	1.7	1.7	1.7	1.7	10.2	1.7	1.7	100.0

[a]See text for definition.

Appendix D

OBSIDIAN SOURCING OF FOUR ARTIFACTS FROM SITE 42SA20289, CANYONLANDS NATIONAL PARK, SOUTHEASTERN UTAH

by Richard E. Hughes

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Appendix D

OBSIDIAN SOURCING OF FOUR ARTIFACTS FROM SITE 42SA20289, CANYONLANDS NATIONAL PARK, SOUTHEASTERN UTAH

by Richard E. Hughes

Four obsidian artifacts collected from site 42SA20289 in the Squaw Butte Area of the Needles District of Canyonlands National Park, Utah, were submitted for obsidian sourcing analysis. Laboratory investigations were performed on a Spectrace–5000 (Tractor X-ray) energy dispersive x-ray fluorescence spectrometer equipped with a Rh x-ray tube, a 50kV x-ray generator, with microprocessor controlled pulse processor (amplifier) and bias/protection module, a 100 mHz analog to digital converter (ADC) with automated energy calibration, and a Si(Li) solid state detector with 150 eV resolution (FWHM) at 5.9 keV in a 30 mm^2 area. The x-ray tube was operated at 35.0 kV, .28 mA, using a .127 mm rhodium (Rh) primary beam filter in an air path at 300 seconds livetime to generate x-ray intensity data for the trace elements zinc (Zn Kα), gallium (GA Kα), rubidium (Rb Kα), strontium (Sr Kα), yttrium (Y Kα), zirconium (Zr Kα), and niobium (Nb Kα). Barium (BA Kα) intensities were generated by operating the x-ray tube at 50.0 kV, .35 mA, with a .63 mm copper (Cu) filter at 300 seconds livetime. X-ray intensities were converted to concentration estimates employing a least-squares calibration line established for each element from analysis of up to 26 international rock standards certified by the U.S. Geological Survey, the U.S. National Institute of Standards and Technology (formerly National Bureau of Standards), the Geological Survey of Japan, and the Centre de Recherches Petrographiques et Geochimiques (France). Data processing for all analytical subroutines is executed by a Hewlett Packard Vectra–microcomputer, with operating software and analytical results stored on a Hewlett Packard 20 megabyte fixed disk. Further details pertaining to x-ray tube operating conditions and calibration appear in Hughes (1988).

Trace element measurements on the xrf data table are expressed in quantitative units (i.e., parts per million [ppm] by weight), and matches between unknowns and known obsidian chemical groups were made on the basis of correspondences (at the 2-sigma level) in diagnostic trace element concentration values (in this case, ppm values for Rb, Sr, Y, Zr, and Ba) that appear in Anderson et al. (1986), Nelson (1984), Nelson and Holmes (1979), Hughes and Nelson (1987), and Jack (1971). Artifact-to-obsidian source (geochemical type) matches were considered reliable if diagnostic mean measurements for artifacts fell within two standard deviations of mean values for source standards. The term "diagnostic" is used here to specify those trace elements that are well measured by x-ray fluorescence, and whose concentrations show low intrasource variability and marked variability across sources. Diagnostic elements, then, are those whose concentration values allow one to draw the clearest geochemical distinctions between sources (see Hughes 1990; Hughes and Lees 1991). Although Zn, Ga, and Nb ppm concentrations also were measured and reported for each specimen, they are not considered "diagnostic" because they do not usually vary significantly across obsidian sources (see Hughes 1982, 1984). This is particularly true of Ga which occurs in concentrations between 10 and 30 ppm in nearly all parent obsidians in the study area. Zn ppm values are infrequently diagnostic; they are always high in Zr-rich, Sr-poor peralkaline volcanic glasses, but otherwise they do not vary significantly between sources in the study area. Likewise, Nb occurs in low concentrations in most volcanic glasses in the study area.

The trace element composition measurements presented in the enclosed table are reported to the nearest ppm to reflect the resolution capabilities of nondestructive energy dispersive x-ray fluorescence spectrometry. The resolution limits of the present x-ray fluorescence instrument for the determination of Zn is about 3 ppm, Ga about 2 ppm, for Rb about 4 ppm, for Sr about 3 ppm, Y about 2 ppm, Zr about 5 ppm, Nb about 3 ppm, and Ba about 10 ppm. When counting and fitting error uncertainty estimates (the "±" value in the table) for a sample are greater than calibration-imposed limits of resolution, the larger number is preferred as a more conservative, robus reflection of elemental composition and measurement error due to variations in sample size, surface and x-ray reflection geometry (see Hughes 1988).

Table D-1 presents geochemical data for each specimen, indicating that all four of the samples match the trace element profile of obsidian of the Government Mountain/Sitgreaves Peak geochemical type of the San Francisco volcanic field, Arizona (cf. Jack 1971:Table 1; Nelson 1984:Table 7).

Table D-1. Geochemical data for each obsidian specimen from site 42SA20289.

Catalog Number	Trace Element Concentrations								Obsidian Source
	Zn	Ga	Rb	Sr	Y	Zr	Nb	Ba	
42SA20289-A	69	27	122	87	24	85	54	356	Government Mtn./
	±6	±3	±4	±3	±2	±5	±3	±14	Sitgreaves Peak, AZ
42SA20289-B	69	28	124	83	22	86	55	322	Government Mtn./
	±6	±3	±4	±3	±2	±5	±3	±15	Sitgreaves Peak, AZ
42SA20289-C	79	25	121	81	21	82	55	333	Government Mtn./
	±6	±3	±4	±3	±2	±5	±3	±15	Sitgreaves Peak, AZ
42SA20289-D	64	21	118	77	22	83	52	307	Government Mtn./
	±6	±4	±4	±3	±2	±5	±3	±15	Sitgreaves Peak, AZ

NOTE: All trace element values in parts per million (ppm); ± = pooled expression (in ppm) of x-ray counting uncertainty and regression fitting error at 300 seconds livetime.

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Appendix E

CATALOG OF ISOLATED FINDS

Table E-1. Catalog of Isolated Finds (IFs) in the Squaw Butte Area.

IF Number	Description
1	1 secondary flake of purple chert
2	1 decortication flake of Cedar Mesa Chert
3	1 piece of shatter of Cedar Mesa Chert
4	2 decortication flakes of Cedar Mesa Chert
	1 secondary flake of Summerville Chalcedony
5	1 tertiary flake of Cedar Mesa Chert
6	1 secondary flake of Cedar Mesa Chert
7	1 tertiary flake of algalitic chert
8	1 secondary flake of Cedar Mesa Chert
9	1 secondary flake of Cedar Mesa Chert
10	1 triangular-shaped biface midsection of Summerville Chalcedony; exhibits pressure flaking; fragment measures 1.5 cm long by 2.0 cm wide by 3.0 cm thick
11	1 decortication flake of algalitic chert
	1 secondary flake of algalitic chert
	1 piece of shatter of algalitic chert
12	1 piece of shatter of Cedar Mesa Chert
	1 secondary flake of Cedar Mesa Chert
13	1 tertiary flake of Cedar Mesa Chert
14	3 pieces of shatter of Summerville Chalcedony with red speckles
	1 secondary flake of Cedar Mesa Chert
15	1 secondary flake of Cedar Mesa Chert
16	1 secondary flake of Summerville Chalcedony
	1 secondary flake of Summerville Chalcedony
	1 tertiary flake of Cedar Mesa Chert
17	1 secondary flake of Cedar Mesa Chert
	2 tertiary flakes of Cedar Mesa Chert
18	1 tertiary flake of Summerville Chalcedony
19	1 small, medium-grained sandstone, indeterminate metate fragment; measures 7.0 cm long by 4.0 cm wide by 1.8 cm thick
20	1 piece of shatter of Cedar Mesa Chert
	1 piece of shatter of Summerville Chalcedony
21	1 decortication flake of Cedar Mesa Chert
	1 secondary flake of Cedar Mesa Chert
22	1 secondary flake of Cedar Mesa Chert
23	1 tertiary flake of Cedar Mesa Chert
	1 piece of shatter of Cedar Mesa Chert
24	6 tertiary flakes of Summerville Chalcedony
25	1 secondary flake of Cedar Mesa Chert
26	1 decortication flake of Cedar Mesa Chert
	1 secondary flake of Cedar Mesa Chert
27	1 secondary flake of Cedar Mesa Chert
28	1 secondary flake of Cedar Mesa Chert
29	1 decortication flake of Cedar Mesa Chert
30	1 decortication flake of Cedar Mesa Chert
31	1 finely flaked biface fragment of Summerville Chalcedony

Table E-1. Catalog of Isolated Finds (IFs) in the Squaw Butte Area (continued).

IF Number	Description
32	1 decortication flake of Cedar Mesa Chert
	1 secondary flake of Cedar Mesa Chert
	1 piece of shatter of Cedar Mesa Chert
33	1 decortication flake of white chert
34	1 secondary flake of Cedar Mesa Chert
	1 secondary flake of white chert
35	1 decortication flake of white chert
36	1 decortication flake of Summerville Chalcedony
37	2 tested cobbles of Cedar Mesa Chert
38	1 decortication flake of Cedar Mesa Chert
	1 secondary flake of Cedar Mesa Chert
39	1 decortication flake of Cedar Mesa Chert
	3 tertiary flakes of Cedar Mesa Chert

Appendix F

LABORATORY METHODS AND ANALYTICAL PROCEDURES USED TO ANALYZE CHIPPED STONE ARTIFACTS RECOVERED DURING THE TESTING

by André D. La Fond and Betsy L. Tipps

Appendix F

LABORATORY METHODS AND ANALYTICAL PROCEDURES USED TO ANALYZE CHIPPED STONE ARTIFACTS RECOVERED DURING THE TESTING

by André D. La Fond and Betsy L. Tipps

The chipped stone artifacts recovered during the limited testing program were analyzed according to the procedures outlined in this appendix. The analysis began by sorting the artifacts into three categories: tools, unworked debitage, and cores. Tools were defined as specimens that had been flaked into formal, often symmetrically shaped items as well as debitage displaying modification from either use or deliberate shaping. Debitage was defined as the unworked residual lithic debris produced by flaking during core reduction and tool manufacture/maintenance. Cores were defined as the mass of stone reduced by the flintknapper to obtain flakes, blades, and blanks which could be fashioned into tools. For this analysis, items were only considered cores if they exhibited at least two negative flake scars and a sufficient portion of the margin to indicate the direction of flake removal. This definition eliminated corelike shatter and flakes that result from early stages of lithic reduction. Material type, cortex type, and evidence of heat treatment were recorded for each artifact. Additional information was recorded for each artifact class, as appropriate.

Material Type

Material types were assigned using the toolstone categories identified in Tipps and Hewitt (1989) and Chapter 3. Items that did not appear to represent one of the previously recognized types were subsumed in unknown chert, chalcedony, and quartzite categories. Identifications were made with the aid of comparative specimens and descriptions provided in Tipps and Hewitt (1989) and Chapter 3 of this report.

Cortex

Cortex refers to the natural exterior surface or rind that develops on siliceous stone materials. Cortex was recorded as incipient cone cortex present, quarry cortex present, or no cortex present. Incipient cone cortex is evidenced by a battered, rounded exterior surface indicating that the material was transported in a streambed environment and probably derived from a gravel deposit in cobble form. Quarry cortex is the weathered surface that develops on in situ bedded or nodular stone deposits that are exposed to the elements for long periods of time.

Heat Treatment

Heat treatment is a common aboriginal practice that improves stone flakeability. Initially, artifacts were only considered heat treated if they exhibited both an older generation of preheat treatment matte

surface flake scars and a younger generation of postheat treatment glossy flake scars. This approach excluded tools and flakes from the entirely lustrous interior of heat treated pieces from being coded as heat treated because they lack the combination of glossy and matte flake scars. This analysis resulted in the identification of so few specimens being identified as heat treated that a second analysis was conducted by comparing the artifacts to an experimentally heat treated type collection that was specifically prepared for this purpose. The heat treatment experiments are described in Appendix G and were limited to the most common material type, Cedar Mesa Chert. Crazing and pot lidding which often result from unsuccessful heat treatment were also noted, but such items were not considered heat treated in this analysis because they can also be the result of accidental inclusion in a fire.

Debitage

Debitage was sorted into 13 categories which reflect various aspects of bifacial, core-flake, and bipolar reduction. The debitage types used in the analysis of the testing assemblage are based on a modification of Moore's (1990) classificatory system. Definitions, illustrations, and discussions of flake types similar to those used here can be found in that text.

Decortication Flake: Decortication flakes are indicative of the initial stage of lithic reduction but they are not good indicators of reduction strategy. Decortication flakes can be produced during quarrying, core face preparation in a core-flake reduction strategy, or initial thinning in a bifacial reduction strategy. These flakes usually have more than 75 percent cortex on the dorsal face.

Core Reduction Flake: Core reduction flakes are produced during core-face preparation or core rejuvenation. *Core face preparation flakes* are generally large, thick flakes with broad (deep) unprepared single facet or cortical platforms. They exhibit relatively few deep negative flake scars which produce pronounced arrises and often give the flake a triangular cross section. Negative flake scars are generally oriented with the long axis of the flake. *Core rejuvenation flakes* are large flakes that tend to have an approximately circular plan view with a plano-convex cross section. They resemble small cores except that the negative flake scars on the dorsal surface do not originate on the margins (because they have been truncated by the removal of the core rejuvenation flakes). These flakes represent portions of cores which have been truncated to produce a new platform.

Both of these flake types generally have quite prominent bulbs of percussion. They often have cortex on the dorsal face but it rarely exceeds 75 percent. Because both flake types represent a core reduction strategy, they were not differentiated during the analysis.

Early Reduction Flake: Early reduction flakes, as defined in this analysis, are indeterminate core face preparation flakes or initial biface thinning flakes. They often have cortex on the dorsal face but it rarely exceeds 75 percent. Bulbs of percussion are usually prominent. These flakes tend to be relatively thick and wide compared to definitive biface thinning flakes. In addition, they lack the angular cross section and broad, unprepared platforms of core reduction flakes. However, platforms are single faceted or cortical. When present, negative flake scars tend to be relatively large, deep, and few in number. Dorsal faces often exhibit an irregular, rough surface topography when negative flake scars are present. These flakes are not strategy specific as they may result from core reduction or initial biface thinning. However, they do indicate an early stage of lithic reduction.

Early Biface Thinning Flake: Early biface thinning flakes tend to be of intermediate size compared to early and late stage reduction flakes of the same assemblage. Platforms are relatively thin and narrow in relation to surface size of the flake, and they usually exhibit more careful platform preparation (e.g., multiple faceting, "scrubbing," abrading) than early reduction flakes. Bulbs of applied force are moderately prominent to diffuse. These flakes tend to be longer than they are wide and usually expand distally. Early biface thinning flakes tend to be flat to slightly curved in long section and are generally thinner than early reduction flakes. Negative flake scars are few and are often oriented at various angles; they are smaller and shallower than on early reduction flakes which gives the reduction flake a smoother, more regular dorsal surface topography. These flakes are indicative of early stages in a bifacial reduction strategy (Callahan's [1979] Stage 3 and Stage 4 reduction).

Final Biface Thinning/Shaping Flake: Final biface thinning/shaping flakes tend to be smaller than early biface thinning flakes from the same assemblage. Platforms normally exhibit careful preparation (multiple faceting and grinding) and are narrow and thin relative to the surface size of the flake. Bulbs of applied force (the force may be percussion or pressure) are usually diffuse or nonexistent. Negative flake scars are generally more numerous, shallower, and smaller than on early biface thinning flakes and tend toward a consistent orientation with the long axis of the flake. These flakes are usually longer than they are wide and tend to be parallel sided (although they may expand distally). Late stage reduction flakes are indicative of final biface reduction and shaping (Callahan's [1979] Stage 5 reduction).

Retouch Flake: These are small pressure flakes that are generally greater in width than length. Bulbs of applied force are very diffuse to nonexistent. Negative flake scars are extremely small, shallow, few in number, and consistently oriented with the proximal-distal axis of the flake. Platforms of these flakes often exhibit evidence of usewear and/or previous retouch flake removals. These flakes are diagnostic of final edge regularization (very late in Callahan's Stage 5 reduction) or tool edge rejuvenation.

Bipolar Flake: Bipolar flakes may possess two opposite platforms (usually crushed), flat ventral surfaces, and diffuse or "sheared" bulbs of percussion (Crabtree 1972). These flakes frequently terminate in step or hinge fractures and negative flake scars will often exhibit step or hinge terminations. These flakes are indicative of either core reduction on small masses of toolstone (Binford and Quimby 1972; Forsman 1975) or possibly scavenging of broken tools (Skinner n.d.).

Contact Removal Flake: Contact removal flakes are detached during early bifacial reduction to edge and thin the proximal end of flake blanks (area of the platform and bulb of applied force) (Moore 1990). The dorsal face of these flakes retains the contact point and a portion of the cone of force produced during detachment of the flake blank from the core. Bulbs of applied force are generally nonexistent. These flakes are easily identified and diagnostic of initial stages of a flake blank-biface reduction strategy.

Notching Flake: Notching flakes have a concave proximal edge which gives the flake a characteristic crescent-shaped plan view. The cross section at the proximal margin (platform) is U-shaped although the cross section flattens out rapidly toward the distal end. The dorsal surface often exhibits a small flake scar centered on the proximal concavity resulting from previous notching flake removal. Notching flakes are usually relatively small but size varies according to the size of the notch being produced. These flakes are produced during notching of the hafting element of projectile points and are diagnostic of the final stage in point manufacture.

Pot Lid: Pot lids are not intentionally produced flakes. They result from inadequate temperature control during thermal alteration (either intentional or accidental). They are generally circular in plan view and semicircular in cross section (thickest in the center and rapidly tapering to all margins). These artifacts do not possess bulbs of percussion, platforms, or rings of compression.

Angular Debris/Shatter: The angular debris/shatter category refers to lithic debitage which lacks definitive flake attributes (i.e., platforms, bulbs of applied force, rings of compression, and negative flake scars). Angular debris or shatter can be produced in all reduction strategies and stages. However, it is primarily associated with initial stages of reduction (Binford and Quimby 1972).

Indeterminate/Other: This class includes all flakes and flake fragments that cannot definitively be assigned to any of the previous debitage categories.

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Appendix G

HEAT TREATMENT EXPERIMENTS ON CEDAR MESA CHERT

by André D. La Fond

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HEAT TREATMENT EXPERIMENTS ON CEDAR MESA CHERT

by André D. La Fond

Judgmental grab samples of noncultural toolstone were collected from four Cedar Mesa Chert source areas in the Squaw Butte Area by Alan R. Schroedl and Betsy L. Tipps in March of 1994. An attempt was made to collect specimens representing the full range of variation exhibited at each source. The samples were collected with the permission of the Park Archeologist, Dr. Nancy J. Coulam.

In the laboratory, a minimum of two flakes exhibiting significant macroscopic variation in texture, translucency, and/or color was removed from each nodule. One flake from each set was experimentally heat treated. The other was labeled with provenience information and specimen codes and set aside as a control.

Heat treatment was conducted in a standard gas kitchen oven. A 4-cm-thick layer of dry silt loam was placed in the bottom of a small dutch oven. The flakes were placed in a single layer on top of the silt loam and another 4-cm-thick layer of silt loam was added to cover the flakes. The flakes were then placed in an oven heated to 200°F. The heating schedule involved increases of 100°F per hour until a temperature of 400°F was achieved. This temperature was maintained for an hour after which temperature increases of 50°F per hour were initiated. The target temperature of 600°F was maintained for 3 hours. Then the oven was turned off and the flakes were left to cool undisturbed for 12 hours. Temperatures were monitored with a standard oven thermometer.

Upon completion of the heat treatment, at least one flake was removed from each heat treated blank to reveal any internal changes in texture, translucency, or color. Each heat treated blank was labeled with provenience and specimen codes corresponding to those of the natural specimens from the same set. Then the heat treated and unheat treated examples were added to the comparative collection.

The heat treatment produced a noticeable increase in glossiness in the interior of all Cedar Mesa Chert specimens. In most cases, the resultant gloss was outside of the range of glossiness exhibited by natural specimens. In addition, some reddish brown specimens showed a slight increase in reddish tint. No other visible changes were noted.