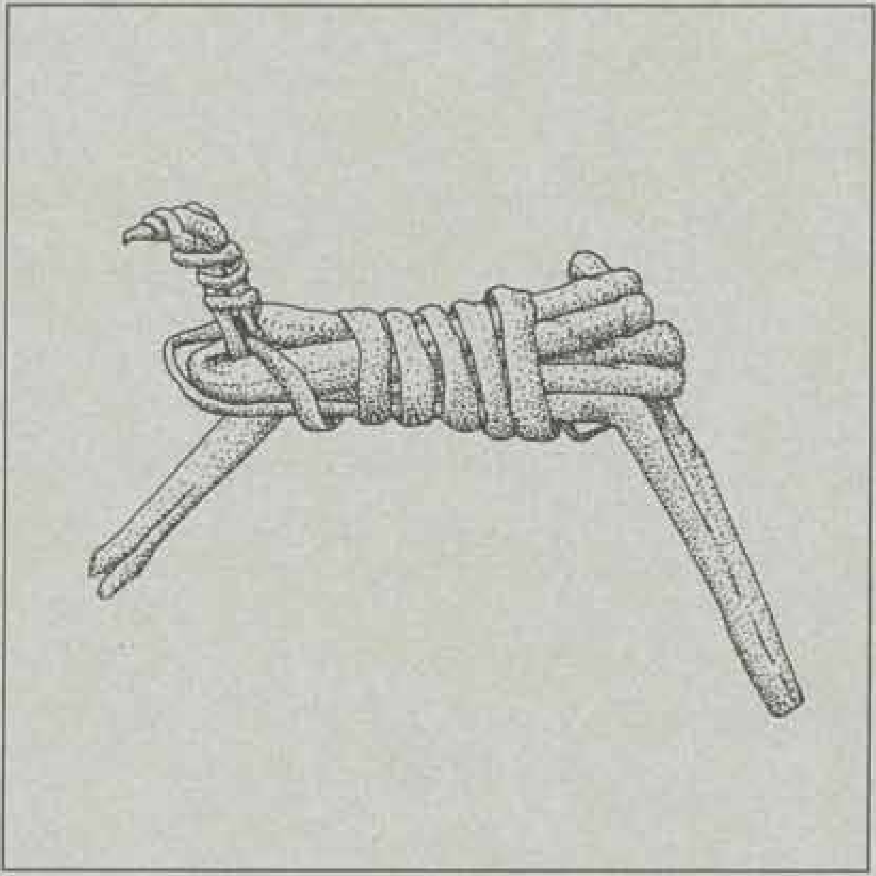
UTAH ARCHAEOLOGY
1991



A Publication of

Utah Statewide Archaeological Society
Utah Professional Archaeological Council
Utah Division of State History

UTAH ARCHAEOLOGY 1991

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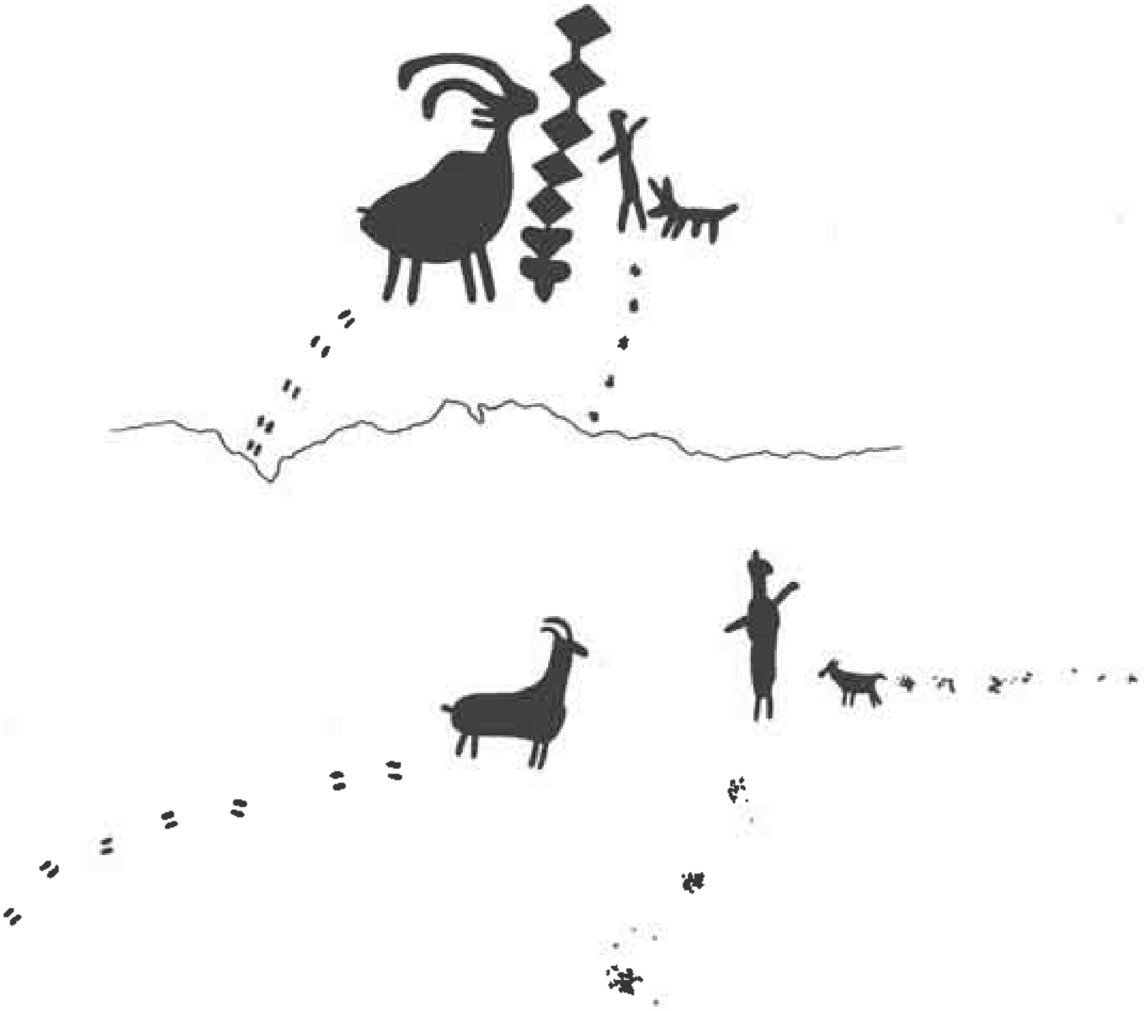

The small images that mark the end of the articles in this volume of *UTAH ARCHAEOLOGY* are taken from pictographs and petroglyphs of Utah. The images in this edition are classified under the broad category quadrupeds. A quadruped is defined as a four-footed animal. Quadrupeds are often easily identified as deer, bison, horses, mountain sheep or goats, bears, dogs, cats of various types, etc. Frequently quadrupeds play an important, if not central, role in compositions as they do in the panel illustrated above, which is found in the San Rafael Reef in eastern-central Utah. Animals are often shown in a profile view, the artist occasionally illustrated four-footed animals showing only two legs. The ease of identification of quadrupeds enables the classification of these images into this category even where four legs are not shown. There are, however, some images with four legs that escape identification. Images from diverse parts of the state have been selected for this edition to illustrate the variety of forms that are present within Utah.

Steven J. Manning

UTAH ARCHAEOLOGY 1991

Editors: Joel C. Janetski, Utah Professional Archaeological Council
Robert B. Kohl, Utah Statewide Archaeological Society

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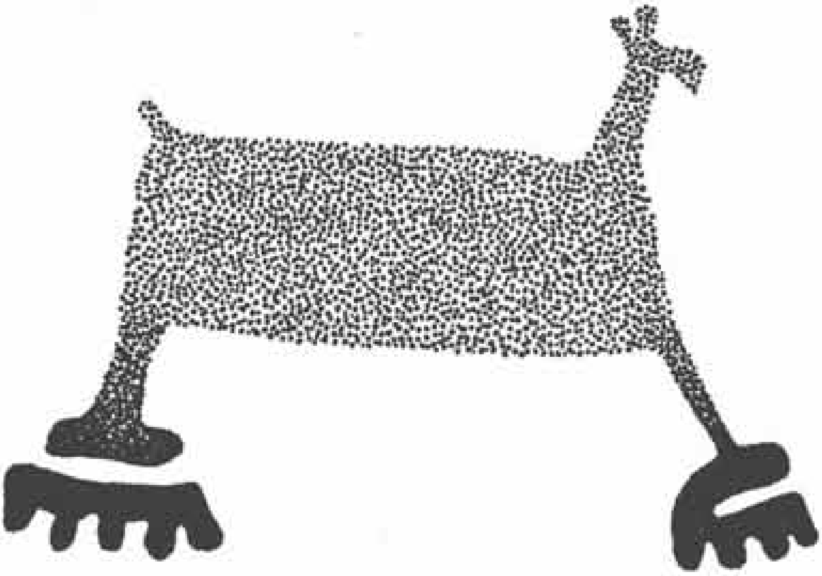


Arches National Park

MESSAGE FROM THE EDITORS

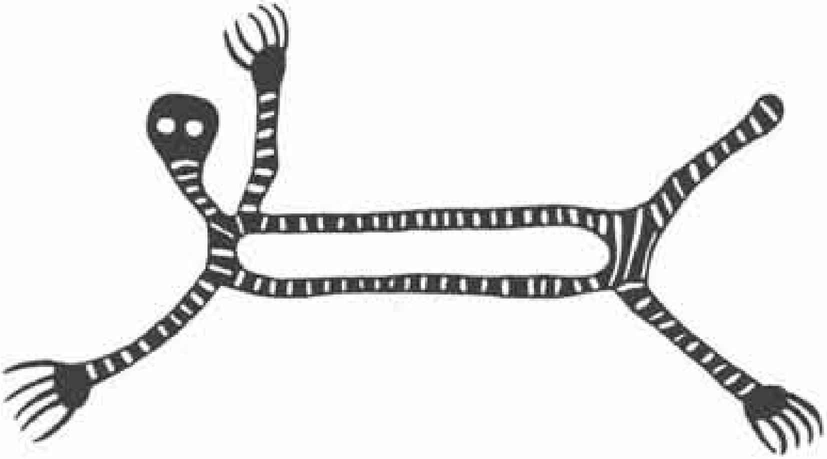
This issue welcomes Bob Kohl to the editorship of *UTAH ARCHAEOLOGY*! Bob's name is familiar to the readers of *UTAH ARCHAEOLOGY* as he has been active in supplying useful reviews of various archaeological texts since the inception of the journal. Bob replaces Steve Manning who served as the USAS editor for the first three issues and made many contributions to the high quality of the journal (pardon us for slapping our own backs). We thank Steve for all his efforts and significant contributions. Steve has agreed to continue to assist the editors by providing his excellent drawings of Utah rock art to illustrate the journal.

In *UTAH ARCHAEOLOGY 1991* readers will see the addition of a new category of papers that we are calling Notes. This category is designed to include descriptions of significant, enigmatic , or just interesting items of material culture from Utah. All of us in archaeology are aware of finds that are functionally puzzling and wonder if others have insights or have encountered similar artifacts, remains, roct art, etc. The Notes section is intended to be descriptive rather than analytical or comparative and does not require extensive knowledge of archaeological reports. The Notes need to focus only on the items being reported. Consequently, few references (bibliography) are needed. What is most important in this section are good, accurate drawings or clear black and white photos of the items being described.

The intent of this addition is two-fold: first, we hope that by encouraging the publication of such information some of these puzzles might be solved. Second, we hope that such a section will encourage greater participation in the journal by both amateurs and professional. As mentioned above, the Notes section requires little in the way of comparative material; however, should references to the literature be made, those references need to follow the same style as for the rest of journal (see Style Guide on inside back cover). The editors can help authors with those housekeeping chores, however.

We hope you enjoy and will contribute liberally to this and the other sections of *UTAH ARCHAEOLOGY*!

Joel C. Janetski, editor for UPAC
Robert B. Kohl, editor for USAS



South-central Utah

PALEO-INDIAN OCCUPATION IN THE EASTERN GREAT BASIN AND NORTHERN COLORADO PLATEAU

Alan R. Schroedl, P-III Associates, Inc., 2212 South West Temple, Suite 21, Salt Lake City, Utah 84115-2645

ABSTRACT

A review of Paleo-Indian data from throughout Utah suggests that there were differences in the lithic technology and settlement and subsistence patterns between Paleo-Indian groups in the eastern Great Basin and the northern Colorado Plateau. Discussions of Paleo-Indian terminology, projectile point types, and evidence of subsistence patterns are presented. Differences between the Paleo-Indian occupation in the eastern Great Basin and the northern Colorado Plateau are discussed.

INTRODUCTION

Recently, Willig and Aikens (1988) provided an overview of the Western Clovis and Western Stemmed complexes in the Far West. They define the Far West as the portion of North America west of the Rocky Mountains and discuss 31 Paleo-Indian sites and locales within this region. Only three of these sites are located in the eastern Great Basin, in Utah. Although they include the Colorado Plateau within the scope of their article, they do not mention any of the Paleo-Indian sites or finds from the Colorado Plateau (Willig and Aikens 1988:Figure 1). At the time of publication of Willig and Aikens's summary, preliminary reports of the Lime Ridge site (Davis and Brown 1986) and the Montgomery site (Davis 1985) were available. In addition, numerous isolated finds of Paleo-Indian points had been reported on the Colorado Plateau by 1988 (Copeland and Fike 1988; Schroedl 1977).

This paper reviews the Paleo-Indian evidence from the northern Colorado Plateau relative to the chronological and subsistence framework proposed by Willig and Aikens for the entire area they defined as the Far West. My review of these data suggests their framework is not applicable to the northern Colorado Plateau and that the Paleo-Indian complexes in the eastern Great Basin and northern Colorado Plateau have different chronological sequences as well as different subsistence patterns. It appears that as early as 10,000 B.C. Paleo-Indian groups within the eastern Great Basin and the northern Colorado Plateau were differentiating themselves technologically as they adapted to changing local environmental conditions.

DEFINITION: THE PALEO-INDIAN PERIOD

Simms (1988) discusses the terminological quagmire that engulfs researchers attempting to understand the earliest prehistoric occupation in western North America. The term Paleo-Indian is burdened with a variety of connotative meanings depending on its context. Although the term Paleo-Indian was initially defined as an archaeological stage representing a specific adaptation and lifeway (Willey and Phillips 1958:80–81), the term has also been widely used to refer to a *time period* that is marked by certain Paleo-Indian tool complexes, and to the complexes and assemblages that occur within that time period. Ideally, researchers would have a separate label for the specific time period, separate labels for the technological complexes and artifact assemblages (cf. Willig and Aikens 1988), and still other separate terms for the subsistence practices. The fact that big game hunting is part of the stage definition of the term Paleo-Indian has caused Willig and Aikens (1988:5) to reject the term Paleo-Indian completely for the Far West. Likewise, Elston and Budy (1990) also reject the term Paleo-Indian in favor of Pre-Archaic to distinguish what they perceive to be a difference in subsistence patterns between Paleo-Indian groups known to have hunted large migratory megafauna in the Southwest and the Great Plains and contemporary people in the Great Basin.

It is beyond the scope of this paper to debate the merits of proper terminology for stages, periods,

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complexes, and lifeways for the earliest occupations in the eastern Great Basin and the northern Colorado Plateau. Therefore, for the purposes of this paper, I will use Paleo-Indian Period to refer to a specific *time period* during which Paleo-Indian tool complexes are identified in the archaeological record. The use of the term Paleo-Indian in the context of this paper, as will become apparent in the discussions below, is not meant to associate a particular form of subsistence adaptation or lifeway to any technological complex, nor is the term *a priori* used to differentiate Archaic lifeways from earlier Paleo-Indian lifeways. In fact, Simms (1988:45) suggests that lifeways during the Paleo-Indian and Archaic periods in the Great Basin were relatively similar and undifferentiated.

Additionally, throughout this discussion, the term Paleo-Indian refers to sites that fall into a specific time period (defined below) and have specific archaeological traits or complexes. It continues to be a research issue whether the prehistoric peoples at these sites were big game hunters or broad spectrum hunter-gatherers. Below, I will briefly discuss the limited data on subsistence strategies identified in the eastern Great Basin and northern Colorado Plateau and how they relate to the different technological complexes present during the Paleo-Indian Period.

DEFINITION: PALEO-INDIAN PROJECTILE POINTS

Paleo-Indian projectile point types, in general, have some distinctive characteristics that make them easily identifiable. They often exhibit technological characteristics that are not found on point types from other time periods, such as basal grinding, channel fluting, and parallel collateral and parallel oblique flaking patterns. Often, Paleo-Indian points are made of high-quality lithic material and exhibit high quality generally larger than later point types (with the exception of the Folsom point). These point types are sometimes found in association with extinct types of fauna and always lack notches that are considered a latter technological innovation (Holmer 1986).

Paleo-Indian projectile points from Utah and the surrounding areas can be grouped into two major traditions, fluted point and stemmed/shouldered point. There are only two types of fluted points, Clovis (Figure 1) and Folsom (Figure 2). The homogeneity of the morphology of both types throughout western North America is exceptional. In fact, Willig and Aikens (1988:17–19) note that the morphology of Clovis specimens from the Far West fall within the variability of known Clovis points from the Great Plains and Southwest. However, to distinguish possible adaptational differences between the Far West and the Great Plains and Southwest, Willig and Aikens (1988:3) refer to these points as Western Clovis. Presumably, Willig and Aikens (1988:10) do not differentiate any variants of Folsom because of the rarity of these points in the Far West.

Stemmed/shouldered Paleo-Indian points exhibit much more stylistic variability than fluted points and include numerous named regional variants such as the Western Stemmed (Figure 3), Agate Basin, Hell Gap (Figure 4), Scottsbluff, Eden (Figure 5), and a wide variety of other types (Frison 1978; Frison and Stanford 1982; Wormington 1957). Willig and Aikens (1988:4) use the label Western Stemmed Complex to distinguish stemmed/shouldered points in the Far West from technologically similar point types from the Great Plains and farther east. Willig and Aikens include a wide variety of named stemmed/shouldered points in their Western Stemmed Complex, including Lake Mohave, Silver Lake, Parman, Haskett, Lind Coulee, Black Rock Concave Base, and others.

Fluted points appear chronologically to precede the stemmed/shouldered points throughout North America. In most cases, these distinctive Paleo-Indian points are temporally and regionally diagnostic. Because these artifacts are so distinctive and such sensitive timemarkers, researchers expend much effort on analyzing the artifacts themselves (Boldurian 1990; Bradley and Frison 1987; cf. Copeland and Fike 1988; Frison and Bradley 1980; Hutchinson 1988; Warren and Phagan 1988).

The function of Paleo-Indian points is identified through ethnographic analogy, archaeological context, and replicative studies. Ethnographic analogy refers to analyzing how a similar item is used by known ethnographic groups. Functional interpretations are strengthened when wear and fracture patterns on ethnographic specimens match those of archaeological specimens. Archaeological context refers to the archaeological associations of the implement. Paleo-Indian points have often been found in the body cavities of extinct fauna leading archaeologists to believe they functioned as projectile points or thrusting spear points. Although Frison (1990) notes

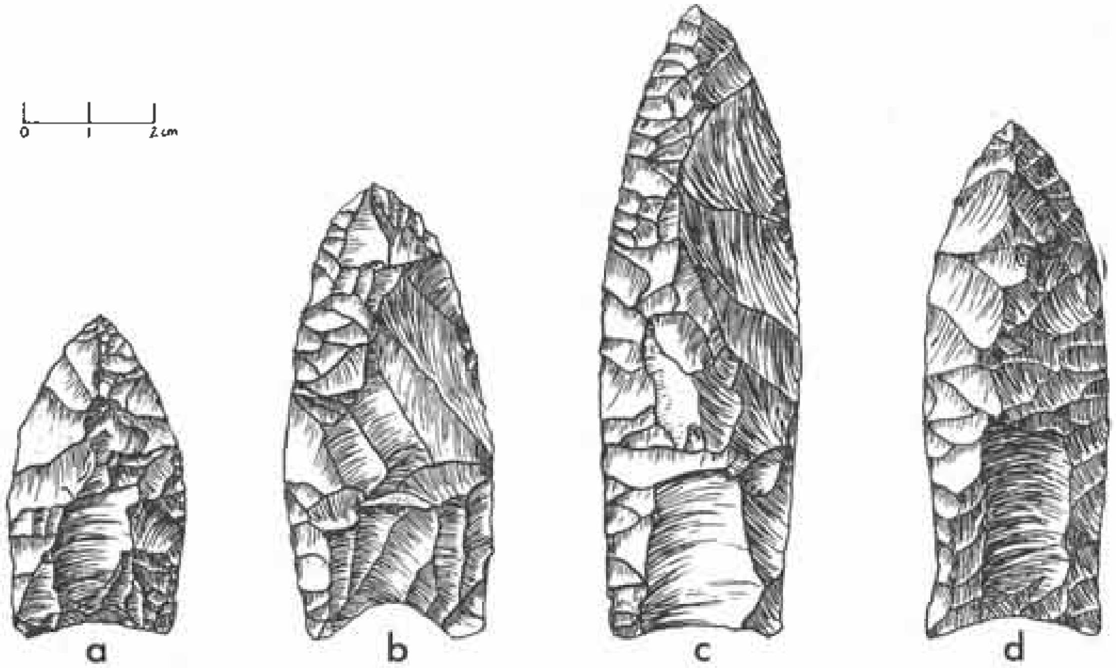

Figure 1. Examples of Clovis points: (*a–b*), from the Naco site, Arizona (Wormington 1957:Figure 15); (*c–d*), Lehner site, Arizona (Wormington 1957:Figure 17).

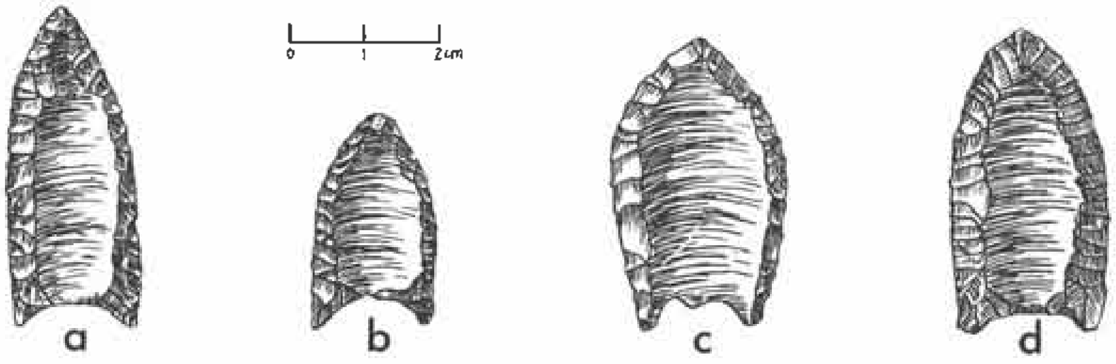

Figure 2. Examples of Folsom points: (*a–d*), Lindenmeier site, Colorado (Wilmsen and Roberts 1984:Figure 105b, h; Figure 106b, g).

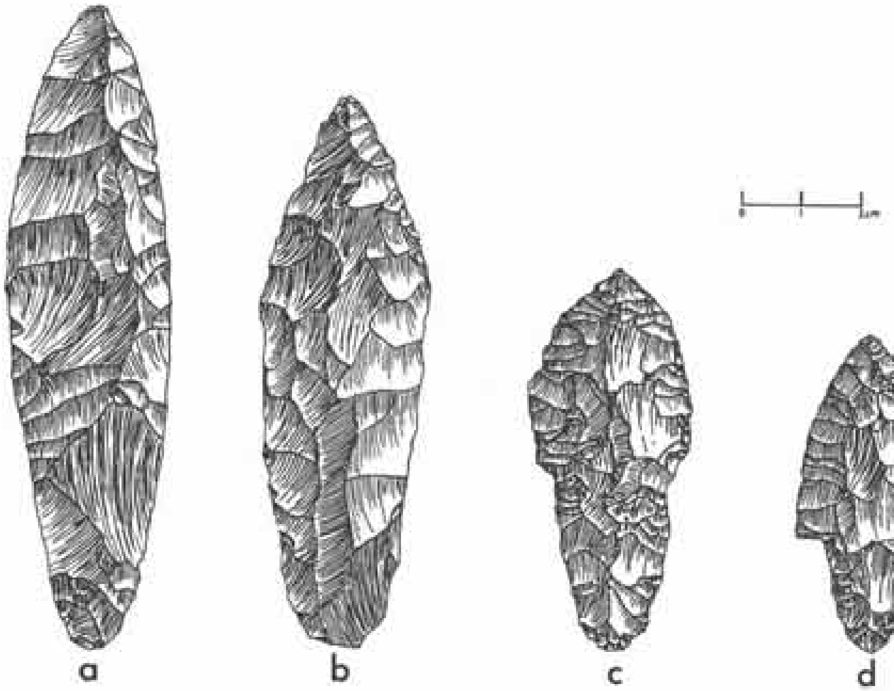

Figure 3. Examples of Western Stemmed points: (*a–b*), from the Lake Mohave site, California (Amsden 1937:LXb, c); (*c–d*), from the Northern Alkali Lake Basin, Oregon (Willig 1988:Figure 37i, j).

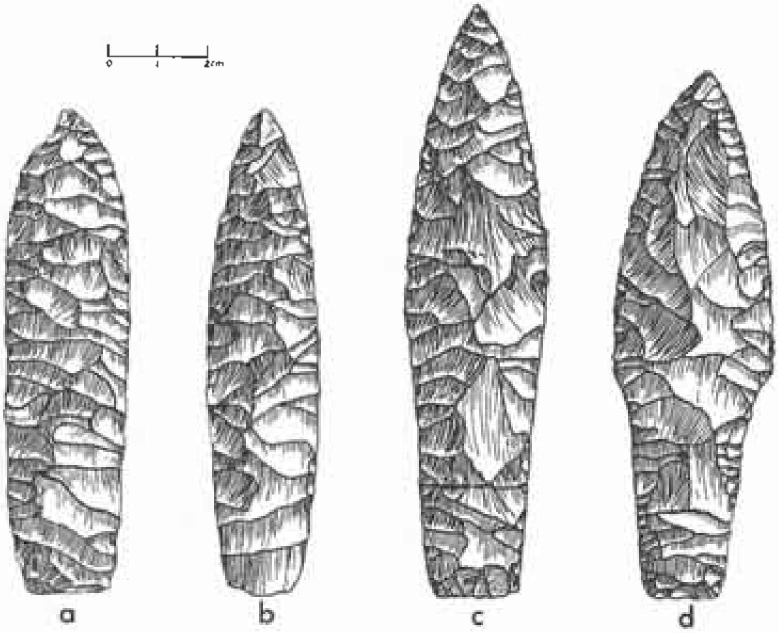

Figure 4. Agate Basin and Hell Gap points from the Northwest Plains: (*a–b*), Agate Basin points from the Agate Basin site in Wyoming (Frison and Stanford 1982:Figure 2.56A, a, j); (*c–d*), Hell Gap points from the Casper site in Wyoming (Frison 1974:Figure 1.35b, d).

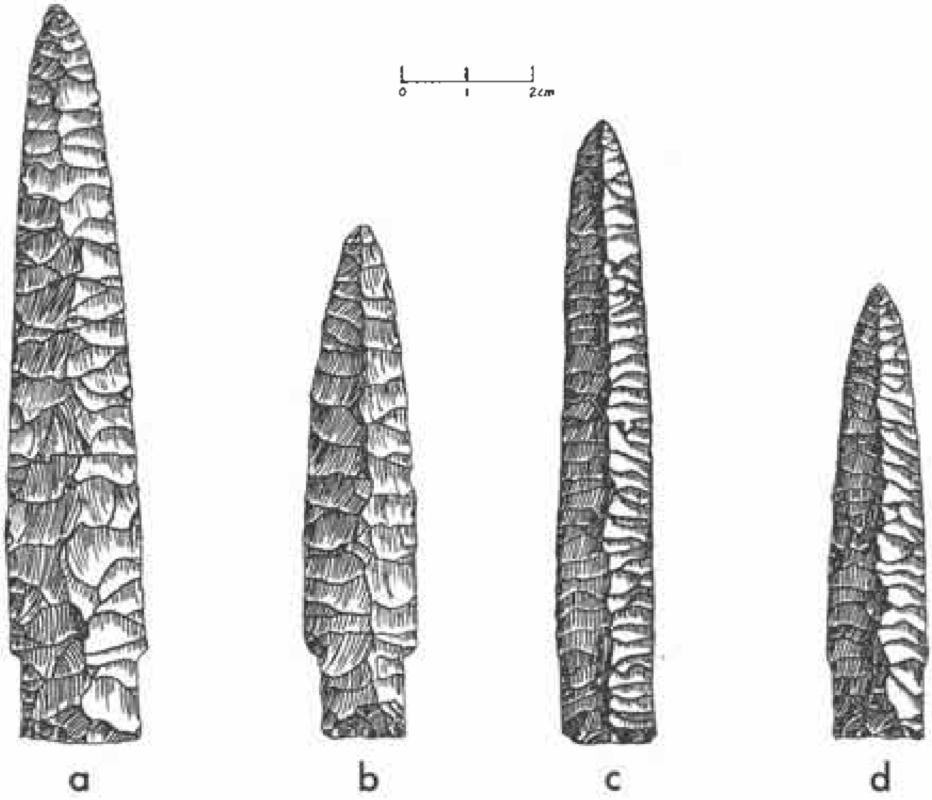

Figure 5. Scottsbluff and Eden points from the Horner I site in Wyoming: (*a–b*), Scottsbluff points on the Horner I site (Bradley and Frison 1987:Figure 6.7a, b); (*c–d*), Eden points from the Horner I site (Bradley and Frison 1987:Figure 6.10a, d).

that replicas of Paleo-Indian tools would have been sufficient for dispatching and butchering modern African elephants, such replicative studies are the weakest means of assessing implement function. While replicative studies define the parameters of possible use and function, they can never prove the function.

Given Frison's replication studies, the association of Paleo-Indian points with extinct faunal remains, and ethnographic analogy on hunting and spearing techniques, it seems certain that Paleo-Indian projectile points were indeed part of the hunting tool kit these people used to kill game animals. Paleo-Indian points are formidable weapons and could have easily been used to dispatch large game by Paleo-Indian hunters. How often Paleo-Indian people in the Far West actually had opportunities to hunt Late Pleistocene megafauna, is an open issue.

DEFINITION: PALEO-INDIAN SUBSISTENCE PATTERNS

Archaeologists use several lines of evidence to discover subsistence patterns. The strongest evidence of subsistence practices is human coprolites and plant and animal remains from archaeological sites. Coprolites (fossil human feces) provide the only direct means of knowing what prehistoric individuals actually ate, but they are extremely rare in the archaeological record. It is more likely that plant and animal remains will be recovered from a site, with charring, parching, and grinding taken as direct evidence of plant utilization, and disarticulation, butchering marks, and charred bones interpreted as evidence of animal utilization.

When plant and animal remains are not present on a site, other secondary evidence is used to discern subsistence practices. Ethnographic analogy is used to derive subsistence practices from the tool assemblage and site structure. Replicative studies of implements and implement use also can be used to suggest subsistence patterns, but again, this is weak evidence.

The weakest form of evidence for subsistence practices is what can be called geographic propinquity. The location of a site relative to the local distribution of plants and animals is taken as the basis for inferring subsistence practices. It is assumed that prehistoric people will locate themselves as close as possible to the most important plant and animal resources. In general, archaeologists attempt to evaluate and combine all these lines of evidence to form a coherent picture of the procurement, processing, and utilization of plants and animals.

In light of this discussion of varying kinds of evidence, what is actually known about Paleo-Indian subsistence practices in the Far West? Very little, in fact. Willig and Aikens (1988:22) note that "Currently, there are no dated subsistence remains from Western Clovis sites" with the possible exception of the Old Humboldt site (Rusco and Davis 1987). At the Old Humboldt site, a faunal assemblage, including clam and eggshells that may be associated with Paleo-Indian points, was recovered at the site. The fauna also included bison, other large artiodactyls, rabbits, rodents, and reptiles (Dansie 1987).

Elston (1982) and Madsen (1982) also address Paleo-Indian subsistence patterns in the western and eastern Great Basin, respectively. Neither provides direct evidence of subsistence procedures at that time. Both rely heavily on geographic propinquity to suggest that lacustrine-marsh resources were the primary focus of subsistence prior to about 6000 B.C.

Since Paleo-Indian sites have yet to produce any direct subsistence data, it is intuitively compelling to suggest the first people in the Far West, particularly the Great Basin, followed a mixed hunting and gathering lifeway that was similar to the main focus of adaptation for the following prehistoric periods.

But this does not explain away big game procurement during the Paleo-Indian Period. First, there must be some functional explanation for the continued manufacture of these large, well-made Paleo-Indian points within the Intermountain West. As noted above, their implied function is to kill large game. Second, the limited tool assemblages that have been recovered from Paleo-Indian sites contain different tool types than are found on later Archaic sites such as scrapers, gravers, crescents, etc. (Basgall 1988; Fagan 1988; Gramly 1990; Hutchinson 1988), tool types that are often believed to be related to animal processing. And, third, in general, these assemblages lack implements such as hand stones and milling stones indicative of extensive plant processing.

The real issue is not whether Paleo-Indian people in the eastern Great Basin and northern Colorado Plateau were big game hunters or hunter-gatherers, but rather *to what extent big game contributed to the overall subsistence pattern of local groups during the Paleo-Indian Period.* This question, of course, will only be answered when direct evidence of Paleo-Indian subsistence activities is recovered.

WESTERN UTAH: PALEO-INDIAN CHRONOLOGY AND SUBSISTENCE

The Paleo-Indian date ranges provided by Willig and Aikens (1988) are consistent throughout the Far West and are comparable to dates from other Paleo-Indian sites in western North America. Thus, these date ranges should be generally applicable to Paleo-Indian finds and sites in the eastern Great Basin. However, most Paleo-Indian researchers continue to report date ranges from the Paleo-Indian Period in terms of radiocarbon years, even though it is well known that carbon fluctuations in the atmosphere cause the chronology to expand or contract during certain time spans. For example, 100 radiocarbon years during one span of time in the prehistoric past may be shorter or longer than another 100 radiocarbon-year span in a different part of the sequence.

Recent advances in Paleoclimatic research (Stuiver et al. 1991) now allow radiocarbon dates between 8,100 and 11,000 radiocarbon years to be calibrated to the Gregorian calendar. These calibrations are based on varve years (varve counting) and croyears (annual ice layering). By matching varve years, croyears, and dendroyears, it is possible to derive a calibrated A.D./B.C. Gregorian calendar date for radiocarbon dates almost back to the beginning of the Paleo-Indian Period. All chronological data presented in this paper has been calibrated to the Gregorian calendar using the data in Stuiver et al. (1991). One important outcome of calibrating the Paleo-Indian radiocarbon dates is that the time span of Clovis occupation in the Far West, as well as the rest of North America, is significantly lengthened. The fact that the Clovis Complex existed longer than previously believed has important implications for any arguments that are based on relative time spans (cf. Martin 1973).

According to Willig and Aikens (1988), the Western Clovis Complex has a calibrated date range between 12,250 and 9950 B.C. in the Far West. The Western Stemmed Complex appears to date from about 10,300 B.C. to about 6400 B.C. with a slight overlap between the end of Western Clovis and the beginning of the Western Stemmed Complex. Willig and Aikens interpret this as an indication that the Western Stemmed Complex arose out of the Western Clovis Complex. For the purposes of chronological placement of the Paleo-Indian Period, these are appropriate date ranges for the portion of Utah in the eastern Great Basin since they are derived in part from dates from three sites with Paleo-Indian projectile points in western Utah. These three sites are Danger Cave, 42Md300, and Hogup Cave.

The earliest dated Paleo-Indian occupation in western Utah is from Danger Cave (Jennings 1957). The early occupation of Danger Cave had been suspected since the early 1940s, but it was not until the 1950s that the true time depth of Danger Cave became apparent. Danger Cave was one of the first sites in the West to be radiocarbon dated. At first, even Jennings was skeptical of the early dates (Jesse D. Jennings, personal communication 1976). Because some of these are based on solid carbon, the accuracy of the dates is questionable. However, during the past few years, David Madsen (personal communication 1991) re-excavated a portion of Danger Cave. Based on a series of 5+ radiocarbon dates, the lowest levels of cultural material from Danger Cave have a calibrated date of about 9450 B.C. This date is compatible with Jennings's data. Another site, 42Md300 (Simms and Lindsay 1989), located in the Sevier Desert near Delta, is also directly dated to the Paleo-Indian Period. At this site, an assemblage of stemmed points is apparently associated with an occupation radiocarbon dated to about 8600 B.C. (calibrated). At Hogup Cave, Aikens (1970) recovered a Paleo-Indian point that he identified as a possible Scottsbluff point from Stratum 1. This stratum produced two radiocarbon dates, the earlier of which, is about 7350 B.C (calibrated). Currently, these are the only radiocarbon dated Paleo-Indian components in the state of Utah. All the other Paleo-Indian finds in western Utah are dated by cross reference to radiometrically dated sites noted by Willig and Aikens.

As discussed above, virtually nothing concrete is known about the subsistence strategies of Paleo-Indian people of the region. Arguments about subsistence strategies are based on either ethnographic analogy or geographic propinquity. Willig and Aikens (1988:27) and others (Elston 1982; Madsen 1982) note that most of the Paleo-Indian sites are located along shrinking pluvial lake margins or stream channels feeding these lakes. The absence of kill sites in these areas has led these researchers to assume an Archaic subsistence pattern for occupants at these sites.

The few Paleo-Indian sites and finds in the Great Basin portion of western Utah fit this pattern of geographic distribution. Subsistence data from the earliest components at the three dated Paleo-Indian sites in western Utah, Danger Cave, Hogup Cave, and 42Md300, are limited but do seem to support the notion of Archaic or mixed hunting and gathering lifeway in a lakeside-marsh setting.

EASTERN UTAH: PALEO-INDIAN CHRONOLOGY AND SUBSISTENCE

As discussed above, a number of Paleo-Indian finds and several Paleo-Indian sites are located on the northern Colorado Plateau. However, Willig and Aikens failed to incorporate any of these sites or finds into their discussion. Nonetheless, by including the Colorado Plateau in their definition of the Far West, they have tacitly applied their dating scheme and cultural sequence to the region.

But is Willig and Aikens's chronology suitable for the Colorado Plateau? Even at the most superficial level, the existing Paleo-Indian data indicates some differences between projectile point types in the eastern Great Basin and the Colorado Plateau. First, within the boundary of Utah, Clovis points are far more common on the Colorado Plateau, particularly near the confluence of the Green and Colorado rivers, than in the eastern Great Basin. Second, although a few scattered Western Stemmed points exist on the Colorado Plateau (Black and Metcalf 1986:Figure 13), the Western Stemmed Complex is far more common in the eastern Great Basin as demonstrated by the surface collections of

Keller and Hunt (1967) and the assemblage from site 42Md300 (Simms and Isgreen 1984; Simms and Lindsay 1989).

Another difference between the eastern Great Basin and the Colorado Plateau is that Folsom points are relatively rare in the eastern Great Basin (Copeland and Fike 1988:Figure 1; Willig and Aikens 1988:10) compared to the Colorado Plateau. Given their distinctive form, it is doubtful that Folsom points are more common in the Great Basin but have not been recognized or identified.

Fourth, Paleo-Indian points of the Plano Tradition appear to be lacking (except for the possible Scottsbluff point from Hogup Cave) in the eastern Great Basin. Although rare, they have been identified on the Colorado Plateau. Hunt (1953) identifies a possible Angostura point from the Beaver Creek area in the La Sal Mountains. Copeland and Webster (1983:Figure 19) report on one Hell Gap and two Scottsbluff fragments from the Old Woman Plateau and Trough Hollow area near Emery, Utah. Black et al. (1981) report on two James Allen-like points from Lisbon Valley in southeastern Utah. Additionally, they illustrate two projectile points with collateral flaking that they identify as Humboldt Concave Base points. Tipps (1988:Figure 24) depicts a base of a stemmed Paleo-Indian point from the San Rafael area. Black and Metcalf (1986:Figure 13) report on a Lovell Constricted point and three Plano Tradition midsections from central Utah. The date ranges of some of these types postdate 7800 B.C., the date at which Archaic assemblages appear in the archaeological record on the northern Colorado Plateau (see below).

The implication of the projectile point data is that the Paleo-Indian occupation of the eastern Great Basin in western Utah and the Paleo-Indian occupation on the Colorado Plateau in eastern Utah assumed different forms as early as 10,000 B.C. While fluted Clovis points gave way to Western Stemmed Complex points in the Great Basin area, the projectile point sequence on the Colorado Plateau more closely parallels that of the Greater Southwest and the High Plains. In these areas, Clovis is shortly followed by Folsom and, later, by a variety of lanceolate stemmed/shouldered Plano Tradition points, some of which may be contemporaneous with Archaic occupation in the area.

Thus, while Willig and Aikens (1988) see the Western Stemmed Complex lasting until about 6400 B.C. in the Great Basin, this stemmed point tradition on the Colorado Plateau is limited to a few isolated finds. This suggests that there are chronological and technological differences during the Paleo-Indian Period between the Colorado Plateau and the Great Basin in Utah.

While the Paleo-Indian Period continued on the Northwest Plains (cf. Frison 1978) as evidenced by a wide variety of Plano complexes, full-scale Archaic occupation had developed on the northern Colorado Plateau even though some late dating Plano points are found. By about 7800 B.C., Archaic complexes, primarily represented by notched points and milling stones, are well represented in the area (Ambler 1984; Jennings 1980; Lindsay et al. 1968). Thus, while Plano Tradition technologies were still evolving on the High Plains, populations on the northern Colorado Plateau had already shifted to Early Archaic chipped stone and groundstone tool assemblages.

None of the Paleo-Indian finds or sites on the northern Colorado have provided direct evidence of subsistence patterns. Ethnographic analogy and geographic propinquity are the only means of assessing Paleo-Indian subsistence strategies on the northern Colorado Plateau. While the few Paleo-Indian sites and finds in western Utah fit the pattern of lakeside adaption, this is not the case with Paleo-Indian sites and finds on the northern Colorado Plateau. Given the absence of playa lakes on the northern Colorado Plateau, such a lacustrine subsistence strategy is impossible. This may explain why Western Stemmed Complex sites, which seem to be associated with lake margin adaptation, are not found on the northern Colorado Plateau.

Data presented by Copeland and Fike (1988) may shed some light on possible subsistence strategies for the early portion of the Paleo-Indian Period on the Colorado Plateau. Copeland and Fike (1988) present a table of environmental characteristics for the sites and locations from which fluted points were recovered. Analysis of the elevation of these sites and locations shows that Clovis sites have an average elevation of about 5,740 ft while the Folsom locales have an average elevation of about 5,410 ft. Given that almost 40 locales are represented, it is obvious that early Paleo-Indian utilization of the Colorado Plateau was in the lower elevations, usually below 5,900 ft, and that during this time, few forays were made to the higher elevations that are common on the plateau. In fact, probably less than 40% of the surface area of the northern Colorado Plateau has an elevation of less than 6,000 ft (see Lindsay 1986: Figure 3), yet the fluted points are concentrated in these low areas near major water courses.

The concentration of fluted points on the Colorado Plateau, particularly around the confluences of the Green and Colorado rivers, closely parallels the distribution of Pleistocene megafauna that have been recorded in the area (Figure 6) (Agenbroad 1991; Agenbroad and Mead 1987; Madsen et al. 1976). There are numerous finds on the northern Colorado Plateau, particularly in the Canyonlands area, of dung deposits, hair, and bone fragments from Pleistocene fauna. Species represented include mammoth, mylodont sloth, Shasta ground sloth, horse, bison, and present day fauna such as bighorn sheep, deer, and bear (Agenbroad 1991).

Pack rat data, alluvial stratigraphy, and molluscan data from Upper Salt Creek in the Needles District of Canyonlands National Park (Agenbroad 1991) have demonstrated the presence of lush environments at the end of the Pleistocene within the local canyons. In addition, paleoenvironmental data on the Pleistocene/Holocene boundary from elsewhere in the region (Agenbroad and Elder 1987; Agenbroad and Mead 1989; Agenbroad et al. 1989; Madsen 1989; Mead 1987; Mead and Agenbroad 1986) indicate that the Late Pleistocene-Early Holocene environment was a time of dramatic change. Larry D. Agenbroad (personal communication 1990) notes that the local environments in the dissected Canyonlands area were quite complex but the canyon environment would have been ideal for megafauna. These canyons were well watered and the numerous caves and overhangs would have provided shelter. The Late Pleistocene alluvium would have supported rich and diverse vegetation. Relative to the Great Basin, the Colorado Plateau appears to have been able to support larger big game populations.

Although geographic propinquity is weak evidence, to me it is more than coincidence that the spatial distribution of Pleistocene megafauna coincides with the distribution of fluted points in this area of the Colorado Plateau. Although no unequivocal finds of Pleistocene fauna associated with Paleo-Indian artifacts have been discovered on the northern Colorado Plateau, big game hunting was probably an important part of the Paleo-Indian subsistence pattern in this area, even if it was not an important part of the subsistence strategy in the eastern Great Basin. Contrary to Willig and Aikens (1988), I believe that Paleo-Indian occupation on the Colorado Plateau has greater affinities to Paleo-Indian occupation on the Northern Plains (Frison 1978) and the Rocky Mountains (Stanford and Day 1991) than to the Great Basin.

Ultimately, it was probably environmental changes that brought about the transition in complexes, technologies, and subsistence patterns on the northern Colorado Plateau. Drying climatic conditions at the beginning of the Holocene may have forced megafauna and people to concentrate around and near water sources. As the overall climate changed, it is possible that megafauna, followed by Paleo-Indian hunters, migrated to refugia at higher elevations. This might explain the presence of a mammoth near Huntington, Utah, at about 9,000 ft with a calibrated date of about 8450 B.C. (Madsen 1989).

Intriguing support for this scenario is the fact that several of the late dating, Plano Tradition Paleo-Indian points from the Colorado Plateau are from relatively high elevations. The Angostura point reported by Hunt (1953) was found at an elevation of 10,500 ft. The Hell Gap and the two Scottsbluff points reported by Copeland and Webster (1983) were all found at elevations above 8,000 ft. The Lisbon Valley study area, which produced two James Allen-like point fragments, ranges in elevation from 6,000 to 7,200 ft.

Following from this scenario of Paleo-Indian occupation on the Colorado Plateau is the possibility the Archaic occupation in the area evolved within the confines of the rugged and narrow canyons of the Canyonlands section rather than upland or highland environments of the region. Some of the earliest Archaic sites on the Colorado Plateau, Sand Dune Cave and Dust Devil Cave (Lindsay et al. 1968) and Walters Cave and Cowboy Cave (Jennings 1980), are found below 6,000 ft within the local canyon environments.

DISCUSSION

The chronological framework that Willig and Aikens propose for the Paleo-Indian Period in the Great Basin area is too simplistic to be applicable to the northern Colorado Plateau. It is more likely that several different technological complexes existed

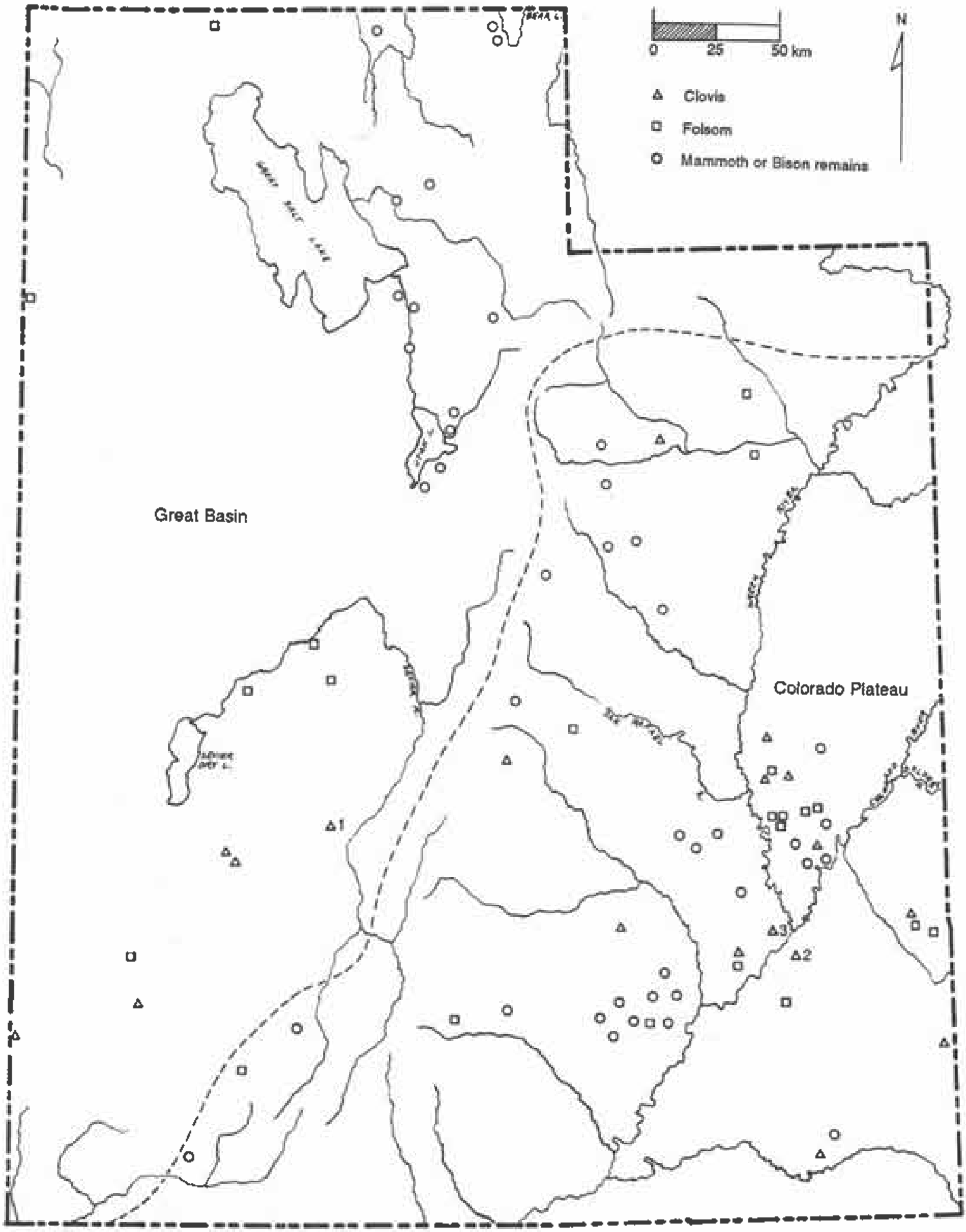

Figure 6. Geographic distribution of fluted points and mammoth and bison remains in Utah. See Note 1 for references.

concurrently in Utah during the Paleo-Indian Period in response to local environmental settings. These local settings conditioned the kind of subsistence patterns and technological complexes we recognize today.

In western Utah, Western Clovis and Western Stemmed complexes are present and probably fall into the 12,250–6400 B.C. time span proposed by Willig and Aikens (1988). Limited evidence suggests that the subsistence pattern of these Paleo-Indian people was primarily focused on lacustrine resources available near freshwater sources such as marshes or pluvial lake margins.

A Clovis Complex is also present on the Colorado Plateau. In addition, Folsom points, generally lacking in the Great Basin, represent a later Paleo-Indian complex in the area. The Western Stemmed Complex is minimally represented on the northern Colorado Plateau while stemmed/shouldered points similar to Late Paleo-Indian points on the Northern Plains have been noted. The abundant evidence of Pleistocene megafauna in the same environmental settings as the fluted points suggests a subsistence strategy that involved big game. Paleo-Indian complexes on the Utah portion of the Colorado Plateau probably begin as early as 12,250 B.C. and limited finds of Plano Tradition points suggest they continued until to at least 7800 B.C. Speculating from limited evidence, I hypothesize that Paleo-Indian subsistence patterns may have continued in the higher elevations of the northern Colorado Plateau while an Archaic lifeway and associated assemblages were evolving in the lowland canyon environments on the central Colorado Plateau. One general observation needs to be made about Paleo-Indian occupation in the eastern Great Basin and the northern Colorado Plateau. Paleo-Indian occupation in these areas probably spanned more than 4,000 years of human prehistory. This represents almost 25% of the prehistoric period in Utah. Yet, the number of sites and artifacts from this time period are minuscule relative to the data from 8,000+ years of prehistoric occupation that followed the Paleo-Indian Period. While researchers have tended to emphasize the changing environmental conditions coupled with technological changes during this time, there must have been a high degree of cultural and demographic stability, otherwise we would expect to see *more* variability in this 4,000-year period than is evident. What intrigued me in 1976 (Schroedl 1976), and continues to intrigue me, is how local populations with Archaic tool kits seem to burgeon on the archaeological landscape on the Colorado Plateau between 7500 and 7000 B.C. The transition from Paleo-Indian to Archaic is still an important research issue.

I also offer recommendations for future research on the Paleo-Indian period in Utah. First, researchers should take a broader view in the analysis of artifacts from Paleo-Indian sites and attempt to identify Paleo-Indian *assemblages* rather than diagnostic Paleo-Indian projectile points (cf. Davis 1989). Only by understanding the entire Paleo-Indian tool assemblage will we be able to identify Paleo-Indian sites that do not have diagnostic points associated with them.

Second, more effort should be expended in the analysis of the environmental characteristics associated with isolated finds and sites of the Paleo-Indian Period. It is obvious that environmental shifts at the Late Pleistocene/Holocene boundary are complex. Analysis of these past environmental characteristics in relation to Paleo-Indian sites and surface finds could strengthen geographic propinquity arguments about the Paleo-Indian lifeway within the eastern Great Basin and the northern Colorado Plateau.

Third, we need to continue to re-examine old data in light of new theories and techniques. I would urge that the Silverhorn site tested by Gunnerson in 1956 (Gunnerson 1956) be re-evaluated. Also, the artifact collection from the site should be re-analyzed in light of our current understanding of Paleo-Indian lithic technology. A thorough tabulation of Plano Tradition and other Late Paleo-Indian projectile points from the northern Colorado Plateau is in order. The listing of nonfluted Paleo-Indian points from the northern Colorado Plateau provided above is not complete and more information on Late Paleo-Indian points may support or refute my hypothesis of subsistence patterns on the Colorado Plateau during this time span.

Finally, I want to note that it is in the area of Paleo-Indian research that avocational archaeologists have an opportunity to make important contributions (see as an example, Kohl in this volume). Presently, there are only six known sites in Utah that have Paleo-Indian components or Paleo-Indian assemblages (Table 1).

Because of the distinctive nature of the Paleo-Indian assemblages, including the Paleo-Indian

Table 1. Sites with Paleo-Indian assemblages in Utah.

Site	Reference
Danger Cave	Jennings 1957
Hogup Cave	Aikens 1970
42Md300	Simms and Lindsay 1989
Lime Ridge site	Davis 1989
Montgomery site[1]	Davis 1985
Silverhorn site[2]	Gunnerson 1956

[1] No final report has appeared on this site yet.
[2] When tested in 1956, it did not produce any diagnostic tools, although an assemblage was present.

projectile points and the obvious nature of fossil remains of Pleistocene fauna, avocational archaeologists can identify these sites as easily as professional archaeologists. As rare as these sites are, any new Paleo-Indian site is significant. In fact, most of the major Paleo-Indian sites reported in the past 50 years have been discovered by amateurs, land owners, or cowboys.

If you do find one of these sites, it is important that it remain undisturbed and that appropriate state and federal agencies be notified of such a find. In return for not disturbing the site, you will become famous in Archaeology. It is archaeological tradition that a Paleo-Indian site is named after the original discoverer. More importantly, the discoverer could make a lasting and unique contribution to our knowledge about the past.

ACKNOWLEDGMENTS

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NOTE

1. This figure is derived from Copeland and Fike (1988:Figure 1), Agenbroad (1991:Figure 32), and Madsen et al. (1976:Figure 9). The boundary of the Colorado Plateau is derived from Hunt (1974:Figure 15.1). Mammoth and bison locations are noted only for the Colorado Plateau, while only mammoth are identified for the rest of the state. Three Clovis point fragments noted on the maps were not included in Copeland and Fike (1988), No. 1 (Larsen 1990), No. 2 (Tipps 1992), and No. 3 (Adrienne B. Anderson, personal communication 1990). The correct bibliographic citation for the Clovis point from site 42Ga3049 (Copeland and Fike 1988:Table 1, No. 4) and the Folsom point from site 42Ga034 (Copeland and Fike 1988:Table 1, No. 24) is Geib et al. (1986:224).

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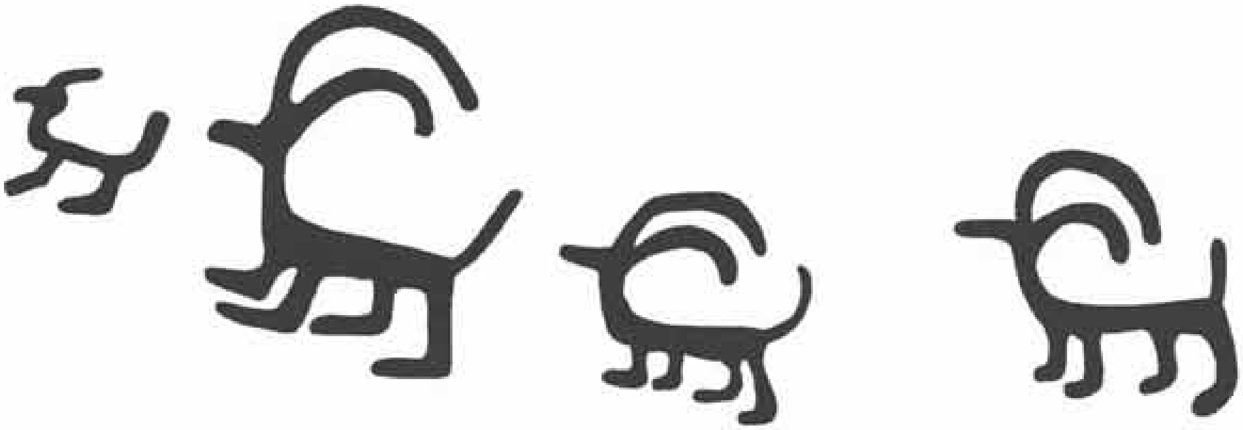

Montezuma Creek, southeastern Utah

REPORTS

SAND DUNE SIDE-NOTCHED: AN EARLY ARCHAIC PROJECTILE POINT TYPE OF THE NORTHERN COLORADO PLATEAU

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INTRODUCTION

Tipps et al. (1989:89–92) recently designated a tentative early Archaic point type for the Northern Colorado Plateau: Sand Dune Side-notched. The type was proposed to provide a named category for a shallowly side-notched dart point recovered from the surface of Salt Pocket Shelter (42Sa17092) in Canyonlands National Park, Utah (Figure 1), and for three similar points recovered from Sand Dune Cave in southern Utah (Lindsay et al. 1968:44), hence, the type name. The purpose of this report is to present additional data about this proposed point type, specifically with regard to temporal placement, geographical distribution, and production technology.

THE TYPE SPECIMENS

Association and Dating

The type specimens for Sand Dune Side-notched were associated with Burial 2 from Sand Dune Cave, a burial ascribed to the early Archaic Desha Complex (Lindsay et al. 1968). Since the cave was excavated by arbitrary levels rather than natural strata, some may question the temporal association of the type specimens. When the head of Burial 2 was encountered in level 4 of grid K26, Strata II, III, and IV were visible in the 25 cm profile. Stratum II (the lowest) was a mostly sterile sandy layer with evidence of slight human use; Stratum III was an irregular, thin cultural layer; Stratum IV was a largely sterile layer of eolian sand, most of which had been removed by level 3. The profile along the line between squares K26 and K27 allowed the outline of the burial pit to be traced vertically "up into Stratum III, but not through that stratum or into Stratum IV" (Lindsay et al. 1968:44). Ambler's 1961 field notes housed at the Museum of Northern Arizona state that the "pit outline could be traced to within 5 cm of the top of L4" (level 4), which places the pit's origin near the top of Stratum III. A Stratum IV origin for the burial is highly doubtful, and the lack of trash in the burial pit indicates that the burial did not originate from the trashy Stratum V.

Stratum III was not dated, but three samples of open-twined sandals from the lower portion of Stratum V yielded dates between 7150 and 7700 years B.P. (Lindsay et al. 1968:96). Allowing some time for the essentially sterile sand of Stratum IV to accumulate, Stratum III and Burial 2 could be over 8000 years old. There is a likelihood that this stratum and the burial are contemporaneous with the first use of the nearby Dust Devil Cave, which is radiocarbon dated at 8730±110 B.P. and 8830±160 B.P. (Ambler 1984, Table 1). Such an early temporal placement would not be out of line with the Pinto point from the burial (see below).

The Burial 2 Point Collection

Six projectile points, four coal pendants, and some sulphur crystals were found in a tight cluster immediately in front of the thoracic area of Burial 2 (Lindsay et al. 1968:44, Figure 21). The tight grouping of these artifacts and an organic stain around and under them suggests that they had been within a bag. A seventh point found close by was thought possibly associated, but this last item (Lindsay et al. 1968:Figure 24a) resembles Basketmaker II points from this cave and elsewhere in the Kayenta region. The field notes reveal that it was found in the extensively rodent disturbed torso area of the burial and was, therefore, likely intruded from the

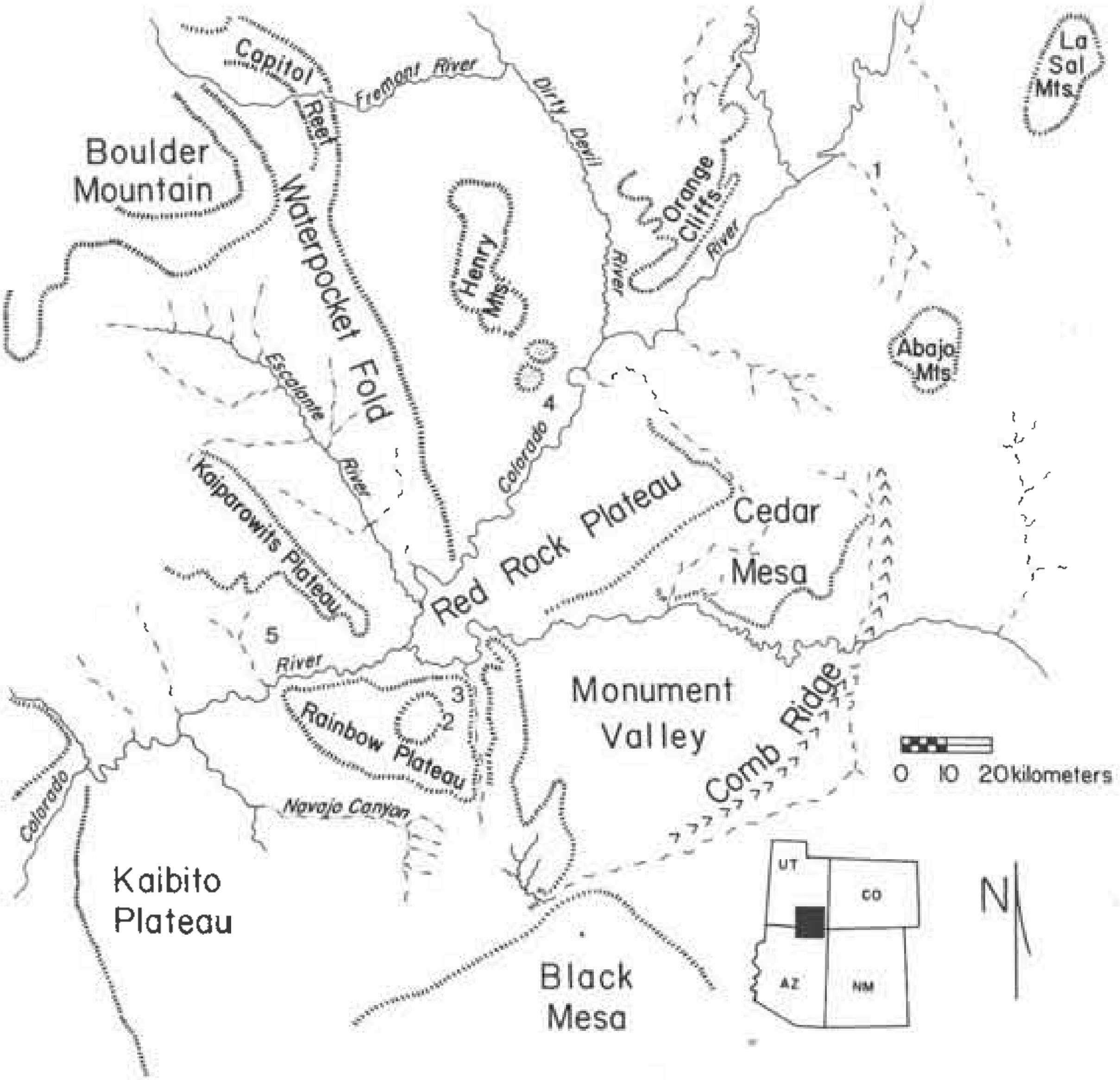

Figure 1. The Glen Canyon region showing locations of the sites and isolated find discussed in this report: (1) Salt Creek Shelter (42Sa17092); (2) Sand Dune Cave; (3) Dust Devil Cave; (4) isolated find IF-UT-V-6-39; (5) 42Ka3233.

Basketmaker II occupation of the cave; it will not be further considered.

The six points were re-analyzed to provide detailed morphological and technological data for comparative purposes. The points are shown in Figure 2 and Table 1 provides descriptive data. They are readily separable into three groups: (1) two stemmed, basally indented points; (2) three that are the type specimens for Sand Dune Side-notched (SDS); and (3) one point that appears to be an unnotched version of SDS.

The SDS points exhibit a general lack of plan and section symmetry and unpatterned flaking; technologically they are characterized by poor

Table 1. Dimensions (mm) for Projectile Points from Burial 2 of Sand Dune Cave and for Other Points Discussed in the Text

Site Number	Figure Number	Length	Width	Thickness	Neck Width	Type
Sand Dune Cave, Burial 2						
	2.1	41	13	5	10	SDS[a]
	2.2	50	17	6	10	SDS[a]
	2.3	51	17	6	10	SDS[a]
	2.4	48	16	6	—	unnotched SDS
	2.5	36	20	5	15	Pinto
	2.6	55	15	5	10	Elko Eared (?)
Dust Devil Cave, Stratum V						
	3.4	69	20	7	11	untyped
	3.3	63	17	6	10	untyped
	3.1	54	14	6	8	untyped
	3.2	47	15	6	9	untyped
42KA3233	4.1	42±3	15	5	9	SDS
IF-UT-V-6-39	4.2	40±2	17	3	11	SDS
42SA17092[b]	—	38±2	15	5	9	SDS

[a]SDS = Sand Dune Side-notched

[b]Data from Tipps et al. (1989:92) except that length is approximated from their drawing.

workmanship. The points were evidently produced from thin flakes that were shaped by marginal pressure flaking. The original surface of the flakes from which they were made is present on two of the three points. Item thinness was produced only to the extent that the flake blank was thin; thinness was selected for rather than produced and the pressure flaking was essentially for shaping purposes only. The pressure flakes used to fashion the points generally do not run past the items' midsections and many only carry about one-third onto the faces. The points are relatively narrow and thick and have shallow and asymmetrical side-notches. The one unnotched point from Burial 2 is technologically identical to these SDS points.

One of the stemmed points has a true basal notch and can be classified as a Pinto Shouldered (Figure 2.5). This item is basally ground, but is otherwise technologically equivalent to the SDS points: a thin flake was marginally pressure flaked to shape the point. It clearly retains traces of the ventral surface of its original flake blank. The other stemmed point (Figure 2.6) is similar to points classified as Elko Eared, though quite narrow. It is not basally ground and is technologically different since it apparently was fashioned from a percussion thinned biface preform and has good plan and section symmetry.

COMPARABLE POINTS

Dust Devil Cave

Tested in 1961 following the excavation of Sand Dune Cave, Dust Devil Cave was completely excavated following natural stratigraphy in 1970. Seven radiocarbon dates prove conclusively that Stratum IV at Dust Devil Cave accumulated during

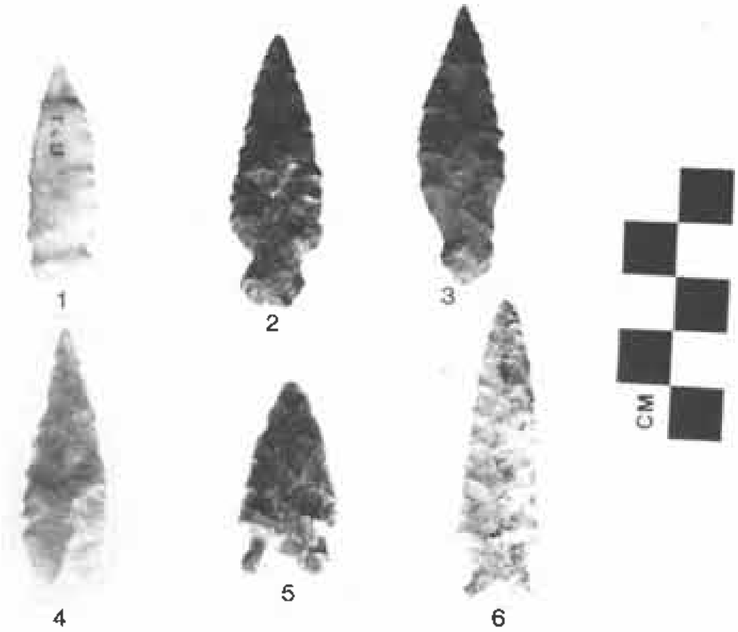

Figure 2. The collection of six projectile points associated with the early Archaic burial at Sand Dune Cave: (1–3) Sand Dune Side-notched type specimens; (4) unnotched SDS; (5) Pinto Shouldered; (6) Elko Eared?. A fresh break on (6) makes one shoulder less angular than it was originally.

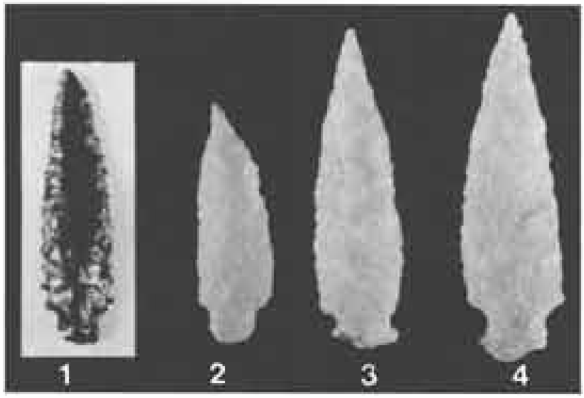

Figure 3. Untyped points somewhat similar to Sand Dune Side-notched from the middle-late Archaic Stratum V of Dust Devil Cave (length of number 4 is 69 mm).

the early Archaic (from 6740 to 8830 year B.P.; Ambler 1984). Given that Sand Dune and Dust Devil caves are only 6 km apart (see Figure 1), and that Dust Devil had substantial early Archaic deposits, the projectile point assemblage from this latter site was examined for additional examples of SDS points. Eighteen points from the early Archaic Stratum IV are complete enough to be identifiable, but none resemble the SDS points. Elko Corner/Side-notched points are most common, with a few examples of other types, such as Pinto, also represented. It is notable, though, that the Elko points are characterized by the same expedient production effort as the SDS points.

Though no SDS points came from Stratum IV, four examples from the overlying, largely sterile Stratum V are somewhat comparable in general form and technology (Figure 3). All were evidently produced on blade-like flakes using pressure flaking, though the flaking for these items was more invasive and better controlled than for the SDS points, and had removed traces of the ventral surfaces of the flake blanks. The points retain, however, a longitudinal curvature or plano-convex cross-section indicative of their production from flakes. These points are mostly larger than the SDS points (Table 1), and distinct enough not to be securely included in the type. It seems more than coincidence that these four whole points, the only ones of their kind from Dust Devil Cave, came from less than a 2 m diameter area within Stratum V in the back of the cave. The points likely represent a small point cache, or may have been associated with a very deteriorated and disturbed infant burial found in the same area.

No radiocarbon dates have been processed from Stratum V, nor did the stratum contain much in the way of cultural material. Evidently there was only very sporadic and ephemeral use of the cave during the time that this eolian sand layer was deposited. The stratum must date to the middle or late Archaic periods since it is bracketed by the early Archaic Stratum IV and the Basketmaker II Stratum VI. A few Gypsum points from Stratum VI support a middle Archaic temporal assignment; most of the other points from this stratum are Elko Corner/Side-notched.

Glen Canyon Surface Finds

From 1984 to 1989 the Archaeology Laboratory of Northern Arizona University conducted archaeological survey in the Glen Canyon National Recreation Area. During the course of this work over 480 archaeological sites and an equal number of isolated finds were recorded, resulting in the recovery of about 200 projectile points. Roughly half of these were arrow points, but from the dart points we located two examples (Figure 4) similar in morphology and dimension to those from Sand Dune Cave and Salt Pocket Shelter. One of these points is an isolated find (IF-UT-V-6-39) from the Ticaboo Mesa area in the central Glen Canyon region. It was found 1 km away from an alcove with an early Archaic component radiocarbon dated 7560±130 B.P. (Geib 1989b). The second point came from an open lithic site (42KA3233) on Grand Bench in the southern portion of the Glen Canyon region (Geib 1989a); an Elko Corner-notched point was also found on the site. In the reports these two specimens were listed as untyped, but they clearly can be classified as Sand Dune Side-notched.

Tabeguache Cave II

Long, narrow, side-notched dart points recovered from the lowest cultural stratum of Tabeguache Cave II were designated by Hurst (1943, 1944, 1945) as the Tabeguache Point. Four illustrated examples (Hurst 1943:Plate II, 4, middle two; Hurst 1945:Plate II, 4 and 8) resemble SDS points. Since this lower stratum is undated, the temporal placement of these points is unknown, but a clue to their antiquity is provided by the stratigraphy of this cave. The stratum with Tabeguache Points is separated from overlying cultural deposits by a layer of sterile sand. This is comparable with both Cowboy Cave (Jennings 1980) and Dust Devil Cave, where the lowest cultural deposits were separated from overlying cultural strata by a layer of sterile sand. The lowest deposits at both sites are dated to the early Archaic.

Figure 4. Sand Dune Side-notched points from Glen Canyon: (1) site 42KA3233 on Grand Bench; (2) isolated find IF-UT-V-6-39 from the Ticaboo Mesa area.

CONCLUSIONS

We were initially dubious of the validity of Sand Dune Side-notched as a distinct type, let alone an Archaic diagnostic, but the process of writing this paper has mollified our skepticism; it seems that Tipps et al. have made a useful suggestion. The general plan morphology of the point is clearly distinct from other point types of the northern Colorado Plateau, and the production technology consists of relatively crude shaping of a thin flake blank using marginal pressure flaking. Points of this style are not numerous, but they occur throughout a broad portion of the Glen Canyon-Canyonlands region, and are comparable to certain points from the lowest stratum of Tabeguache Cave II located along the southwest margin of the Uncompahgre Plateau.

While SDS points are readily recognizable, their temporal placement still needs inquiry. The Sand Dune Cave Burial 2 collection reveals that the point type was used during the start of the early Archaic since the burial is securely associated with a cultural layer older than the three eighth millennium B.P. radiocarbon dates from the overlying Stratum V. Burial 2 may be contemporaneous with the 8700–8800 B.P. initial occupation of the nearby Dust Devil Cave, but no SDS points were recovered from the early Archaic stratum of this site. Somewhat similar points were recovered from the probable middle Archaic Unit V of Dust Devil Cave, but we would not include these within the SDS type. It is noteworthy that the SDS point Tipps et al. reported came from the surface of a site with a radiocarbon date of 3340±110 years B.P. (1989:92). If the point is actually of this age, then it might be contemporaneous with the four SDS-like points from Dust Devil Cave, though it does not closely resemble them. Final statements regarding the temporal and geographic span of Sand Dune Side-notched must await further documentation of this style from secure, dated proveniences. As a first step it would be worth while dating the lowest cultural stratum of Tabeguache Cave II. In the interim, it seems that the point can be used as a diagnostic of the Archaic in southeast Utah, and with caution as a diagnostic of the early Archaic.

ACKNOWLEDGMENTS

We thank the Museum of Northern Arizona for access to the Sand Dune Cave collections and field notes and Betsy Tipps for helpful comments on this paper.

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SPLIT-TWIG FIGURINES, EARLY MAIZE, AND A CHILD BURIAL IN EAST-CENTRAL UTAH

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INTRODUCTION

Archaic Period figurines made of willow and other split twigs, found in caves in the Greater Southwest, have not only received the attention of scholars but have also captured the popular imagination to a significant degree (see Agenbroad 1990:27; Jacka and Jacka 1988:102–03; Jett 1987; Jones and Euler 1979:1–4; Kelsey 1987:95, 97; Smith and Turner 1975:23; Schwartz [1989]:17–23, back cover; Thybony and Bean 1988:6). Split-twig figurines have appeared on postcards, one has become the cover logo of *The Journal of Ethnobiology* and another the logo of the Museum of Northern Arizona Collector's Club. The effigies have inspired such diverse popular objects as andirons at Grand Canyon National Park and women's earrings (Plateau Expressions 1989). And at the behest of a Flagstaff, Arizona, crafts dealer, some Havasupai have been making replica split-twig figurines during the last few years. One also may mention pictographs recently discovered on the northern side of the Grand Canyon that look very much like split-twig figurines (Allen n.d.:Figure 8b; Mary Allen, personal communication 1988; Schaafsma 1990).

Despite the interest and activity of the archaeological community (see references in Jett 1987; Pierson 1980; and Schroedl 1988), none of these objects has been reported in any kind of specific archaeological context or associated with other diagnostic artifacts in a way that could reveal much about the cultural affiliations or functions of the objects. Some years ago it was proposed that most of the figurines from Arizona, California, and Nevada date from the second and third millennia B.C., and were used in sympathetic hunting magic, while those from the Utah Canyonlands region were children's toys, dating from around the time of Christ (Schroedl 1977). However, the evidence for the latter use was circumstantial and the conclusion speculative.

THE BURIAL AND ITS APPARENT ASSOCIATIONS

In addition to split-twig figurines professionally unearthed, a number have been found by amateurs (Jett 1968; 1987). In 1988, I learned of figurines in a private collection in Grand County, Utah. Through the efforts of my assistant P. Nugee and the generosity of the possessor (whose attitudes toward unauthorized digging had altered), I was allowed to examine and photograph the figurines reported in this paper. Information as to the circumstances and context of the find was also obtained. Of course, the individuals involved in the excavation were not trained in archaeology; consequently, the information they provided cannot be viewed with the same confidence that professionally obtained data could. I am, however, convinced, on the basis of interviews in May and October 1988 and November 1989, that I have been given a reasonably accurate description, despite the approximately 15 years elapsed since the original finds. Although some workers question the value or the ethics of reporting on illegally and unprofessionally collected archaeological materials, I feel that the significance of this site is such as to justify publication of what information there is. However, it must be emphasized that the associations postulated may simply reflect imperfect observation on the part of the diggers.

The excavations were reportedly undertaken in about 1973 at a sandstone cliff shelter in the Island Mesa area to the east of Lisbon Valley, Utah, almost on the Colorado border. The area is administered by the Bureau of Land Management. This is the easternmost site from which split-twig figurines have been reported, including the figurine alluded to by Pierson (1980:21) found in a branch of the same canyon (Black et al. 1982:101). According to one of the excavators, the top of the head of a burial was encountered about a meter down, in deep, stratified fill. Further excavation revealed the desiccated corpse of a child—a girl, the diggers supposed, although the cadaver was not sexed—sitting upright. The body had originally been flexed, and wrapped from head (crown exposed) to ankles (feet bare) with sewn-deerskin swaddling; no other clothing was noticed. Although the knees and arms had been held against the chest by the wrapping, the right-side limbs appeared to have come loose from the wrapping. The fingernails, some hair, and a full set of baby teeth were present. The body was re-interred after removal of supposedly associated artifacts.

Arranged around the lower part of the corpse were six or seven fragments of deep, broken metates. In addition to the swaddling and the metate fragments, the following other artifacts were apparently associated with the burial: (1) ca. 1.22 m of 2-ply fiber cord, the individual plys being z-twisted, and then s-twisted together (Figure 1); (2) a ca. 7-cm strip of twisted rabbit skin; (3) three split-twig figurines (described below) located behind the cadaver; and (4) two juniper-bark-wrapped bundles of maize grains (see below) positioned to the left of the body. Exact measurements could not be taken by the present author, since at the time of his examination most of the materials were in sealed glass display boxes.

In addition to those items found as part of the burial, other cultural materials, of wood, bone, and fiber were present in the fill; however, these were not culturally diagnostic nor had they been in any apparent association with the burial.

THE FIGURINES

Figurines numbers 1 and 2 (below) were examined by the author; figurine 3 was described by the principal excavator but was seen by the author only via poor-quality photographs, the object currently being in an out-of-state private collection. The figurines include the following:

1. A split-willow-twig figurine of a quadruped, probably a deer (Figure 1a). A single twig splint forms the hind legs, bends to become the back, descends to become one foreleg, doubles back up to form the second foreleg, continues ascending to make part of the neck, bends to form the basis for the head, turns and descends once more to augment the neck, and then wraps five times horizontally from front legs to hind legs and back again, to create the bulk of the body. A separate

Table 1. Approximate Dimensions of Figurines 1 and 2

Measurement	Figurine 1	Figurine 2
Front foot to top of head	9.53 cm	6.03 cm
Rump to nose	10.16 cm	8.41 cm
Back: rump to chest	7.62 cm	7.62 cm
Hind foot to top of rump	7.62 cm	7.62 cm
Head length	2.06 cm	1.51 cm

split-twig half is wrapped vertically nine times, to complete the body. There is also a separate, nine-turn, split-twig neck-and-head wrapping. The dimensions are approximated in Table 1.

2. A split-willow-twig figurine of a quadruped, probably a deer (Figure 1b). The front leg consists of a single whole twig, the end of which is split for about 2.0 cm; this twig splits into unequal halves at the chest, one part rising to form part of the neck and head and descending again to complete the foundation for the neck; the second part bends to form the belly, turns downward to create one hind leg, doubles back and ascends to create the second hind leg and the rump, and wraps six times vertically to finish the body, the basis for which had been established with four horizontal wrappings accomplished with a separate split-twig half. Separate split-twig-half wrapping of the neck (four turns) and head (three and one-half turns) is provided; the head is proportionately small. Approximate dimensions are given in Table 1.
3. A tiny figurine of a duck about 4.3 cm in length, consisting of a twig coiled in three turns to form a more-or-less flat oval, at one end of which a split-twig-wrapped neck and head emerge.

THE BUNDLES OF MAIZE

It is reported that on the left side of the body were two juniper-bark-wrapped bundles, each secured by being bound around in two places with ca. .15-cm-wide strips of yucca leaf in a sort of network, and with a yucca tie at either end (Figure 2a). The bundles were attached to one another with a strip of yucca; one bundle had been very badly damaged by vermin, and only one of the ties was salvaged (my identification as yucca was confirmed by plant anatomist Thomas L. Rost, University of California, Davis, through maceration and through sectioning and microscopic examination). The other bundle—some 30.5 to 33.0 cm long (ca. 24.1 cm from end tie to end tie) and about 9.5 cm in diameter—was intact. It was x-rayed (Figure 2b), and this revealed that the bundle contained a large number of maize grains. Ten of these had fallen out (Figure 3), and were taken for analysis. As shown in Table 2, they average about .74 cm long (s = .05 cm or 6.7%) by ca. .74 cm wide (across the row; s = .05 cm or 6.7%) by .61 cm deep (along the row; s = .065 cm or 10.7%). The grains are yellow-brown in color, show no denting, and are apparently some variety of flint corn.

The ten maize grains were submitted to Walton C. Galinat, University of Massachusetts, for examination. Dr. Galinat responded (Feb. 17, 1989):

> They [the grains] have the brown pericarp of Chapalote but they are wider than deep in contrast to Chapalote kernels which are deeper than wide [cf. Galinat 1985:261–63]. I can only conclude that they are transitional to the evolution of Maiz de Ocho. When the kernel row number of 12 to 14 in thick cob types of Chapalote is reduced to 8 or 10 by back crossing to more primitive forms, the kernels may become wider through recombination with the thick cob. I believe the wide kernels are easier to grind and, therefore, make a better food plant than long narrow kernels. . . .
>
> If you have enough kernels, you might want to do some grinding experiments to test out my above stated hypothesis.

Chapalote is a race of pod corn that is still cultivated in Mexico. The earliest archaeological

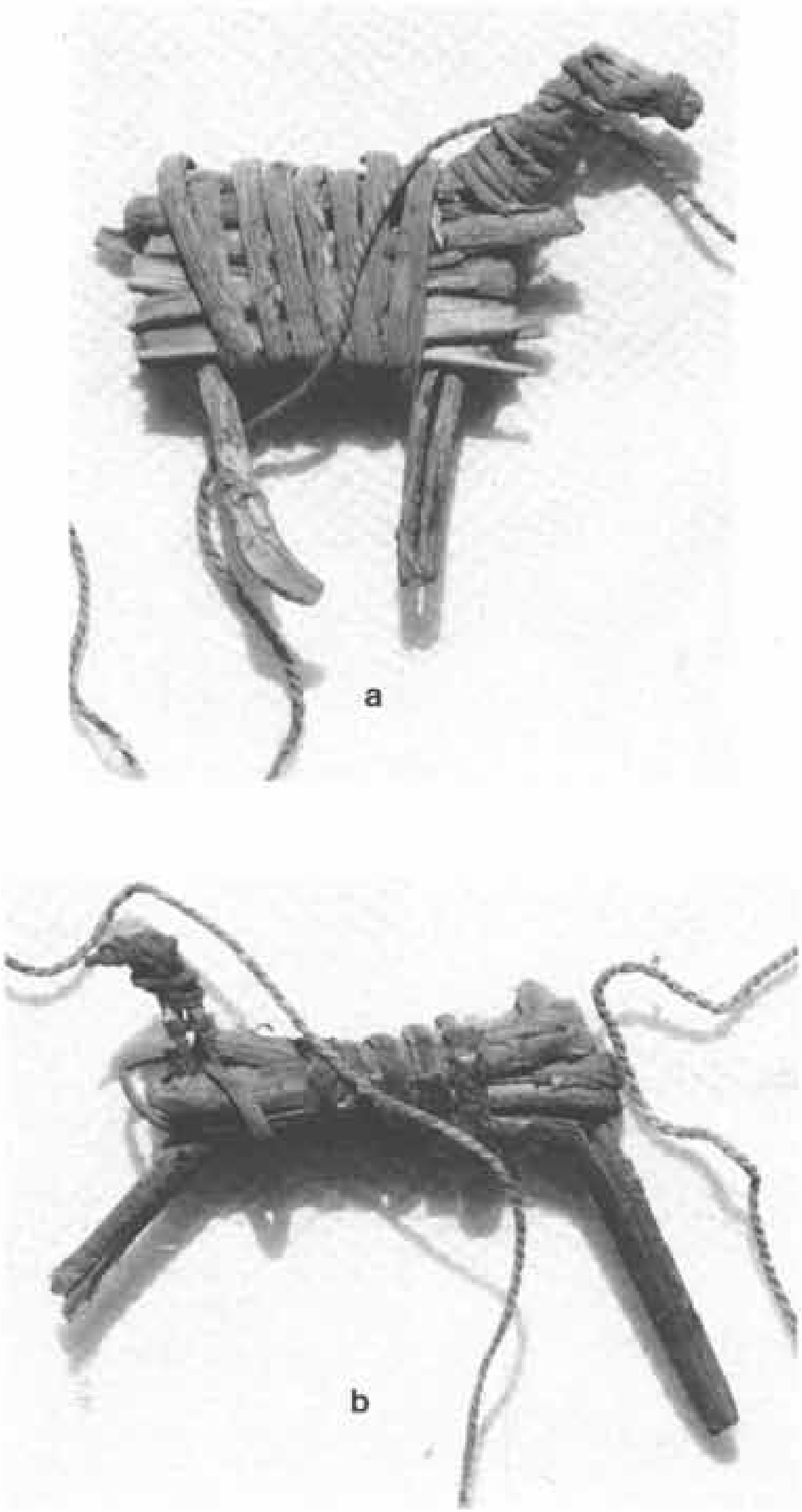

Figure 1. Split-twig figurines 1 (*a*) and 2 (*b*), probably representing deer, plus cord.

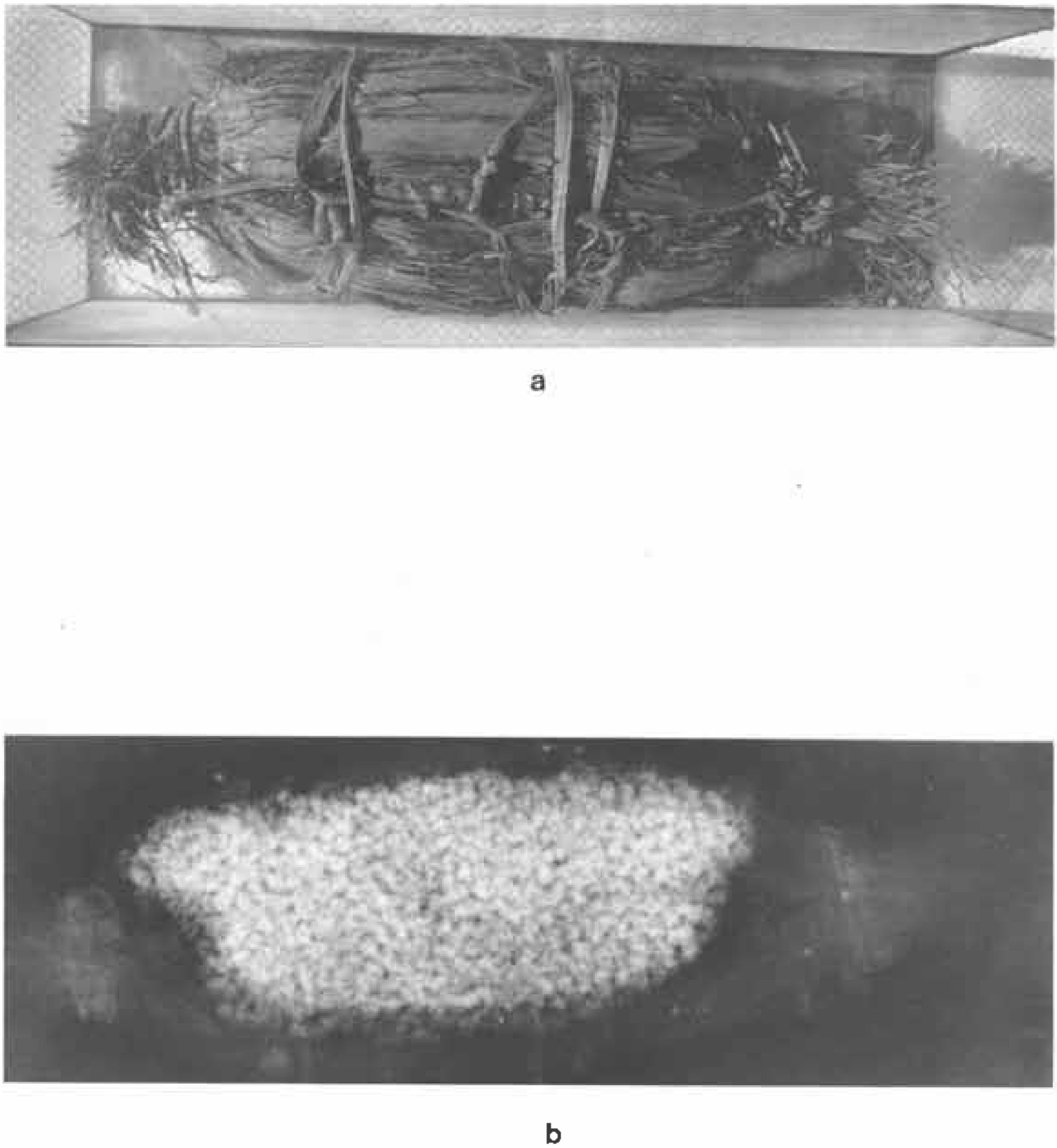

Figure 2. Juniper-bark-wrapped bundle, bound with yucca-leaf strips (*a*). X-ray of the bundle, showing maize grains inside (*b*).

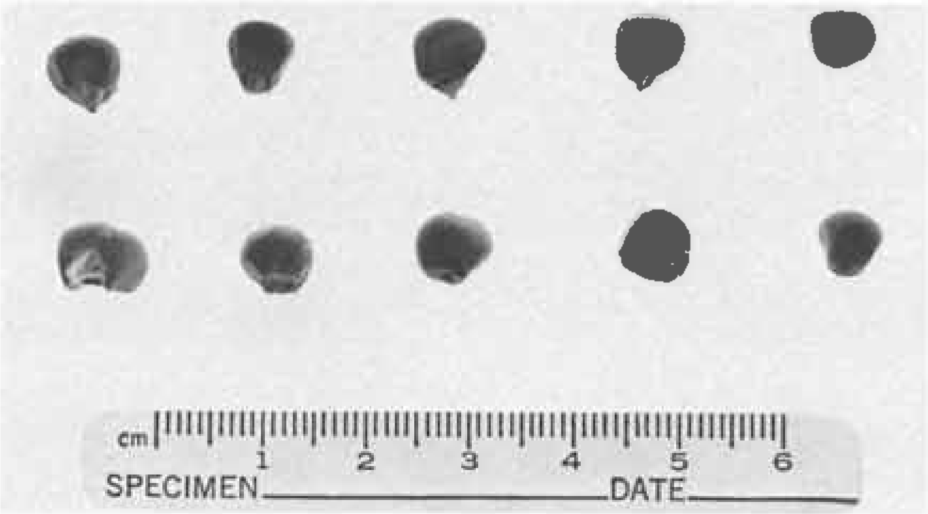

Figure 3. Ten maize grains from the destroyed bundle.

Table 2. Dimensions of Ten Maize Grains

Grain Number	Height	Width[a]	Maximum Thickness[b]	Height	Width[a]	Maximum Thickness[b]
	Measurements in Centimeters			Deviations from $\bar{x}$[c]		
1	.80	.73	.55	.06	.01	.06
2	.80	.73	.70	.06	.01	.09
3	.77	.74	.60	.03	.00	.01
4	.70	.63	.50	.04	.11	.11
5	.79	.78	.52	.05	.04	.09
6	.61	.68	.69	.13	.06	.08
7	.72[d]	.90	.62	—	.16	.01
8	.72	.68	.52	.02	.06	.09
9	.72	.69[d]	.71	.02	—	.10
10	.71	.75	.60	.03	.01	.01
$\bar{x}$[c]	.74	.74	.61	.05	.05	.065
				(6.7%)	(6.7%)	(10.7%)

[a] Width in cob's axial direction

[b] Maximum thickness in cob's circumferential direction

[c] $\bar{x}$ = Mean

[d] Indicates minimum possible dimension only, owing to damage

maize at Bat Cave in west-central New Mexico "is definitely related to the Mexican [popcorn] race Chapalote" (Mangelsdorf 1974:149). Bat Cave maize, although its dates have recently been revised upward, is thought to be among the earliest known specimens of maize for the Southwest; and "All early corn north of Mexico belongs to the Chapalote series . . . , a small cob, popcorn" (Ford 1981:11), which may date to as early as about 3200 B.C. (Berry 1985; Minnis 1985; and Wills 1989:125–29, 148–49, 151–52). Maiz (Harinoso) de Ocho is considerably more recent, its ancestors having generally been believed to be of ultimate South American origin. Mangelsdorf (1974: 113–14) considered Maiz de Ocho to have first appeared in western Mexico about A.D. 700 (see also, Galinat 1985:266), whence it spread into the Southwest. More recent thought is, that the influence of Maize de Ocho was being felt in the Southwest by at least 300 B.C. (Ford 1981:12–13; see also, Galinat et al. 1970). Recent dates of Proto-Maiz de Ocho in southern New Mexico take it back to about 1200 B.C. and Galinat now hypothesizes that Maiz de Ocho evolved in the southern Southwest (Upham et al. 1987). The implication seems to be that the Utah maize represents a stage between the ancient Chapalote and the later-emerging Maiz de Ocho.

DATING

One maize grain and one piece of yucca-leaf binding said to have come from the unsalvageable bundle of maize were submitted to Beta Analytic Inc. for accelerator-AMS radiocarbon dating at the Eidgenossische Technische Hochschule in Zurich. The reported dates have been adjusted by C^{13} for total isotope effects generated both in nature and during the physical and chemical laboratory procedures. The maize kernel (Beta-32290, ETH-5664) was dated at 2,110±70 (160 B.C.), and the yucca fragment (Beta-32291, ETH-5665) at 2,610±65 (660 B.C.). The 500-year discrepancy between the two dates may be a result of either excavator error in believing the yucca fragment was from the destroyed bundle of maize, or of laboratory error. Although treatment for possible contaminants was performed, if any remained they presumably resulted in radiocarbon dates younger than the true dates. Thus, both true dates are almost certainly from the pre-Christian era.

DISCUSSION

The presently described site is significant in several ways. Among these is that it extends the known range of occurrence of split-twig figurines to its farthest eastward point, almost to the Colorado border.

Secondly, *if the excavator's report is accurate*, the context of the figurines in a child burial—the first specific cultural/functional context for such figurines—has relevance for the question of the use of these intriguing objects. Previously reported split-twig figurines from the Canyonlands region have—to the extent that their proveniences have been described—been found scattered through deposits in habitation caves, but not in association with any particular features or diagnostic artifacts. It has been speculated that the objects were toys (Schroedl 1977:263), unlike the earlier, ritually cached, Grand Canyon-area figurines which were presumably employed in hunting magic (Emslie 1987; Reilly 1969; Schroedl 1989:14–15; Schwartz [1989]:20–23). The possible association of a previously reported Canyonlands figurine with a child's sandal (Jett 1987:393) gives some small support to the idea of the toy function, but the reality of that association is unverified. However, the interring of the present three figurines with a child burial—if correct—is much more definite and suggestive.

The "duck" figurine reported herein is so far unique among split-twig figurines. The probably cervid figurines (*vide* the long necks) are typical of those of the Canyonlands region in many ways—e.g., in that they have vertical body wrapping—but figurine 2 is unusual, particularly in that the main twig does not form the back; this is, however, consistent with the observation (Euler 1984:9) that Canyonlands figurines are more variable that those from the Grand Canyon region.

The apparent occurrence of maize with the burial is of great potential interest. Maize was present at two of the other sites where figurines were found (Cowboy Cave: Jennings 1980; Mill Creek, near Moab: Pierson 1980:44), but not in direct association with figurines. Although Schroedl (1988:383; Alan Schroedl, personal communication 1989) now believes that the Cowboy Cave figurines do not correlate with the maize found there, the information presented herein is evidence (if imperfect) that at least some of the figurine-makers of the Canyonlands region were maize-using (and perhaps corn-growing) people, and not simply hunter-gatherers. Maize was formerly thought to have reached central and northern Utah about A.D. 460 (Winter 1976:421)—although recent radiocarbon dates for the southern Colorado Plateau have exceeded 3000 B.C. in age (Berry 1982, 1985; Glassow 1980:34; Leonard 1991:721; Powers 1989; Simmons 1986; and Wills 1989:148–49) and recent reconsideration of the Cowboy Cave maize—some of which was formerly thought to be B.C. in date—suggests an age of about the second century A.D. (Geib and Bungart 1989:41). But the Late Archaic burial near Elsinore in central Utah has since yielded the oldest well dated Utah maize at ca. 175 B.C. (Wilde and Newman 1989:714), which is so close to my 160 B.C. date as to be statistically indistinguishable. The maize described herein seems to be not only one of the two very oldest reported occurrences in Utah but also a very early example of influence of Maiz de Ocho in the northern Southwest. Thus, regardless of the validity of the association of the maize with the figurines, the early radiocarbon date for maize in east-central Utah is of considerable interest in its own right.

It has been proposed that split-twig figurines correlate with Gatecliff Series Gypsum points of the Middle or Late Archaic, which are thought to date from ca. 3050 B.C. to A.D. 450—although a narrower time span of ca. 1650 to 1350 B.C. has also been suggested (Schroedl 1988:383–85). Admittedly, there is much surface evidence of Archaic occupation, including Gypsum points, in Lisbon Valley (Black et al. 1982:92, 101, 103–04). Schroedl (1988:383–85) has recently made a cogent case that the points and all the figurines date to the period of about 2100 B.C. to 1900 B.C. Yet, if the present figurines were truly in association with maize, they appear to be a thousand years or more younger than Schroedl's dates. Perhaps the fact that the Cowboy Cave figurines were found mostly in an older stratum reflected their having been interred there at a later time. Or, perhaps the Lisbon Valley-area figurines were heirlooms, buried long after they were made; these questions could only be resolved by direct dating of the figurines. In any case, it is indeed unfortunate that the materials discussed in the present article were not excavated under controlled conditions.

In summary, the finds reported herein expand the range of known formal variability of split-twig figurines; extend their eastward geographical range and produce one of the two earliest radiocarbon dates for maize in Utah. More equivocally, these items appear to be associated with a child burial, which adds some support to the notions that Canyonlands-area figurines functioned as toys and that their makers engaged in some farming. Unfortunately, the circumstances of the disinterment preclude certainty on these points, which could be definitively demonstrated only with rigorously controlled excavation.

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PRELIMINARY REPORT ON ASPEN SHELTER: AN UPLAND DEER HUNTING CAMP ON THE OLD WOMAN PLATEAU

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INTRODUCTION

During the summers of 1989, 1990, and 1991 archaeologists from the Office of Public Archaeology (OPA) at Brigham Young University in cooperation with the United States Forest Service excavated at Aspen Shelter (42Sv1365) in central Utah. Support for the project was also provided by volunteer efforts from members of the Utah Statewide Archaeological Society from several chapters. This work was done under the direction of OPA archaeologists Joel C. Janetski and James D. Wilde. Crews worked for six weeks in 1989, three weeks in 1990 and two weeks in 1991. The site contained evidence of sporadic use as a hunting camp from about 4,000 years ago well into the Fremont era. The lowest cultural level contained two basin-shaped house floors—the earliest remains of domestic structures yet found in Utah.

SITE DESCRIPTION AND SETTING

Aspen Shelter is a small to medium sized (ca. 17 m x 7 m) south-facing rock shelter located on the upper reaches of Saleratus Creek on the Old Woman Plateau at about 8,200 feet elevation (Figure 1). The shelter lies at the base of a low (10–15 m high) sandstone cliff and was formed by a process of erosion as water seeping from the base of the sandstone layer caused the gradual exfoliation its roof and walls (Figure 2). The sandy deposits in the shelter are primarily a consequence of these natural processes. A small drainage channels runoff from spring snow melt and summer thundershowers over the cliff and onto the eastern portion of the site. As a consequence, the deposits in the shelter have been alternately wet and dry and preservation is limited to stone, ceramics, and bone.

The site is in an aspen-spruce context and the front of the shelter is screened from view by a fairly dense stand of aspen, serviceberry, and chokecherry bushes. The region around the site is moderately to densely wooded with aspen, ponderosa pine, spruce, serviceberry, and manzanita bushes. Deer and rabbits (white-tailed and black-tailed jacks, cottontails, and snowshoes) were seen daily during our trips to the site. Elk and grouse were also occasionally encountered.

PREVIOUS WORK AND CURRENT RESEARCH INTERESTS

Aspen Shelter was first recorded and investigated by Forest Service archaeologists in 1979 (DeBloois 1983). They placed two 1 m x 2 m test pits in the shelter and documented over a meter of deposits containing both Archaic and Fremont style diagnostics. Dates from the site were in the 4000 B.P. range. The artifactual and faunal collections from these tests were analyzed and those results made available to OPA staff.

Additional relevant research in the region includes the work by the University of Utah at Sudden Shelter on Ivie Creek only about five miles south of Aspen (Jennings et al. 1980). Sudden Shelter contained evidence of Archaic use from 7,500 to 3,500 years ago. To the east in Castle Valley on the lower reaches of Ivy Creek and other small drainages emanating from the Old Woman Plateau are numerous Fremont rancherias with pithouses and storage units (e.g., Aikens 1967).

The Forest Service work suggested to OPA staff that information about the transition from hunting and gathering to the farming period might be profitably pursued at the site. The transition period (ca. 2500 to 1500 B.P.) was absent at nearby Sudden Shelter (Jennings et al. 1980). Specifically, the research design set up a series of archaeological expectations for residential use of the site by Archaic hunter-gatherers and more logistical use by Fremont farmers. Simply stated, we expected the Archaic use of the site

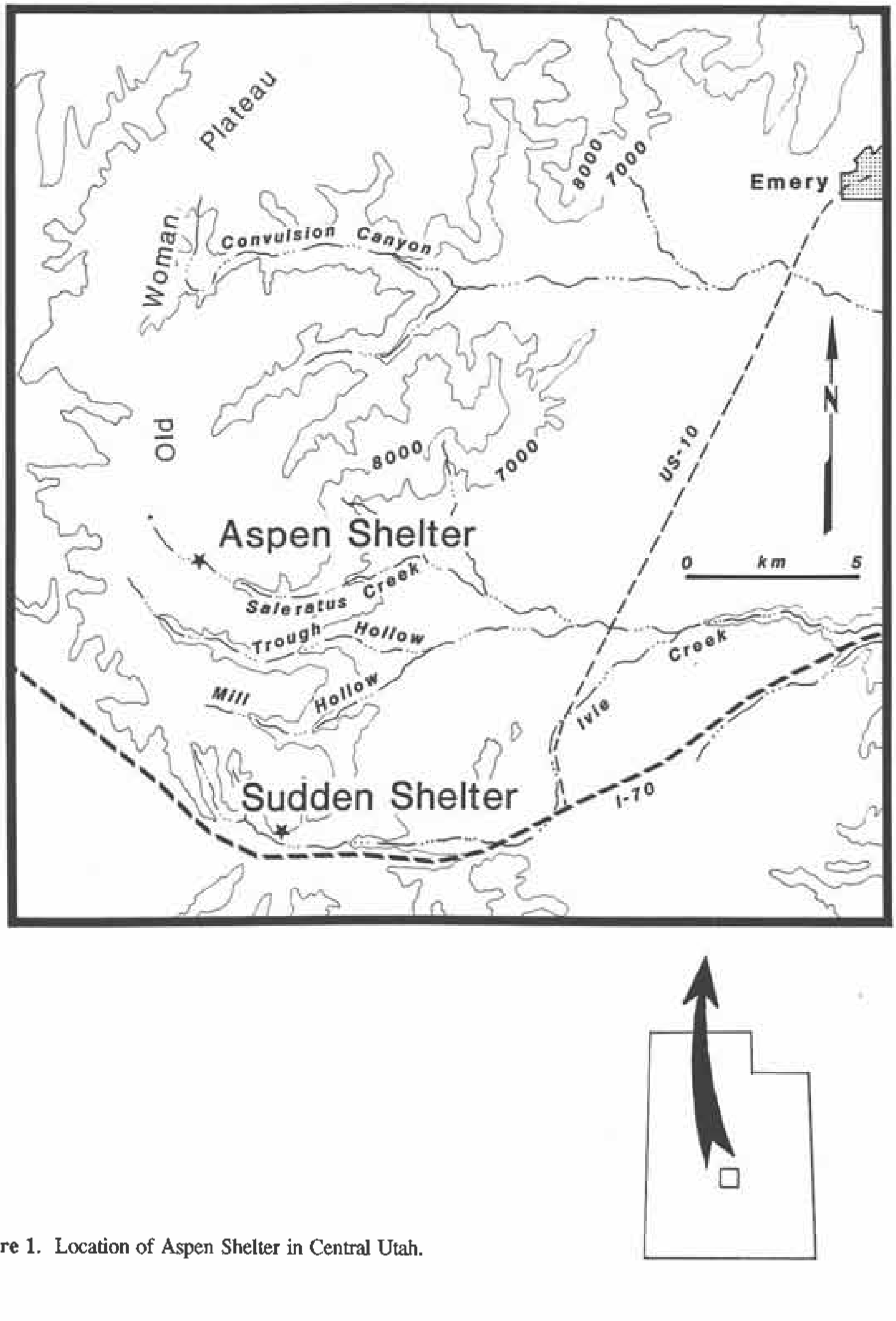


Figure 1. Location of Aspen Shelter in Central Utah.

Figure 2. View of Aspen Shelter in Saleratus Canyon. The shelter lies behind the aspen trees at the base of the sandstone cliffs on the far side of the canyon.

would have been by families pursuing a relatively wide range of activities and who would have consumed much of their foodstuffs at the site. In contrast, we expected that Fremont use would have been mostly short term by groups of hunters who transported much of the captured prey or other consummables to families at residences in the lowlands to the east. The research done to date tends

Table 1. Radiocarbon Dates from Aspen Shelter.

Sample Number	Raw Date	Calibrated Range	Range with Highest Probability	
Beta-33804	1070±60 B.P.	A.D. 780–1149	A.D. 791–1042 100%	2 σ
Beta-33476	1720±60 B.P.	A.D. 130–430	A.D. 247–385 100%	1 σ
Beta-33474	2130±100 B.P.	400 B.C.–A.D. 70	B.C. 390–A.D. 30 99%	2 σ
Beta-33479	3380±160 B.P.	2136–1321 B.C.	B.C. 1840–1510 100%	1 σ
Beta-41927	3560±90 B.P.	2199–1662 B.C.	B.C. 2142–1685 99%	2 σ
Beta-41929	3620±100 B.P.	2307–1695 B.C.	B.C. 2140–1880 97%	1 σ
Beta-41926	3680±60 B.P.	2280–1900 B.C.	B.C. 2209–1905 95%	2 σ
Beta-41928	3770±70 B.P.	2460–1985 B.C.	B.C. 2409–2033 94%	2 σ
Beta-41930	3790±60 B.P.	2460–2039 B.C.	B.C. 2457–2124 95%	2 σ
Beta-33477	3890±60 B.P.	2570–2149 B.C.	B.C. 2502–2199 96%	2 σ
Beta-33806	4140±80 B.P.	2920–2490 B.C.	B.C. 2910–2567 95%	2 σ
Beta-33805	4570±110 B.P.	3627-2924 B.C.	B.C. 3530–3020 92%	2 σ

to support these predictions; however, much of the analysis of the bone and lithics from the site has yet to be done.

The impetus for our excavations at Aspen, however, was ongoing destruction of the site by looters. A large pothole had been intruded into the central portion of the site and various other smaller pits were present in the site as well. Consequently, the Forest Service felt it necessary to pursue excavations to recover the data from the site before it was lost to the looters.

FINDINGS

Excavations at the site began by cleaning one of the existing Forest Service test areas to reveal the stratigraphic sequence. Once cleaned it was clear that the sediments in the shelter are quite sandy with alternating bands of ash and culturally stained deposits. The sediment profile is dominated by a massive basal layer that is particularly dark and rich in bone and cultural debris. Below the cultural deposits are alternating bands of sterile sand some of which contain some charcoal probably due to natural burn episodes in Saleratus Canyon. These lower levels were tested but no cultural debris was recovered. The systematic removal of the cultural sediments found that immediately below the massive, dark basal layer was a rather compacted sandy surface. The presence of artifacts lying on this compacted level and the fact that numerous features originated from this surface suggests it was a living floor.

DATING

We found evidence at Aspen Shelter of an intensive use by Archaic peoples dating to around 4000 B.P. and continuing through the Fremont period, although post-Archaic use was clearly considerably lighter and probably more sporadic. Radiocarbon dates ladder up from 4000 B.P. to 1300 B.P. (Table 1) and diagnostics such as Fremont painted ware and Bull Creek projectile points in the upper levels are evidence of prehistoric use until about A.D. 1200 or so (Holmer and Weder 1980). Associated with the 4000

B.P. dates are numerous Gypsum style projectile points that date to about the same time period at nearby Sudden Shelter (Jennings et al. 1980) and Cowboy Cave (Jennings 1980).

Twelve radiocarbon samples have been run from the Aspen Shelter deposits (Table 1). The results of these analyses have yielded dates ranging from about 4500 B.P. to 1000 B.P. The 4500 B.P. date is from a charcoal-bearing stratum located below the earliest cultural occupation. It is likely that the charcoal in this and in other similar non-cultural strata noted in test pits is derived from forest fire events in the area. The earliest date from unequivocal cultural deposits is Beta-33806 at 4140±80 B.P. Calibrations in Table 1 are from Stuiver and Reimer (1987).

Temporal diagnostics from the site are consistent with the dates in Table 1. Gypsum or Gatecliff Contracting Stem points, which are associated with the basal cultural features and massive midden deposits at Aspen, are dated to between 2500 B.C. and A.D. 500 throughout much of the Great Basin and Colorado Plateau (Holmer 1986:105). Two probable Sudden Side-notched points (see Jennings et al. 1980:70 and Figure 5, n-o this report) were found at Aspen: one from unprovenienced fill and another from the basal levels. Large side-notched points such as these tend to date a bit earlier than the Gypsum style but clearly overlap in time (see Holmer 1986:96). Other temporally diagnostic artifacts such as Rosegate and Bull Creek style arrow points and ceramics occur at higher levels and are consistent with the dates obtained.

FEATURES

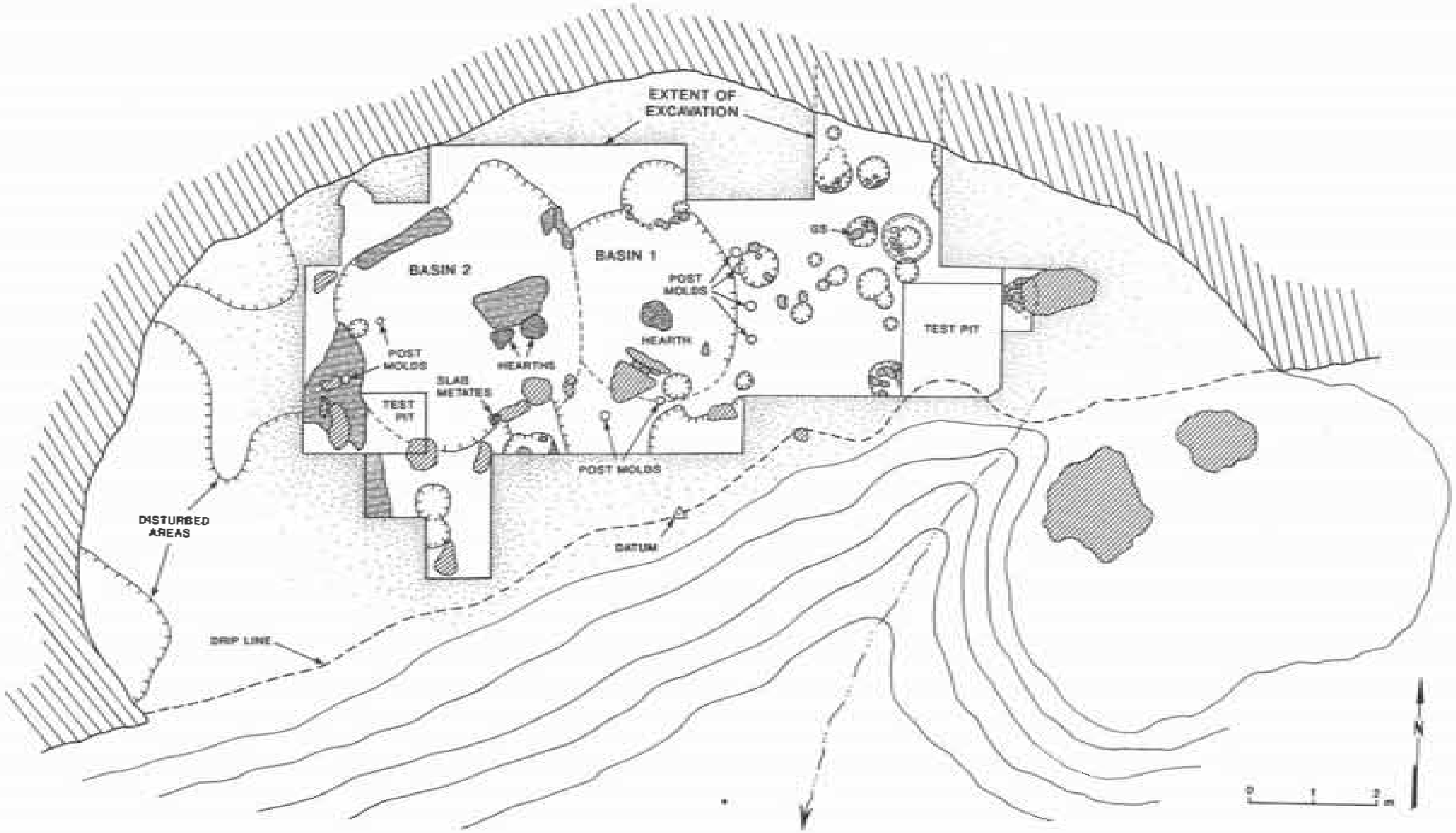
Features discovered at Aspen include numerous pits, hearths and two basin-shaped house floors. The pit features found tend to cluster on the compacted surface to the east of Basin 1 (Figure 3), although pits are also present on the surface to the south of the structures toward the front of the shelter. The pits were essentially of two types: (1) fairly small, jug-shaped pits probably used for storage, and (2) larger bowl-shaped pits containing fire cracked rocks and dense, charcoal-laden midden probably resulting from roasting activities. A number of pits at this level were superimposed. As noted, the majority of the pits originated from the compacted surface, although bowl-shaped pits and several hearths were found in the upper strata.

Toward the rear of the central portion of the shelter and at the basal cultural level were two shallow, basin-shaped house floors sitting essentially side by side (Figures 4 and 5). Basin 1 was fairly small (about 2 m in diameter) and lightly used as evidenced by the paucity of debris and lightly stained and compacted use surface contained within it. A small, oval-shaped hearth was present toward the southern edge of the basin. An upright sandstone slab was located about 75 cm south of the hearth and likely served as a reflector stone. Four probable post sockets were found along the eastern edge of Basin 1 and argue rather strongly for some kind of superstructure roofing the feature. Basin 1 was well-defined only along its eastern edge. Other edges were either blurred by subsequent cultural activity in the prehistoric past (such as the construction of a large pit that cut through the north edge; see Figure 4) or were destroyed by looting activity. In addition, the 1979 test may have cut through the western edge of Basin 1 as well as the eastern edge of Basin 2, which, along with the extensive looting activity in the central part of the site, made relative dating of the two house features very difficult.

Basin 2 lay immediately to the west of Basin 1 and was somewhat larger (ca. 3.5 m in diameter). It was heavily used as evidenced by the presence of a more compacted, more heavily stained use surface, and numerous tools. The floor contact tools included two complete Gypsum points, two bone awls, several modified and utilized flakes, fragments of grinding stones, and numerous bone fragments. These were found on a shelf/storage area along the back edge of the feature. A small, well-defined, and well-used circular hearth and an irregular hearth were both present a bit south of center in Basin 2. As with Basin 1, reflector stones were present, this time in the form of two rather blocky stones located about one meter south of the hearths. One of these stones was upright; the other was lying flat. A slab metate was found leaning against the western edge of the upright stone. A compacted sandy surface nearly identical in elevation to the surface east of Basin 1 lay immediately south of these stones. The northern and western edges of Basin 2 were well marked by sandstone boulders or bedrock just behind which was relatively clean sand. A single, shallow post socket

Figure 3. View of the compacted surface and associated pit features to the east of Basin 1.

Figure 4. View of Basin 1 and Basin 2 in Aspen Shelter.



ASPEN SHELTER (42Sv 1365)
Excavations 1989 - 1991

Figure 5. Plan view of features associated with the basal cultural level in the shelter.

adjacent to a medium sized boulder was found just outside the western edge of the basin and another possible post hole was found just inside the western edge adjacent to a small pit.

Basin 2 also contained a second use surface about 15 to 20 cm above its lower floor zone. This upper use surface was also present along the western edge where a compacted burned area overlay the floor by about 15 cm. Two hearths were present on this upper use surface and a single awl was found near one of them. The upper use surface was in fact more discrete than the lower surface as it consisted of fine, light-colored silts while the lower floor is best described as a zone of accumulated sand and cultural debris.

ANIMAL AND PLANT REMAINS

Animal bones were abundant at Aspen Shelter in all levels, but especially in the massive, dense, midden just above the compacted surface and the house floor. The jumbled nature of this midden suggests a fairly rapid deposition. Thus far a 50% sample (about 47,000 individual elements) of the bone assemblage recovered during 1989 and 1990 has been analyzed by Crosland (n.d.). Only 3,924 of these elements could be identified to the Genus or species level (see Table 2). Deer make up over 85% of all bones. Other species present in decreasing order of importance include squirrel (7%), rabbits (5%), porcupine (2%), and woodrat (1%). Mountain sheep and possibly elk were also present but in very small numbers. Of the fragments not identified to species, between 80% and 90% are from large mammals, most likely deer. Numerous deer cranial fragments with antlers attached were found in the faunal assemblage.

Analysis of plant remains has only begun. Pollen was not well preserved in the lower levels of the site. Numerous flotation samples were collected but have not yet been analyzed.

CULTURAL MATERIAL

Portable artifacts from the excavations include abundant chipped stone tools, particularly projectile points, bifaces, and detritus from tool retouching (Figures 6 and 7). In one area just outside Basin 1 flakes were literally piled up either as a result of tool making or perhaps as a result of an individual actually picking up and saving flakes for future use or cleaning up detritus from the living areas. Utilized flakes are also present, although no information on distribution is yet available. Numerous worked antler tips presumably for tool working and occasional bone awls and beads were found. Provenienced groundstone consists of numerous one-handed manos from the Archaic levels, two complete slab metates (both of which were leaning against the reflector stone in Basin 2) and various fragments that appear to be most abundant in the Archaic levels. Ceramics were present in the upper levels where no disturbance had occurred. All sherds were either Fremont gray ware or black on gray styles.

DISCUSSION

The presence of the two house floors and associated pits, superpositioning of several features, and the massive and dense midden all point to a heavy use of the shelter during the middle to late Archaic period. The presence of numerous deer cranial fragments with antlers attached in the Archaic deposits suggest fall occupations. Grinding implements, both manos and metates, are evidence of plant gathering and processing, although direct evidence in the form of carbonized seeds has yet to be found as soil samples have not been processed. The modern presence of stands of serviceberries, manzanita, and some chokecherries, all of which begin ripening in mid-August, suggest that use of the shelter may have begun as early as late summer to exploit these resources and perhaps to escape the hot season in the valley east of the Old Woman Plateau.

Particularly interesting at Aspen are the two house basins. These are the earliest houses found to date in Utah. Other Utah Archaic houses have been found at North Richfield (Talbot and Richens n.d.) and Moab (Louthan 1990) dating to about 2600 B.P. and 2200 B.P. respectively. Late Archaic houses have been found at the Icicle Bench site south of Richfield and at Muddy Creek located just a few miles to the east of the Old Woman Plateau (Gundy et al. 1990). All the houses documented to date have been basin-shaped, although they are variable in size (see Janetski n.d. for a summary). The house floors in

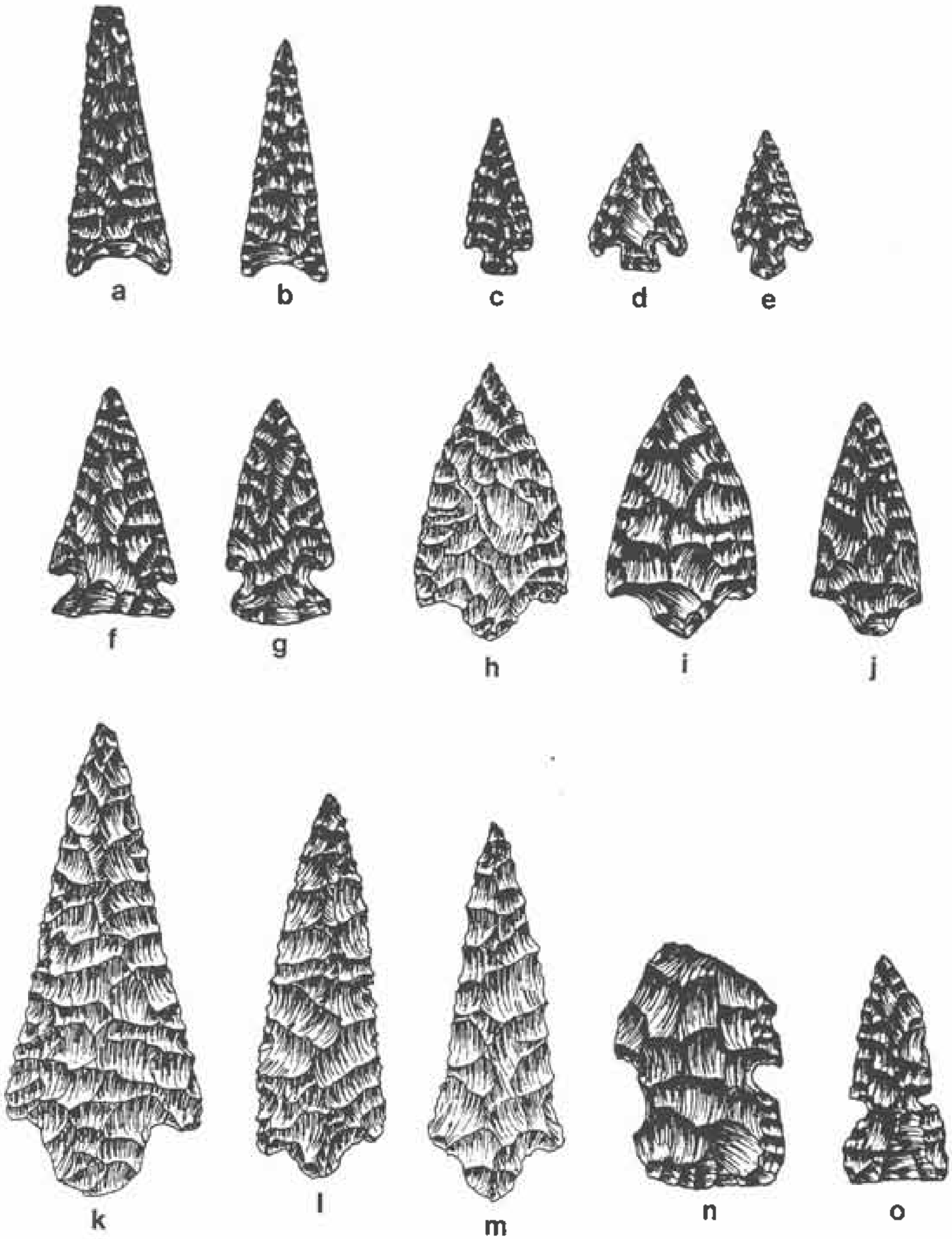


Figure 6. Projectile points from Aspen Shelter: (*a–b*) Bull Creek; (*c–e*) Rosegate; (*f–g*) Elko Series; (*h–m*) Gypsum or Gatecliff Contracting Stem; (*n–o*) Sudden Side-notched (actual size).

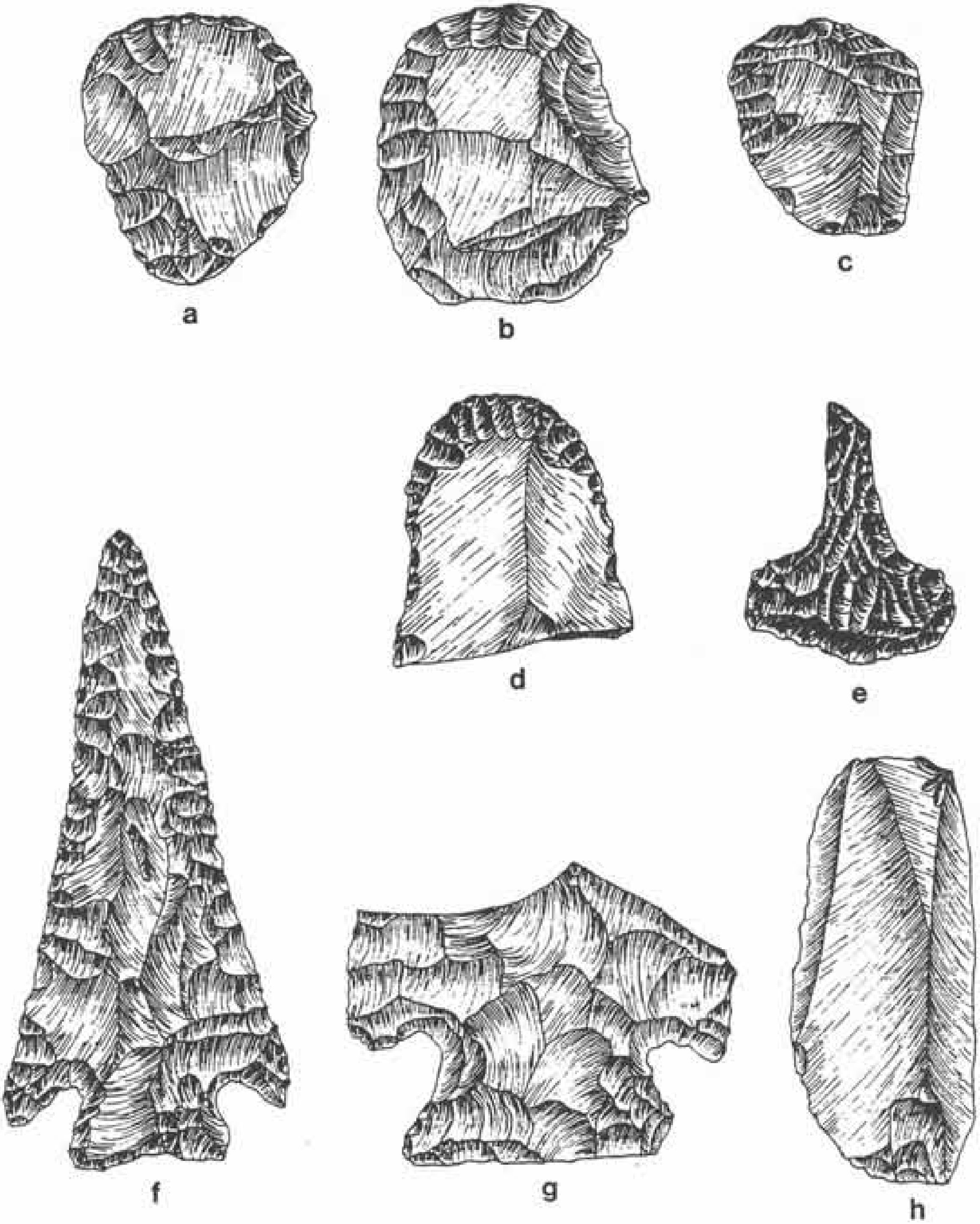


Figure 7. Miscellaneous chipped stone tools from Aspen Shelter: (*a–d*) snub-nosed scrapers; (*e*) drill; (*f–g*) hafted bifaces; (*h*) prismatic utilized flake (actual size).

Table 2. Preliminary Results of Animal Bone Analysis from all Levels at Aspen Shelter.

Taxon	*NISP	Percentage of NISP
Mule Deer (*Odocoileus Hemionus*)	3,319	85.0%
Squirrels (*Spermophilus* spp.)	290	7.0%
Cottontail (*Sylvilagus* sp.)	167	4.0%
Jack Rabbit (*Lepus* sp.)	17	0.4%
Porcupine (*Erethizon dorsatum*)	60	2.0%
Wood rat (*Neotoma* sp.)	37	1.0%
Vole (*Microtus* sp.)	20	0.4%
Canine	4	—
Elk (cf. *Cervus elaphus*)	4	—
Mountain sheep (*Ovis canadensis*)	3	—
Bobcat (*Lynx rufus*)	1	—
Marmot (*Marmota* sp.)	1	—
Gopher (*Thomomys* sp.)	1	—
Totals for Identifiable Bone	3,924	99.8%

*NISP stands for the number of bone elements identified to a genus or species.

Aspen Shelter are unique in that they both contain small, slightly off-center hearths and what appear to be reflector stones.

Although the Aspen houses are the earliest known to date for Utah, numerous Archaic structures have been found in the Intermountain area (see Metcalf and Black 1991 for a review). These include structures within shelters (such as that at Sysyphus Shelter in western Colorado [Gooding and Shields 1985]) and open sites such as Yarmony House (Metcalf and Black 1988, 1991).

The data gathered from the heavily used Gypsum level provides support for our initial predictions about site use by hunter-gatherers: that is, it was used by groups of Archaic families who hunted, gathered, and lived at Aspen Shelter. Probably they lived there when the weather was cool in the fall necessitating the construction of the houses. However, during the later Archaic no houses were built (that we found anyway), although a very dense midden was rapidly deposited in the two existing houses. This midden was deposited after the abandonment of the houses, although it appears to date to about the same time period and contains similar kinds of artifacts. Very little midden was found that could clearly be associated with the use of the houses.

When compared to the data available from nearby Sudden Shelter, Aspen appears to have been occupied later in the Archaic and was used well into the Fremont period, while Sudden was apparently abandoned by the onset of the Formative. The most recent date from the upper most layer at Sudden Shelter was 3360±85 B.P. (Jennings et al. 1980), while Aspen dates obtained are as recent as 1070±60 B.P. (see Table 1), which is consistent with the presence of Fremont artifacts such as Bull Creek points and painted grayware ceramics. It also appears that Aspen was more of a specialized camp for hunting deer than was Sudden Shelter, although this is a preliminary interpretation, as none of the macrobotanical analysis has been completed for Aspen. Hunting activities at Sudden Shelter during the period Aspen Shelter was being used were split between deer (55%) and mountain sheep (37%) while at Aspen fewer than 1% of the identifiable bone could be attributed to mountain sheep. This difference could be best explained by the somewhat lower elevation of Sudden (6,900 feet) and the differences in local habitat. Tools and pit features, on the other hand, are similar between the two sites. For example, the features referred to as firebasins at Sudden were identical to features found in the Archaic deposits at Aspen. Interestingly, the slab-lined pits so abundant at Sudden were not found at Aspen.

CONCLUSIONS

Aspen Shelter was an upland sheltered location used heavily during the Archaic period about 4,000 years ago and more sporadically during the Fremont period until at least 1,000 years ago. The primary use of the site appears to have been the hunting of deer during the fall. The research at Aspen has produced the earliest information to date on Archaic houses in Utah. Analysis on the stone tools, botanical samples, worked and unworked bone, etc., continues and should provide more detailed insights into the kinds of activities carried out here.

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ARCHAEOLOGICAL EVIDENCE OF PREHISTORIC FISHING AT UTAH LAKE

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INTRODUCTION

Utah Lake in the eastern Great Basin, has long been known as a major fishery that was important to prehistoric peoples. However, we have little in the way of prehistoric fishing gear to support this statement. This is surprising, especially when compared with western (Lahontan) Basin fisheries such as Pyramid and Winnemucca lakes, where archaeologists have documented an abundance of prehistoric fishing equipment (cf. Tuohy 1990). Utah Lake, however, has only recently become the focus of researchers studying various wetland subsistence strategies. The principal objective of this paper is to serve as an introduction to ongoing research geared toward understanding the fishing technologies employed at Utah Lake in the prehistoric past and to present examples of early fishing gear recently recovered from lake edge sites.

STUDY AREA

Utah Lake (Figure 1), located in north central Utah, is one the largest freshwater lakes in the United States west of the Mississippi River (Jackson and Stevens 1981:3). It measures about 32 km long north to south and 10 to 12 km east to west excluding Provo Bay. It also inundates approximately 25% of the valley floor and contains about 900,000 acre-feet of water (Heckmann et al. 1981:1). It is a relatively shallow lake with an average depth of only 2.8 m (9.2 ft) at the compromise level elevation of 1368.35 m (4489.34 ft) (Fuhriman et al. 1981:43). This shallowness combined with wind and lake bed sediments comprised of fine clays and organic silt, contributes greatly to the turbidity or polluted image of the lake. However, this turbidity is, for the most part, a natural feature (Brimhall and Merritt 1981:30,31). The lake is fed by several tributary streams draining the Wasatch Front. The most significant in terms of inflow are the Provo River, American Fork River, Spanish Fork River, and Hobble Creek. However, inflow from springs and numerous secondary streams, both perennial and intermittent also contribute to the lake's volume. The lake has one perennial outlet, the Jordan River.

NATIVE FISHERY

The wetlands of Utah Valley are rich in lacustral resources. Extensive marshlands provide a wide variety of both flora and faunal species. One of the most important of these to the early inhabitants of the valley was fish (Janetski 1986, 1990a, 1990b, 1991). Fish species endemic to Utah Lake and its tributaries include: Bonneville cutthroat trout (*salmo clarki utah*), Mountain whitefish (*Prosopium williamsoni*), Utah sucker, Webug sucker, Mountain sucker (*catostomus* spp.), June sucker (*chasmistes liorus*), Utah chub, Leatherside chub (*Gila* spp.), Least chub (*Iatichthys phlegethontis*), Longnose dace (*Rhinichthyes cataractae*), Bonneville mottled sculpin and the Utah lake sculpin (*cottus* spp.) (Heckman et al. 1981:108). The spawning season for these species, with one exception (the Mountain whitefish, a late fall spawner) occurred in the spring. It was during these spawning runs that fish were most susceptible to the various harvesting techniques used by early fishermen.

ETHNOGRAPHIC FISHING PATTERNS

Written accounts concerning Utah Valley by early explorers, trappers, settlers, and ethnographers, provide important information on the various subsistence strategies used by native inhabitants in both the recent and prehistoric pasts. The ethnographies and ethnohistories all document the importance of lacustrine resources to the Timpanogots or Utah Valley Utes (Janetski 1991). They also provide useful data on the types of strategies and equipment used to take fish in the lake and its tributaries. For example, Smith (1974:61,64) working with Ute informants in 1936–37, received information on the use of such items as: special unfeathered fish arrows, composite fish spears 4 to 8 ft long with sharpened greasewood tips, gorge hooks made of bone or greasewood, basketry traps, cordage nets, dip

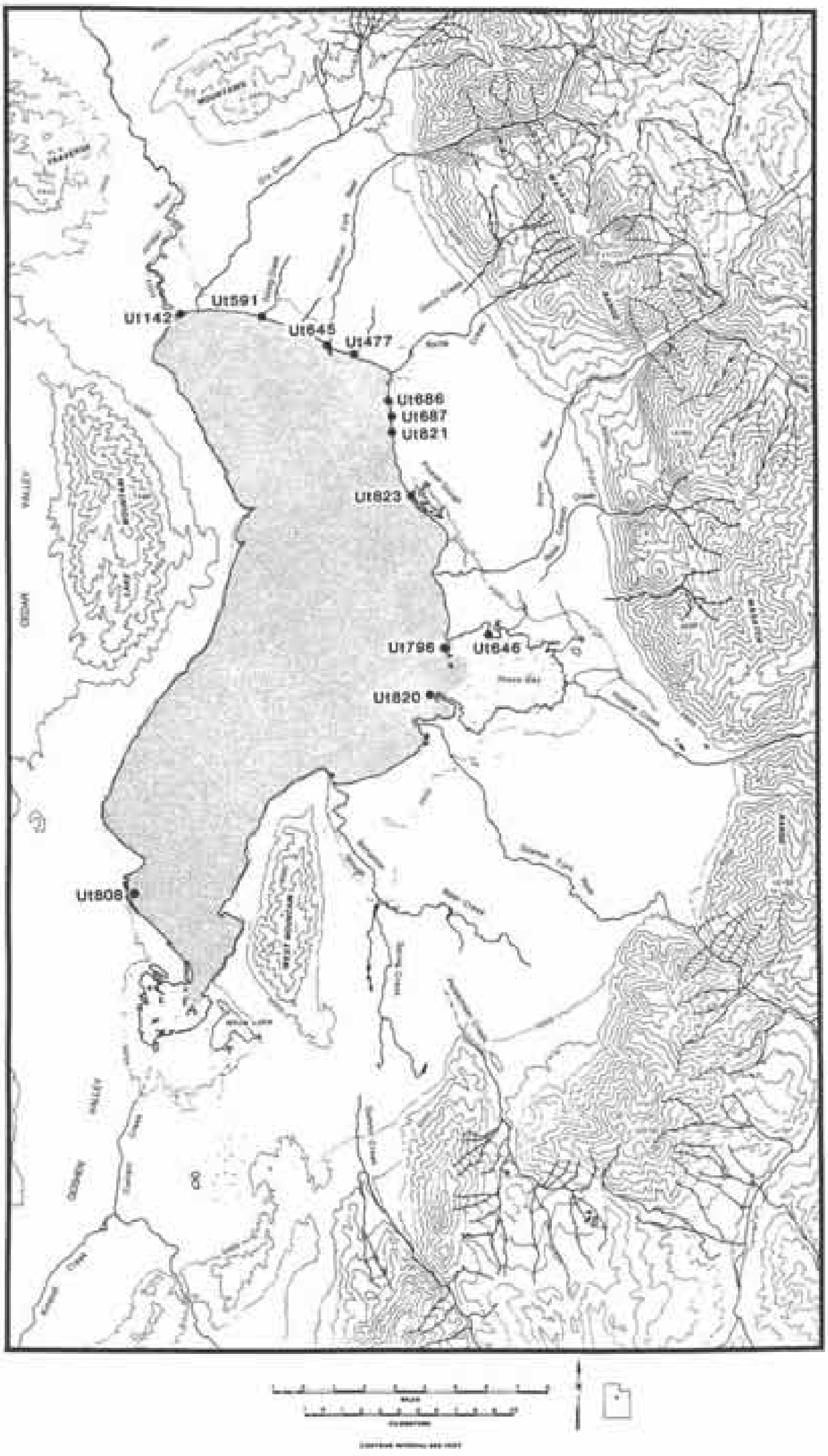

Figure 1. Utah Lake archaeological sites mentioned in the text.

nets and weirs made of brush used in conjunction with many of the above items. Fish were also clubbed, or simply caught by hand. Smith also states that rafts were used for deep water hook and line fishing. Although important, this information is lacking in some detail and probably reflects the fact that these accounts were obtained from informants long after the Utes had been displaced from Utah Valley to their Uintah Basin reservation (Janetski 1991:1).

Ethnographic accounts of fishing practices that were obtained at fisheries where native peoples were still *in situ*, tend to provide a more complete picture. For example, Willard Z. Park an early twentieth century ethnographer, working with the Northern Paiute of Pyramid Lake in western Nevada, received very detailed information concerning both fishing techniques and gear used by the Paiute in pre- and immediate post-contact times (Fowler 1989). His description of hook and line fishing is presented here primarily to demonstrate how bone hooks were used. Parks's informant stated that:

> Fishing was done with wiha (*Apocynum cannabinum*) ropes a couple of hundred feet long to which about 30 bone hooks were attached. The hooks were made of bone and had a barb. They would tie on a small minnow on each hook for bait. The fisherman then removes his clothes. He has a large tule float in a circle around his neck. It is tied to his neck. He holds one end of a rope in his mouth. The other end is on the shore held by a man who keeps it from tangling. He swims out as far as he can and when he is at the end of the line the man on the shore shouts that it is the end. He takes the float off his neck and ties the wiha rope to it as well as a stone sinker. This is left there until the next morning and then he pulls it in and takes off the fish. He may catch 10 or 15 fish that way. The hooks are spaced on the long rope. They hang down a couple of feet. A fish caught on one hook would moved back and forth causing the other hooks to move and making it appear that the minnows used as bait were alive thus attracting other fish (Fowler 1989:37).

ARCHAEOLOGICAL FISHING GEAR

As stated in the introduction, numerous examples of prehistoric fishing gear have been found at the major fisheries of the Great Basin. Western basin sites within the Lahontan system are especially rich in archaeological fishing equipment. Researchers there have documented such artifacts as: caches of dried fish, net fragments, complete setlines with hooks (mostly from dry caves), net weights, line sinkers, bone harpoons, and a wide variety of bone fishhooks, all used to take fish prehistorically. Donald Tuohy (1990:129-142) working with the extensive collections of fishing gear from Pyramid Lake, has worked out typologies for both fishhooks and stone net sinkers, with over 100 examples of the former and more than 300 of the latter.

Archaeological examples of fishing gear from Utah Lake, however, have been poorly represented in both numbers and types. Past research conducted in Utah Valley has generated little data concerning early fishing equipment. However, some of the artifacts that have been found and documented in the literature include: several complete and fragmentary bone harpoons recovered from two Fremont period mound sites Seamon's (Gilsen 1968) and Woodard Mound (Richens 1983); a wood harpoon recovered in 1938 from American Fork Cave in the Wasatch mountains east of Utah Lake (Hansen and Stokes 1941:35); and a number of grooved and perforated stones referred to as sinkers recovered during surveys from at least two sites, 42Ut142 located along the inlet channel to the Jordan River (Jones 1961) and 42Ut295 in Goshen Valley (Gilsen 1968).

Recent surface finds at several lake edge sites have now added to the above assemblage. Included are a bone fishook and several types of stone sinkers. The bone hook was found at Heron Springs (42Ut591) a Late Prehistoric lake edge settlement excavated by Brigham Young University in 1987 (Janetski 1990). The site was radiocarbon dated to about A.D. 1400 and contained a large number of fish bones. However, no clear evidence of fishing gear was recovered during the excavations. The bone hook discussed below was recovered from the surface in 1988. The bone point (Figure 2a) appears to be part of a composite-angle hook, fitting into Tuohy's (1990:130) Pyramid Lake Type II unbarbed-single-pointed hook classification. It is made from a splinter of mammal bone, 4.4 cm long and .5 cm wide at the center, and is somewhat triangular in cross-section. The distal end is ground to a sharp point. The proximal end, although tapered, is not sharpened. Also located on the proximal end are two short lashing grooves, used to assist in the attachment of the bone point to a wooden or bone shank. A complete composite-angle hook from Pyramid Lake is illustrated in Figure 2b.

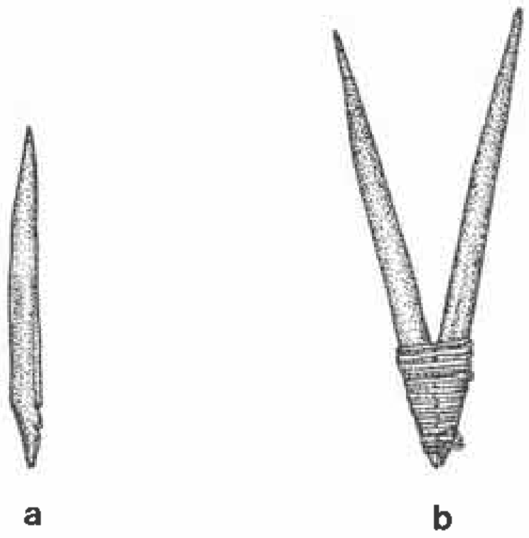

Figure 2. Bone fishhook element from Ut591 (*a*); composite-angle hook from Pyramid Lake (*b*) (after Tuohy 1990:137, Figure 12).

In addition to this hook, numerous sinkers have now been found at several lake edge sites. During August 1991, the receding waters of Utah Lake exposed a cluster of stone sinkers, located along the inlet channel of the Jordan River. This site (42Ut142) was first recorded in 1961 during a survey of Utah County by Jones (Jones 1961:70,71). It was then considered to be an Archaic site based on projectile point styles and the presence of a number of atlatl weights. Of particular interest here is the mention of grooved stones found at the site (Jones 1961:70).

Recent work conducted by the author and Joel Janetski of Brigham Young University at 42Ut142 during August and September of 1991, consisting primarily of mapping, photographing, and collecting samples, has resulted in the recovery of a large number of these grooved stones in a variety of sizes and styles. It is interesting to note that they occurred in a cluster along the edge of the river channel; however, it was not possible to determine with certainty if this clustering was the result of natural deposition or past dredging operations. Over 148 modified stone sinkers were found in the cluster alone, and another 76 were scattered across the site.

A cluster of about 30 sinkers was found in 1988 at another lake edge site (42Ut645) located along an extinct channel of the American Fork River. This site is considered to be Late Prehistoric based on diagnostic artifacts. These sinkers differ from the Jordan River sinkers in being smaller and much more uniform in size, weight, and modification techniques.

Based on these finds a revised version of Tuohy's (1990:141–142) western basin sinker typology has been adopted by the author, strictly for the purposes of this report, in classifying the various styles of Utah Lake sinkers. This typology is based primarily on modification of a stone (grooving, notching etc.) to make it suitable for line attachment, or, as in the case of the Class I sinkers, on natural suitable shape. This revised typology and a brief description of classes follows:

I. Unmodified (Figure 3a)
II. Perforated (Figure 3b)

III. Knobbed
  A. Grooved (not illustrated)
  B. Notched (Figure 4a)
IV. Grooved
  A. Longitudinally grooved (not illustrated)
  B. Radially grooved (Figure 4b, 5b)
  C. Combination longitudinally and radially grooved (not illustrated)
V. Notched
  A. Longitudinally notched (Figure 5a)
  B. Radially notched (not illustrated)
  C. Combination longitudinally and radially notched (not illustrated)
VI. Combination grooved and notched (not illustrated)
VII. Reworked ground stone sinkers
  A. Grooved (Figure 6a)
  B. Notched (not illustrated)
VIII. Historic Stone Sinkers
  A. Unmodified with line attached (not illustrated)
  B. Notched with line attached (Figure 6b)

It became apparent during the field work at 42Ut142 in 1991, that many of the unmodified rocks associated with the sinker cluster, were of a natural shape suitable for line attachment. Natural notches and central depressions were the most noted attributes. Also size and weight ranges were consistent with the modified sinkers. Based on these findings it was hypothesized that these stones may have also been used as sinkers. It should be stressed, however, that only stones found within the Jordan River cluster were included in this class.

As can be seen from the above typology, fishing sinkers from Utah Lake are highly variable in the types of modifications used in their manufacture. The grooved and notched styles are by far the most common. Both of these classes exhibit a high degree of variation in both the amount and placement of the modifications on a stone. On the grooved sinkers, these modifications range from subtle pecking to deep, full grooving, and on the notched classes they range from the dulling of a sharp edge, to deep, broad notching. Placement of the modifications occurs in at least two styles, longitudinally (around the long axis) and radially (around the short axis). Combination grooved and notched styles were also found. The perforated sinkers are generally smaller, lighter in weight (usually under 100 g), and less common than sinkers in the other classes. The knobbed class consists of stones modified on one end as opposed to a central modification and are also less common. The reworked groundstone class consists of manos and metates both fragmentary and whole that have been modified in a variety of ways for line attachment. This class was common in the Jordan River cluster, and is interesting in that it suggests a rather opportunistic use of available stone. The historic stone sinkers are the modern day counterparts to the other seven classes. They have been observed at numerous locations around Utah Lake. At least two styles occur, unmodified and notched. They are distinguished from the other classes by having a modern fishing line attached and an absence of calcium carbonate deposits in their notches. Historic sinkers exhibit fresher looking modifications, whereas, many examples in the other classes have heavy calcium deposits both inside and outside of their modifications, suggesting greater age.

Table 1 plots the distribution and number of sinkers by class found in both of the clusters as well as at various lake edge archaeological sites. 42Ut142 is represented by two columns, a cluster count and a general site count. As shown in Table 1, the Jordan River cluster contained seven of the eight sinker classes; only Class III was not represented. The notched and grooved styles were the most common types of modified sinkers. The hypothesized Class I unmodified sinkers were also very common with 68 specimens. When combined with the 148 modified specimens, then a total number of 216 sinkers were present in the Jordan River cluster. Weights ranged from 18 kg down to about 300 g and averaged about 1.5 k.

The American Fork River cluster contained only three of the sinker classes, grooved, notched, and combination grooved and notched. Also as noted above, they were smaller and more uniform in size and weight than the Jordan River sinkers. Weights ranged from 590 g to 180 g with an average weight of 360 g. The stone material used for sinkers and their possible sources has not yet been analyzed.

CONCLUSIONS AND SUMMARY

It seems likely that these stones functioned as fishing sinkers based on several lines of evidence: (1) their presence at strategic locations at a major fishery;

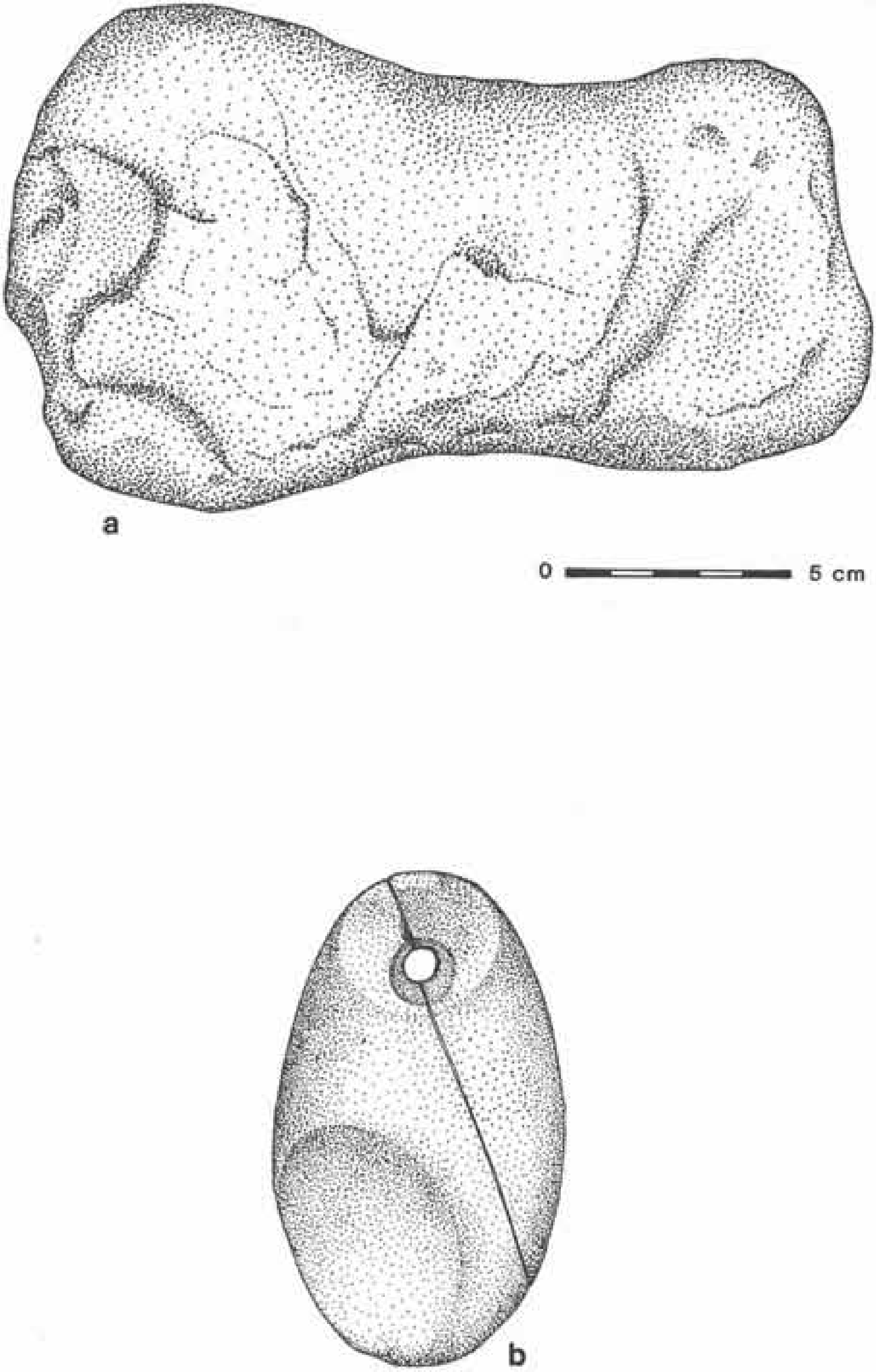

Figure 3. Stone sinkers: (*a*) Type IA, unmodified; (*b*) Type II, perforated (actual size).

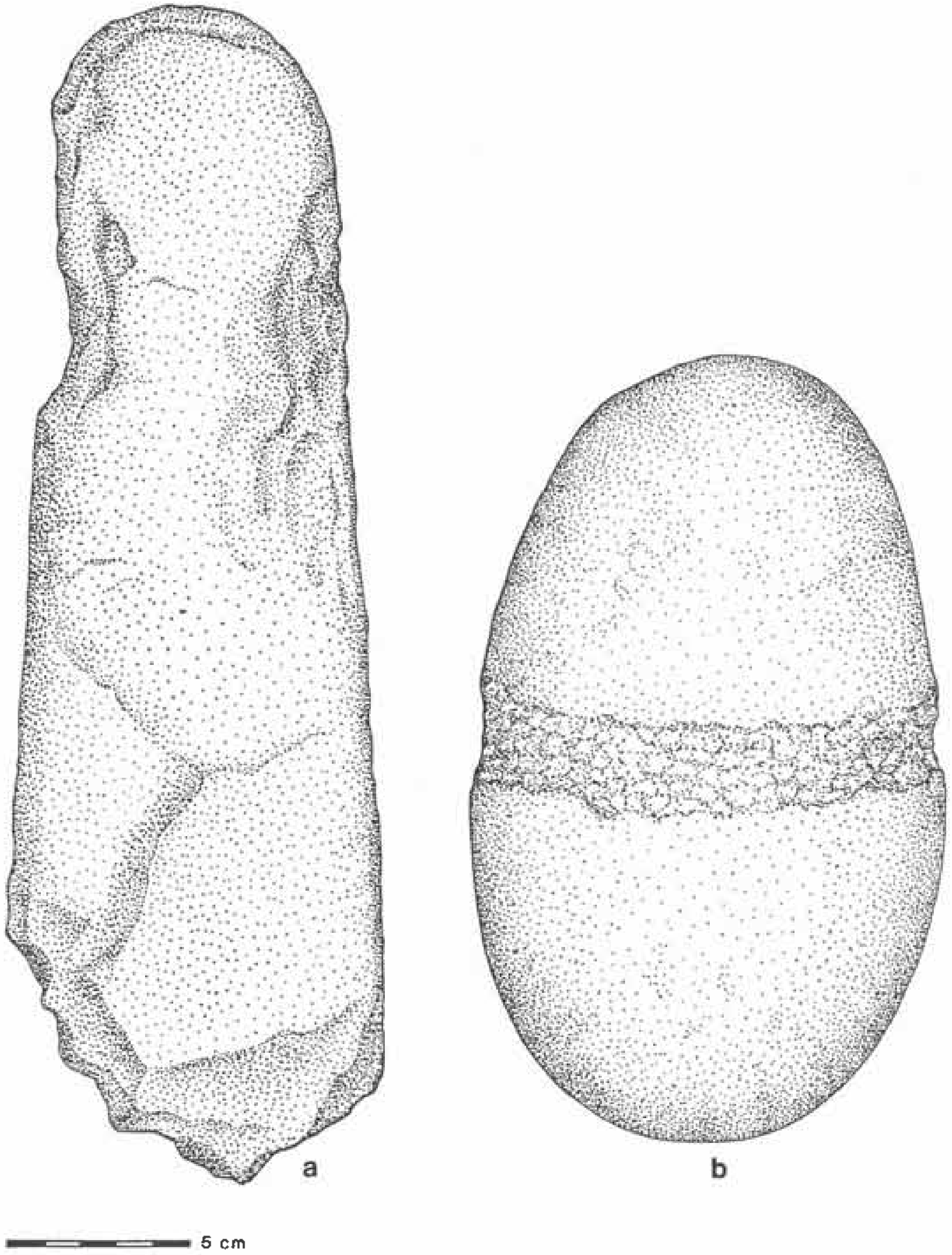

Figure 4. Stone sinkers: (*a*) Type IIIB, knobbed, notched; (*b*) Type IVB, radially grooved (actual size).

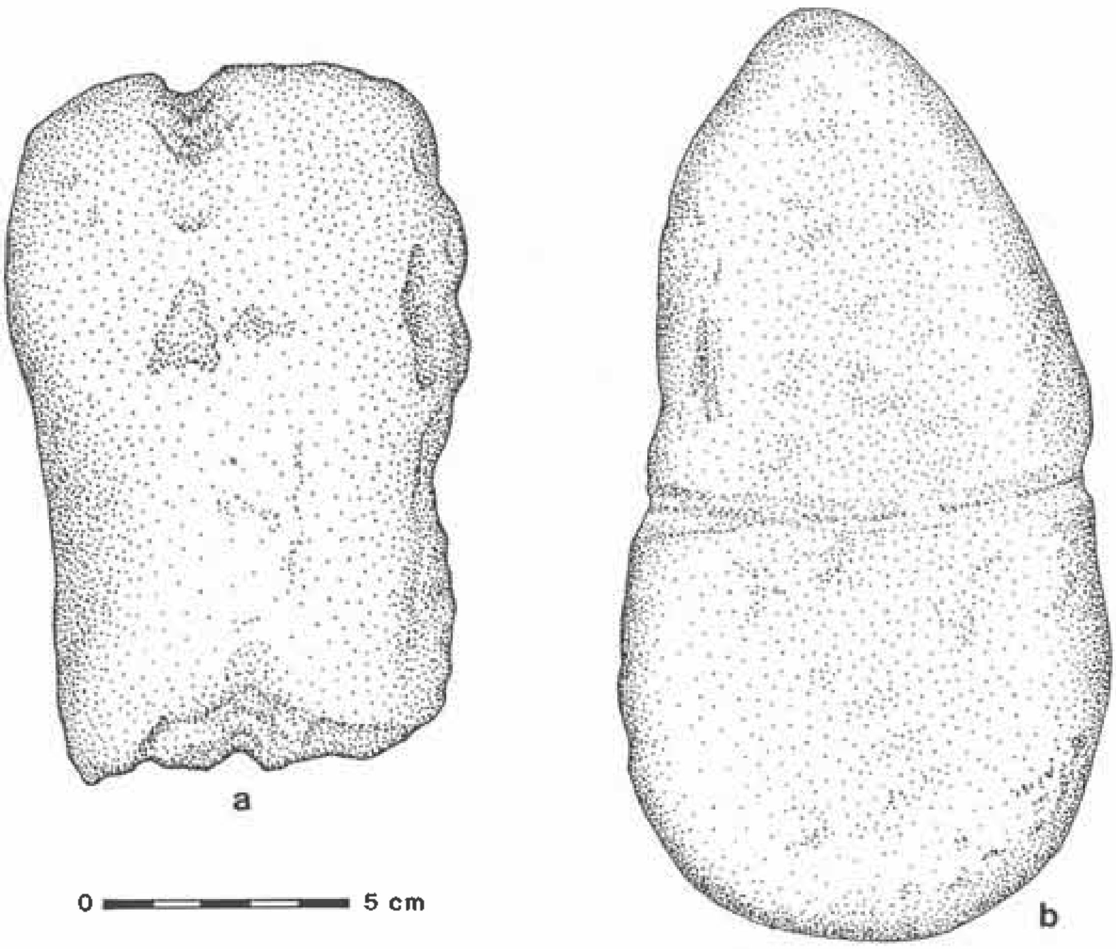

Figure 5. Stone sinkers: (*a*) Type VA, longitudinally notched; (*b*) Type IVB, radially grooved (actual size).

(2) they exhibit no use-wear markings indicating other functions such as hammers or mauls, and (3) the use of stones for fishing sinkers is documented in some of the ethnographic accounts of Great Basin fishing (Fowler 1989:37).

As stated above, the sinkers discussed in this report were found in clusters. Tuohy (1990:139) also states that sinkers are found in clusters at Pyramid and Winnemucca lakes in the western basin. This clustering suggests that these sites probably functioned as specialized fishing stations associated with river netting operations. However, as shown in Table 1, fishing sinkers also occur in non-clustered surface contexts at several Utah Lake archaeological sites.

Temporal placement of the fishing sinkers is difficult as no sinkers have been found yet in a dated context at Utah Lake. However, several inferences

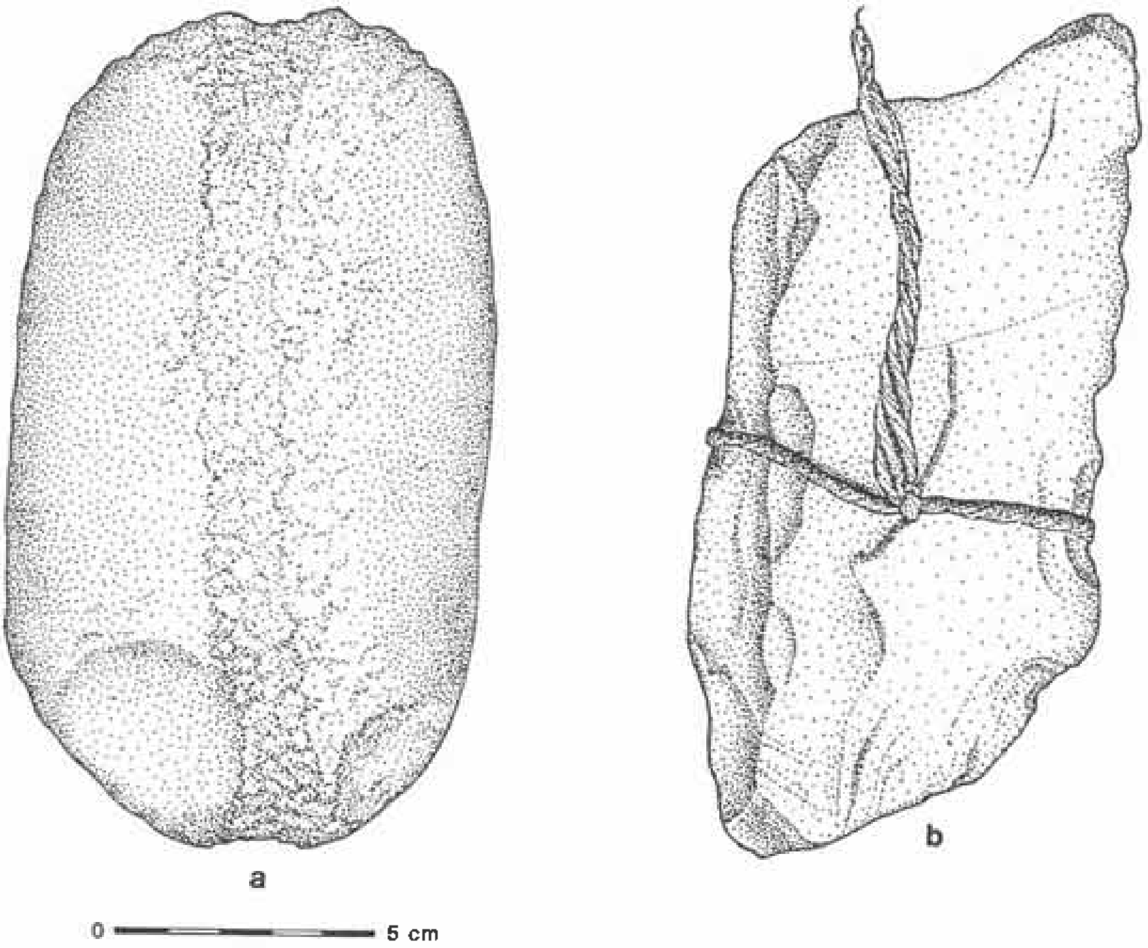

Figure 6. Stone sinkers: (*a*) Type VIIA, reworked groundstone (mano); (*b*) Type VIIIB, historic notched with line attached.

concerning dating can be made. For example, a Class V notched sinker was found on the surface at a site (42Ut808) located on the southwest side of Utah Lake, which contained a burial dated to ca. 5500 B.P. (Joel Janetski, personal communication 1991). This suggests that a sinker technology was in place by at least 3500 B.C. The presence of sinkers at the American Fork River site, a Late Prehistoric occupation, suggests that this technology was still being used in later times. However, differences in styles and weights, as noted above, may reflect a possible change through time. It is also interesting to note that several examples of modern stone sinkers with fishing lines attached were found at the Jordan River site, demonstrating that this old technology is still being used today, basically unchanged, at the same place as it was in the prehistoric past.

The wetlands of Utah Valley have long been the focus of various subsistence strategies of both the recent and prehistoric pasts. The ethnographies, as

Table 1. Distribution of sinkers by class from various Utah Lake sites

	UTAH LAKE SITES														
Sinker Classes	Ut142 Cluster	Ut142 Site	Ut645 Cluster	Ut646	Ut591	Ut823	Ut796	Ut477	Ut686	Ut821	Ut687	Ut808	Ut820	Isolated Finds	Totals
I. Unmodified	68	0	0	0	0	0	0	0	0	0	0	0	0	0	68
II. Perforated	1	0	0	0	0	0	0	0	2	1	1	0	0	0	5
III. Knobbed	0	0	0	0	1	1	0	1	0	0	0	0	0	1	4
IV. Grooved	27	9	4	3	0	1	0	0	1	0	0	0	0	0	45
V. Notched	90	39	18	1	2	1	2	0	0	0	0	1	1	2	157
VI. Combination Grooved-Notched	9	7	8	0	1	0	0	0	0	0	0	0	0	0	25
VII. Reworked Ground Stone	17	18	0	0	0	0	0	0	0	0	0	0	0	0	35
VIII. Historic Stone Sinkers	4	3	0	0	0	0	0	0	0	0	0	0	0	0	7
Totals	216	76	30	4	4	3	2	1	3	1	1	1	1	3	346

well as recent archaeological research conducted at several lake edge settlements, all document the importance of fish to the native inhabitants of Utah Valley. However, as stated in the introduction, we have found little in the way of prehistoric fishing gear. This may reflect the fact that Utah Lake has only recently become the focus of researchers studying these strategies. The recent finds presented here have begun to shed some new light on this problem.

ACKNOWLEDGMENTS

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EXPERIMENTS ON ARTIFACT DISPLACEMENT IN CANYONLANDS NATIONAL PARK

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INTRODUCTION

How materials discarded by humans change in character and context through time has become a topic of study that transcends theoretical approaches in anthropological archaeology. Identifying variables that are important to gaining some insight into the history of these artifact assemblages (i.e., formation processes) is, as Wandsnider (1987:150) aptly notes, "an immature avocation in archaeology." Nevertheless, the growth of the study of formation processes continues to provide optimism that the study of the organization of prehistoric cultural systems is a productive line of research in anthropology.

The integrity of the archaeological record is a dimension of research that is fundamental yet uniquely a problem to anthropological archaeology. Numerous studies have been conducted since the 1970s concerning the effects of the physical environment and animal (including human) activities on our interpretations of archaeological remains (e.g., Frink 1984; Fuchs et al. 1977; Gifford-Gonzalez et al. 1985; Nash and Petraglia 1984; Odell and Cowan 1987; Osborn et al. 1987; Pryor 1988; Roper 1976; Stockton 1973; and Yorston et al. 1990). The effects of natural processes on the archaeological record in arid and semi-arid regions is of special interest because the ground surface yields a highly visible archaeological record. These surface remains are therefore considered potentially useful in assessing behavioral manifestations of adaptations in the past.

The spatial configuration of artifacts and their association with other cultural and natural features is used often to build interpretative scenerios of activities at sites (e.g., Metcalfe and Heath 1990; O'Connell 1987; Simms and Heath 1990; Stevenson 1991; Stiger 1986; and Whallon 1984). Wandsnider (1989) emphasizes that the archeological record cannot be viewed as being formed through simple accumulation of debris from cultural activities, but rather through the interaction of cultural and natural processes on artifact assemblages. That is, an exposed archeological assemblage is subject to being a source of material for human activities as well as being vulnerable to disturbance by natural processes.

The present study reports an empirical investigation of artifact behavior in Canyonlands National Park in southeastern Utah. The park lies within the Canyonlands physiographic division of the Colorado Plateau, formed by the drainage system of the Colorado and Green rivers (see Hunt 1974; Stokes 1977). The area is characterized as having a cold, middle-latitude, semi-arid climate. Most of the soil is shallow, dry and without distinct horizons. Many areas have less than 20 inches to bedrock, although some areas are deeper. Eolian deposits cover several areas in this region.

Eight different microenvironments that vary in geomorphological position, but which are influenced by similar climatological factors were chosen for experiments on the displacement of lithic materials. These field experiments took place in the Island-in-the-Sky district of the park. This mesa north of the confluence of the Colorado and Green rivers lies at an elevation of 1,500–1,800 m.

The research of previous investigators suggests that predicting artifact movement on the basis of artifact attributes and/or the microenvironment of the artifact is complex. A thorough review of experimental studies of natural formation processes on lithic materials has been provided by Wandsnider (1989:398-423). No attempt is made here to reiterate this review, however several of these experiments have examined the displacement of lithic artifacts introduced into dune systems. With few exceptions, many studies to date have reported the effects of natural processes in limited time frames (e.g., Shelley and Nials 1983; Simms 1984).

Long term behavior of artifactual materials has been assessed using simulation techniques (e.g., Bowers et al. 1983; Wandsnider 1989; Yorston et al. 1990). The time frame upon which actual experimental data is collected for simulation trials is, however, critical to the interpretation of these long-term movement sequences. Wandsnider (1988, 1989) emphasizes geomorpological research that suggests the behavior of introduced objects on a land surface is likely to be highly active until the surface reaches a stable-equilibrium and the objects settle-in (e.g., up to one year).

Those conditions that determine the surface displacement of lithic artifacts with varying attributes yield variables that permit the exploration of relationships between these flakes, their movement, and the variability in their geomorphological position on the landscape. Environmental conditions that are considered to affect artifacts in these different microenvironments include precipitation, temperature, wind direction, and wind velocity. The complex relationships between artifact attributes, geomorphological position, and climatic conditions were investigated to ascertain the extent to which displacement from the position of discard was influenced by the effects of long-term environmental conditions.

Fundamental questions that arise when observing the variable density of artifacts visible on the surface in southeastern Utah include: how do meteorological conditions in this environment affect the integrity of archeological assemblages and secondly, is there some predictive means by which we can assess the state of assemblage integrity when attributes of artifacts, ground surface, and meteorological conditions are known (see Wandsnider 1988:20)?

This study was designed as an inductive investigation of the effects of natural processes on the archaeological record to provide a foundation for assessing the spatial integrity of lithic assemblages in the park. It should be emphasized that this research focused on the impact of non-human induced variables to artifact position. Livestock grazing is currently prohibited in the park and the experimental stations were situated so as to minimize potential disturbance by park visitors and staff.

PREDICTIONS

Previous studies of artifact movement in arid to semi-arid environments allow for several expectations about the horizontal displacement of lithics. Much of the previous empirical investigations concerning artifact movement in the American Southwest has focused on sand dune geomorphology because of their observed change and the high number of lithic scatters observed under these conditions. The geomorphological history and current conditions of the Island-in-the-Sky area permit the assessments of these experiments to be used as comparative data in establishing some understanding of assemblage integrity in this environment. Expectations for this study are summarized as follows.

1. The effect of natural processes (precipitation, temperature, wind) resulting in artifact movement is assumed to vary with the degree of exposure to these factors. Vegetation characteristics of the ground surface are also known to affect eolian processes (Thomas 1988). It is expected that the total displacement of each class of artifact by size varies significantly between the eight different microenvironments studied. The attribute of size is used predominantly in these analyses because size is recognized as a determining factor in the life-history of the artifact in terms of cultural forces (i.e., discard and loss) and geomorphological forces that operate on subsequent incorporation of the artifact into sediments (see Schiffer 1983, 1987:267-269; Wandsnider 1987, 1988).
2. Geomorphological study suggests that the movement of introduced particles to a surface is greatest during the first few weeks after placement, subsequently becoming more spatially stable as part of the surface context (Wandsnider 1988, 1989). It is expected that displacement of artifacts will be greatest at all eight experimental stations during the first period (seven months) of monitoring.
3. Artifact movement is expected to vary differentially based on morphological characteristics of lithic material. It is expected that the degree of movement of lithic artifacts will be conditioned by the size and weight of the artifacts. The smaller the size and weight of the artifact, the greater the horizontal movement in all eight microenvironments.

METHODOLOGY

In March of 1984 manufactured flakes were systematically placed at eight experimental stations in the Island-in-the-Sky district of the park. Each station contained a systematic arrangement of 38 flakes produced from reddish chalcedony from the Cedar Mesa formation (Cedar Mesa Chert). (Station 4 was plotted with only 37 flakes due to an error in field placement.) Prior to field placement each artifact was weighed, its maximum length and width recorded, and

Table 1. Artifact Assemblage by Size Grade

Size Grade	N[a]	$\bar{x}^b$ length (cm)	$\bar{x}^2$ width (cm)
1	24	6.01	3.81
2	40	4.18	2.71
3	64	3.18	2.16
4	88	2.29	1.57
5	88	1.51	1.27

[a] N = Number
[b] $\bar{x}$ = Mean

size graded into five classes.[1] This artifact assemblage was sorted using a variable size grid template drawn on K and E metric scale paper. Individual pieces were moved across this template until their total surface area most closely approximated that for a particular size. Table 1 reports the mean dimensions for each size grade used in the experiment.

Each station was plotted with an equal number of artifacts per size grade. Experimental plots were layed out on intersecting axis of 1 m length, forming a 2 m x 2 m surface from which to orient measures of movement (cf. Bowers et al. 1983; Nash and Petraglia 1984). Steel spikes were used to mark the end of each one meter axis as well as the intersection of the x and y axis. Axis (Y) was aligned with magnetic north using a Brunton field compass.

Artifacts were positioned along each axis at 10 cm intervals. Each flake was situated so that the long axis of the artifact lay perpendicular to the up-down slope of the experimental plot. Flakes were numbered with India ink and coated with clear lacquer polish. This artifact number faced the ground surface to avoid deteriorating effects of the sun as well as to minimize attention to the experimental station by park visitors. Subsequent measures of displacement were made using portable meter grid frames subdivided into one hundred 10 cm x 10 cm cells. A photographic record including black and white and also color photographs was kept of each station. This documentation also included photographs taken of each cardinal direction from the experimental station.

The coordinates of each artifact's position were measured five times between March 1984 and October 1989. The frequency or intervals for these observations could not be predetermined at the outset of the experiment (cf. Wandsnider 1988:19; 1989:44). Periods between artifact observations ranged from approximately seven to 25 months. All stations were examined and artifacts measured on the same day or consecutive days, and not independently of each other.

The analysis reported here is of the horizontal movement of these artifacts. Some flakes, however, were buried by natural processes, and some buried items subsequently reappeared on the surface. A summary of the rate and frequency of artifact burial for each of the eight microenvironments studied is presented below.

Meteorological data were compiled from daily records kept by park staff using instruments located on the mesa near the current visitor's contact station. The data used here dates from March 1984, when the experimental stations were introduced, to May of 1990, encompassing the overall period in which the experimental stations were monitored. These daily records are logged on National Oceanic and Atmospheric Administration forms (WS Form E-15) that record temperature, precipitation and water equivalency, and wind data. Wind data was described using cardinal directions. Cardinal direction was translated to degrees from north for the purposes of computing. When the wind velocity was recorded as calm by park staff, direction was recorded as 0. Wind data is complete for all days except for the period from March to September 1988, during which time instruments were inoperable. Table 2

Table 2. Mean Meteorological Data by Time Period Between Artifact Measures

Period (dates)	Wind Direction*	Wind Velocity (mph)	Low Temperature (F)	High Temperature (F)	Precipitation (inches)
1 (3/84-11/84)	163.4	6.2	47.4	68.5	1.35
2 (11/84-10/85)	43.9	6.1	42.2	62.8	1.08
3 (10/85-6/86)	121.6	6.2	36.2	56.6	.53
4 (6/86-9/87)	108.3	5.2	45.1	66.0	.84
5 (9/87-10/89)	72.3	2.3	38.9	61.3	.55

*Expressed in degrees from north

summarizes the data used in these analyses by period for each observation.

EXPERIMENTAL STATIONS

Placement of the eight experimental stations was conditioned by several factors; (1) stations were located in diverse microenvironments but representative of those surfaces where similar prehistoric materials are observed; consequently many are located near prehistoric sites. (2) Experimental stations were positioned so that the likelihood of disturbance by park visitors would be minimized, yet access to the stations would allow for subsequent and repeated artifact observations. Table 3 summarizes the environmental context of these stations.

ANALYSES

The effect of natural processes (precipitation, temperature, and wind) on artifact movement is expected to vary with the surface on which the artifacts are placed. The interaction of these variables is, however, complex. Wandsnider (1989:62) outlines a complex set of interactions between artifact attributes, geomorphological, and meteorological variables. Although fewer sets of variables are considered, the question of interest here is how a basic set of meteorological variables affect artifact movement of various sizes in different microenvironments.

Precipitation, wind direction and velocity, and temperature are, of course, highly related in terms of meteorological and climatological dynamics. The effect of temperature on artifact movement is difficult to assess intuitively in this environment. However, we do know that in cold deserts there exists extreme seasonal differences in temperature and that temperature variation is often associated, in many complex ways, with precipitation and wind velocity. Precipitation, as used in these analyses, includes the water equivalency of snowfall.

This data was subjected to the least squares method of multiple regression analysis using SPSS-PC version 3.0. Multivariate analysis produced measures of the strength of the linear relationship between two variables after controlling for the effects of the other independent variables. An examination of the partial correlation coefficients allowed for an assessment of the expectations of artifact behavior and natural processes in this environment.

Some general patterns about the effect of these basic natural processes on artifacts of various sizes in different microenvironments were noted. One is that temperature had a minor effect on artifact movement, and in some cases acted as a suppressor variable, inhibiting the strength of the relationship between the other variables. Larger size artifacts (i.e., size grades 1–3) were, however, somewhat affected by temperature, although no geomorphological similarity

Table 3. Experimental Station Descriptions

Station	Soil/Substrate	Vegetation	Remarks
1	sandy	rice grass, wheat grass	level/dunes;juniper surrounds station
2	sandy/pebbles	blackbrush, piñon	gradual slope south
3	cryptogamic[a]	piñon, juniper, blackbrush	slope 10% south
4	sandy	juniper, blackbrush, miscellaneous grass	level clearing; stablized dunes
5	sandy	dense grass	level/dunes
6	cryptogamic[a]	yucca, *Opuntia*	level/on small rise surrounded by slickrock
7	sandstone	none	slickrock gradual slope to southwest
8	sandy	piñon, blackbrush, miscellaneous grass	deflated area in stablized sand dunes

[a] Cryptogamic soil is a microbiotic crust formed by cyanobacteria that, because of their ability to stablize soil particles, capture nutrients and retain moisture. These characteristics allow them to colonize areas of bare rock and soil forming a surface mass that is ubiquitous to the semi-arid cold desert of the Colorado Plateau.

between experimental stations is apparent where this effect occurs.

Wind velocity and precipitation, as may be expected, dominate in effects on artifact movement, with wind velocity showing a slightly stronger role than precipitation. Precipitation influenced movement of artifacts of a wide range of sizes in grass covered stabilized dune surfaces (experimental stations 1, 4, and 5) and in cryptogamic soil (experimental station 6). Effects of precipitation on artifacts on slickrock (experimental station 7) were also apparent but strongest on small artifacts (size grades 4 and 5), when controlling for the effects of wind velocity and both mean low and high temperature. Wind velocity showed strong association with artifact movement within a broad range of artifact sizes in sandy vegetated surfaces (experimental stations 1, 2, and 4), and especially at station 3, cryptogamic soil, irrespective of temperature conditions. It should be emphasized, however, that both precipitation and wind velocity showed strong effects at station 3, when controlling for each other and temperature.

Analysis of variance procedures was used to ascertain significant differences in the distances moved for each size grade at each experimental station during each of the five measures (time periods) made. Artifact movement in station 7 was significantly different ($P < .05$) from that of other stations in the case of at least one artifact size in multiple time periods. Table 4 shows the artifact size grades for which the difference in mean distance moved between station seven and all others by period were statistically significant. Of primary interest here is the size grades for which this difference exists. Size grade four is shown to be the most prevalent in terms of its statistical difference in mean distance moved through time. The small size of these artifacts likely accounts for this activity in all microenvironments studied. However, the absence of size grade five in each column of Table 4 beyond that of period one also reveals the vulnerability of small artifacts to the natural processes of the cold desert environment. Figure 1 shows the prevalence of size grade five to being buried in sediments of each experimental station (ES), when compared to all other size grades.[2] The variance in burial of these artifacts by weight is shown in Figure 2. Those artifacts in the 0–2 g category are those most likely to be buried in all experimental stations observed. Wandsnider (1987, 1988, 1989) also found that, in general, small artifacts are more often buried than are larger artifacts but that this tendency is enhanced by the compactness of the substrate. These analyses suggest that the smaller the artifact the more likely it will not be

Table 4. Artifact Size Grade for Which There is a Significant Difference ($P < .05$) in Mean Artifact Movement Between Experimental Station 7 and All Other Stations by Time Period

Time Periods	Experimental Stations						
	1	2	3	4	5	6	8
1	3,4,5	3,4,5	4,5	3,4,5	3,4,5	3,4,5	4,5
2	4	4	4	4	4	4	
3	3		3	3	3	1,3	
4	4	4	4	4	4	4	4
5			4	4	4	4	4
All Periods	2,3,4,5	3,4,5	2,3,4,5	2,3,4,5	3,4,5,	2,3,4,5	4,5

visible on the surface regardless of the microenvironment and that movement prior to burial is greater than artifacts of a larger size.

Artifact movement across the eight microenvironments studied appears to be quite variable (see Figures 3 and 4). Figure 5 shows this movement by size grade and weight. Station 7, an experiment of artifact displacement on slickrock is, not surprisingly, the surface on which movement was greatest when all measures are compiled. Artifacts in stations 3, 4, and 6 show the least overall displacement. Two of these experimental stations (3 and 6) are positioned in cryptogamic soil and station 4 lies in stabilized sand near the base of vertical Navajo sandstone rock.

The greatest movement during each observation is characterized, for the most part, by those of the smallest size. One exception is during period 4 (June 1986–September 1987) during which time larger, heavier artifacts moved substantially relative to other size grades at stations 2 and 4. Both of these surfaces are sparsely vegetated. However, it also can be noted that large size grades also moved a greater distance, relative to other sizes in cryptogamic soil (station 6; see also station 3).

Similar to the results of Wandsnider's study, the mobility of artifacts in all microenvironments studied here was not significantly greater during the first period of observation (March 1984–November 1984) than in later periods. As Wandsnider (1989:44) points out "Artifacts in an eolian context may be repeatedly subjected to destablizing forces and so may never come to an equilibrium position within the surface system." On the other hand, she presents evidence that an experimental study of less than ten years may be insufficient to detect a settling-effect considered by some geomorphologists to be characteristic of particles introduced to a surface.

Multivariate analysis of variance was used in a nested design to hypothesize that there was no difference in distance moved by artifacts of the five size grades within the eight experimental stations across all five time periods of observation. A statistically significant difference (Pillai's = 0.68816, $P < .0005$) between the mean distance moved by artifact size within stations across the five time periods was found. Univariate analysis results for all periods show a significant difference ($P < .05$) in artifact movement by size in all stations with the exception of periods two and three (see Table 5). No apparent meteorological cause for this lack of significance is available from the kinds and scale of variables used here. It may be worth noting that, in fact, average wind velocity for both period 2 (12 months) and period 3 (8 months) was over six miles per hour, greater by nearly two miles per hour than the mean wind velocity of the entire duration of the experiment. Furthermore, mean precipitation for period 2 (1.08 inch per month) was the second highest of the five monitoring periods.

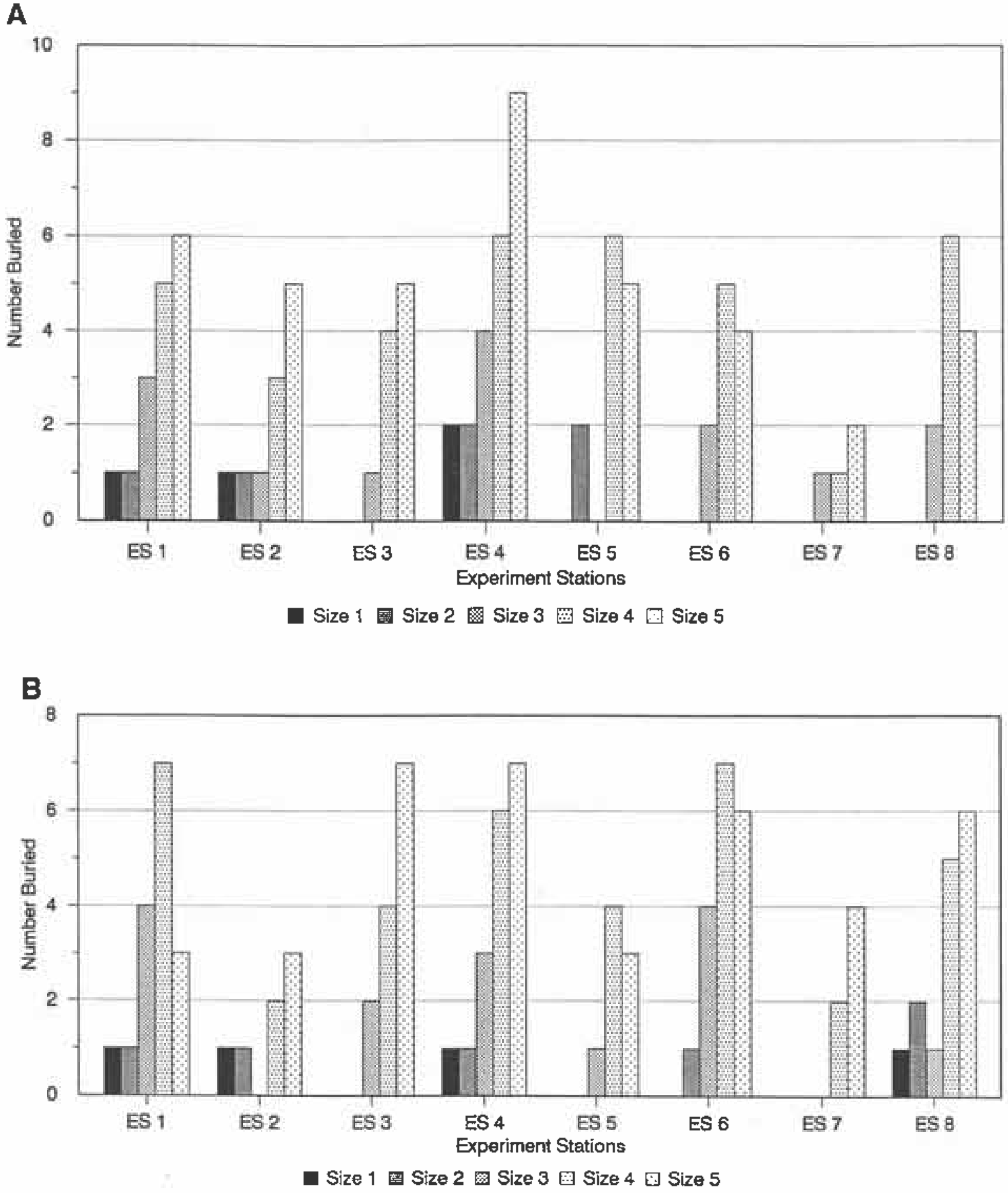

Figure 1. Exposure according to artifact size: (*A*) items found buried for at least one observation; (*B*) items found buried at final observation.

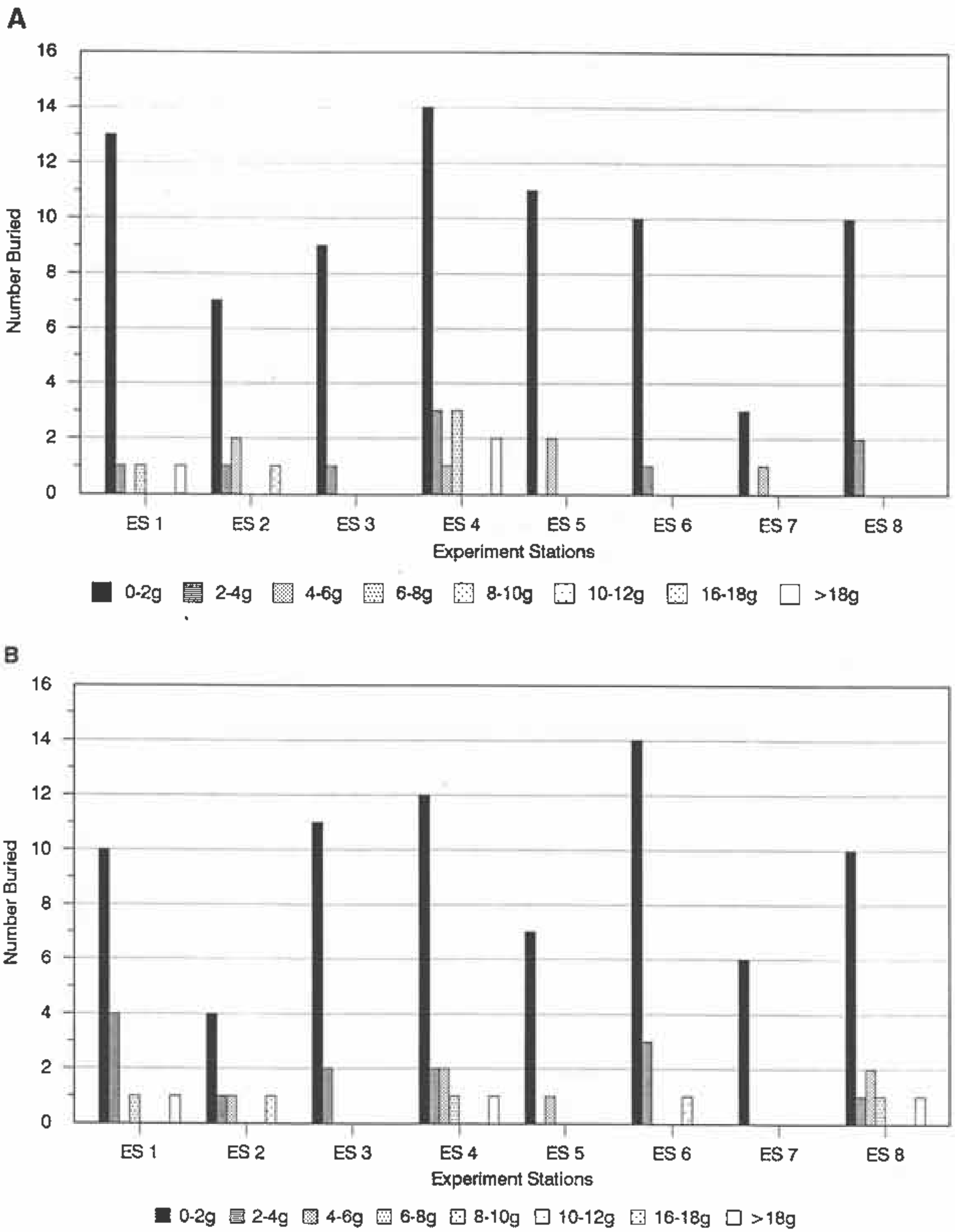

Figure 2. Exposure according to artifact weight: (*A*) items found buried for at least one observation; (*B*) items found buried at final observation.

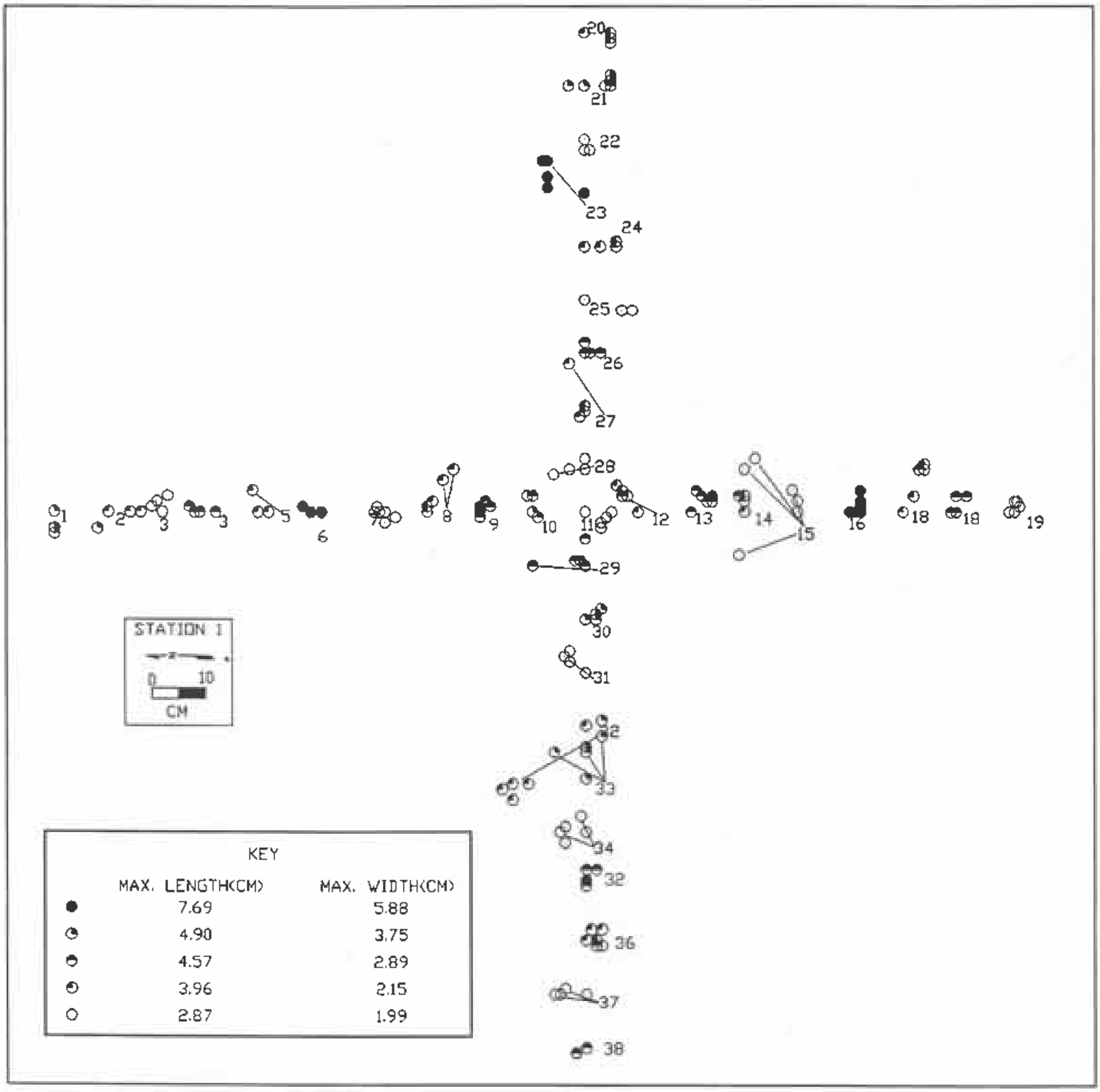

Figure 3. Artifact movement at experimental station 1 for the duration of the study.

CONCLUSIONS

One of the fundamental goals of this experiment was to assess the spatial integrity of lithic assemblages found in the study area. This assessment was needed to help establish the scale at which the surface density and diversity of artifactual materials might most profitably be analyzed. Results of this experiment permit two generalizations that are pertinent to archaeological research in this portion of the Colorado Plateau.

1. The smaller the artifact the more mobile that artifact will be through time, irrespective of the microenvironment. Smaller artifacts will be underrepresented in surface assemblages, due to their greater potential for burial. Wandsnider's (1989:16) long-term simulation analysis suggests

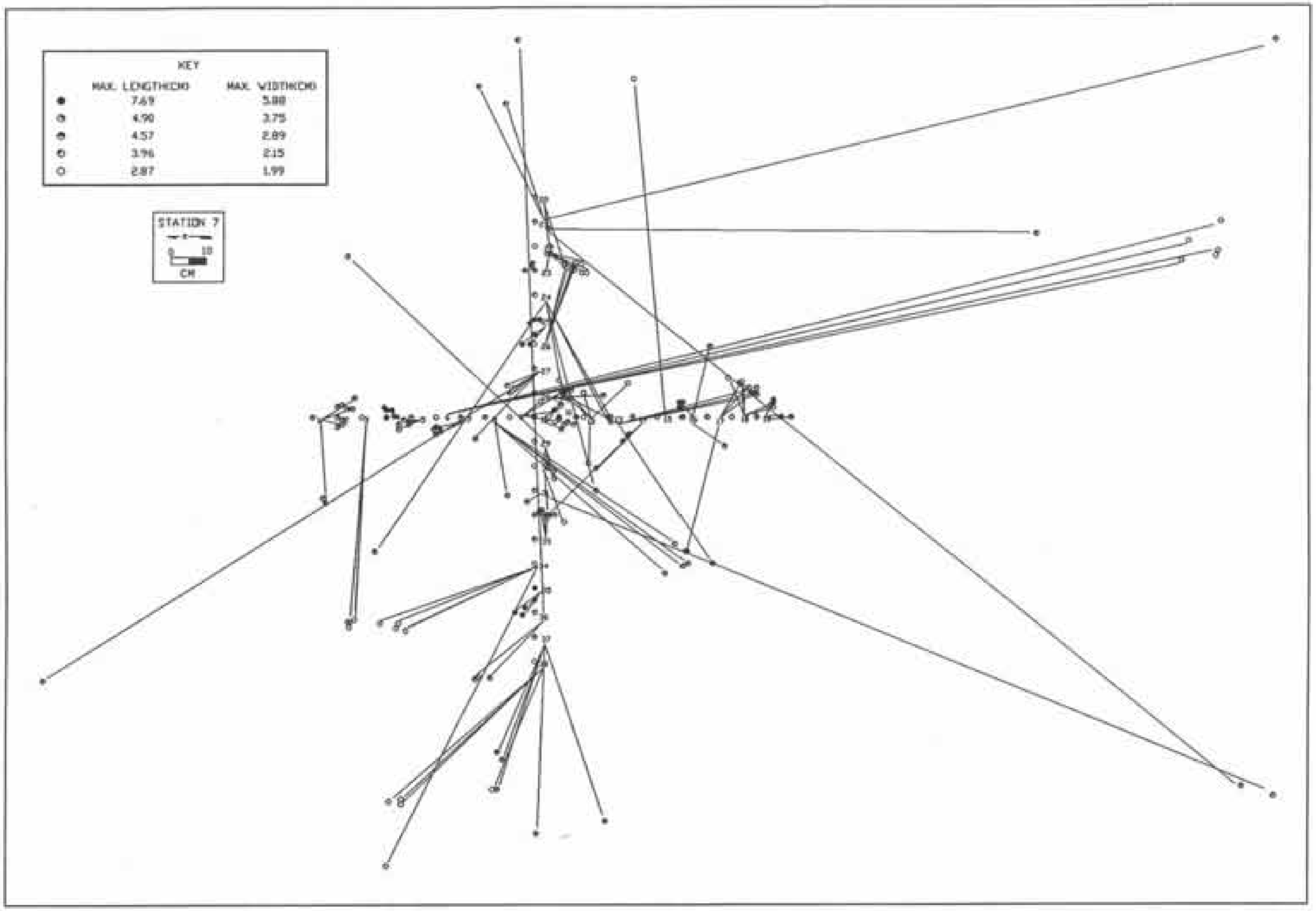

Figure 4. Artifact movement at experimental station 7 for the duration of the study.

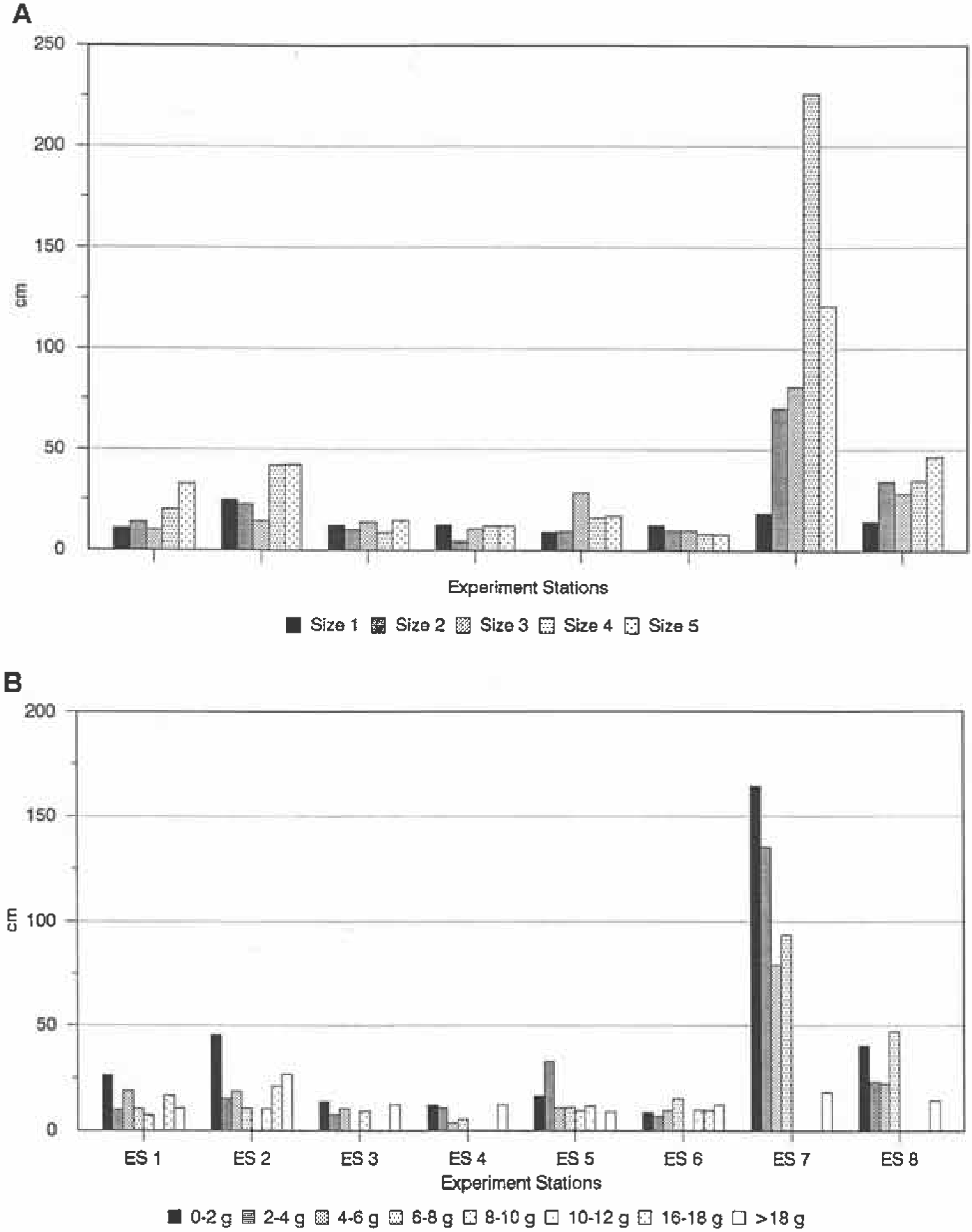

Figure 5. (*A*) Mean distance moved according to artifact size for all periods; (*B*) Mean distance moved according to artifact weight for all periods.

Table 5. Univariate F-Tests by Period

Period	F Score	Significance
Period 1	3.37973	.000
Period 2	1.45560	.070
Period 3	0.76751	.797
Period 4	1.86956	.006
Period 5	1.51747	.050

that the amount of dispersion an assemblage incurs is related to the size distribution of that assemblage. The dispersion depicted in these experiments is therefore potentially greater than that of an assemblage of approximately the same size artifacts deposited at any one point in time, due to the broad range of artifact sizes comprising each station.

2. The spatial integrity of artifactual assemblages on the Island-in-the-Sky district is sensitive to the microenvironment in which they were deposited. Artifact displacement, however, does not detract from the spatial information inherent in these assemblages when interest in patterns is on the order of .5 to 1 square meter (cf. Wandsnider 1988, 1989). The only exception to this generalization is the event of an artifact assemblage deposited on slickrock, a phenomenon characteristic of few sites located in this area.

The experimental stations described here remain in place. Hence, the mapping of horizontal displacement can be monitored indefinitely. Potentially more advantageous might be the systematic excavation of these plots to compile vertical data on artifact movement. This combined horizontal and vertical information can then be converted to data that allows systematic comparison with the data of other research for incorporation into long-term simulation analysis. Only by continuing analysis of the effect of natural processes on artifact assemblages will we be able confidently to adjust our scales of spatial analysis in different environments.

ACKNOWLEDGMENTS

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NOTES

1. The assemblage of artifacts used in this experiment were categorized by weight in 2 gram increments, up to 18 grams with those weighing more than 18 grams included as one category. Descriptive analysis of artifact behavior by weight is presented here as comparative data only. Some statistical tests could not be justifiably considered here because not all weight classes were represented at all stations. No artifacts weighing 12–16 grams were found in the assemblage, with the exception of one flake (13.7 g) placed at station 7 that has moved a total of 18.05 cm to date.

2. The burial of an artifact in this study is defined as being a minimum of 50% below surface at time of observation.

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FURTHER EXPERIMENTS IN NATIVE FOOD PROCUREMENT

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INTRODUCTION

Over the last decade, a number of experimental studies on the costs and benefits of collecting and processing a variety of native food resources have been conducted in the Great Basin and adjoining areas (e.g., Fowler and Walter 1985; Jones 1981; Larralde and Chandler 1980; Madsen and Kirkman 1988; Simms 1984). The goal of most of these is to collect data on resource return rates—the amount of edible food or energy that could be obtained in a given amount of time. These values are expressed as a ratio, such as calories per hour. Return rates for different resources can be compared and ranked, giving insight into the energetic efficiency with which various resources can be harvested. Most of this work is guided by optimal foraging theory and related models (see Charnov and Orians 1973; Pyke et al. 1977; Simms 1987; Smith 1983; Stephens and Krebs 1986).

Information on resource return rates has proven useful in understanding prehistoric hunter-gatherer subsistence practices in the Great Basin. For example, Simms (1985), using information on return rates for piñon nuts, hypothesized that they should have been utilized as soon as they were available in a region. When he examined the archaeological records of selected areas he found that ground stone, likely to have been important in processing piñon nuts, was often differentially distributed with respect to site age, being skewed toward later sites, prompting investigation into curation and re-use of ground stone by later inhabitants of an area. This research also influenced the investigation of Danger Cave, and engendered a fruitful search for evidence of early piñon nut use in the area (Madsen and Rhode 1990). The interpretation of remains excavated from Lakeside Cave would have been considerably different and inferior had experiments on grasshopper procurement not been conducted (Madsen and Kirkman 1988). Current investigations in the Silver Island Range have been influenced by information on return rates for pickleweed, a plant commonly found in Bonneville Basin sites. The discovery of large quantities of pickleweed stem material, and variable processing methods reflected in coprolites from different localities has prompted refinement of earlier interpretations, and additional studies on the energetic returns of pickleweed and other local resources are underway (Barlow 1990; Hall 1988; Madsen and Jones n.d.).

A most impressive and comprehensive application of this approach was conducted in the Stillwater Marshes of the Carson Desert, in western Nevada by Christopher Raven and Robert Elston (Raven 1990; Raven and Elston 1989). Combining biogeographical information with data and assumptions from foraging theory, they constructed a series of hypotheses about prehistoric resource use and how it should vary in different environmental circumstances. They posited that prehistoric foragers efficiently exploited the various habitat types available to them. Raven and Elston then constructed a model that identified the expected archaeological outcomes of the different foraging strategies employed in different areas, and conducted surveys to test the models. They found a strong correspondence between the hypotheses and the archaeology. The scientific approach to explaining archaeological data employed by Raven and Elston is innovative and powerful, and was made possible by experimentally-obtained resource return rate data.

Experimental return rates are now available for 30 collected resources from the Great Basin, and estimated return rates for a variety of hunted resources have also been produced (Simms 1984). Many of these rates are based on a single, or few experiments of limited duration and in a limited array of circumstances. We know, however, that a range of variation in the productivity, nutritional content, ease of harvesting, individual gathering and processing ability, and other factors is present (e.g., Madsen and Kirkman 1988). This variation is to be expected, and is an important facet of data to be considered when using return rate in modeling subsistence. We encourage additional experimentation on native resources, including resources for which information is currently available. In the following sections we present some information relevant to understanding the range of variation in some Great Basin resources. We report on experimental gathering of the Mormon Cricket (*Anabrus simplex*), and present the results of additional experiments on cattail (*Typha latifolia*) rhizomes and Indian Ricegrass (*Oryzopsis hymenoides*) seeds.

MORMON CRICKETS

Ethnographic and ethnohistoric data suggest that crickets (*Anabrus simplex*) were the most commonly collected insect resource in the eastern Great Basin (e.g., Egan 1917; Fowler and Fowler 1971; Gottfredson 1874). Collection strategies varied widely, but drives into trenches, brush corrals, or streams seem to have been most commonly employed. Less efficient methods, such as picking by hand, were also used. In our experiments with cricket collecting, we focused on two different methods in order to assess the range of variation in cricket return rates.

Our experiments took place in the Diamond Mountain area northeast of Vernal, Utah on July 1, 1986, and June 17, 1987, (Table 1). In both cases, the crickets were in a near-adult instar (the period between molts), and were migrating in bands. Average weight per cricket in our sample was 2.77 g, but in other studies in the same area adult weights averaged 3.56 g (DeFoliart et al. 1982) and 3.03 g (Tyus and Minckley 1988). Cricket bands often cover 1 km^2 and have been estimated to contain up to 30–60 metric tons of crickets (Tyus and Minckley 1988). Two separate analyses of crickets collected in our experiments yielded energy values of 1062 Cal/kg (calories per kilogram) and 1361 Cal/kg (live weight), and 3270 Cal/kg and 3630 Cal/kg (dry weight). These values are similar to results obtained by DeFoliart et al. (1982) of ca. 3700 Cal/kg (dry weight). Here we use the average weight and energy values determined in our analyses: 2.77 g/cricket, and 1212 Cal/kg live weight.

Our first test involved picking crickets individually from the ground surface and vegetative cover during their most active period. Crickets become more active with warmer temperatures; when cold or excessively hot they become more lethargic and are easier to collect by hand (Young 1978). We conducted our experiments during the mid-day period when crickets were quite active. The terrain was relatively flat, and the ground cover consisted of low sage and grasses.

We conducted five tests involving three individuals, one of whom made three of the collecting runs. All were males in good health ranging from 36 to 65 years of age. Individual A collected 46 crickets in 15 minutes, or 184/hr. Individual B collected 221 crickets in 15 minutes, or 884/hr. Individual C collected 56 crickets in 15 minutes, or 224/hr, 150 crickets in 15 minutes, or 600 /hr, and 242 crickets in 10 minutes, or 1452 crickets/hr in successive tests. This latter set of tests suggests a clear learning curve. Subjectively, it became easier to collect the crickets as we learned to judge their movements. The range of variation for collecting crickets in these five tests is 618 Cal/hr (calories per hour) to 4875 Cal/hr, with an average return rate of 2245 Cal/hr.

In the second experiment we collected crickets in the shallow water of a small reservoir where they had concentrated in a 3 m wide band of low *Juncus* along the water's edge. The crickets were not driven into the water, but were found there as part of a natural migration pattern. The crickets were collected by picking them from *Juncus* and the water surface. It was clear that with the right equipment the return rate could have been substantially increased. A large mouthed, tapered vessel containing holes large enough for water to pass readily through, but small enough to trap the crickets (e.g., a conical carrying basket) would have been perfect for the job.

Three tests were conducted by two individuals; a 41 year old male and a 31 year old female. Individual A collected 260 crickets in 5 minutes, or 3120 crickets/hr, individual B collected 471 crickets in 5 minutes, or 5652 crickets/hr and individual A collected 823 crickets in 5 minutes, or 9876 crickets/hr in a third test. Again, learning from both experience and observation appeared to play a role. The energetic return rates for collecting crickets from

Table 1. Cricket Collecting Experiments

Individual	Time (hr)	Number Collected	Weight at 2.77 g each	Calories at 1212/kg	Calories/hour
		Hand Picking, Open Field			
A	0.25	46	127	154	618
B	0.25	221	612	742	2,968
C	0.25	56	155	188	752
C	0.25	150	416	504	2,014
C	0.17	242	670	812	4,875
Sum	1.17	715	1,980	2,400	
Mean					2,245±1,758
		Hand Picking, Water's Edge			
A	0.08	260	720	873	10,475
A	0.08	823	2,280	2,763	33,156
B	0.08	471	1,305	1,581	18,975
Sum	0.25	1,554	4,305	5,217	
Mean					20,869±11,458
		Total—Both Experiments			
Sum	1.42	2,269	6,285	7,617	
Mean					9,229±11,497

a natural water trap ranged from 10,475 to 33,156 Cal/hr, with an average rate of 20,869 Cal/hr.

The return rates obtained in these experiments place crickets well above most gathered resources, but they are likely lower than what could have been obtained by an experienced gatherer, as the apparent effect of learning suggests that a practiced collector might do considerably better. The crickets collected in these experiments were not processed for consumption or storage, so it is important to note that the inclusion of processing time would reduce the apparent return rate, perhaps appreciably.

To examine how closely our experimental return rates may mirror ethnographic values, we calculated the return rate for an 1864 ethnohistoric account described by Gottfredson (1874:15):

> The squaws [placed] baskets in the ditch for the crickets to float into. The male Indians with long willows strung along about twenty feet apart whipping the ground behind the crickets driving them towards the ditch. . . [The crickets] tumbled into the ditch and floated down into the baskets. . . They got more than fifty bushels.

A bushel contains about 35 liters (l), so 50 bushels would contain about 1,750 l. Our measurements indicate that a liter contains about 200 crickets. The total taken in this episode would have been approximately 350,000 crickets, which at 2.77 g each, would amount to 970 kg. At 1212 Cal/kg, the total caloric value would have been 1,175,000 Cal. If the group included eight people working for an hour the return rate would be 146,875 Cal/hr. If there were eight people working for two hours it would be 73,437 Cal/hr. These figures are higher than we obtained collecting by hand, but in keeping with what we expect for mass collection techniques.

A report by a range scientist on cricket bands in Elko County, Nevada states that "Pit traps 5 ft (1.5 m) deep and 25 ft^3 (0.7 m^3) in volume have filled with crickets in 3 hours" (Young 1978:194). The total volume of 700 l of crickets at 200 crickets per liter, 2.77 g per cricket, and 1212 Cal per kg, would amount to 470,000 Calories. If it took a single person four hours to dig the pit, the return rate would be over 117,500 Cal/hr. Again, this figure does not include processing time for the crickets, but is an indication that with mass collection techniques, when large bands of crickets were available, native foragers might have obtained very high caloric returns, and had access to very large quantities of a highly nutritious food source.

CATTAIL ROOTS AND RICEGRASS SEEDS

Additional gathering experiments were conducted on cattail (*Typha latifolia*) roots and Indian ricegrass seeds (*Oryzopsis hymenoides*). Return rates for these resources have been reported elsewhere (Jones 1981; Simms 1984, 1987), and the experiments reported here are intended to add information relevant to understanding the range of variability in returns.

Cattails

Cattail rhizomes were collected in October 1990 from a small marsh along the Sevier River north of Marysvale, in Piute County, Utah. Seventeen individuals ranging in age from 10 to 58 participated in the experiment. The marsh was dry and the ground was relatively hard-packed. Rhizomes were excavated with digging sticks by the participants working singly or in groups of two or three, for 30 to 40 minutes. The results of the experiment are summarized in Table 2. Return rates for unprocessed rhizomes ranged from 0.2 kg/hr to 2.0 kg/hr, with a mean of 1.01 + 0.56 kg/hr.

Processing experiments were conducted on two of the samples. The rhizomes were rinsed in water, pounded between mano and metate, then squeezed in water to release the starch from the ropy fiber. In the first case, 800 g of rhizome was processed in 0.17 hr, and in the second case 600 g was processed in 0.33 hr. At this rate, 2.8 kg of rhizome could be processed in one hour, or 1 kg in .36 hrs. Previous experiments (Jones 1981) have shown that processing in this manner yields an edible portion (dry weight) of approximately 6.7% of the moist weight of the rhizome. The edible portion contains 3340 Cal per kilogram. Using these figures, the caloric return rate for the experiments ranges from 42 Cal/hr to 260 Cal/hr, with a mean of 160±67 Cal/hr.

The rates obtained here are comparable with rates obtained in other experiments. Jones (1981) reported a return rate of 128 Cal/hr for *Typha rhizomes* collected and processed by the same method described here. Simms (1987:32) reported a return rate of 267 Cal/hr for rhizomes processed by scraping off the outer covering and drying the rest.

Ricegrass seeds

Seeds of Indian ricegrass (*Oryzopsis hymenoides*) were collected in June 1991 in a sandy field south of Sevier, Utah. The patch was of moderate density, ranging from approximately five bunches per m^2 to 1 bunch per m^2. The seeds had just ripened and were beginning to drop. Sixteen gatherers collected for 25 minutes each, hand-stripping the seeds from the stalks. The total collecting effort yielded 3.4 kg of seeds and chaff collected in 6.7 hrs, or a yield of 0.5 kg/hr (Table 3). A portion of the seeds was processed by winnowing with hot coals to burn the chaff and parch the seeds, hand rubbing, and further winnowing. Beginning with 250 g of unprocessed seeds and chaff, a yield of 102 g of processed seeds (with very little chaff) was obtained with 23 minutes of processing. This results in a processing rate of .65 kg/hr, and a processed/unprocessed weight ratio of .41. At this rate the 3.4 kg obtained would process down to 1.4 kg of seed in 5.2 hr. The caloric value

Table 2. Typha Collecting Experiment

Collector, Age	Time (hr)	Yield (kg)	Kg/Hr	Edible Fraction (kg)	Processing Time (hr)	Calories at 3,340	Calories/ Hour
m-47 (with f-40)	0.50	1.00	2.00	0.07	0.36	224	260
f-40 (with m-47)	0.50	1.00	2.00	0.07	0.36	224	260
f-37	0.50	0.50	1.00	0.03	0.18	112	165
f-49	0.50	0.60	1.20	0.04	0.22	134	188
f-40 (with f-49)	0.50	0.30	0.60	0.02	0.11	67	110
f-49 (with f-40)	0.50	0.30	0.60	0.02	0.11	67	110
f-40 (with f-13 & f-10)	0.50	0.53	1.06	0.04	0.19	119	172
f-13 (with f-40 & f-10)	0.50	0.53	1.06	0.04	0.19	119	172
f-10 (with f-40 & f-13)	0.50	0.53	1.06	0.04	0.19	119	172
f-23	0.50	0.80	1.60	0.05	0.29	179	227
f-50	0.50	0.10	0.20	0.01	0.04	22	42
f-48	0.50	0.20	0.40	0.01	0.07	45	78
f-48	0.50	0.30	0.60	0.02	0.11	67	110
m-58	0.50	0.80	1.60	0.05	0.29	179	227
m-44	0.67	0.90	1.34	0.06	0.32	201	203
f-39 (with f-37)	0.67	0.30	0.45	0.02	0.11	67	86
f-37 (with f-39)	0.67	0.30	0.45	0.02	0.11	67	86
Mean:		0.53	1.01			118	157
Standard Deviation:		0.28	0.56			64	67

for ricegrass seed is 2850 Cal/kg (Jones 1981), thus the value for the collected seed is 3962 Cal, collected in 6.7 hrs and processed for 5.2 hrs, yielding a return rate of 333 Cal/hr.

This rate compares favorably with previously published rates. Simms (1987:119-120) reported rates of 301 Cal/hr, 364 Cal/hr, and 392 Cal/hr obtained in three separate experiments. Jones (1981) reported a return rate of 336 Cal/hr. Data on selected Great Basin collected resources, including the experiments reported here, are summarized in Table 4.

DISCUSSION

Collecting experiments such as these serve several purposes. The primary goal is to obtain information on the efficiency with which various native resources could have been obtained by prehistoric peoples. This information can be used to interpret data from archaeological sites, to form predictions about resource use, settlement patterns, and seasonality, and to guide archaeological data collection. In addition, by conducting gathering

Table 3. Ricegrass Collecting Experiment

Number of collectors:	16.00
Time, each (hr):	0.42
Total time (hr):	6.67
Total yield (kg):	3.40
Processing time (hr):	5.30
Edible portion (kg):	1.39
Calories at 2850/kg:	3,962.00
Return rate (cal/hr):	333.00

Table 4. Energetic Return Rates for Selected Great Basin Collected Resources (Data from Simms [1987] and this paper, except where noted)

Rank	Resource	Return Rate (Cal/hr)			Number of Experiments
		Range	Mean	Standard Deviation	
1	Grasshoppers[1] (*Menlanoplus sanguinipes*)	4,160–71,441	27,265	27,366	5
2	Mormon Crickets (*Anabrus simplex*)	618–33,156	9,229	11,497	8
3	Cattail (pollen) (*Typha latifolia*)	2,750–9,360	5,739	—	2
4	Pandora Moth[2] (larvae) (*Coloradia pandora lindseyi*)	1,840–2,753	2,407	—	3
5	Gambel Oak (acorns) (*Quercus gambelli*)	1,488	2,232	—	2
6	Bulrush (seeds) (*Scirpus acutus*)	1,699	1,699	—	1
7	Tansymustard (seeds) (*Descurainia pinnata*)	1,307	1,307	—	1
8	Bitterroot (roots) (*Lewisia rediviva*)	1,237	1,237	—	3
9	Shadscale (seeds) (*Atriplex confertiflora*)	1,200	1,200	—	1
10	Salina Wild Rye (seeds) (*Elymus salinas*)	921–1,238	1,080	—	2

Table 4. Energetic Return Rates for Selected Great Basin Collected Resources (Data from Simms [1987] and this paper, except where noted) (Continued)

Rank	Resource	Return Rate (Cal/hr)			Number of Experiments
		Range	Mean	Standard Deviation	
11	Nuttal Shadscale (seeds) (*Atriplex nuttalli*)	1,033	1,033	—	1
12	Piñon Pine (nuts) (*Pinus monophylla*)	841–1,408+	941	—	3
13	Barnyard Grass (seeds) (*Echinocholoa crusgalli*)	702	702	—	1
14	Peppergrass (seeds) (*Lepidium* sp.)	537	684	—	2
15	Bluegrass (seeds) (*Poa compressa*)	491	491	—	1
16	Sunflower (seeds) (*Helianthus annus*)	467–504	486	—	2
17	Bulrush (seeds) (*Scirpus paludosus*)	470	470	—	1
18	Bluegrass (seeds) (*Poa bulbosa*)	418	418	—	1
19	Great Basin Wild Rye (seeds) (*Elymus cinereus*)	266–473	370	—	2
20	Indian Rice Grass (seeds) (*Oryzopsis hymenoides*)	301–392	345	34	5
21	Bulrush (seeds) (*Scirpus microcarpus*)	302	302	—	1
22	Reed Canary Grass (seeds) (*Phalaris arundinacea*)	261–321	291	—	2
23	Scratchgrass or Dropseed (seeds) (*Sporobolis asperifolius* and *Muhlenbergia asperifolia*)	162–294	249	—	3
24	Foxtail Barley (seeds) (*Hordeum jubatum*)	138–273	206	—	2
25	Sedge (seeds) *Carex* (species unknown)	202	202	—	1

Table 4. Energetic Return Rates for Selected Great Basin Collected Resources (Data from Simms [1987] and this paper, except where noted) (Continued)

Rank	Resource	Return Rate (Cal/hr) Range	Mean	Standard Deviation	Number of Experiments
26	Bulrush (roots) (*Scirpus* sp.)	160–257	200	—	3
27	Cattail (roots) (*Typha latifolia*)	42–267	161	68	19
28	Saltgrass (seeds) (*Distichlis stricta*)	146–160	153	—	2
29	Pickleweed (seeds) (*Allenrolfea occidentalis*)	90–150	111	—	3
30	Squirreltail Grass (seeds) (*Sitanion hystrix*)	91	91	—	1

[1] Madsen and Kirkman (1988)
[2] Fowler and Walter (1985)

experiments, we find that our understanding of the decisions faced by aboriginal foragers is enhanced in many intangible ways, such as an increased appreciation of the enormity of the problem of finding food in an inhospitable region. Besides, these experiments are just plain fun.

Experimental or actualistic data are a necessary component of contemporary archaeology, but it is important that they be used as part of a systematic, theoretically-grounded approach to the study of prehistoric human behavior. Proper use of models, and critical examination of the limitations of the approach and data are crucial. Experimental data on resource return rates are simply samples of the great potential range of variation expected for all resources. We expect that for any given resource, the return rates obtained would approximate a normal distribution about some mean, with variation influenced by resource density, quality, and condition, gatherer skill, gatherer motivation, gatherer time constraints, technology, weather, competition, and other factors. By conducting a number of experiments we hope to be able to better comprehend the nature of the variability in return rates and increase the applicability and reality of hypotheses based on them. The relatively good agreement obtained between the results of different experiments may only indicate that we have been consistent in our methods, however, it is apparent that the results obtained to date are relatively robust: additional experiments on a given resource have rarely had a significant effect on that resource's placement in the rankings. We do not want to imply that additional precision is needed, as the rates and rankings currently available are adequate for the kinds of applications and models that require them (Simms 1987:42). Our goal is to increase the strength of predictions that use return rate data by strengthening the data upon which they draw.

Criticisms of the experiments conducted to date have emphasized that collection by novices may be of limited utility (e.g., Bettinger 1991). We are certain that the figures we have presented are lower than average native collectors could have obtained. Our gathering and processing skills are limited at best, and the participants in experiments are not motivated by the necessity of feeding a family or of storing food for the winter. We hope, however, that with increased numbers of replications, we will begin to get a feel for the kind of variability to expect, and for the factors that may influence the variability. We have no doubt that, despite shortcomings of the experimental approach, it is infinitely better to have obtained data on the energetics of resource use through experiment, than to have assumed them (e.g., Bettinger and Baumhoff 1982, 1983).

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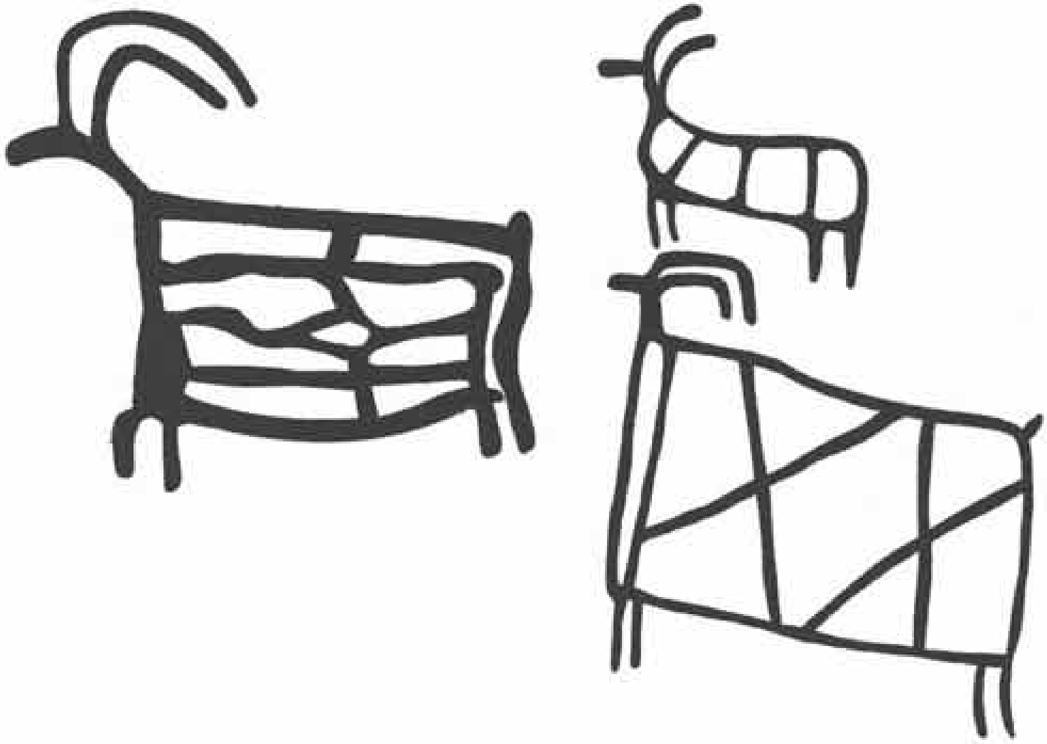
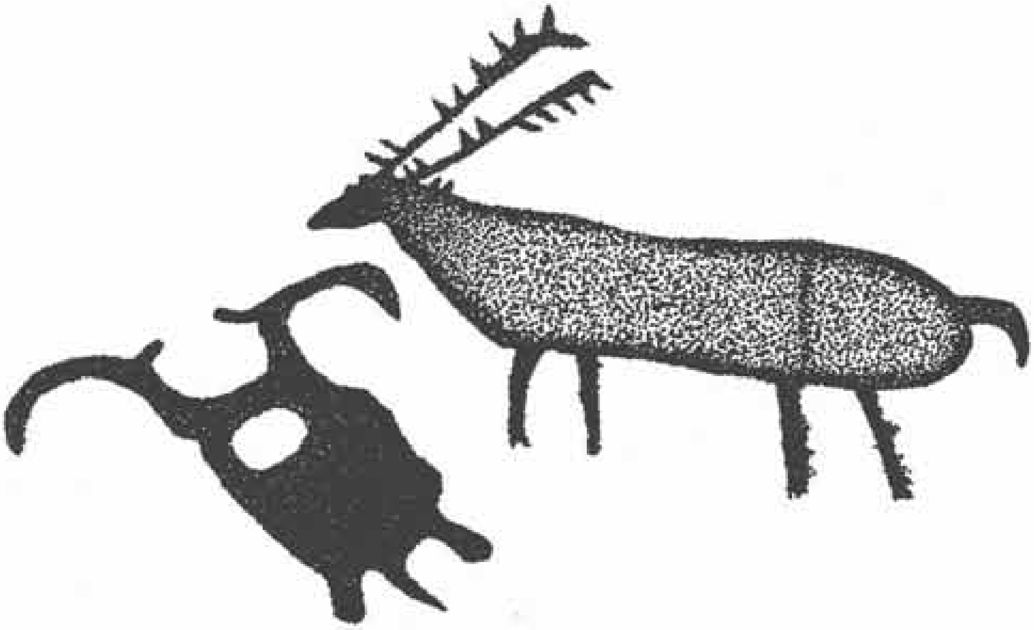


Paria Canyon Wilderness Area



Near Manila, northeastern Utah

NOTES

FLUTED PROJECTILE POINTS IN SOUTHWESTERN UTAH

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INTRODUCTION

Copeland and Fike (1988) published their comprehensive paper, *Report on Fluted Points in Utah*, in *UTAH ARCHAEOLOGY 1988*. Their research of published and unpublished reports and interviews with professional archaeologists and some private collectors identified 43 Clovis and Folsom projectile points in the state. Only two Clovis and three Folsom points were recorded in southwestern Utah, most of them in Bureau of Land Management files and few in private collections.

Since this southwestern region has seen the collecting of artifacts as a hobby from the time of the first settlement by Europeans in 1855, it was presumed that more of these earliest points were unrecorded. The great number of man-hours that are devoted to private arrowhead hunting makes virtually insignificant those hours available to a minimum number of professionals in seeking these diagnostics of the first American culture.

The Jennifer Jack-Dixie Chapter of the Utah Statewide Archaeological Society initiated a project to seek out privately-held Paleo points within an approximate 65-mile radius of St. George. A grant was awarded to the chapter by the Utah Division of State History for the project with 50 percent or more of the grant amount to be matched by local cash outlay. With the exception of hourly rate paid for the drawings, all other time was voluntary.

Fluted points are the primary diagnostic of the Clovis people of 11,500 to 11,000 years ago and of the Folsom people who followed. None of these fluted points, so accurately dated elsewhere in the Americas, has been found in a datable context in Utah or the Great Basin. It was anticipated that this project could locate fluted points with other cultural associations or tools.

Clovis points are usually about 3 to 5 inches long (7.6 cm to 12.8 cm), and wide willow-leaf or lanceolate in shape. They are unnotched but usually fluted on either or both sides with the flute extending upward from a concave base to about one-third or less of the point length (Copeland and Fike 1989). In the majority of these points the cutting edge is flaked into a perfectly straight linear alignment. The classic shape is symmetrical. The flute is centered on the axis, and the lower edges of the point and base of the flute indicate grinding—perhaps to avoid cutting the sinew binding. The points are often superbly thinned by percussion with the transverse flakes reaching the centerline of the point or beyond.

Some authors speculate that these early hunters occasionally carried fine-grained siliceous stone blanks, preforms, or finished points nearly 200 miles from material sources. This also warrants speculation that the unworked or finished points may have been trade items.

METHODOLOGY

Since the primary effort was directed toward revealing fluted points in private collections, the need to encourage public participation was obvious. Media publicity appeared to be the most practical approach. This coverage, originating in St. George, would cover Washington County, partially cover Iron and Kane counties, as well as Mojave and Coconino counties in the Arizona Strip District, and in Lincoln County, Nevada.

Handouts with drawings of both partial and complete specimens of fluted points were distributed by chapter members to friends and acquaintances who were known to have collections. The handouts were also posted or distributed in area libraries, laundromats, supermarkets and other businesses.

A chapter news release was published in the St. George daily *Spectrum* newspaper, and hand-delivered to local radio stations KDXU/KZEZ, KONY,

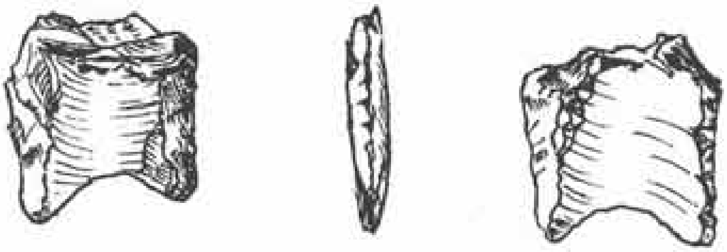

Figure 1. Projectile point number 1, probable Clovis base.

KREC/FM, and KSGI. All of the stations apparently broadcast the release, according to member listener reports.

Public reaction was initially favorable considering the known scarcity of fluted points. A number of telephone responses were received during which the callers would not identify themselves, but promised to stop by and show their Clovis or Folsom specimens. They did not.

Some individuals rather reluctantly said they would allow us to see and photograph their suspected points, but only on their own premises and would not allow borrowing of the points.

It became apparent that all of the anti-vandalism, anti-looting publicity in years is a double-edged sword. It has cut down on some private collecting, but it has also cut off from research many artifacts of considerable importance now hidden away in private collections. Almost all of the private collectors expressed concern about confiscation, fines, and even imprisonment. It is obvious that at least some knowledge of state and federal antiquities law is widespread.

Those individuals who did permit an on-premise interview were apparently pleased with the professionalism of the chapter crew in the photography, measurement, and drawing and molding of their points. They were also pleased with the information about Clovis and Folsom lifeways discussed with them—even when their suspected points turned out not to be fluted.

A work sheet was prepared for each point to gather as much information as possible. The few points that were loaned to the chapter were checked in during a personal visitation with Rick Malcomson, archaeologist and resource area manager, Arizona Strip, Shivwit District, Bureau of Land Management, and with Gardiner Dalley, archaeologist, Cedar City District, Bureau of Land Management.

Two fluted points were identified during the project. These are described below.

POINT DESCRIPTIONS

Point Number 1. This is probably the lower one-third or one-fourth of an obsidian Clovis point with the transversal breakage above the flute on both sides (Figure 1). It measures 23 mm at the widest, 26 mm in length, with a maximum thickness of 11 mm above the flutes. The flutes measure 24 mm and 17 mm, both apparently struck with a single percussive blow. Both edges and the base are dulled and show evidence of grinding. The point was patinated and unavailable for laboratory testing, although the nearest major source of obsidian is north and south of Modena adjacent to the Nevada state line.

The point was a surface find (by Jim Wade, St. George) in 1964 in the first wash west of SR 18 and just north of the Snow Canyon State Park north entry, approximately seven miles north of St. George. No other evidence of prehistoric peoples was noted by the collector at the site and it may be assumed that it was a point broken during hunting, perhaps by striking one of the wash rock faces. Petroglyphs are nearby, however. One-half mile east in Dammeron Valley there is evidence of later rock-rimmed pithouses, several panels of rock art and a now-dry seep in a shallow cave. Within the general area are a number of natural sandstone tanks, which hold rainwater for lengthy periods.

Point Number 2. This is a near-classic Clovis point found in 1984 (by Brooks Pace, St. George) on the surface in the eastern part of Diamond Valley Estates (Figure 2). The owner is the developer of the land and reports no other evidence of flaking or habitation near the site, which is located approximately 20 miles north of St. George.

The point measures 35 mm at the widest, 11 cm in length, with a maximum thickness of 8.5 mm above the flutes. Both flutes measure 31 mm in length, and are 12 to 15 mm in width, respectively. One flute was made with a single percussion blow, the other with two strikes ending in a small transversal hip fracture. Both edges are dulled the length of the flutes, as is the concave base.

The point is made of fine-grained chert with mottled bronze alternating with light and dark tan banding. The owner has carried it wrapped in a bandanna as a pocket showpiece, which has had an effect of polishing the point surfaces. Normally, a surface find in this area will show a sandblasted surface on the exposed face while the reverse will show sharper flaking detail (Rick Malcomson, personal communication 1991).

The nearest current water source is the Santa Clara River, about three miles west, but the meadow in which the point was found, may have been a shallow swamp in times past. It is now surrounded by low hills covered with piñon-juniper.

The only Folsom points seen during the investigation were said by their owners to have come from Idaho and Colorado.

DISCUSSION

One of the barriers to archaeological research by avocationalists in southwestern Utah is the distance factor. Most of the professional reports are housed in libraries 300-plus miles northward. The Interlibrary loan system is very helpful but time consuming, somewhat slow in response, and incomplete especially regarding unpublished manuscripts. Access to reference material from this corner of the state is very difficult.

Furthermore, most of the published reports rely heavily on extrapolated information, i.e., quoting from authors who have quoted from earlier authors who have, etc., ad infinitum.To avoid this redundancy and to bypass the difficulties of research papers, this amateur paper has summarized from the most recent summarizers who have had the time and income to study the complete file on Clovis and Folsom finds.

There is, in reality, nothing much new that this project can add about these Clovis lifeways. Recent discoveries are primarily addenda; another surface find, another location, but very little disturbance of previous information or conclusions.

Something can be learned from this paper: efforts to invade private collections are frustrating! In spite of all of the diplomacy, the publicity, the need for information, and the assurance that confiscation or other legal action would not follow such revelation, there is a severe paranoia present in collectors' minds. Another reason given by one collector for not sharing information was his concern that the early dates for the presence of Clovis people might conflict with the origin of Native Americans in certain widely-held religious beliefs.

Often, cooperating collectors did not know what they had collected. In several instances, numerous telephone calls were made to establish that they, indeed, did have a Paleo point. What frequently turned up were concave-based, basally-flaked, but not fluted points.

The matter of provenience is equally frustrating. The failure to obtain contextual data can be excused where artifacts are inherited, but, to many, it means only "somewhere east of town X or Y." Rarely is there any information about other evidence at the find-site, no recollection of any debris, debitage, bones, or intrusive rock or hearths. In light of the scarcity of information about Paleo-Indians in Utah, any find (even surface) is important and its

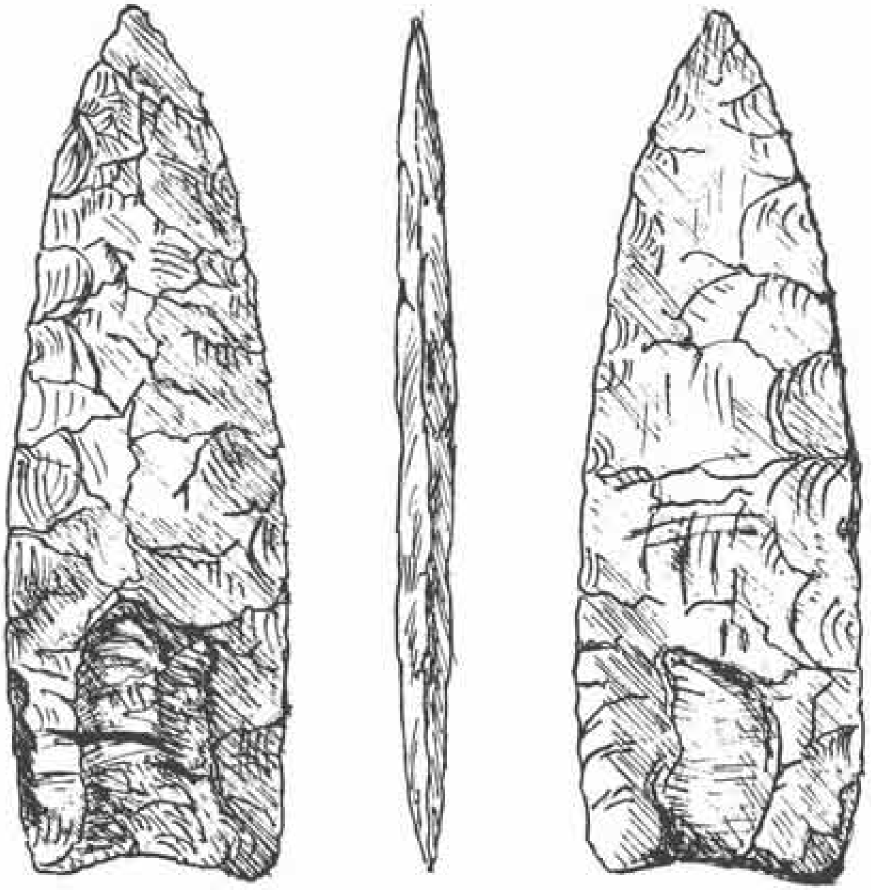

Figure 2. Projectile point number 2, classic Clovis point.

provenience should be carefully documented by a professional, if possible. A buried Paleo site would, of course, be extremely important since none are known in the state and if such a locale is suspected professionals should be called. Certainly no ground disturbing activities should be carried out at such a site.

From an archaeological standpoint the cold-fact results of this project are simply two more dots on the map of Paleo travel in Utah. They merely reinforce the obvious: that these people were nomadic, built biodegradable shelters, and lost or broke their uniquely-fluted points in hunting or travel.

ACKNOWLEDGMENTS

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My sincere thanks to Joel Janetski for providing a sense of direction to these amateur notes, an attention to objectivity and elimination of excess and redundant diagnostics of fluted point people.

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SOME CALIBRATED RADIOCARBON DATES FROM UTAH COUNTY, UTAH

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INTRODUCTION

Over the last 45 years archaeologists at Brigham Young University have sporadically undertaken a number of excavations on the east side of Utah Lake in the region near the modern airport and in the southern portion of Utah Valley near Goshen, Utah. These excavations centered on the Hinckley Mounds, a group of low mounds on the property of G. M. Hinckley (Figure 1), an area previously tested by Julian Steward (1933) and Albert Reagan (1935). However, investigations in other sites in the vicinity, but not on the Hinckley property, such as Seamons Mound and the Smoking Pipe site, were also investigated. With the exception of Seamons Mound, all of these mounds proved to be single component sites occupied by the Fremont as indicated by standard Fremont artifact and feature configurations. Two sites near Goshen, Utah, Spotten Cave and Woodard Mound (Figure 2) were also excavated. Woodard Mound was determined to be a Fremont site, while Spotten Cave exhibited usage from Archaic through modern times.

The results of these excavations have only been partially reported, primarily in master's' theses (Christensen 1947; Green 1961; Mock 1971; Richens 1983); however, a few preliminary reports or articles (Green 1964; Forsyth 1984; 1986) have also been published. For this reason I have undertaken a reanalysis of the archaeological materials from these excavations in order to provide a synthesis of the work done there over the years and to bring more up-to-date the data that have been published. Consequently I discovered that a number of potential C^{14} samples were recovered from several of these sites, but had never been analyzed. Unfortunately, they had been stored under variable conditions in the Museum of Archaeology and Ethnology (now the Museum of Peoples and Cultures). Some of them had been stored in cloth bags, others in paper bags, and still others carefully wrapped in aluminum foil. However, since there were few chronometric dates for these sites, I decided to take a number of the samples and send them to Beta Analytic Inc. for assay in order to try to establish a chronological framework for the sites on the basis of something other than cross-dating with other Fremont sites. The sites for which dates were obtained are 42Ut110 and 42Ut111 (two of the Hinckley Mounds) 42Ut102 (Woodard Mound), 42Ut150 (Smoking Pipe), Spotten Cave (42Ut104), and 42Ut271 (Seamons Mound). The results of the C^{14} analyses are given in Table 1.

Calibration of radiocarbon ages is done to correct for the variation in the amount of atmospheric radiocarbon produced over time. Thus, it is necessary to calibrate the radiocarbon ages into calendar years using data collected by measuring the radiocarbon age of tree rings, whose calendar age could be determined by tree ring dating independently of C^{14}. Using this

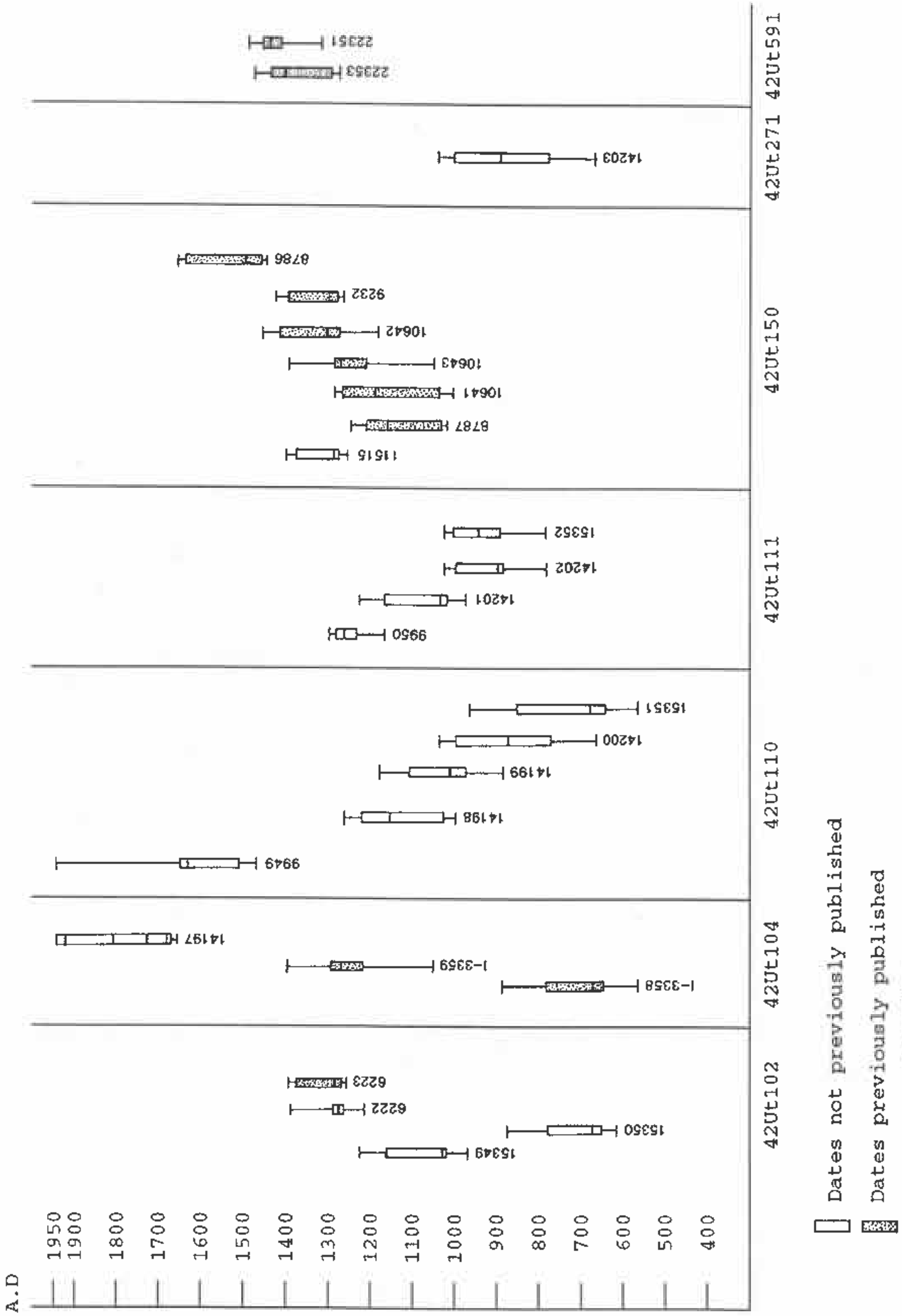

Figure 1. Some calibrated radiocarbon dates for Utah County sites A.D. 500–present.

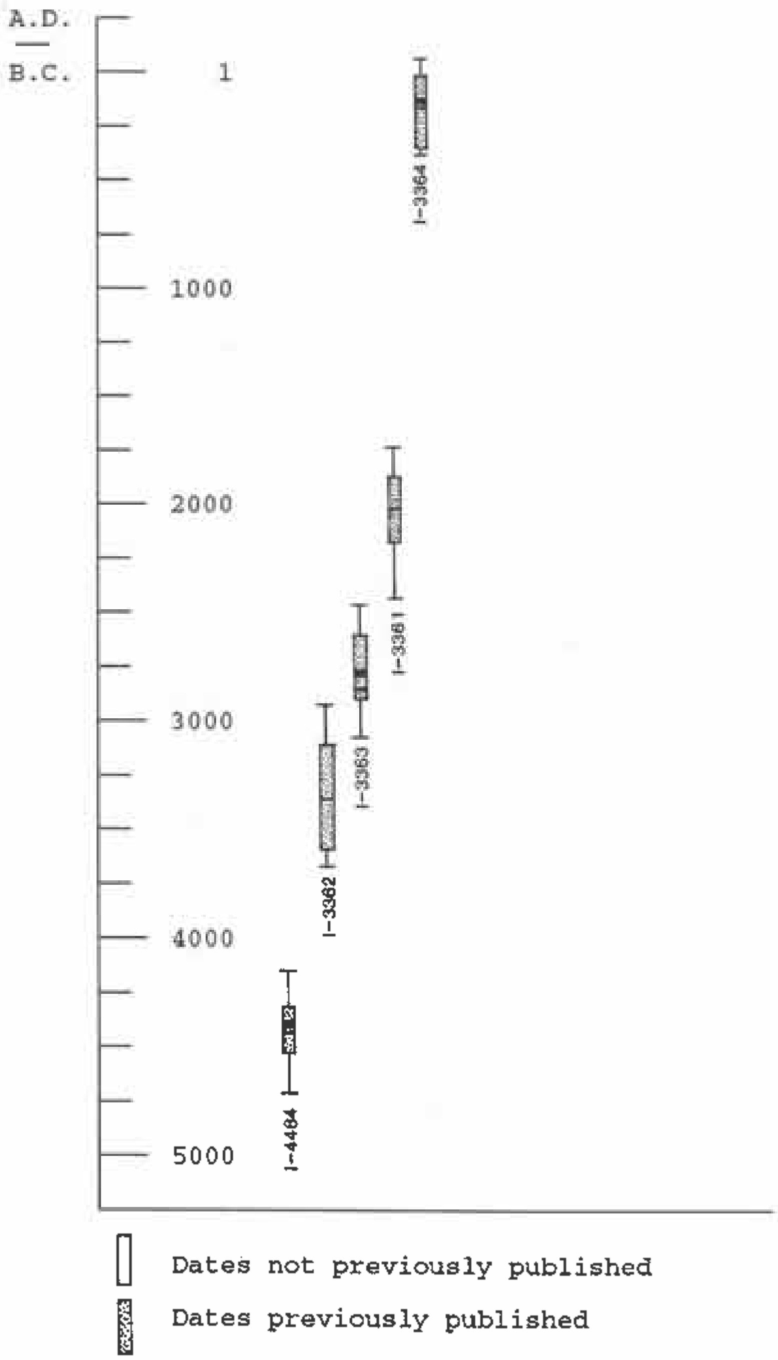

Figure 2. Some calibrated radiocarbon dates for 42Ut104 5000 B.C.–A.D. 1.

Table 1. Calibrated Dates for Some Previously Unpublished Radiocarbon Dates from Utah Valley

Site	ID Number	Radiocarbon Age	One Sigma Maximum-Minimum of Calibrated Age Ranges	Two Sigma Maximum-Minimum of Calibrated Age Ranges
42Ut102[1]	Beta-15349	950±70	A.D. 1022 **(1035)** 1166	A.D. 970 **(1035)** 1230
42Ut102	Beta-15350	1300±70	A.D. 657 **(681)** 781	A.D. 620 **(681)** 890
42Ut104[2]	Beta-14197[a]	130±50	A.D. 1672 **(1689,1732,1811,1926,1955)** 1955	A.D. 1660 **(1689,1732,1811,1926,1955)** 1950
42Ut110[3]	Beta-9949	290±50	A.D. 1514 **(1639)** 1654	A.D. 1470 **(1639)** 1953
42Ut110	Beta-14198	900±70	A.D. 1027 **(1160)** 1221	A.D. 1000 **(1160)** 1270
42Ut110	Beta-14199	1000±70	A.D. 979 **(1018)** 1113	A.D. 890 **(1018)** 1180
42Ut110	Beta-14200	1140±100	A.D. 780 **(891)** 1000	A.D. 670 **(891)** 1040
42Ut110	Beta-15351	1290±100	A.D. 650 **(685)** 860	A.D. 567 **(685)** 970
42Ut111[3]	Beta-9950	770±60	A.D. 1221 **(1262)** 1277	A.D. 1160 **(1262)** 1290
42Ut111	Beta-14201	960±60	A.D. 1012 **(1030)** 1160	A.D. 970 **(1030)** 1220
42Ut111	Beta-14202	1120±60	A.D. 880 **(897)** 986	A.D. 780 **(897)** 1020
42Ut111	Beta-15352	1100±60	A.D. 886 **(960)** 999	A.D. 780 **(960)** 1020
42Ut150[4]	Beta-11515	680±50	A.D. 1272 **(1283)** 1375	A.D. 1258 **(1283)** 1395
42Ut271[5]	Beta-14203	1140±100	A.D. 780 **(891)** 1000	A.D. 670 **(891)** 1040

[1] Woodard Mound
[2] Spotten Cave
[3] Hinckley Mounds
[4] Smoking Pipe
[5] Seamons Mound

[a] Zone III-Fremont (see Mock 1971:71-81)

Table 2. Calibrated Dates for Previously Published Radiocarbon Dates from Utah Valley

Site	ID Number	Radiocarbon Age	One Sigma Maximum-Minimum of Calibrated Age Ranges	Two Sigma Maximum-Minimum of Calibrated Age Ranges
42Ut102[1]	Beta-6222	700±60	A.D. 1265 (**1279**) 1295	A.D. 1220 (**1279**) 1395 (Richens 1983; Janetski 1990)
42Ut102	Beta-6223	670±50	A.D. 1275 (**1285**) 1379	A.D. 1260 (**1285**) 1400 (Richens 1983; Janetski 1990)
42Ut102	Beta-6224	Modern		(Richens 1983)
42Ut104[2]	I-3821[a]	12400±180	[beyond calibration limits]	(Mock 1971)
42Ut104	I-4484[b]	5580±120	B.C. 4573 (**4456,4417,4403**) 4340	B.C. 4720 (**4456,4417,4403**) 4162 (Mock 1971)
42Ut104	I-3362[b]	4640±120	B.C. 3616 (**3373**) 3142	B.C. 3690 (**3373**) 2947 (Mock 1971)
42Ut104	I-3363[b]	4200±120	B.C. 2920 (**2880,2798,2782**) 2611	B.C. 3094 (**2880,2798,2782**) 2470 (Mock 1971)
42Ut104	I-3361[c]	3660±110	B.C. 2199 (**2037**) 1890	B.C. 2453 (**2037**) 1750 (Mock 1971)
42Ut104	I-3364[c]	2110±100	B.C. 358 (**160,138,124**) 10	B.C. 390 (**160,138,124**) A.D. 80 (Mock 1971)
42Ut104	I-3358[d]	1310±90	A.D. 647 (**677**) 786	A.D. 567 (**677**) 890 (Mock 1971)
42Ut104	I-3359[d]	730±90	A.D. 1225 (**1272**) 1295	A.D. 1057 (**1272**) 1400 (Mock 1971)
42Ut150[3]	Beta-8786	360±50*	A.D. 1452 (**1486**) 1633	A.D. 1440 (**1486**) 1650 (Janetski 1990)
42Ut150	Beta-9232	640±70	A.D. 1277 (**1295**) 1398	A.D. 1260 (**1295**) 1420 (Janetski 1990)
42Ut150	Beta-10642	640±110	A.D. 1270 (**1295**) 1410	A.D. 1180 (**1295**) 1450 (Janetski 1990)
42Ut150	Beta-10643	770±80	A.D. 1207 (**1262**) 1281	A.D. 1043 (**1262**) 1384 (Janetski 1990)
42Ut150	Beta-10641	860±90	A.D. 1034 (**1182**) 1262	A.D. 1000 (**1182**) 1280 (Janetski 1990)
42Ut150	Beta-8787	890±50	A.D. 1039 (**1163**) 1217	A.D. 1020 (**1163**) 1250 (Janetski 1990)
42Ut591[4]	Beta-22351	490±60*	A.D. 1403 (**1427**) 1446	A.D. 1310 (**1427**) 1482 (Janetski 1990)
42Ut591	Beta-22353	570±90	A.D. 1287 (**1398**) 1431	A.D. 1270 (**1398**) 1470 (Janetski 1990)
42Ut591	Beta-22354	2600±100	B.C. 838 (**801**) 608	B.C. 977 (**801**) 410 (Unreported)

*Incorrectly reported in Janetski 1990

[1] Woodard Mound
[2] Spotten Cave
[3] Smoking Pipe Site
[4] Heron Springs Site

[a] Provo stage of Lake Bonneville (Mock 1971:12)
[b] Zone I of Spotten Cave–Archaic (Mock 1971:61)
[c] Zone II of Spotten Cave–Archaic (Mock 1971:66)
[d] Zone III of Spotten Cave–Fremont (Mock 1971:71)

data, calibration curves for radiocarbon ages over the last 9,000 years have been constructed. Calibrated dates for the Utah County samples were obtained using the CALIB[1] program and Method A for calibrated radiocarbon age ranges (Stuiver and Reimer 1986). Calibrated ages and ranges are reported in columns 4 and 5 of Table 1 by giving "the extremes of the 1 sigma or 2 sigma ranges with the calibrated ages between them in parentheses" (Stuiver and Reimer n.d.:7). Figures 1 and 2 show these dates in graphic form.

In addition to the above dates, a number of radiocarbon dates for Utah Valley have been published in theses and other publications. The calibrations for some of those dates are given in Table 2 and shown graphically also in Figure 1 and Figure 2.

NOTE

1. University of Washington Quaternary Isotope Lab Radiocarbon Calibration Program, 1987.

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ANTIQUITIES SECTION, DIVISION OF STATE HISTORY, LIST OF REPORTS WITH 1990 PROJECT NUMBERS

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INTRODUCTION

All archaeological organizations holding an antiquities permit issued by the Antiquities Section and who carry out archaeological projects in the state are obliged to: (1) obtain a project number from the Antiquties Section and (2) submit a report on the work done.

The following is a list of reports received by the Antiquities Section, Division of State History, for projects with 1990 project numbers. These reports are on file, and are available to researchers holding a current Utah Antiquities Annual Permit. If a report for a project with a 1990 project number has been submitted but is not listed here, please contact Evelyn Seelinger at (801) 533-4563.

ANTIQUITIES SECTION-UTAH DIVISION OF STATE HISTORY
1990 PROJECT REPORTS RECEIVED

County	Activity	Organization	Field Supervisor	Project Name	Project Number
BE	Survey	Dames & Moore	Bassett/Lindsay	Kern River Four Stockpile Sites Sprds 4,5 & 6	U-90-DH-584p
BE	Survey	Dames & Moore	G. Woodall	Kern River Pipeline Milford Unloading & Stock	U-90-DH-604b,f,p
BE/WS	Survey	Dames & Moore	Larson/Bassett	Kern River SR 21 & Veyo Shoal Crk Rd Staging	U-90-DH-642p
BE	Survey	Nielson Cons.	A. Nielson	UP&L Frisco Peak Microwave	U-90-NP-131b
BE/PI	Survey	Nielson Cons.	A. Nielson	Mt. Holly to Alunite Powerline Removal	U-90-NP-160f,p
BE	Survey	USFS–Fishlake	C. Kesler	Skyline Trailhead	U-90-FS-288f
BE	Survey	USFS–Fishlake	C. Kesler	Fish Barrier Project-North Fork North Creek	U-90-FS-253f
BE	Survey	USFS–Fishlake	J. DeYoung	Baker Canyon Prescribed Burn	U-90-FS-085f
BE	Survey	USFS–Fishlake	J. DeYoung	Mud Flats Prescribed Burn	U-90-FS-086f
BE/PI	Survey	USFS–Fishlake	M. Cartwright	Betensen Flat Gravel Pit	U-90-FS-313f
BE/PI	Survey	USFS–Fishlake	M. Cartwright	SR 153 Road Widening	U-90-FS-312f
BO	Survey	BLM–Salt Lake	S. Smith	Public Shooting Grounds Trestle	U-90-BL-524b
BO	Survey	BLM–Salt Lake	S. Smith	Cyprus Farms Exchange	U-90-BL-533b
BO	Survey	BLM–Salt Lake	N. Shearin	Vost Sale	U-90-BL-242b
BO	Survey	BLM–Salt Lake	N. Shearin	Chokecherry Pipeline	U-90-BL-343b
BO	Survey	BLM–Salt Lake	N. Shearin	Goose Creek Ponds	U-90-BL-330b
BO	Survey	BLM–Salt Lake	N. Shearin	Pole Creek Fence	U-90-BL-244b
BO	Survey	BLM–Salt Lake	N. Shearin	Bedke Springs Pipeline Extension	U-90-BL-243b
BO	Survey	BLM–Salt Lake	S. Smith	Snowville Land Exchange	U-90-BL-323b
BO	Survey	BLM–Salt Lake	S. Smith	Thomas Exchange	U-90-BL-503b
BO	Survey	BLM–Salt Lake	N. Shearin	Portage Sale	U-90-BL-241b
BO	Survey	BLM–Salt Lake	S. Smith	Lucky Boy No. I	U-90-BL-115b

ANTIQUITIES SECTION-UTAH DIVISION OF STATE HISTORY 1990 PROJECT REPORTS RECEIVED

County	Activity	Organization	Field Supervisor	Project Name	Project Number
BO/TO	Survey	BLM–Salt Lake	D. Christensen	Air Force Fiberoptics EA	U-90-BL-158b
BO	Survey	BLM–Salt Lake	N. Shearin	Crater Island Mine	U-90-BL-230b
BO	Survey	Sagebrush	M. Polk	Interchange at Plymouth, SR 13 & 20800 North	U-90-SJ-547s
BO	Survey	Sagebrush	M. Polk	West Forest St., Brigham City	U-90-SJ-035s
BO	Survey	USFS–Sawtooth	C. Zimmerman	Wildcat Road Relocation and Update	U-90-FS-042f
BO	Survey	USFS–Sawtooth	K. Hardy	Raft River Projects 1990	U-90-FS-207f
CA	Survey	Sagebrush	M. Polk	Bridge Replacement on SR-30, Cache County	U-90-SJ-397s
CA	Survey	USFS–Cache	T. Scott	Malibu Scout Lodge Removal	U-90-FS-075f
CB	Survey	AERC	R. Beaty	Conveyor Corridor, Eccles Canyon	U-90-AF-463p
CB	Survey	AERC	R. Hauck	3 Wells vic Winter Qtrs Cny & Granger Ridge	U-90-AF-480f
CB	Survey	AERC	R. Beaty	Conveyor Corridor, Eccles Canyon, No. 2	U-90-AF-488f
CB	Survey	BLM–Price	R. Matheny	Nine Mile Canyon Archaeological Survey 1990	U-90-BL-338b,p,s
CB	Survey	BLM–Price	B. Miller	Anderson Allotment Boundary Fence	U-90-BL-499b
CB	Survey	Metcalf	J. Scott	Cockrell Oil, 5 Wells and Access	U-90-MM-380p
CB	Survey	Metcalf	J. Scott	Cockrell Oil 1210-2310 No. 1 Access Reroute	U-90-MM-557p
CB	Survey	Nielson Cons.	Matheny/ Nielsen	Soldier Creek Coal Company Mine Plan	U-90-NP-542b
CB	Survey	USFS–Manti	B. Broadbear	Finn Canyon Timber Sale	U-90-FS-638f
CB/SP	Survey	USFS–Manti	H. Weymouth	Little Bear Canyon Prescribed Burn	U-90-FS-357f
CB/SP	Survey	USFS–Manti	E. Stoker	Addendum Questar Pipeline Main Line	U-90-FS-452f
DA	Survey	BLM–Craig, CO	H. Keesling	Four Stock Ponds in Da Co. & Browns Pk. Store	U-90-BL-465b
DA	Survey	BLM–Vernal	B. Phillips	Ruple Ranch Exchange	U-90-BL-333b

ANTIQUITIES SECTION-UTAH DIVISION OF STATE HISTORY
1990 PROJECT REPORTS RECEIVED

County	Activity	Organization	Field Supervisor	Project Name	Project Number
DA	Survey	BYU–OPA	S. Billat	Seismic Line vic. O-Wi-Yu-Kuts Mountains	U-90-BC-342s,b
DA	Survey	BYU–OPA	S. Billat	Clay Basin Seismic Line	U-90-BC-276b,f,s
DA	Survey	USFS–Ashley	G. Reese	Antelope Flat Boy Scout Camp	U-90-FS-223f
DC	Survey	AERC	R. Beaty	Gate Canyon Fed No. 41-10, Badland Cliffs	U-90-AF-462b
DC	Survey	AERC	R. Hauck	Ute Tribal Unit No. 2-12A3 vic. Monarch Ridge	U-90-AF-561i
DC	Survey	AERC	R. Hauck	Pipeline in Altamont Locality	U-90-AF-304i
DC	Survey	ARCON	G. Norman	Arcandia Road Survey	U-90-AK-059p,i
DC	Survey	BLM–Vernal	B. Phillips	Castle Peak Erosion Structures	U-90-BL-023b
DC	Survey	BLM–Vernal	B. Phillips	Nelson Pipeline and Reservoir	U-90-BL-602b
DC/WA	Survey	BYU–OPA	S. Billat	BOR Jordanelle II	U-90-BC-472w
DC	Survey	BYU–OPA	D. Southworth	Evaluation of the Remund Ranch	U-90-BC-490w
DC	Survey	BYU–OPA	R. Talbot	Starvation Reservoir State Park Well	U-90-BC-396s
DC	Survey	Grand River Ins	C. Conner	Federal # 21-29 Well and Access	U-90-GB-346b
DC	Survey	Sagebrush	M. Polk	Three Wells for Zinke & Trumbo	U-90-SJ-229i
DC	Survey	Sagebrush	M. Polk	Well 13-33b	U-90-SJ-143b
DC	Survey	Sagebrush	M. Polk	PG & E Wells, Monument Butte	U-90-SJ-065b
DC	Survey	Sagebrush	M. Polk	Pipeline near Pine Ridge	U-90-SJ-302i
DC	Survey	Sagebrush	M. Polk	Two Powerline Corridors, vic. Blue Bell	U-90-SJ-453i
DC	Survey	USFS–Ashley	S. Feltis	Bull Pasture P-J Openings, Units 1,2	U-90-FS-014f
DC	Survey	USFS–Ashley	S. Feltis	North Gilsonite Guzzler	U-90-FS-134f
DC	Survey	USFS–Ashley	T. Scott	Yellow Pine Campground Interp. Trail	U-90-FS-139f
DC	Survey	USFS–Ashley	C. Pfaffengut	Wilken Land Exchange	U-90-FS-214f
DC	Survey	USFS–Wasatch	S. Feltis	East Dry Gulch Creek Fisheries Project	U-90-FS-399f

ANTIQUITIES SECTION-UTAH DIVISION OF STATE HISTORY
1990 PROJECT REPORTS RECEIVED

County	Activity	Organization	Field Supervisor	Project Name	Project Number
DC	Survey	Utah State Univ	L. Travis	Fruitland Survey	U-90-UJ-502s
DV	Survey	Sagebrush	M. Polk	SR89/SR193 Overpass	U-90-SJ-147p,s
EM	Survey	Abajo	W. Howell	UP&L Hunter-Moore 69 KV Powerline	U-90-AS-516b,p,s
EM	Survey	Abajo	K. Montgomery	Emery County Road, Lawrence Westerly	U-90-AS-361p,s
EM	Survey	Abajo	K. Montgomery	Huntington Cny Water Line Relocation, SR 31	U-90-AS-362b,p,s
EM	Survey	Abajo	C. Coder	Chevron Range Creek Unit No. 2 Well	U-90-AS-298b
EM	Survey	AERC	R. Beaty	UP&L Drill Survey on Trail Mtn.	U-90-AF-487f
EM	Survey	AERC	G. Norman	Archaeological Studies on East Mountain	U-90-AF-363f
EM	Survey	AERC	R. Hauck	UP&L Coal Locations, Trail Mtn.	U-90-AF-148f
EM	Survey	BLM–Price	B. Miller	Goblin Guzzler	U-90-BL-492b
EM	Survey	BLM–Price	B. Miller	SCS Soil Pit	U-90-BL-498b
EM	Survey	BLM–Price	B. Miller	Buckhorn Reservoir Road	U-90-BL-495b
EM	Survey	BLM–Price	B. Miller	Bush Well Govt. 31-1	U-90-BL-496b
EM	Survey	BLM–Price	B. Miller	Globe Link Horse Capture	U-90-BL-493b
EM/SV	Survey	BLM–Richfield	L. Lindsay	Solomon's Pipeline Extension	U-90-BL-281b
EM/WN	Survey	BYU–OPA	R. Talbot	3 Pits & 2 Hot Plants, SR 24 nr Hanksville	U-90-BC-044b,p,s
EM	Survey	Intersearch	R. Thompson	Highway Resurface	U-90-IG-068b,p
EM	Survey	Metcalf	M. Metcalf	Buzzard Bench Pipeline	U-90-MM-546b,s
EM	Survey	Nielson Cons.	A. Nielson	Huntington Creek Bridge	U-90-NP-559p
EM	Survey	OPA–BYU	S. Billat	Seis Line 201, San Rafael vic. The Flat Tops	U-90-BC-226b,s
EM	Survey	Senco–Phenix	J. Senulis	Co-op Mine Expansion	U-90-SC-263f
EM	Survey	USFS–Manti	D. Harber	Trail Mountain Pond Construction	U-90-FS-603f
EM	Survey	USFS–Manti	D. Harber	Joes Valley Area Fish Structures	U-90-FS-311f

ANTIQUITIES SECTION-UTAH DIVISION OF STATE HISTORY 1990 PROJECT REPORTS RECEIVED

County	Activity	Organization	Field Supervisor	Project Name	Project Number
EM	Survey	USFS–Manti	E. Stoker	Hole Trail/Dry Wash Roller Chop Survey	U-90-FS-407f
EM	Survey	USFS–Manti	E. Stoker	Spoon Creek Timber Sale	U-90-FS-358f
EM	Survey	USFS–Manti	B. Avey	Julius Flat Burn	U-90-FS-239f
GA	Survey	Alpine	J. Horn	Panguitch Gravel Pit	U-90-A1-475p
GA	Survey	Alpine	J. Horn	SR 12 at the Escalante Bridge	U-90-A1-477b,p
GA	Survey	BLM–Richfield	L. Lindsay	Eggnog Spring Gravel Pit	U-90-BL-011b
GA	Survey	BLM–Richfield	L. Lindsay	GCRA Kane Spring Desert Rip-Rap	U-90-BL-015b
GA	Survey	BLM–Richfield	L. Lindsay	GCRA Kane Sping Desert Rip-Rap	U-90-BL-058b
GA	Survey	BLM–Richfield	L. Lindsay	Crescent Creek No. 3	U-90-BL-079b
GA	Survey	BLM–Richfield	L. Lindsay	Gold Queen Placer	U-90-BL-078b
GA	Survey	BLM–Richfield	L. Lindsay	Big Thompson Mesa Reservoir #1	U-90-BL-041b
GA	Survey	BLM–Richfield	L. Lindsay	Clay Point Pipeline & Reservoir	U-90-BL-010b
GA	Survey	USFS–Dixie	M. Jacklin	Losee Road & Trailhead	U-90-FS-434b,f
GA	Survey	USFS–Dixie	M. Jacklin	South Hollow Timber Sale	U-90-FS-436f
GA	Survey	USFS–Dixie	M. Jacklin	Water Well Locations D-2	U-90-FS-320f
GA	Survey	USFS–Dixie	M. Jacklin	Main Canyon Pit Run Sources	U-90-FS-433f
GA	Survey	USFS–Dixie	M. Jacklin	Hoosier Road Right-of-Way	U-90-FS-317f
GA	Survey	USFS–Dixie	M. Jacklin	Mammoth Creek Gravel Pit	U-90-FS-318f
GA	Survey	USFS–Dixie	M. Jacklin	Golden Wall Trail	U-90-FS-435f
GA	Survey	USFS–Dixie	D. Young	Castle Bridge Trail	U-90-FS-520f
GA	Survey	USFS–Dixie	R. Madril	Rim Trail First Phase	U-90-FS-566f
GA	Survey	USFS–Dixie	M. Jacklin	Tom Best Spring Development	U-90-FS-259f
GA	Survey	USFS–Dixie	M. Jacklin	Red Canyon Pipeline	U-90-FS-522f
GA	Survey	USFS–Dixie	M. Jacklin	Gateway Trailhead and Trail	U-90-FS-521f
GA	Survey	USFS–Dixie	D. Harris	Losee Canyon Trail	U-90-FS-519f
GA	Survey	USFS–Dixie	M. Jacklin	East Fork OHV Trail	U-90-FS-155f
GA	Survey	USFS–Dixie	M. Jacklin	Allen's Canyon Land Exchange	U-90-FS-111f
GA	Survey	USFS–Dixie	M. Jacklin	Rocky Draw Pond	U-90-FS-112f

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1990 PROJECT REPORTS RECEIVED

County	Activity	Organization	Field Supervisor	Project Name	Project Number
GA	Survey	USFS–Dixie	M. Jacklin	Casto Canyon Road Improvement	U-90-FS-126f
GR	Survey	Abajo	C. Coder	UDOT Floy Materials Pit	U-90-AS-031b
GR	Survey	Abajo	C. Coder	UDOT Fish Ford Material Pit	U-90-AS-032b
GR	Survey	Abajo	M. Bond	Floy-Crescent Jct. UDOT Way Station	U-90-AS-080b,s
GR	Survey	Abajo	B. Davis	NW Pipeline Grand Gas Discharge Line	U-90-AS-051b
GR	Survey	Abajo	D. Westfall	Four Film Locations for Thelma & Louise Prod.	U-90-AS-324s,b
GR	Test	Abajo	P. Flanigan	Evaluation & Determ. of Elig. at 42Gr2260	U-90-AS-464n
GR	Survey	Abajo	J. Montgomery	UP&L Hauers Property Powerline	U-90-AS-430b
GR	Survey	BLM–Grand	J. Howard	Sego Canyon Rock Art Development	U-90-BL-613b
GR	Survey	BLM–Grand	J. Howard	Book Cliffs Reservoir	U-90-BL-609b
GR	Survey	BLM–Grand	J. Howard	Cliffside Reservoir	U-90-BL-641b
GR	Survey	BLM–Grand	J. Howard	Hide-Out Canyon-Kokopelli Trail Campsite	U-90-BL-334b
GR	Survey	BLM–Grand	J. Howard	Long Valley Well	U-90-BL-043b
GR	Survey	BLM–Grand	J. Howard	U of U Performing Arts Theaters	U-90-BL-020b
GR	Survey	BLM–Grand	J. Howard	Kokopelli Trail Campsites	U-90-BL-231b
GR	Survey	Edge of Cedars	W. Hurst	Dead Horse Point State Park North Fenceline	U-90-UD-406b,s
GR	Survey	Grand River Ins	C. Conner	Pipeline to San Arroyo #43	U-90-GB-550b
GR	Survey	Grand River Ins	C. Conner	Pipeline to Hancock Federal No. 1	U-90-GB-551b
GR	Survey	Grand River Ins	C. Conner	Mountain Island Ranch Fence Lines	U-90-GB-055b
GR	Survey	Grand River Ins	C. Conner	#15-2 Surface Pipeline	U-90-GB-081b
GR	Survey	Grand River Ins	C. Conner	Pipeline to No. 44	U-90-GB-440b
GR	Survey	Grand River Ins	C. Conner	Burton Hancock Federal No. 20-R	U-90-GB-610b

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
GR	Survey	Grand River Ins	C. Conner	Kane Springs Prospects	U-90-GB-376b
GR	Survey	Grand River Ins	C. Conner	Pipeline to 29-13	U-90-GB-439b,s
GR	Survey	NPS–Canyonlands	P. Flanigan	Monitoring & Maintenance in SE Utah Group	U-90-NA-301n
GR	Survey	P-III	A. Schroedl	Kane Springs Federal #27-1	U-90-PD-507b
GR	Survey	USFS–Manti	S. McDonald	FMC Exploraiton Gold Drilling, Miners Basin	U-90-FS-248f
GR/SA	Survey	USFS–Manti	E. Stoker	Burkholder Draw/South Mesa Roller Chop	U-90-FS-356f
IN	Survey	Dames & Moore	E. Bassett	Kern River Iron Sprs Unloading & Stockpile	U-90-DH-645p
IN	Survey	Intersearch	R. Thompson	Iron County Bridge Replacement	U-90-IG-187p
IN	Survey	Intersearch	R. Thompson	Weeco	U-90-IG-069b
IN	Survey	USFS–Dixie	W. Houston	Mineral Canyon Revegetation	U-90-FS-571f
IN	Survey	USFS–Dixie	W. Houston	Mineral Stock Ponds	U-90-FS-083f
IN	Survey	USFS–Dixie	F. Ybright	Iron Mt. Fuelwood	U-90-FS-094f
IN	Survey	USFS–Dixie	W. Houston	Bowery Watershed	U-90-FS-567f
IN	Survey	USFS–Dixie	M. Jacklin	Trail Canyon Riparian Project	U-90-FS-569f
IN	Survey	USFS–Dixie	M. Jacklin	N. Red Creek Ponds	U-90-FS-157f
JB	Survey	BLM–Richfield	L. Linsday	Riley Spring Trunk Line	U-90-BL-235b
JB	Survey	BLM–Richfield	D. Christensen	No Name Cattle Guard	U-90-BL-572b
JB	Survey	BLM–Richfield	L. Lindsay	Brush-Wellman Pit Extensions	U-90-BL-100b
JB	Survey	BLM–Richfield	L. Linsday	Nettle Spring Pipeline	U-90-BL-237b
JB	Survey	BLM–Richfield	L. Linsday	Furner Ridge Fence	U-90-BL-238b
JB	Survey	BLM–Richfield	L. Linsday	Death Creek Trough	U-90-BL-236b
JB	Survey	BLM–Richfield	L. Lindsay	Bryan Agricultural LUP	U-90-BL-007b
JB	Survey	BLM–Richfield	L. Lindsay	Chappell Fire Rehabilitation	U-90-BL-445b
JB	Survey	BLM–Richfield	L. Lindsay	Kent Spring Pipeline Replacement	U-90-BL-383b
JB	Survey	BLM–Richfield	L. Lindsay	Jumbo Mining	U-90-BL-098b
JB	Survey	BLM–Richfield	L. Lindsay	Juab Co. Road Realignment-Indian Farm Creek	U-90-BL-099b

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1990 PROJECT REPORTS RECEIVED

County	Activity	Organization	Field Supervisor	Project Name	Project Number
JB	Survey	BLM–Richfield	L. Lindsay	C. Garland DLE	U-90-BL-351b
JB	Survey	BLM–Richfield	L. Lindsay	Cherry Creek Fence	U-90-BL-446b
JB	Survey	BLM–Richfield	L. Lindsay	Painter Agricultural LUP	U-90-BL-006b
JB	Survey	BLM–Richfield	L. Lindsay	Mizpah Pit-Drum Mine	U-90-BL-097b
JB	Survey	BLM–Richfield	L. Lindsay	Jakel's Canyon Cattleguard	U-90-BL-220b
JB	Survey	BLM–Richfield	L. Lindsay	Fumerole Butte Basalt Quarry	U-90-BL-201b
JB	Survey	BLM–Richfield	L. Lindsay	Leamington Pass Fence	U-90-BL-222b
JB	Survey	BLM–Richfield	L. Lindsay	Albert Nielsen Mining Improvement	U-90-BL-202b
JB	Survey	BLM–Richfield	L. Linsday	Keg Mountain Fence	U-90-BL-233b
JB	Survey	Nielson Cons.	A. Nielson	Topaz Beryllium Venture Juab	U-90-NP-578b,p
JB	Survey	USFS–Manti	D. Okerlund	Henry No. 1 and 2 Mining Claims	U-90-FS-597f
JB	Survey	USFS–Uinta	C. Thompson	Carnotite King Group Mine Claim	U-90-FS-449f
KA	Survey	AERC	R. Hauck	6 Gwen Tower Locations, Kanab-Hells Bellows	U-90-AF-481b,p
KA	Survey	BLM–Kanab	D. McFadden	Skutumpah Creek Seeding	U-90-BL-142b
KA	Survey	Intersearch	B. Walling	Andalex Drill Sites	U-90-IG-091b
KA	Survey	Intersearch	B. Walling	Andalex Mine Site	U-90-IG-275b
KA	Survey	USFS–Dixie	M. Jacklin	Pink Cliffs/Trailhead	U-90-FS-256f
KA	Survey	USFS–Dixie	M. Jacklin	Straight Canyon TMP	U-90-FS-255f
KA	Survey	USFS–Fishlake	J. DeYoung	Deep Creek Snow Bench Timber Sale	U-90-FS-373f
MD	Survey	BLM–Richfield	L. Lindsay	Jackson Buried Tank	U-90-BL-416b
MD	Survey	BLM–Richfield	L. Lindsay	Shotgun Knoll Well and Road Upgrade	U-90-BL-415b
MD	Survey	BLM–Richfield	L. Lindsay	Crystal Peak Fence and Cattleguard	U-90-BL-414b
MD	Survey	BLM–Richfield	L. Lindsay	Three Sevier River Study Exclosures	U-90-BL-410b
MD	Survey	BLM–Richfield	L. Lindsay	Three Black Rock Chukar Guzzlers	U-90-BL-409b
MD	Survey	BLM–Richfield	L. Lindsay	Snake Valley Pipeline	U-90-BL-384b

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
MD	Survey	BLM–Richfield	L. Lindsay	Rough Range Buried Tank	U-90-BL-417b
MD	Survey	BLM–Richfield	L. Lindsay	Mineral South Guzzler	U-90-BL-411b
MD	Survey	BLM–Richfield	L. Lindsay	Lawson Reservoir Guzzler	U-90-BL-412b
MD	Survey	BLM–Richfield	L. Lindsay	Gray Hills Guzzler	U-90-BL-413b
MD	Survey	BLM–Richfield	L. Lindsay	Millard County FUP No. RD-81-258	U-90-BL-002b
MD	Survey	BLM–Richfield	L. Lindsay	Mud Lake Spring Enhancement	U-90-BL-003b
MD	Survey	BLM–Richfield	L. Lindsay	Clay Springs Pipeline Replacement	U-90-BL-122b
MD	Survey	BLM–Richfield	L. Lindsay	Second Patch Pipeline	U-90-BL-121b
MD	Survey	BLM–Richfield	L. Lindsay	Headquarters Pipeline	U-90-BL-120b
MD	Survey	BLM–Richfield	L. Lindsay	Mountain Home Pipeline Modification	U-90-BL-005b
MD	Survey	BLM–Richfield	L. Lindsay	South Twin Well Pipeline	U-90-BL-468b,s
MD	Survey	BLM–Richfield	L. Lindsay	Second Patch Pipeline	U-90-BL-467b
MD	Survey	BLM–Richfield	L. Lindsay	East Little Valley Corral	U-90-BL-419b
MD	Survey	BLM–Richfield	L. Lindsay	Williams Tel. Regen. Sta. Enlarg. at Sunstone	U-90-BL-420b
MD	Survey	BLM–Richfield	L. Lindsay	Williams Tel. Regen. Sta. Enlarg., Cat Canyon	U-90-BL-421b
MD	Survey	BLM–Richfield	L. Lindsay	Ferguson Hardpan Pipeline	U-90-BL-001b
MD	Survey	BLM–Richfield	L. Lindsay	Tunnel Springs Buried Tank	U-90-BL-418b
MD	Survey	BLM–Richfield	L. Lindsay	Red Pass Antelope Guzzler	U-90-BL-004b
MD	Survey	BLM–Richfield	L. Lindsay	Boob Flat Reservoir Fence	U-90-BL-195b
MD	Survey	BLM–Richfield	L. Lindsay	Tractor Tire Guzzler No. 1	U-90-BL-194b
MD	Survey	BLM–Richfield	L. Lindsay	Rattlesnake Bench Guzzler	U-90-BL-193b
MD	Survey	BLM–Richfield	L. Lindsay	Antelope Wash Reservoir Fence	U-90-BL-196b
MD	Survey	BLM–Richfield	L. Lindsay	South Crow's Nest Tank	U-90-BL-197b
MD	Survey	BLM–Richfield	L. Lindsay	Gray Slate Quarry	U-90-BL-200b
MD	Survey	BLM–Richfield	L. Lindsay	Hole in the Rock Boundary Fence Rev. & E. Side	U-90-BL-199b
MD	Survey	BLM–Richfield	L. Lindsay	Burbank Hills Storage Tank and Trough	U-90-BL-198b

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
MD	Survey	BLM–Richfield	L. Lindsay	Little Mile and a Half Guzzler	U-90-BL-192b
MD	Survey	BLM–Richfield	L. Lindsay	Hodges Obsidian Extraction	U-90-BL-203b
MD	Survey	BLM–Richfield	L. Lindsay	Mile and a Half Guzzler	U-90-BL-191b
MD	Survey	P–III	G. Popek	Desolation Federal Survey	U-90-PD-469b
MD	Survey	USFS–Fishlake	C. Christensen	Second Creek Drift Fence	U-90-FS-394f
MD	Survey	USFS–Fishlake	B. Stevens	Baldy Ponds	U-90-FS-539f
MD	Survey	USFS–Fishlake	B. Stevens	Wide Canyon Ponds	U-90-FS-538f
MD	Survey	USFS–Fishlake	B. Stevens	Oak City Water System	U-90-FS-709f
MULTI	Survey	Dames & Moore	S. Bruder	Kern River Pipeline Project	U–90-DH-184b,f,p,s
MULTI	Survey	Dames & Moore	D. Larson	Kern River 5 Extra Work Areas, Spreads 5 & 6	U-90-DH-606b,s,f,p
PI/GA	Survey	Alpine	J. Horn	3.2 Miles of US 89, Circleville Road Widening	U-90-A1-476p
PI	Survey	BLM–Richfield	L. Lindsay	John Frederick Road	U-90-BL-277b
PI/SV	Survey	BLM–Richfield	L. Lindsay	Chimney Pipeline Extension	U-90-BL-280b
PI	Survey	BLM–Richfield	L. Lindsay	Sharron Steel Drill Holes	U-90-BL-278b
PI	Survey	BLM–Richfield	L. Lindsay	Sevier River ATV Bridge	U-90-BL-279b
PI	Survey	BLM–Richfield	L. Lindsay	Manning Creek Gravel Pit	U-90-BL-117b
PI	Survey	BLM–Richfield	L. Lindsay	Val Snow Gravel Pit	U-90-BL-118b
PI	Survey	BLM–Richfield	L. Lindsay	Hatch Pipeline Right of Way	U-90-BL-284b,f
PI	Survey	BLM–Richfield	L. Lindsay	Narrows Clearcut Extension	U-90-BL-285b
PI	Survey	USFS–Fishlake	G. DeYoung	Barney Lake Road Relocation	U-90-FS-341f
PI	Survey	USFS–Fishlake	J. DeYoung	Barney Lake Rip-Rap	U-90-FS-314f
PI	Survey	USFS–Fishlake	P. Joseph	Ted Christensen Land Exchange	U-90-FS-018f
PI	Survey	USFS–Fishlake	J. DeYoung	Upper Box Creek Borrow Pit	U-90-FS-364f
PI	Survey	USFS–Fishlake	C. Christensen	Revenue Gulch Burn	U-90-FS-393f
PI	Survey	USFS–Fishlake	J. De Young	Oak Basin Gravel Pit	U-90-FS-378f
PI	Survey	USFS–Fishlake	C. Christensen	Birch Creek Gravel Pit	U-90-FS-395f
RI	Survey	BLM–Salt Lake	S. Smtih	Weston Trespass	U-90-BL-210b
RI	Survey	BLM–Salt Lake	S. Smith	Wildlife Viewing Area	U-90-BL-531b

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
RI	Survey	BLM–Salt Lake	S. Smith	Hog Back Ridge Ponds	U-90-BL-185b
RI	Survey	BLM–Salt Lake	S. Smith	Willis Trespass Sale	U-90-BL-022b
RI	Survey	BLM–Salt Lake	S. Smith	Crawford Mountain Ponds	U-90-BL-186b
RI	Survey	USFS–Wasatch	T. Scott	N. Randolph Cattle Allotment Stock Ponds	U-90-FS-389f
RI	Survey/ Test	Utah State Univ	Beckstead/ Simms	Historic Cabin at Bear Lake	U–90-UJ-224p
RI	Survey	Western Wy. Col	K.Thompson	Sessions Mt. Prospect	U-90-Wk-154b,s
SA	Survey	Abajo	J. Montgomery	UDOT SR 191 Between MP 92 and 100	U-90-AS-530b,p,s
SA	Survey	Abajo	B. Davis	UP&L Meridian Arabian Federal Well #3	U-90-AS-582b
SA	Survey	Abajo	D. Westfall	Mexican Hat Wastewater Lagoons	U-90-AS-381b
SA	Survey	Abajo	B. Davis	UP&L Lines to 4 Duncan Oil Wells, Cave Canyon	U-90-AS-581b
SA	Survey	Abajo	B. Davis	UP&L 25KV Distribution Line	U-90-AS-545b
SA	Survey	Abajo	M. Bond	Contel Upper Horse Flats Microwave Site	U-90-AS-486b
SA	Survey	Abajo	M. Bond	UP&L Abajo/Aneth No. 2 69 KV Transmission Ln	U-90-AS-136b,p,s
SA	Survey	Abajo	C. Coder	Redrock Four-Wheelers of Moab	U-90-AS-124b
SA	Survey	Abajo	M. Bond	San Juan County Road 206, Alkali Canyon	U-90-AS-269s
SA	Survey	Abajo	C. Coder	UP & L Jameson Extension, letter report	U-90-AS-073p,b
SA	Survey	Abajo	D. Westfall	UP & L Havasu Circ. to Merid. Kiva Wells	U-90-AS-074b
SA	Survey	Abajo	B. Davis	Sindor Resources Lower Lisbon Valley Uranium	U-90-AS-050b
SA	Survey	Abajo	B. Davis	San Juan County Rd 402, Ismay to Aneth	U-90-AS-355i,p,s
SA	Survey	Abajo	B. Davis	UDOT 191 Shirttail R/W Acquistion	U-90-AS-353p

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
SA	Survey	AERC	R. Hauck	20 Wells, Deer Flat & Wingate Plateau	U-90-AF-375b
SA	Excavation	Alpine	A. Reed	Excav. 5 Sites at Halls Crossing Airport	U-90-A1-583b(e)
SA	Survey	Alpine	A. Reed	New Frontier Seismic	U-90-A1-162b
SA	Survey	Alpine	R. Greubel	Hovenweep Class III CR Inventory	U-90-A1-461b
SA	Survey	Alpine	A. Reed	New Frontier CP-2 Seismic Line	U-90-A1-382b,s
SA	Survey	Alpine	A. Reed	Hall's Crossing Airport Material Pits	U-90-A1-525b
SA	Survey	BLM–Grand	J. Howard	Eightmile Rock Water Development	U-90-BL-232b
SA	Survey	BLM–Grand	J. Howard	Lower Lisbon Valley Fence Line	U-90-BL-565b
SA	Survey	BLM–Grand	J. Howard	Over The Hill Antelope Catchment	U-90-BL-428b
SA	Survey	BLM–Grand	J. Howard	Hatch Point Sage Grouse Exclosure Fence	U-90-BL-466b
SA	Survey	BLM–Grand	J. Howard	No Soup Rock Antelope Catchment	U-90-BL-427b
SA	Survey	BLM–Grand	J. Howard	Pyramid Butte Reservoir	U-90-BL-608b
SA	Survey	CASA	N. Hammack	Horsehead Well and Access	U-90-CH-246b
SA	Survey	CASA	N. Hammack	White Mesa Housing	U-90-CH-245i
SA	Survey	CASA	L. Hammack	Gothic Mesa Units 16-12 and 17-41	U-90-CH-386i
SA	Survey	CASA	L. Hammack	CGG Seismic, Ismay Trend Phase 2	U-90-CH-052b,i,p
SA	Survey	CASA	L. Hammack	Sugarloaf Limestone Quarry	U-90-CH-552b
SA	Survey	CASA	L. Hammack	Horsehead Point No. 2	U-90-CH-553b
SA	Survey	CASA	L. Hammack	Alkali Point #1 and #2, Montezuma Prospect	U-90-CH-554i
SA	Survey	Four Corners	C. DeFrancia	Seismic Line MOI-SAP-91-1	U-90-FE-541b
SA	Survey	La Plata	S. Fuller	Lisbon Unit C-615 Well Pad	U-90-LA-092b
SA	Survey	La Plata	S. Fuller	B 407 SE Well, Access & Powerline	U-90-LA-701i

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
SA	Survey	La Plata	S. Fuller	Chuska Energy White Mesa Gathering System	U-90-LA-180i
SA	Survey	La Plata	S. Fuller	F 218 SE Well, Access & Powerline	U-90-LA-704i
SA	Survey	La Plata	M. Cavanaugh	Stag. Areas and Access for Seismic Lines	U--90-LA-556b
SA	Survey	La Plata	S. Fuller	New Frontier Seimic Line CP-1	U-90-LA-327b,s
SA	Survey	La Plata	S. Fuller	Chuska Energy Hovenweep Gathering System	U-90-LA-179i
SA	Survey	La Plata	M. Cavanaugh	Marathon Tin Cup Mesa Unit 6-26 Well & Access	U-90-LA-178b
SA	Survey	La Plata	S. Fuller	G 323 X, Well Pad & Powerline	U-90-LA-706i
SA	Survey	La Plata	S. Fuller	R. Duncan Cave Canyon Fed 12-3 & 13-3 Wells	U-90-LA-515b
SA	Survey	La Plata	S. Fuller	B-412 Well Pad, Access & Powerline	U-90-LA-036i
SA	Survey	La Plata	M. Cavanaugh	Horse Canyon Seis Lines 101, 103 and 105	U-90-LA-076b
SA	Survey	La Plata	S. Fuller	Unocal Lisbon Vlly Tank Battery, Rd & Pipeln	U-90-LA-019p
SA	Survey	La Plata	S. Fuller	H 129 Well, Access & Powerline	U-90-LA-705i
SA	Survey	La Plata	M. Cavanaugh	Frontier Seismic Line 90-13	U-90-LA-474b,s
SA	Survey	La Plata	S. Fuller	F 407 SE Well, Access & Powerline	U-90-LA-702i
SA	Survey	La Plata	S. Fuller	Texaco USA's Nine Aneth Wells	U-90-LA-325i
SA	Survey	La Plata	S. Fuller	Chuska Abandoned Canyonhead 29-I-1 Access Rd	U-90-LA-217i
SA	Survey	La Plata	S. Fuller	Horse Canyon Federal 22-14 Well and Road	U-90-LA-106b
SA	Survey	La Plata	S. Fuller	Blanding Seis Lines BL-90-1, 2 and 3	U-90-LA-093b,p
SA	Survey	La Plata	S. Fuller	F 118 SE Well, Access & Powerline	U-90-LA-703i

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
SA	Survey	La Plata	L. Sesler	Reliable Hatch Point Seis Lines 1 and 2	U-90-LA-631b
SA	Survey	La Plata	S. Fuller	Addend to Cave Cny Fed 4-4 Well, Access & Pip	U-90-LA-218b
SA	Survey	La Plata	C. DeFrancia	New Frontier Road Canyon Seismic Line	U-90-LA-177b,s
SA	Survey	La Plata	S. Fuller	New Frontier Seimic Line CC-1 & CC-2	U-90-LA-326b,s
SA	Survey	La Plata	S. Fuller	H 325 Well, Access & Powerline	U-90-LA-708i
SA	Survey	La Plata	S. Fuller	G 325 Y, Well Pad & Powerline	U-90-LA-707i
SA	Survey	LA Plata	S. Fuller	Celsius Mantel Federal No. 1 Well	U-90-LA-387b
SA	Survey	LA Plata	M. Cavanaugh	Reliable Alkali Point and Cross Canyon	U-90-LA-038i
SA	Survey	Navajo Nation	R. Martin	Addend. 1 to Water Line & Homes, Hatch/Cajon	U-90-NK-601i,s
SA	Survey	Navajo Nation	J. Anderson	Black Steer 25-E-1 Well, Rd & Pipeline	U-90-NK-108b,i,p,s
SA	Survey	Navajo Nation	G. Pino	Water Line & Homesites, Hatch/Cajon Mesa	U-90-NK-310i,s
SA	Survey	Powers Elevatn.	G. Tucker	Meridian Oil Lion Mesa 23-27H	U-90-PA-544b
SA	Survey	Sagebrush	K. Montgomery	Gold Mining Prospect near Soup Rock	U-90-SJ-066b
SA	Survey	USFS–Manti	L. Wikle	Easter Peters Point Roller Chop	U-90-FS-262f
SA	Survey	USFS–Manti	S. McDonald	Harts Draw Road Construction	U-90-FS-388f
SA	Survey	USFS–Manti	S. McDonald	Mormon Pasture Vegetation Improvement	U-90-FS-408f
SA	Survey	USFS–Manti	S. McDonald	Lackey Basin Water Line and Pond	U-90-FS-261f
SA	Survey	USFS–Manti	S. McDonald	Pine Ridge Guzzlers	U-90-FS-240f
SA	Survey	USFS–Manti	E. Stoker	Addendum to Eastern Peters Point Roller Chop	U-90-FS-422f
SA	Survey	USFS–Manti	S. McDonald	Moab Ranger District 1990 Stock Ponds	U-90-FS-360f

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
SA	Survey	USFS–Manti	E. Stoker	Medicine and Beaver Lakes Dredging	U-90-FS-639f
SA	Survey	USFS–Manti	S. McDonald	Access Rd. R-O-W for Shumway Residence	U-90-FS-107f
SA	Survey	USFS–Manti	L. Wikle	Chimney Park Timber Sale	U-90-FS-564f
SL	Survey	BYU–OPA	S. Billat	Five Areas North and West of Granger for UDOT	U-90-BC-587p
SL	Survey	Nielson Cons.	A. Nielson	Salt Lake Airport Expansn Wetlands Developmnt	U-90-NP-460p
SL	Survey	Sagebrush	M. Polk	90th South Between State & 700 East, Sandy	U-90-SJ-482s
SL	Survey	Sagebrush	M. Polk	Evaluation of the Wilson Farmstead	U-90-SJ-260s
SL	Test	Sagebrush	M. Polk	Wilson Farmstead Test Excavation (UDOT)	U-90-SJ-400s
SL	Survey	Sagebrush	M. Polk	Eight Intersections in Salt Lake County	U-90-SJ-489s
SL	Survey	Sagebrush	M. Polk	Access to West Valley Highway at 8600 South	U-90-SJ-548s
SL	Survey	Sagebrush	M. Polk	West Valley Highwy, 9000 So. to 12600 So.	U-90-SJ-483s
SL	Survey	Sagebrush	M. Polk	West Valley Highway, 5400 South to 9000 South	U-90-SJ-146p,s
SL	Survey	USFS–Ashley	S. Sarver	Mill-D South Fork Spring Development	U-90-FS-040f
SL	Survey	USFS–Wasatch	S. Sarver	Brighton Ski Area Renovation	U-90-FS-176f
SL	Survey	USFS–Wasatch	T. Scott	Don Gibson Water Development	U-90-FS-013f
SM	Survey	BLM–Salt Lake	N. Shearin	Park City Land Sale	U-90-BL-329b
SM	Survey	Sagebrush	A. Polk	Echo Canyon Rest Area Water Tank & Access	U-90-SJ-116s
SM	Survey	USFS–Wasatch	B. Asay	Lynn Drift Fence	U-90-FS-365f
SM	Survey	USFS–Wasatch	T. Scott	China Meadows Trailhead Reconstruction	U-90-FS-205f
SP	Survey	BLM–Richfield	L. Lindsay	South Hills Well	U-90-BL-221b
SP	Survey	Nielson Cons.	A. Nielson	Fish Hatchery Relocation	U-90-NP-110s

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
SP	Survey	USFS–Manti	C. Anderson	Bench Timber Sale	U-90-FS-596f
SP	Survey	USFS–Manti	S. McDonald	South Skyline Watershed Treatment	U-90-FS-300f
SP	Survey	USFS–Manti	C. Anderson	Strawberry Gulch Timber Sale	U-90-FS-598f
SP	Survey	USFS–Manti	S. McDonald	Seely Administrative Site Documentation	U-90-FS-485f
SP	Survey	USFS–Manti	B. Broadbear	Rolfson Reservoir T/S	U-90-FS-140f
SV	Survey	BLM–Price	B. Miller	Walker Flat Well Repair	U-90-BL-336b
SV	Survey	BLM–Richfield	L. Lindsay	Deer Peak Pipeline and Storage Tank	U-90-BL-286b
SV	Survey	BLM–Richfield	L. Lindsay	Live Oak Canyon Commun. Pit	U-90-BL-119b
SV	Survey	BLM–Richfield	L. Lindsay	Red Canyon Pipeline Extension	U-90-BL-441b
SV	Survey	BLM–Richfield	L. Lindsay	South Central Utah Telephone Fiberoptic	U-90-BL-305b,f
SV	Survey	BLM–Richfield	L. Lindsay	Albinus Canyon Stone Quarry	U-90-BL-135b
SV	Survey	BLM–Richfield	L. Lindsay	Birch Spring Development	U-90-BL-282b
SV	Survey	BLM–Richfield	L. Lindsay	Aurora City Pipeline Project Continuation	U-90-BL-442b
SV	Survey	BLM–Richfield	L. Lindsay	Ivie Creek Pipeline Extension Realignment	U-90-BL-283b
SV	Survey	USFS–Fishlake	B. Tuttle	Lizonbee Fence	U-90-FS-455f
SV	Survey	USFS–Fishlake	J. DeYoung	Shoap Springs Watering Troughs	U-90-FS-335f
SV	Survey	USFS–Fishlake	J. DeYoung	Paradise Valley Site Eval. (FL-986/42Sv1485)	U-90-FS-028f
SV	Survey	USFS–Fishlake	B. Leonard	Greenwich Canyon Burials	U-90-FS-030f
SV	Survey	USFS–Fishlake	J. DeYoung	Paradise Valley Site Eval. (FL-987/42Sv1486)	U-90-FS-029f
SV	Survey	USFS–Fishlake	C. Christensen	Forsyth Reservoir Drift Fence	U-90-FS-287f
SV	Survey	USFS–Fishlake	J. DeYoung	Paradise Valley Site Eval. (FL-375/42Sv1443)	U-90-FS-027f
SV	Survey	USFS–Fishlake	J. DeYoung	Paradise Valley Site Eval. (FL-374/42Sv1442)	U-90-FS-026f
SV	Survey	USFS–Fishlake	B. Leonard	Musina Borrow Pit	U-90-FS-252f

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
SV	Survey	USFS–Fishlake	J. De Young	Annabella Reservoir Ditch	U-90-FS-289f
SV	Survey	USFS–Fishlake	C. Christensen	Dead Elk Water Development	U-90-FS-392f
SV	Survey	USFS–Fishlake	J. DeYoung	Milo's Kitchen Borrow Pit	U-90-FS-307f
TO	Survey	AERC	R. Hauck	Lookout Pass Locality	U-90-AF-037b
TO	Survey	BLM–Richfield	L. Linsday	Brush Creek Pipeline Extension	U-90-BL-234b
TO/JB	Survey	BLM–Richfield	L. Lindsay	Cherry Creek Burn Fire Rehab. and Fence	U-90-BL-444b
TO/JB	Survey	BLM–Richfield	L. Lindsay	Don't Know Fire Rehab. & Fence Line	U-90-BL-443b
TO	Survey	BLM–Richfield	L. Lindsay	A. Garland DLE	U-90-BL-350b
TO	Survey	BLM–Richfield	L. Lindsay	Death Canyon Pipeline Extension	U-90-BL-096b
TO	Survey	BLM–Salt Lake	D. Christensen	USPCI Well Sites & Access	U-90-BL-501b
TO	Survey	BLM–Salt Lake	D. Christensen	Clel's Spring Development	U-90-BL-271b
TO	Survey	BLM–Salt Lake	D. Christensen	Wendover Land Fill Sale	U-90-BL-212b
TO	Survey	BLM–Salt Lake	D. Christensen	Knolls Sample Survey	U-90-BL-272b
TO	Survey	BLM–Salt Lake	D. Christensen	Ibapah Isolated Tract #1	U-90-BL-328b
TO	Survey	BLM–Salt Lake	D. Christensen	Delle Well Pipeline	U-90-BL-159b
TO/SL	Survey	BLM–Salt Lake	N. Shearin	Butterfield Peak Comm. Sites	U-90-BL-211b
TO	Survey	BLM–Salt Lake	D. Christensen	Wendover Cemetery Site	U-90-BL-071b
TO	Survey	BLM–Salt Lake	D. Christensen	Air Force Fiber Optics Overhead Line	U-90-BL-426b
TO	Survey	BLM–Salt Lake	D. Christensen	Big Hollow Emergency Fire Rehabilitation	U-90-BL-425b
TO	Survey	BLM–Salt Lake	D. Christensen	Vernon Hills Mining Exploration	U-90-BL-332b
TO	Survey	BLM–Salt Lake	D. Christensen	Ibapah Isolated Tract #3	U-90-BL-348b
TO/BO	Survey	BLM–Salt Lake	D. Christensen	HAMOT Sites	U-90-BL-424b
TO/UT	Survey	BLM–Salt Lake	D. Christensen	Ten Mile Pass Mining Exploration	U-90-BL-526b
TO	Survey	BYU–OPA	L. Billat	Dugway Instrum. Sites & Access Roads	U-90-BC-153m
TO	Survey	BYU–OPA	L. Billat	Dugway Antenna Site & Gravel Pit	U-90-BC-543m

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1990 PROJECT REPORTS RECEIVED

County	Activity	Organization	Field Supervisor	Project Name	Project Number
TO	Survey	BYU–OPA	T. Christensen	Dugway West Grate Holding	U-90-BC-371m
TO	Survey	Nielson Cons.	G. Nielsen	Mt. Fuel Pipel. Tooele Army Depot to S. Depot	U-90-NP-558b,p,s
TO	Survey	OPA-BYU	S. Baker	Dugway Weapon Area and Observation Points	U-90-BC-225m
TO	Survey	Sagebrush	M. Polk	Air Monitor Station near Farnsworth Park	U-90-SJ-204b
TO	Survey	Sagebrush	M. Polk	Wendover Culinary Water Line	U-90-SJ-082s
TO	Survey	USFS–Uinta	C. Thompson	Barrick Res. Vernon Drill Holes	U-90-FS-448f,p
Un	Survey	AERC	R. Hauck	Old Squaw's Crossing #2–27, Wild Horse Bench	U-90-AF-303b
Un	Survey	Senco–Phenix	J. Senulis	Nelson Federal No. 12–31	U-90-SC-586i
UN	Survey	Abajo	J. Montgomery	Northwest Pipeline Evac. Creek Inventory	U-90-AS-456b,p,s
UN	Survey	AERC	G. Norman	Wild Horse Bench Pipeline	U-90-AF-008b
UN	Survey	AERC	R. Hauck	Seep Ridge Development Project	U-90-AF-127i
UN	Survey	AERC	R. Hauck	Addend. to Borrow Sites, Ouray Locality	U-90-AF-555i
UN	Survey	AERC	R. Hauck	Two Wells, Wild Horse Bench	U-90-AF-447b,s
UN	Survey	AERC	G. Norman	Three Pipelines vic. Wild Horse Bench	U-90-AF-479b
UN	Survey	AERC	R. Beaty	Cottontail Unit 1-18, Ouray Locality	U-90-AF-268i
UN	Survey	Alpine	S. Chandler	Mitchell Energy Evacuation Creek Well	U-90-A1-478b
UN	Survey	Alpine	R. Greubel	Mitchell Energy Well Pads	U-90-A1-123b
UN/CO	Survey	Alpine	S. Crum	Bittercreek Unit #1-25-14-25 and Access	U-90-A1-471b
UN	Survey	BLM–Price	B. Miller	Sand Wash Drift Fence	U-90-BL-497b
UN	Survey	BLM–Vernal	B. Phillips	East Bench Reservoirs 1 through 6	U-90-BL-540b
UN	Survey	BLM–Vernal	B. Phillips	Apache Federal Well 44-25	U-90-BL-588b
UN	Survey	BLM–Vernal	B. Phillips	West Deadman Reservoir #4	U-90-BL-632b
UN	Survey	BLM–Vernal	B. Phillips	Brush Creek Right-of-Way	U-90-BL-589b

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
UN	Survey	BLM–Vernal	B. Phillips	Walker Hollow Reservoirs 1 thru 6	U-90-BL-633b
UN	Survey	BLM–Vernal	B. Phillips	Donkey Flat Allot. Reservoirs	U-90-BL-024b
UN	Survey	BLM–Vernal	B. Phillips	Bean Draw Springs 1–3	U-90-BL-113b
UN	Survey	BLM–Vernal	B. Phillips	Ouray Refuge Trailer Project	U-90-BL-254b,w
UN	Survey	BLM–Vernal	B. Phillips	Mosby Creek Reservoirs:90	U-90-BL-114b
UN	Survey	BLM–Vernal	B. Phillips	Deadman Bench Guzzlers:FY90	U-90-BL-025b
UN	Survey	BLM–Vernal	B. Phillips	Left Fork of Walker Hollow Res. 1 thru 8	U-90-BL-634b
UN	Survey	Grand River Ins	C. Conner	Four Wells for EPS Resources	U-90-GB-534b,s
UN	Survey	Grand River Ins	C. Conner	Federal 5-5-14 Well and Access	U-90-GB-470b
UN	Survey	Grand River Ins	C. Conner	Phoenix Well, Federal #4-3-L	U-90-GB-535b
UN	Survey	Grand River Ins	C. Conner	Gulf State 36-22	U-90-GB-128s
UN	Survey	Grand River Ins	C. Conner	Red Wash Pipeline	U-90-GB-056b,s
UN	Survey	Grand River Ins	C. Conner	#E Gusher 15-1-A	U-90-GB-377b
UN	Survey	Metcalf	J. Scott	BLM NBU Wells	U-90-MM-635b
UN	Survey	Metcalf	J. Scott	State NBU Wells	U-90-MM-636s
UN	Survey	Metcalf	J. Scott	Indian NBU Wells	U-90-MM-637i
UN	Survey	Metcalf	J. Scott	Coastal Oil and Gas Wells	U-90-MM-457b,i,s
UN	Survey	Nielson Cons.	A. Nielson	Northern Geophys. Seismic, East Seep Canyon	U-90-NP-600s
UN	Survey	NPS–Dinosaur	J. Truesdale	Cub Creek Road, Dinosaur National Monument	U-90-NA-181s
UN	Survey	P-III	B. Tipps	Sunshine Pipeline vic. Brush Creek	U-90-PD-537b
UN	Survey	P-III	G. Popek	Tank Placement & Waterline for Maeser	U-90-PD-322s
UN	Survey	Sagebrush	M. Polk	Four Well Locations on Leland Bench	U-90-SJ-590i
UN	Survey	Sagebrush	M. Polk	Three Well Locations near Pleasant Valley Wash	U-90-SJ-630i
UN	Survey	Sagebrush	M. Polk	Pipeline on Wild Horse Bench	U-90-SJ-591b
UN	Survey	Senco–Phenix	J. Senulis	Apache Federal #42-25 Well Pad and Access	U-90-SC-563b

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1990 PROJECT REPORTS RECEIVED

County	Activity	Organization	Field Supervisor	Project Name	Project Number
UN	Survey	Senco–Phenix	J. Senulis	Flow Line for Chevron	U-90-SC-264i
UN	Survey	Senco–Phenix	J. Senulis	Flow Line Well and Access	U-90-SC-265i
UN/DA	Survey	USFS–Ashley	T. Scott	Vernal District Small Timber Sales	U-90-FS-138f
UT/JB	Survey	AERC	R. Hauck	5 Gwen Tower Locations, vic Nephi–Mona–Goshen	U-90-AF-517p
UT	Survey	BLM–Salt Lake	D. Christensen	Questar Communications Site, West Mountain	U-90-BL-105b
UT	Survey	BLM–Salt Lake	D. Christensen	Chimney Rock Pass Mine Closure	U-90-BL-273b
UT	Survey	BLM–Salt Lake	S. Smith	Gold Fields Mining Notice	U-90-BL-349b
UT	Survey	BLM–Salt Lake	D. Christensen	Stan Smith Land Exchange	U-90-BL-213b
UT	Survey	BLM–Salt Lake	D. Christensen	Goshen Hill Tract	U-90-BL-331b
UT	Survey	BYU–OPA	S. Billat	Two Test Trenches, Rays Valley	U-90-BC-306f
UT	Survey	Nielson Cons.	A. Nielson	Nephi City-Gas Pipeline	U-90-NP-549f
UT	Survey	Nielson Cons.	A. Nielson	Santaquin Waste Water Project	U-90-NP-459p
UT	Survey	Nielson Cons.	A. Nielson	Camp Williams Land Exchange	U-90-NP-219s
UT	Survey	Sagebrush	M. Polk	HAER Doc. of Columbia Ln/Provo River Bridge	U-90-SJ-144s
UT	Survey	USFS–Uinta	C. Thompson	Nebo Loop Trailheads	U-90-FS-402f
UT	Survey	USFS–Uinta	C. Thompson	Mutual Dell to Pine Hollow Trail	U-90-FS-504f
UT	Survey	USFS–Uinta	C. Thompson	Second Water Trailhead	U-90-FS-403f
UT	Survey	USFS–Uinta	C. Thompson	Upper American Fork River Drop Structures	U-90-FS-339f
UT	Survey	USFS–Uinta	C. Thompson	Aspen Grove to Ridge Trail	U-90-FS-505f
UT	Survey	USFS–Uinta	C. Thompson	Spanish Fork Canyon Winter Range	U-90-FS-367f
UT	Survey	USFS–Uinta	C. Thompson	Tie Fork Fuelwood Sale	U-90-FS-251f
UT	Survey	USFS–Uinta	C. Swanson	Mutual Dell Nature Trail	U-90-FS-215f
UT	Survey	USFS–Uinta	T. Scott	South Fork Guard Station Remodeling	U-90-FS-206f

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
UT	Survey	USFS–Uintah	M. DePietro	Red Hollow CUP Mitigation for Monks Hollow	U-90-FS-529f
WA	Survey	Abajo	K. Montgomery	Three Access Routes for Tenneco Potter's Peak	U-90-AS-390b
WA	Survey	AERC	R. Beaty	Two Wells near Deep Creek Canyon	U-90-AF-512s
WA	Survey	Nielson Cons.	A. Nielson	Jordanelle-West Line Relocation near Keetly	U-90-NP-109b
WA	Survey	USFS–Uinta	C. Thompson	Strawberry River Winter Parking	U-90-FS-291f
WA	Survey	USFS–Uinta	C. Thompson	Little Co-op Creek Winter Parking Area	U-90-FS-368f
WA	Survey	USFS–Uinta	C. Thompson	Daniels Summit Winter Parking Area	U-90-FS-369f
WA	Survey	USFS–Uinta	C. Thompson	Mud Creek Trail	U-90-FS-267f
WA	Survey	USFS–Uinta	C. Thompson	Chicken Creek Trail	U-90-FS-340f
WA	Survey	USFS–Uinta	C. Thompson	Renegade Pt. Roads Campground and Boat Launch	U-90-FS-295f
WA	Survey	USFS–Uinta	C. Thompson	Aspen Grove Campground and Boat Launch	U-90-FS-294f
WA	Survey	USFS–Uinta	C. Thompson	Rocky Point Turnout	U-90-FS-293f
WA	Survey	USFS–Uinta	C. Thompson	Chicken Creek Winter Parking	U-90-FS-296f
WA	Survey	USFS–Uinta	C. Thompson	East Side Winter Parking	U-90-FS-292f
WA	Survey	USFS–Uinta	C. Thompson	Coop Creek Road Reroute	U-90-FS-450f
WA	Survey	USFS–Uinta	C. Thompson	Mud Creek Road and Day Use Area	U-90-FS-266f
WA	Survey	USFS–Uinta	C. Thompson	The Ladders Road & Parking	U-90-FS-250f
WA	Survey	USFS–Uinta	C. Thompson	Left Fork of White River Road Armoring	U-90-FS-404f
WB	Survey	USFS–Cache	T. Scott	Weber Power Plant Picnic Area	U-90-FS-228f
WB	Excavation	USU/USHS/USAS	Jones/Simms	USAS/USU Salt Lake Marsh Project	U-90-UC-090p,s (e)
WN	Survey	Abajo	B. Davis	Sorrel Butte No. 33-1 Well	U-90-AS-315b
WN	Survey	BLM–Richfield	L. Lindsay	Wayne Co./Grover Road	U-90-BL-151b
WN	Survey	BLM–Richfield	L. Lindsay	Grover Irrigation Co. Pipeline	U-90-BL-150b

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County	Activity	Organization	Field Supervisor	Project Name	Project Number
WN	Survey	BLM–Richfield	L. Lindsay	Bicknell Water Storage Pond and Pipeline	U-90-BL-152b
WN	Survey	BLM–Richfield	L. Lindsay	Wayne County/Hunt Access Road	U-90-BL-057b
WN	Survey	BLM–Richfield	L. Lindsay	Bert Avery Seep Exclosure	U-90-BL-101b
WN	Survey	BLM–Richfield	L. Lindsay	Goat Park WSA Road	U-90-BL-077b
WN	Survey	BLM–Richfield	L. Lindsay	Granite Well and Pipeline	U-90-BL-102b
WN	Survey	BLM–Richfield	L. Lindsay	Wayne Co./Fremont River Road Reroute	U-90-BL-033b
WN	Survey	BLM–Richfield	L. Lindsay	Donald Gypsum Lease	U-90-BL-149b
WN	Survey	USFS–Fishlake	D. Oyler	Torrey Reservoir Borrow Sites	U-90-FS-061f
WN	Survey	USFS–Fishlake	C. Christensen	Hens Peak Water Development	U-90-FS-391f
WS	Survey	Abajo	B. Davis	UDOT SR 17 Materials Storage	U-90-AS-511s
WS	Survey	Abajo	B. Davis	Interstate 15 Anderson Junction Interchange	U-90-AS-514s
WS	Survey	BYU–OPA	Baker/Christens	Ivins Sewer Line	U-90-BC-372p,b
WS	Survey	Dames & Moore	D. Larson	Kern River Reroute U-34, Spread 5	U-90-DH-643b
WS	Survey	Dames & Moore	D. Larson	Kern River Reroute U-37, Spread 5	U-90-DH-536b,f,p
WS	Survey	Dames & Moore	D. Larson	Kern River Reroute U-30, Spread 6	U-90-DH-644b,s
WS	Survey	Intersearch	B. Walling	Hall Bros. Borrow Pit, Port of Entry Station	U-90-IG-473s
WS	Survey	Nielson Cons.	A. Nielson	UAMPS Middleton to Riverbottom 138KV	U-90-NP-344b,p
WS	Survey	Nielson Cons.	A. Nielson	Leeds 12.5 KV Relocation	U-90-NP-130b,s
WS	Survey	Nielson Cons.	A. Nielson	UAMPS St. George Power	U-90-NP-247b,p,s
WS	Survey	Sagebrush	K. Montgomery	Virgin River Hwy 21, Bridge Replacemnt, Adden	U-90-SJ-067s
WS	Survey	Sagebrush	K. Montgomery	3rd Survey-Virgin River Hwy 21	U-90-SJ-129s
WS	Survey	USFS–Dixie	F. Ybright	Brookside-Central Urban Development	U-90-FS-064f
WS	Survey	USFS–Dixie	M. Jacklin	Wheatgrass Revegetation	U-90-FS-518f

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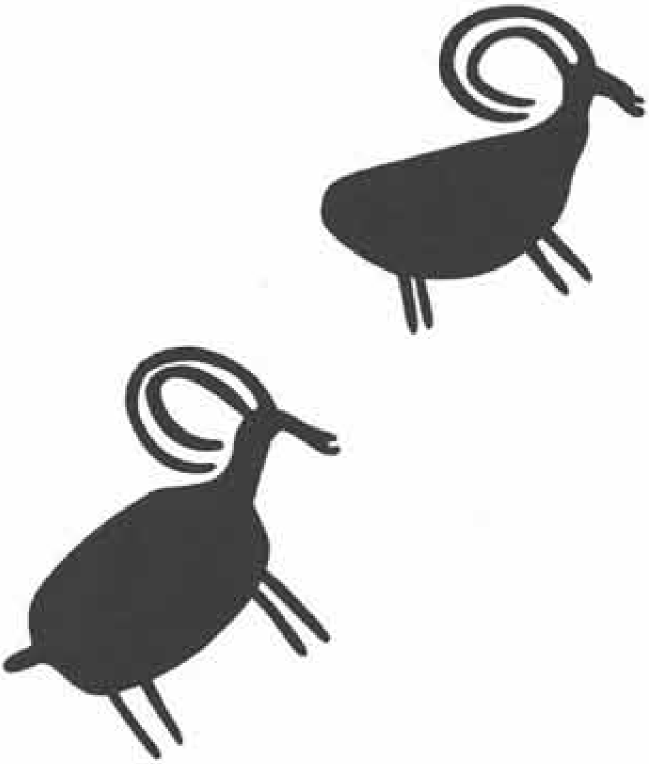
County	Activity	Organization	Field Supervisor	Project Name	Project Number
WS	Survey	USFS–Dixie	A. Bate	Little Pine Creek Gravel	U-90-FS-063f
WS	Survey	USFS–Dixie	M. Jacklin	Wy-Cal Microwave Repeater Site	U-90-FS-319f
WS	Survey	USFS–Dixie	M. Jacklin	Water Well Locations D-1	U-90-FS-321f
WS	Survey	USFS–Dixie	M. Jacklin	Deep Flat Spring Development	U-90-FS-432f
WS	Survey	USFS–Dixie	M. Jacklin	Pioneer Graves	U-90-FS-437f
WS	Survey	USFS–Dixie	M. Jacklin	Leeds Water System Improvement	U-90-FS-156f



Near St. George, southwestern Utah

Central Utah

REVIEWS

***Wetland Adaptations in the Great Basin*,** edited by Joel C. Janetski and David B. Madsen. Museum of Peoples and Cultures Occasional Papers No. 1, Brigham Young University, Provo. 1990. 285 pages (plus V), figures, tables, references cited. $15.00 ($2.00 shipping) soft cover.

Reviewed by: **Mark E. Stuart**
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1849 Brinker
Ogden, UT 84401

As an avocationalist who has spent much time working in the wetlands of the Great Salt Lake, I have had numerous questions about cultural remains frequently encountered. Most of these questions are behavioral, centered around "Why do people do what they do?" As I have pondered these questions and sought for answers, I have searched for information about other marsh sites locations in the Great Basin for similarities, insight, and clues. I have found that much of the information is not published or is part of the hard-to-locate archaeological gray literature. The problem is that we do not know much about wetland areas, either ethnographically or prehistorically.

The volume *Wetland Adaptations in the Great Basin* is an important step in rectifying this problem. This volume is a collection of papers, many of which were given at the Twenty-First Great Basin Anthropological Conference held in Park City, Utah, in 1988. The theme of that conference was wetland studies in the Great Basin. This emphasis was due in part to the research interests of Janetski and Madsen and the proliferation of work being done in wetlands throughout the Great Basin for various reasons (such as flooding at Stillwater Marsh, Nevada). The purpose of this collection of papers is to fill a major void in what we know about those portions of the Great Basin where wetlands are present.

This collection of 17 papers by 23 contributors addresses a wide range of issues such as ethnography, understanding material culture, broad regional overviews, specific analyses of archaeological data, and regional problems of settlement and subsistence. Most of the papers deal with western Great Basin wetland systems, but papers from the east and northwest give the volume a basin-wide perspective. The strength of the volume is the fact that the data and observations generated by these papers give insights into the wide range of variability in Great Basin wetlands. But most importantly, it defines what is needed if we are to understand human adaptation in wetland settings.

The volume opens with a brief introduction by Janetski and Madsen in which they state the purpose of the collection of papers by reviewing current models concerning Great Basin wetland adaptive strategies. This is then followed by "A History of Wetlands Anthropology in the Great Basin," by Catherine and Don Fowler (University of Nevada, Reno), which is a broad but excellent overview of wetlands research conducted over the years. They conclude that given the state of the data base, elucidating the specifics of wetlands adaptations will be a continuing goal and one not soon realized. Two other good overviews in the volume are "Aboriginal Settlement in the Lake Abert-Chewaucan Marsh Basin, Lake County, Oregon," by Albert Oetting (Heritage Research) and "Prehistoric Fishing in the Northern Great Basin," by Ruth Greenspan (Heritage Research) dealing with wetlands in the northwestern Great Basin.

Papers in the volume that deal with settlement patterns are "Archaeological Sites Exposed by Recent Flooding of Stillwater Marsh Carson Desert, Churchill County, Nevada," by Anan Raymond and Virginia Parks (U.S. Fish and Wildlife Service), "Settlement Patterning and Residential Stability at Walker Lake, Nevada: The View from Above," by David Rhode (Desert Research Institute, Reno), and "A Wetlands and Upland Settlement-Subsistence Model for Warner Valley, Oregon," by William J. Cannon and others

(Bureau of Land Management). I was especially taken with the Stillwater Marsh article because of the similarities of the Stillwater sites to sites I have worked on around Utah Lake and the Great Salt Lake wetlands. With the exception of pottery, the similarities are striking. I also found Rhode's paper innovative in attempting to link the Walker River wetlands with neighboring upland areas. I feel more of this kind of work is necessary to really get the big picture of human adaptation in a region.

As I have surveyed sites in the Great Salt Lake wetlands, I have often wondered what role—if any—the fresh water mussels that were found in some abundance played in the subsistence of prehistoric inhabitants. Answers to some questions were given in the article entitled "The Dietary Role of Freshwater Shellfish from Stillwater Marsh," by Michael P. Drews (Intermountain Research). Another paper that dealt with specific data analysis was "Unusual Eburnation Frequencies in a Skeletal Series from the Stillwater Marsh Area, Nevada," by Sheilagh Brooks and others (University of Nevada, Las Vegas). I found this article on possible causes of skeletal pathologies to be extremely interesting and useful in light of the 80+ burials recovered from the exposed Salt Lake marsh sites (Simms et al. 1991). Both of these papers serve as good starting points for future research into these subjects.

Two interesting papers that dealt with subsistence are "Prehistoric Carnivore Usage in Wetland Habitants of Western Nevada," by Amy Dansie (Nevada State Museum), which is an explanation of why the abundance of carnivore bones in western Great Basin wetland sites, and "Mammals in the Marsh: Zooarchaeological Analysis of Six Sites in the Stillwater Wildlife Refuge, Western Nevada," by Nancy D. Sharp (Australian National University). This paper is an attempt to reconstruct environmental conditions, faunal distributions and abundance, and human subsistence and settlement through the analysis of mammal remains in association with detailed stratigraphic and chronological controls.

Joel Janetski (Brigham Young University) in his paper "Wetlands in Utah Valley Prehistory" and Robert Kelly's (University of Louisville) "Marshes and Mobility in the Western Great Basin" have combined detailed settlement and subsistence patterns to create testable models to explain population shifts in wetlands adaptation. In the case of Janetski, his model is in need of further refinement and testing. Kelly's model has somewhat been refuted by the work of Raymond and Parks (this volume) who with extraordinary new archaeological evidence from the Stillwater Marsh have come to rather different conclusions than those offered by Kelly.

I found the most intriguing of the papers to be Donald Tuohy's (Nevada State Museum) "Pyramid Lake Fishing" and Catherine Fowler's (University of Nevada, Reno) "Ethnographic Perspectives on Marsh Basin Cultures in Western Nevada". I found these articles to be fascinating because of the excellent photographs and illustrations that accompany the text and tables. The illustrations alone are well worth the cost of this publication. The theme of both papers is that there is much to do in bringing together or differentiating the ethnographic and archaeological evidence for marsh and lake adaptation. They also call for a re-examination of lake-versus-marsh orientated adaptations with more attention paid to the role of fishing, waterfowl hunting, and the collecting of specific plant types. In light of this plea, Janetski's (1991) new volume *The Ute of Utah Lake* is well timed, but much more work needs to be done for other eastern Great Basin wetlands such as Salt Lake, Bear Lake, Sevier Lake, etc.

The volume ends with an interesting paper by Davis Hurst Thomas (American Museum of Natural History), "On Some Research Strategies for Understanding the Wetlands" and a brief but candid reply by David B. Madsen (Antiquities Section, Utah Division of State History).

Over all I found *Wetland Adaptations in the Great Basin* to be like a taste of cold water on a hot summer day—I wanted more. Despite some minor report limitations and with one exception a dearth of papers dealing with the eastern Great Basin, I found this volume to be refreshing as it attempted to breathe life into the archaeological record. The editors should be complimented in their efforts to fill the void in what we know about Great Basin wetlands. As Anan Raymond of the U.S. Fish and Wildlife Service said in recent correspondence to me "*Wetland Adaptations in the Great Basin* is currently the single best reference on marshes in the Great Basin." I heartily endorse his conclusion and recommend this volume to anyone both avocational and professional alike who has an interest in Great Basin archaeology. I know this volume is a valuable and often used reference in my library.

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1991 *The Ute of Utah Lake.* Anthropological Papers No. 116. University of Utah, Salt Lake City.

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The Student's Guide to Archaeological Illustrating, edited by Brian D. Dillon. Institute of Archaeology, University of California, 405 Hilgard Avenue, Los Angeles, California 90024-1510. 1985. 185 pages, 106 illustrations. $15.00 ($3.00 shipping) soft cover.

Reviewed by: **Robert B. Kohl**
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One of the largest problems in preparing archaeological reports, and especially for avocationals, is locating some cooperative and accomplished illustrator to make the black-and-white drawings required.

As a teenager working as a Saturday volunteer in the Field Museum of Natural History in Chicago, I recall being amazed at the precision of an employee drawing a fish. Each scale was measured under magnification, each scale was precisely positioned as if it were a piece of art work unto itself.

This book, published as Volume 1 of a series titled *Archaeological Research Tools*, can with practice turn an amateur sketcher into an archaeological artist who may become as accomplished as the museum artist I remember so well.

The 13 chapters in the book, all written by experts in the illustration field, cover everything in the archaeological want list. Starting with a chapter on "Tools and Techniques," the book winds through chapters on "Archaeological Map Making," "Architectural Floor Plans," and "Architectural Reconstruction Drawings." There is a chapter on "Stratigraphic Sections," which can certainly be of immense help in completing those necessary but highly involved drawings for final reports on site work.

Seven chapters cover the illustration of objects and artifacts from the stelae of the Mayans to the projectile points of Native North American Indians. Sequentially, they are titled "Relief Monuments," "Ceramics," "Special Problems in Ceramic Illustration," "Ceramic Figurines," "Stone Artifacts," and "Shell and Bone Artifacts." There is even a chapter titled "Burial Illustration."

The book closes with a chapter titled "Archaeological Illustration from Photographs." There are tips for the cameraman, too, in positioning artifacts with both natural and artificial lighting.

Short of an instructor looking over your shoulder in a classroom, I know of no other text that can teach so much in so short a time. There is no padding in this volume, it is all strictly drawing-business for the black-and-white illustrator. I would highly recommend it for anyone preoccupied with crow-quill pen, Indian ink, stippling, and shading blues.

Indian Givers, by Jack Weatherford. Crown Publishers, New York. 1988. 272 pages. $17.95 hardcover.

Reviewed by: **Robert B. Kohl**
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This may be the most attitude-adjusting volume in years to explore an unusual portion of the Native American lifestyle. In fact, this fascinating book is a sort of payment of an I.O.U. long overdue to the First Citizens of the New World.

Ever since the white European invasion of the Americas, the popular stereotype of the Indian has been that of an indolent, illiterate, incompetent, and frequently savage sort of fellow. In diluted form some of that opinion exists today. Most of us, however, now recognize that this brainwash was created to justify somehow the taking of lands and waters and the extermination or confinement of Indian people

Author Weatherford does not address this caricature directly, but investigates the facts of cultivars, medicinals, inventions, and developments of these often maligned prehistoric people of North, Central, and South America. He subliminally abolishes any negative opinions still remaining. We quickly learn from his research that these early ones were imaginative, creative, inventive, and pretty smart folks.

The magic of this author is in relating so many of these items not just in the context of who made or who did what, but in the much broadened view of their impact on the politics, lifestyles and economies of the entire world.

Mention pineapple, for instance, and we think Hawaii. But the Zapotecs, Mixtecs, and Toltecs of Central American were cultivating the fruit for untold centuries before the Dole family started their mid-Pacific plantations. As any traveler to native Mexican markets knows, the ripe pineapple is sold or traded there as a sweet treat by the slice or whole fruit. It has been so since no one remembers when.

Or mention the white potato and we think Idaho or Ireland. The original white potato was first hybridized from a wild variety by the Andean Indians about 8000 B.C. By careful selection they developed potatoes that would mature at various seasons on terraced plots ranging from river floodplain to mountain highs. These early agricultural experimenters developed some 3,000 varieties compared to the mere 250 we know today.

Ireland, as with so many European countries of the time, depended upon grain-based gruels and porridges and despised root crops. Yet the Emerald Isle became so dependent upon the imported tuber that thousands of Irish starved or emigrated when the potato blight destroyed their crop. The Great Potato Famine was the catalyst for the 1.75 million Irish arrivals in the New World in the mid-1800s.

Moreover, the pre-Incas first spread their potatoes on the ground at high elevations, stomped the water out of them, let them freeze overnight, and repeated the process the next day. The resulting mashed and dried pulp could be stored for many months and then reconstituted with water. Most of us believe that freeze-drying is a recent American invention. Not so at all, yet the Andeans get no credit for developing the process that now fills the frozen food sections of supermarkets.

Weatherford frequently traces language. He notes that *batata* was a Caribbean name for the potato, a name corrupted by the Spanish. He also traces the impact of this New World cultivar on Ireland and Russia in causing what may have been the world's first agriculture-based population explosions.

Readers of archaeological books are deluged with the corn/beans/squash syndrome, all of the domesticated in our own front yard. The English still call it *maize* to distinguish it from early Biblical terms and later English laws relating to other grains. Corn, as we know it, is the largest field crop in the United States and our largest agricultural export. It is now grown worldwide and its influence on many nations is perhaps of secondary importance only to rice or wheat.

The author reports that kidney beans, string beans, snap beans, butter beans, lima beans, navy beans, and pole beans were all first cultivated and processed by Indians of the Americas. Many of these beans now carry prefixes such as French, Rangoon, Burma, and Madagascar, but none carry any of the cultural names of their New World paternalism.

Weatherford's story is not just about foodstuffs. Little credit is ever given to the Native South Americans for their discovery of quinine in *cinchona* bark as a preventative and cure for malaria. It is also now used in treating anemia, as an anti-pyretic, in obstetrics, and as a float called tonic water for diluting a jigger or two of gin or vodka.

Also largely uncredited is Ipecac, the medicinal urged to be in every home as an emetic for children who have swallowed household poisons. The roots of this creeping Brazilian shrub were used medicinally by pre-Columbian Indians for centuries, according to Weatherford.

Charles Goodyear gets the credit for inventing vulcanizing; some people even think he invented rubber. Various cultures in Mexico, Guatemala, and Belize first discovered that latex could be tapped from the rubber tree. The first playing balls were all of New World rubber and used in ball court games where the scoreboard indicated not just who lost the game but their heads as well.

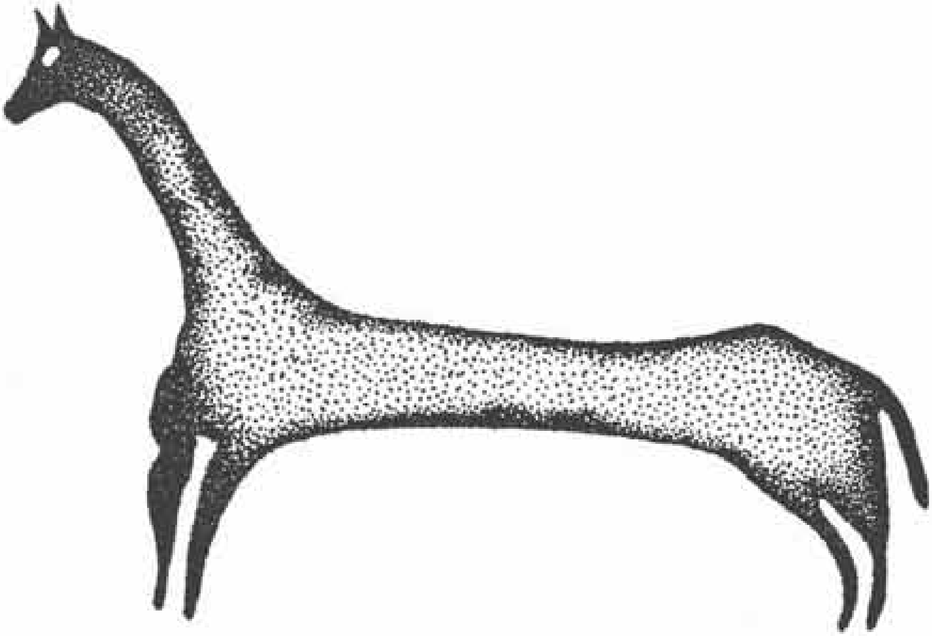
As for vulcanizing, the same Central and South American Indians learned how to eliminate the stickiness of raw latex and get more bounce to the ounce. They simply dipped wooden paddles into sulfurous wood ashes when making their round *pelotas*—and that is primitive vulcanizing.

The review seems endless. Readers, however, should enjoy for themselves the history and impact of amaranth, manioc (tapioca), chilis, tomatoes, peanuts, cashews, Brazil nuts, tobacco, curare, chewing gum, coca (as in colas and cocaine), chocolate, papaya, and avocadoes. And readers will enjoy the stories about origins of succotash, jerky, pemmican, and popcorn!

A final attitude adjustment might include remembrance of last year's Thanksgiving dinner. The turkey was domesticated by Indians who used its feather more than its meat. The probable menu of corn on the cob, sweet potatoes, mashed potatoes, cranberries, squash, pumpkins, pecan pie, and maple sugar candy included all New World crops. All were cultivated or domesticated or processed by the Natives of the Americas so often castigated for lack of innovation.

Weatherford makes an issue of the fact that not one of the foods, medicinals, or processes reported in his book was known in the Old World until Columbus and the Spanish conquistadors who followed him carried them back to their homeland.

It is commendable that author Jack Weatherford has made a payment on an I.O.U. many centuries overdue—and given us some enjoyable reading as well.



Willow Creek, eastern Utah

MANUSCRIPT GUIDE FOR *UTAH ARCHAEOLOGY*

UTAH ARCHAEOLOGY is a journal focusing on archaeological research within or relevant to Utah. Articles on either prehistoric or historic archaeological research are acceptable and both are encouraged. All articles must be factual technical writing with some archaeological application. The journal is sponsored by the Utah Statewide Archaeological Society (USAS), the Utah Professional Archaeological Council (UPAC), and the Utah Division of State History. The journal is published annually.

Authors submitting manuscripts are requested to follow Society for American Archaeology (SAA) style in text references and bibliography (see April 1983 issue of *American Antiquity*). Please **include** authors' first names in your "References Cited" to be consistent with the 1983 style. If you do not have access to a copy of the style guide, write to Joel Janetski requesting a photocopy. Authors are asked to submit one original and three copies of their manuscripts as all submitted articles will be reviewed by three readers. Reviewers will be selected on the basis of paper topic. Manuscripts should be double spaced with margins adequate to allow for comments and should include a short abstract if the manuscript is intended for an article rather than a report or a comment.

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Authors are responsible for figure and photo production. Figures need to be publishable quality and should not exceed 6½ inches by 8 inches in size. Use pressure sensitive transfer letters or KROY lettering for labels. Figure captions should be submitted on a separate sheet and clearly correlated to figures or photos. Please submit figures as computer generated graphics or as positive mechanical transfer prints (PMTs). If such a process is unavailable, submit figures as photo-ready drawings in black ink. Photos should be black and white glossy and 5 inches by 7 inches in size.

Once the manuscript has been reviewed and accepted for publication, usually with revisions, authors will be asked to respond to the reviewer's comments. A hard copy of the revised manuscript should then be submitted to the editor with a computer disk in either WordPerfect or ASCII. The editor will then copy edit and format the article and return a hard copy to the author for final proofreading.

Subscriptions are available through membership in either USAS or UPAC or annual subscriptions. Individual issues are available through selected retail outlets throughout the state. These include the Utah Division of State History Bookstore, the Museum of Peoples and Cultures Publications Department, Fremont Indian State Park, and Edge of the Cedars Museum.

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