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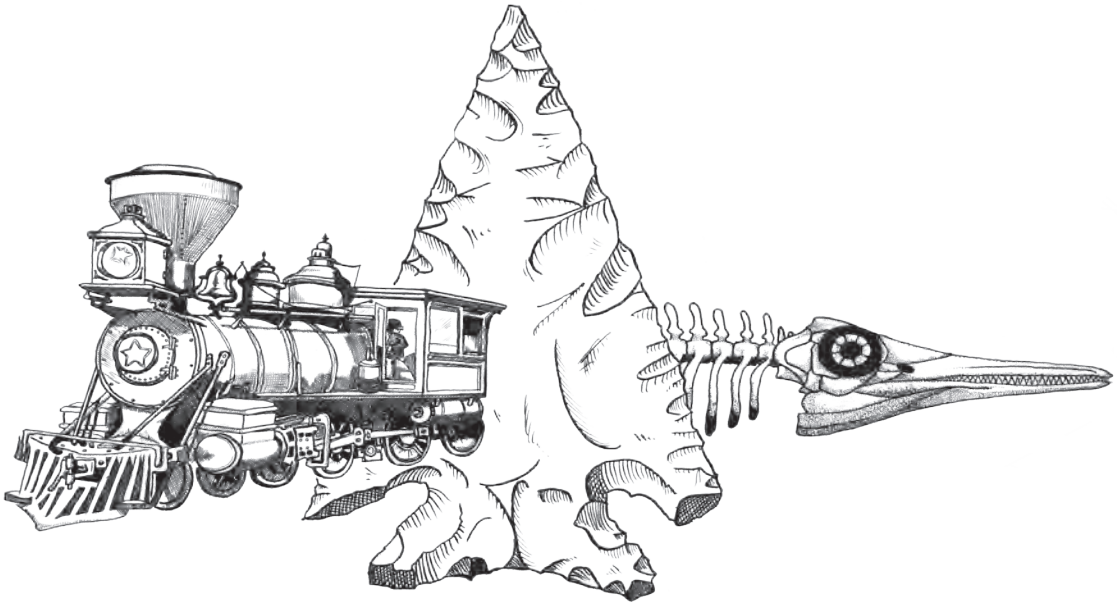

Past, Present and Future Issues in Great Basin Archaeology: Papers in Honor of Don D. Fowler

Edited by
Bryan Hockett

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US Department of Interior

Bureau of Land Management

3900 East Idaho Street

Elko, Nevada 89801

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Introduction

This book provides a compendium of eight broad research topics that have played significant roles in the study of ancient Great Basin cultures and environments. These include (1) mobility patterns, (2) the development of Cultural Resource Management, (3) rock art, (4) textiles, (5) animal paleoecology, (6) lithic studies, (7) large game hunting, and (8) paleoclimates during the Pleistocene and Middle Holocene. Twelve papers summarize the current state of knowledge related to these topics, as well as provide suggestions for future research.

The authors of each individual chapter have more in common than simply an interest in the geographic region known as the Great Basin of western North America. In one way or another, they all have been influenced by a single scholar: Don D. Fowler. As outlined in the opening chapter by Don Hardesy, Don Fowler has spent more than 40 years as a student, teacher, mentor, and researcher of Great Basin aboriginal peoples, cultures, and landscapes. During that time, Don has positively influenced a great many people, including myself.

Don's recent retirement from the University of Nevada, Reno, prompted me to bring together a diverse group of these scholars to present papers in his honor in a symposium I chaired in Las Vegas in 2006. The ballroom in which this symposium took place was standing-room only. The papers presented were of exceptional quality. The discussants were impeccable: Don Grayson, David Hurst Thomas, and David Madsen. I am certain that everyone in attendance will never forget the tribute to Don Fowler offered by Don Grayson – I only wish his presentation could somehow be recreated here. Alas, it was definitely a "you had to be there" event! In any case, I would have been remiss to not proceed forward with a tribute volume following that symposium, and this book is the result of that effort.

This book, however, is more than simply a hodgepodge of papers put together by scholars who have known and worked with Don Fowler. There is, in fact, no other book recently published quite like this one. Several books have been recently published that summarize general issues in Great Basin research. Beck and Jones' (1999) excellent book covers many of the theoretical issues that have guided Great Basin research in the past. Don Grayson's "The Desert's Past", first published in 1993, has become the standard for a general treatment of Great Basin paleoclimates and paleoecology.

Missing, however, is an overview of past, present, and possible future studies of the material remains that archaeologists uncover

from the dirt (textiles, lithics, bones), and issues related to their procurement and interpretation in time and space (both ancient and modern). The chapters of this book reflect the vitality and variety of material remains and issues that Great Basin scholars study, mirroring the multitude of scholars that Don Fowler has influenced.

On a personal note, I would not be in the position of editing a volume such as this without the support and assistance that Don provided to me early in my graduate career. With this book, I can only offer my heartfelt "Thank You".

Bryan Hockett
Elko, Nevada
January, 2009

1
Historical Perspectives on a Great Basin Career

Donald L. Hardesty

*

Don D. Fowler was born in Torrey, Utah. He first did undergraduate work at Weber College in Ogden and then transferred to the University of Utah, where he received a B.A. in Anthropology in 1959 and did graduate work in Anthropology and American Studies between 1959 and 1962. During this time, he worked on archaeological survey and excavation projects in southern Utah and northern Arizona. Of these, the foremost was the Glen Canyon Project, where, under the direction of Jesse Jennings, Don supervised archaeological survey and excavation teams, helped with project administration, edited major publications, and published several articles in the University of Utah Anthropological Papers. In 1962, he entered the doctoral program at the University of Pittsburgh. Don completed his dissertation and received his Ph.D. in anthropology from the University of Pittsburgh in 1965. His dissertation focused on the culture history and ecology of the Wind River Shoshone in Wyoming, where he did ethnographic research in 1961.

In the fall of 1964, Don, still ABD at this time, moved to Reno to take an appointment at the University of Nevada in what was then the Department of Sociology and Anthropology. He taught classes in cultural anthropology, physical anthropology, archaeology, world ethnography, North American archaeology, North American ethnography, archaeological theory, social structure, history of anthropology, and anthropological theory during those early years and did archaeological research in the southeastern Great Basin. In 1966, he received a grant from the Fleischman Foundation to conduct archaeological research in eastern Nevada and in the following two years received grants from the National Science Foundation to conduct excavations at Newark Cave and archaeological surveys in eastern Nevada and Lincoln County. Continuing down this pathway of grantsmanship, Don later served as Principal Investigator on more than 60 research grants and contracts to support research in Great Basin archaeology and anthropology.

In 1967, the university created a separate Department of Anthropology under the chairmanship of Warren d'Azevedo. Don spent the year of 1967-68 at the Museum of Natural History of the Smithsonian Institution on a fellowship to do research on John Wesley Powell and the history of 19th century anthropology in North America. This research launched a new career track with a series of subsequent publications on John

Wesley Powell (Down the Colorado: John Wesley Powell's Diary of the First Trip Through the Grand Canyon, E.P. Dutton, 1969; Anthropology of the Numa, Smithsonian, 1971, with Kay Fowler), western photographer John K. Hillers ("Photographed All the Best Scenery – Jack Hillers' Diary of the Powell Expedition, 1871-1875, University of Utah Press, 1972, and Myself in the Water, Smithsonian, 1989), Edward Curtis photographs (In a Sacred Manner We Live, Barre, 1972), and the history of anthropology in the American Southwest (A Laboratory of Anthropology: Science and Romanticism in the American Southwest, 1846-1930, University of New Mexico Press, 2000). Don began his long-term research collaboration with his spouse, Kay, during this period, with several joint publications on the Powell expedition and indigenous peoples in the Great Basin and the Southwest. They continue to work together today, most recently as editors of a forthcoming book on Great Basin archaeology to be published by the School of American Research.

Don was appointed as Director of what was then the Center for Western North American Studies at the Desert Research Institute of the University of Nevada in the fall of 1968 but continued a joint appointment in the University's Department of anthropology, teaching one course a semester. The Center underwent several name changes over the years, changing first to the Western Studies Center and then to the Social Sciences Center. At DRI, he continued to conduct archaeological research projects within the Great Basin supported by numerous grants and contracts but also collaborated with colleagues on a variety of water resources, energy, and urban planning projects. And between 1969 and 1971, Don worked as a consultant for the Smithsonian Institution to develop archaeological research programs in India. His prowess as an administrator and leader blossomed during the DRI years. From 1970 to 1973, he chaired the Faculty Senate at DRI and was involved in a variety of University System-wide committees focusing on inter-campus research and teaching programs from 1970 to 1978.

In 1978, Don left his position at DRI and assumed the position of Mamie Kleberg Professor of Historic Preservation and Anthropology at what was now the University of Nevada, Reno (UNR) (and which was the first endowed professorship at the university) and Executive Director of the Historic Preservation Program; he continued to occupy those positions until his retirement on July 1, 2005. Don also continued his joint appointment in the Department of Anthropology. He developed innovative teaching and public outreach programs in historic preservation and preservation

management. Among others, Don created new courses in Principles of Historic Preservation, World Architecture, Laws and Policies, and Historic Preservation Survey and Planning. He developed a new university minor in historic preservation and links to an interdisciplinary graduate program in Land Use Planning at UNR. In 1987, he established the UNR Continuing Education Program in Heritage Resources Management, the first of its kind in the United States and which later served as the inspiration for the development of a number of similar programs around the country. He continued as Director of the program until 2004. The program presented over 360 seminars and workshops to over 9,000 heritage management and historic preservation professionals in more than 30 venues across the country. Don was given a Special Achievement Award by the Society of Professional Archaeologists for the program in 1992.

Community involvement in historic preservation marked this period of his career. Don was instrumental in helping the Northern Nevada community organize the Washoe Heritage Council (the late 1970s) and its successor, the Truckee Meadows Heritage Trust (in 1999), as well as the Historic Reno Preservation Society. He is currently president of the Nevada Rock Art Foundation, a statewide organization, and continues his historic preservation community work through this venue. Several local, state, and national organizations have recognized his extensive and innovative involvement in historic preservation and archaeology. He received the City of Reno's Historical Resources Commission Distinguished Service Award in 1999, and the Lifetime Achievement Award from the Nevada State Historic Preservation Office in 2003.

In 1994 Don was responsible for UNR receiving a one million dollar endowment for the Sundance Archaeological Research Fund (SARF) to develop and implement an archaeological research program focused on the earliest people and environments in the Great Basin. He served as Executive Director of Sundance until 2001. And in that year, a long-time supporter of the UNR archaeology program also created the two hundred and fifty thousand dollar Don Fowler Endowment for Great Basin Archaeology through the UNR Foundation.

At the University of Nevada, Reno, he played key roles on numerous departmental, college, and university committees, including the University Master Plan Committee in 1986 and the original Core Curriculum Committee, and served twice as a special hearing officer. He chaired the Department of Anthropology from 1990 to 1998 and presently serves as a member of the College of Liberal Arts Advisory Board. He was selected

as a University Foundation Professor in 1988 and as Outstanding Researcher of the Year in 2003.

At UNR, Don taught hundreds of students in anthropology and historic preservation courses. He chaired 37 master's and doctoral committees in anthropology and land use planning (with an emphasis in historic preservation) and served on many other graduate committees across the university. Brooke Mordy's 1966 MA thesis under the direction of Warren d'Azevedo on the conflict over rights of residence for a Native American settlement in western Nevada appears to be the first graduate degree in what was then the combined Department of Sociology and Anthropology. In 1973 Don directed Joy Leland's MA thesis on alcoholism among Native Americans in North America and produced his first graduate alumni, followed by Bill Self's thesis on the prehistory of Lowe Shelter (near Tonopah) in 1973 and Susan Seck's thesis on Trego Hot Springs in the Black Rock Desert in 1980. The production of MA students boomed in the 1990s. Twelve (12) MA students graduated under Don's tutelage during this time, with a great variety of thesis topics in Great Basin prehistory and historic preservation that included Vernacular Ranch Architecture (Renee Cranston 1991), faunal analysis of prehistoric sites from Warner Valley (Molly Moore 1995), Upland Adaptations in the Buffalo Hills of Northwestern Nevada (Renee Kolvet 1995), archaeology of Duck Flat, Nevada (Cliff Creger 1991), Early Holocene Mobility and Land Use in the Northwestern Great Basin (C.C. Hoffman 1996), An analysis of resource zone relationships in Warner Valley, Oregon (Julie Tipps 1997), survival and detection of blood residues on stone tools (Judy Eisele 1994), house construction methods and matting as ethnic markers in Warner Valley, Oregon (Sunny Eiselt 1997), Early Holocene Typology, chronology, and mobility in the northern Great Basin (Johannes Christian 1997), observational onsiderations in recording archaeological sites (Diane Pritchard 1996), prehistoric land use pattern changes in the vicinity of Beaty's Butte, Southeastern Oregon (Matt Moore 1998), and basalt resource use and technological organization in the North-Central Sierra Nevada (Daron Duke 1998).

Don played a key role in the development of a new doctoral program in anthropology at UNR, which was formally approved by the Board of Regents in January of 1987. The program has produced 15 doctorates since its inception, the first of whom, Gretchen Siegler, researched and wrote a dissertation in 1992 on the development and organization of a religious community in a small town in northeastern California. In 1996, Don's first doctoral

student, Linda Reynolds, completed a dissertation on the prehistory of the Pinyon-Juniper Woodland of the Inyo-White Mountain Range in eastern California. Other dissertation research projects completed under his direction included Late Holocene landscapes and prehistoric land use in Warner Valley, Oregon (Craig Young 1998) and assemblage richness and composition of Paleoarchaic sites in the vicinity of Yucca Mountain, Nevada (Greg Haynes 2004).

In closing, I want to return to professional service and leadership as hallmarks of his career. Don served as President of the Society for American Archaeology from 1985-1987, and the SAA presented him with its Lifetime Achievement Award in 2003. He served as President of the American Society for Conservation Archaeology in 1977-78 and on the Board of Directors of the Society of Professional Archaeologists in the same year. Don was a founding member and Southwestern Regional Director of the National Council on Preservation Education from 1979 to 1989. He has also served as the National Co-Chair of the Council for the Preservation of Anthropological Records since 1992 and as the founding chair of the Resources Development Committee of the American Anthropological Association from 2000 to 2003. And in 1998 he received the Bryon Cummings Award from the Arizona Archaeological and Historical Society for "outstanding contributions to American anthropology." All of this is fitting signage along the pathway to this Great Basin career.

2
CRM: The Next Generation

Alice Baldrica and Renée Corona Kolvet

*

The evolution of American Cultural Resource Management (CRM) has been dramatic, yet in some ways static, since its inception over forty years ago. Passage of the National Historic Preservation Act (Act) has successfully saved many important sites, buildings, and structures, although the success stories are dwindling with the rising cost of doing business, inadequate constituency to support CRM, and a lack of agreement over who owns the past. Despite its many contributions, there is a growing consensus that major changes must be made in the way CRM is conducted or the profession may suffer the consequences, or worse yet--cease to exist. This paper summarizes CRM's past and present, while predicting a more inclusive future for CRM in Nevada and the West.

The task of preserving heritage sites is a constant challenge in the face of the explosive population growth in the American West. In response, federal and state agencies must constantly find new tools to protect important sites amidst a shrinking pool of funds for CRM activities. Today, CRM practitioners are forging new partnerships in previously uncharted areas. Of several crucial issues in CRM, the changing roles of tribes and the public in the CRM process figure the most prominently. We fully expect this trend to continue into the foreseeable future.

CRM: FROM PAST TO PRESENT

In 1966, Congress passed the Act with the intent of preserving the historic fabric of the nation. The newly created Interstate Highway System and huge urban renewal projects resulted in the massive destruction of historic inner-city neighborhoods and architecturally important buildings. Section 106 of the Act calls for federal agencies to consider the effects of their undertakings on properties listed on or considered eligible for listing in the National Register of Historic Places (National Register). Although federal agencies were required to comply with the Act, no one knew who might develop the programs to ensure that this consideration would take place. Similarly, little thought was given to the manner in which historic properties would be defined and identified nor how they would be evaluated and considered before a federal undertaking occurred.

According to Tom King (2002: 1; 2004:9), archaeologists were in on the ground floor to anoint the new program that would manage historic places of archaeological, architectural, and historical interest. Archaeologists were ready, willing and able to deliver solutions to federal agencies. Since then, archaeologists have dominated the field

in the western United States to the exclusion of equally qualified planners, architectural historians, and historians. The fact that archaeologists took charge of CRM programs was not surprising since most cultural resources are archaeological sites.

From the end of the 19th century through the first half of the 20th century, academic archaeologists set the tone for how they and their students would manage resources for federal agencies. One early salvage project and precursor to modern CRM was the Glen Canyon Archaeological Salvage Project. The Historic Sites Act of 1935 enabled the funding for Glen Canyon, a proposed reservoir site (now Lake Powell) with a rich, extensive archaeological record. In the wake of construction, the National Park Service hired the University of Utah to investigate the right bank of the canyon. Professor Jesse Jennings (1994:205) later referred to the Glen Canyon project as his "largest research opportunity." His student Don Fowler described the research as largely descriptive as there was "little time for exhaustive comparative treatment" (Fowler et al. 1959) (Figure 1). Glen Canyon's research strategy was typical for its time and characteristic of the National Park Service's Interagency Archeological Salvage Program. Many of Jennings' students who directed salvage work would come to dominate the field of CRM in Nevada and the West.

The National Park Service encouraged the employment of archaeologists to oversee CRM projects and persuaded federal agencies to put archaeologists in charge of CRM programs. Nevada CRM followed national and western trends. The State Legislature created the Nevada Archaeological Survey operated by the Desert Research Institute, the University of Nevada, Las Vegas, and briefly by the University of Nevada, Reno. The Nevada State Museum hired Mary Rusco (Figure 2) to conduct archaeological surveys and excavate sites for large federal highway projects such as the Lovelock and Carlin Interstate bypasses. Her work on the Bureau of Reclamation's Rye Patch Reservoir provided the foundation for much of what is known today about the prehistory of the Humboldt River Basin (Rusco et al. 1977; Rusco et al. 1979; Rusco et al. 1979).

The Nevada Department of Transportation hired its first archaeologist in 1977 and the Bureau of Land Management followed suit by employing a state archaeologist and several district archaeologists. The practice of contracting CRM work to private consultants, rather than government institutions, came about after the Nevada State Legislature cut funding for the Nevada Archaeological Survey in 1977. The Nevada State Museum ceased funding for its archaeological survey program several years

later. The practice of hiring private contractors to assist under-staffed agencies in fulfilling their mandated duties continues to this day (Figure 3).

Having professional archaeologists run CRM programs satisfied resource managers, but at a high economic cost. That exclusivity would ultimately weaken support for preserving cultural resources. The thinking of archaeologists, however, best fit into a federal agency's management style that provided for the identification, evaluation and treatment in three easy steps.

Unlike today, public involvement and tribal consultation were minimal or non-existent before the 1990s. What mattered most was whether or not archaeologists considered sites eligible for inclusion in the National Register, and if eligible, making provisions to excavate those sites. Occasionally tribes and the public might be notified of an excavation although their opinions regarding the value of these sites held little weight. Non-archaeological sites (i.e., buildings, objects, and engineering features) also received less attention. This may seem too negative an assessment, but in examining the files of the Nevada SHPO in 1986, only two of 59 National Register-eligible properties were historic structures. It seemed that there were two separate programs at SHPO: one program for buildings that stressed National Register nomination and use of incentives such as the Tax Act of 1986 and Historic Preservation Fund grants to rehabilitate and reuse historic structures; the other being the Section 106 process which was geared toward archaeological sites. The archaeological bias was prevalent—project reports received by the Nevada SHPO revealed that efforts to identify cultural resources were hindered by buildings that covered the footprint of a lot or parcel – not considering whether or not the buildings themselves might be historic.

Archaeological domination in the early 1980s when the "New Archaeology" was gaining relevancy ensured that CRM was grounded in science and scientific practices. For example, criterion "d" requires that archaeological sites eligible for inclusion in the National Register contain data that contribute to an understanding of national, regional or local prehistory or history. For a site to be considered eligible its data would have to fit into research designs prepared by archaeologists; all treatment, which at that time was considered data recovery, was also conducted by archaeologists. The goal was to create a comparative database to address regional research issues to aide agencies in managing resources over the long term.

Fitting into this practice was the development of a planning document that

would tie research designs to the National Register. In 1982, Margaret Lyneis organized and edited the Nevada State Historic Preservation Plan's Archaeological Element which established contexts for hydrological basins in Nevada. Ecological concerns guided the development of research domains, such as settlement patterns and subsistence systems that remained the basis for determining the eligibility of prehistoric sites for years to come. Each context contained a description of what was known to date, data gaps and relevant research questions. Management recommendations stressed the need for more public exhibits and public involvement although increased Native American involvement and consultation was not addressed. CRM was dominated by considerations of archaeological research and science, despite intentions to involve the public and Native Americans or consider the types of properties and significance.

In 1984, Don Fowler, as president elect of the Society for American Archaeology (SAA) met with George Frison and the late Cynthia Irwin Williams to call for regional conferences centered on the conduct of CRM research. At the SAA's recommendation, Mel Aikens of the University of Oregon chaired a conference that examined the status of CRM in the Great Basin in 1985. Government and academic archaeologists convened at the Desert Research Institute to assess what was known from past CRM studies and the paleo-environmental record (Aikens 1986). Alice Baldrica participated in this conference that examined the status of state plans and research designs; the location of site records and collections; and communications between archaeologists, the public and Native Americans. Joel Janetski acknowledged a need for improvement in the flow of information between the professional and private sectors. The participants concluded that the interest level in archaeology was high, as evidenced, ironically, by ongoing vandalism, and by the commendable support of amateur organizations (Aikens 1986). Of note, were mixed reports regarding communications with Native Americans. While some participants reported that Native American involvement was a standard operating procedure during federal excavation programs, others indicated that archaeologists rarely communicated findings or notified tribes of excavations or the discovery of burials. Granted, the laws were different in 1986 but the exclusive nature of CRM can be gleaned from publications such as the proceedings of this conference in which archaeologists were the only participants.

Despite some resistance, legislative and procedural changes were underway. In 1988, amendments to the Archaeological Resources Protection Act (ARPA) required that federal land managers establish a

program to increase public awareness of archaeological resources on public and Indian lands, and the need to protect such resources. Other changes occurred with the passage of the Native American Graves Protection and Repatriation Act in 1990 that required that federal agencies consult with tribes prior to the issuance of ARPA permits to excavate where burials, sacred items, human remains and items of cultural patrimony might be found. In 1992, Congress passed the Fowler amendments to the National Historic Preservation Act that required that federal preservation activities be carried out in consultation with tribes, the public and State Historic Preservation Officers (SHPOs) (Section 110 (a)(2)(D)). These legislative changes required that cultural resource managers re-examine their practices with the goal of becoming more inclusive.

The Fowler amendments to the National Historic Preservation Act helped open the door to the public and tribes, and archaeologists in the West have learned that: (1) CRM is multidisciplinary and multi-vocational—it is not just about archaeology and not always about science. It embraces a variety of fields that include ethnography, history, architecture and engineering; (2) Tribes have an interest in how the past is presented and have a stake in the management of properties of cultural and religious significance. Archaeologists can not solely dictate what is important, and science is not the only deciding factor in the management of cultural resources; (3) American taxpayers help support CRM and archaeologists need to ensure that the results of their studies are appropriately disseminated and available for educational purposes. Additionally, the public wants to be more involved in CRM and not just a passive recipient of what the professionals produce.

CURRENT ISSUES

In light of legislative amendments and changing attitudes, public opinion and tribal rights still challenge our perceptions of who owns the past. Barbara Little (2002) in "Archaeology as a Shared Vision" acknowledges on-going tensions between archaeologists and tribes. Despite the ethical code of professional archaeologists that the past belongs to everyone, ethics and values often differ between tribes and professional archaeologists. For example, Native American groups commonly view significance very differently from cultural resource professionals and mainstream America. If Native Americans and archaeologists agree that a site or location is significant, it is usually for different reasons (Baugher 2005:251). While archaeologists must consider a site's ability to yield data important to science, Native Americans view an archaeological site in terms of its association

to their religion, traditional culture, or world view.

Not surprisingly, the National Register's Euroamerican leanings are behind the call for a re-examination of the evaluation process (Preserve American Summit 2006). While National Register eligibility criteria work well for establishing the significance of historic structures, places, and archaeological sites, the shortfall lies in the realm of the intangible (Sidler and Yeatts 2005:277). Despite Parker and King's (1990) helpful guidance, misunderstandings abound over what constitutes a Traditional Cultural Property (TCP) and which TCPs should be eligible for inclusion in the National Register. The need for tangible boundaries and applying eligibility criteria to places of traditional or spiritual importance can stretch the limits of the Act and create new challenges for federal agencies that manage these resources. While the National Register was amended to acknowledge properties of cultural and traditional importance in 1992, the paucity of TCPs (and archaeological sites) listed in the National Register attest to the difficulties that surround these resources.

It is not only Native Americans who have difficulties with the concept of site significance. Recall that the National Register and the concept of significance were conceived at a time when problem-oriented research and culture history dominated archaeological discourse. While academic archaeologists use a variety of theoretical approaches to frame their research, CRM practitioners feel constrained by redundant research topics and a "historical artifact" called significance (Altschul 2005:196). They have grown weary of the routine nature of the compliance process that discourages new questions (Altschul 2005:192-193). This discontent has lead to a rethinking of the way we regard site significance. Although we can expect changes in the way we assess our cultural heritage, new legislation may be necessary before Section 106 can be "uncoupled" from the National Register (King 2003: 287).

PUBLIC OUTREACH AND TRIBAL PARTICIPATION

These problems aside, Native Americans, the public, and CRM professionals are making significant strides toward the common goal of preserving heritage sites. These collaborations are on the rise. Little (2002:7) is certain that "Archaeology is one of the paths that can help us find our way to the elusive connections between all Americans and America".

In Nevada, as elsewhere, the public has demanded more in terms of information, participation and relevancy to its citizens.

Since 1991, the Nevada SHPO has coordinated with the Nevada Archaeological Association (NAA) in organizing and promoting events for National Archaeological Awareness Week. SHPO participation includes sending out notices reminding preservationists and archaeologists to organize events, compiling event information and funding a matching grant to the NAA, an organization comprised of avocational and professional archaeologists, to produce posters and brochures. Archaeology week includes a variety of historic preservation activities that evolve around a chosen theme. In the past, posters featuring historic schools, mining districts and historic homes were circulated to individuals, schools, libraries and government offices around the state. By recent necessity this week expanded to a month to take in a multitude of events including archaeological fairs, a film festival in Elko; walking tours of historic Reno, fieldtrips to petroglyph and pictograph sites, and a culture history fair and lectures in Las Vegas (Figure 4). In 2006, there were 61 events in 12 Nevada counties attended by approximately 5,000 people.

The public is eager to engage in archeological activities and wants to be a part of the archaeological and historic preservation community. Despite professional oversight, the source of these movements is grass roots and channels the public into legitimate activities that promote the preservation of cultural resources. Many groups are involved in this mission including the Nevada Rock Art Foundation (NRAF). With over 520 volunteers, NRAF records rock art to international standards, monitors sensitive sites around the state, works to restore rock art damaged by graffiti artists, and works with tribes, agencies and the public to study sites where appropriate. Don Fowler, with his lifelong interest in rock art, sits on the Board and helped instigate the formation of this private, non-profit organization in 2002. Although directed by professionals, the membership consists of volunteers and the bulk of the work is donated. The NRAF membership is doing the work that was once considered to be the domain of professional archaeologists and federal agencies (Figure 5).

Equally important is the growth of the site stewardship program (Figure 6). Cultural resource managers have long recognized that law enforcement agents alone cannot protect sensitive sites and control illicit activities on the landscape. This realization is ever more apparent with the rising populations in Nevada and the West. Today, trained site stewards are invaluable to resource managers. This change in attitude is relatively new. For years, volunteers were commonly rebuffed or ignored because federal agencies did not have the time to organize and manage volunteers; others were uncomfortable with sharing site information with non-professionals. The

Nevada Archaeological Association (NAA) was determined to create its own program to train and certify volunteers. Clark County, using monies derived from the sale of public lands, employs a regional coordinator to oversee the activities of over 250 volunteers. The State of Nevada eventually caught up with this grass roots movement when the State Legislature passed a bill to create a statewide site steward program. Much credit goes to Assemblyman Harry Mortensen, and his wife Helen Mortensen, a long term leader of both the NAA and ArchaeoNevada. The Mortensens were not to be dissuaded by funding problems and championed a bill through three legislative sessions before its successful passage in 2005. The SHPO coordinates with the NAA and federal agencies and provides consistent training through the state site stewardship coordinator and the 460 volunteers statewide.

With guidance from federal agencies and the SHPO, site stewards monitor and document the condition of threatened archaeological sites on a quarterly basis. One of the SHPO's five-year projects is to scan the monitoring forms and link them to the state's electronic archaeological database, the Nevada Cultural Resource Inventory System (NVCRIS). This database will provide a tool for cultural resource managers to assess changes in site condition through time. The results will be used to set priorities for law enforcement and to access restoration and rehabilitation dollars while providing an avenue for public participation in CRM.

Additional partnerships with the public continue to provide recognition and protection to a variety of resources not otherwise recorded. These include: (1) In 2004, the Nevada SHPO used a National Park Service grant to partially fund a volunteer group, the New Millennium Dive Expeditions' attempt to locate and map the sunken steamship S.S. Tahoe in 400 feet of water at Lake Tahoe. Diving to the site was hazardous and challenging. Combining the interests of thrill seekers and historic preservation, the group mapped the wreck and described it to the satisfaction of the Keeper of the National Register who listed the property in the National Register. (2) The Comstock Archaeological Center funded three public archaeological excavations of historic saloon sites in Virginia City in which volunteers became trained in archaeological methods (Figure 7). Volunteers from AmArchs, an avocational group, donated hundreds of hours cataloging and analyzing artifacts under the direction of the project archaeologist. (3) Volunteers in the Forest Service's Passport in Time program donated over 13 person years of work recording and excavating sites including a Chinese mining camp, Basque aspen art, historic mining towns, and charcoal kilns. (4) The Bureau of Land Management's

(BLM) Project Archaeology program instructs Nevada's teachers on ways to incorporate archaeology and past cultures into science, history and math lessons of 4th graders. (5) The BLM often requires public interpretation or popular publications as part of the treatment plans for significant sites that will be impacted by federal projects. Too often in the past, the documents that resulted from data recovery or other treatment were geared toward an archaeological audience as opposed to the public or tribes. Creative way to resolve the adverse effects of federal undertakings on National Register-eligible sites are on the rise. For example, taking oral histories, writing popular histories, and preparing interpretive media and public displays are, in some circumstances, more appropriate forms of mitigation (Ford 2000; Hartwell et al. 2002; and Obermayr 2005).

CRM professionals and federal land managers are learning what historic preservationists in the East have known all along--that the public can become an advocate for sensitive resources. Grass roots movements of common citizens provide a powerful constituency and CRM would fail to exist without public support for the millions of dollars spent on preservation each year. Recently, this overwhelming support for CRM prevented Congress from making deleterious changes to Section 106 of the National Historic Preservation Act. Under the proposed amendments, only impacts to sites listed on--not determined eligible—to the National Register would be considered. To put this in perspective, Nevada has fewer than 20 archaeological properties listed on the National Register. Passage of this amendment could have resulted in the destruction of thousands of archaeological sites in Nevada alone.

CRM professionals are also responsible for educating the public on the importance of protecting cultural resources. Often the best means of protecting cultural resources is to bring the public to archaeological sites--something archaeologists have been reluctant to do over the years (Figure 8). Although archaeologists are trained to safeguard site locations, there are many well-known sites, some along major highways, which beg for interpretation. The public is often aware of these sites and their location is shared by word of mouth. It is prudent that federal agencies acknowledge this fact and share information through publications and/or small, interpretive parks. The Grimes Point petroglyph site near Fallon is a perfect example of a site worth interpreting. Once a dump and an airstrip, the BLM developed this National Register property into an interpretive site in 1981. Remarkably few incidents of vandalism have occurred since that time. By developing Grimes Point, the public was given something

in return for the tax monies spent protecting the majority of sites. As an added benefit, outside visitors often infuse monies into the local economy.

One of CRM's most challenging accomplishments has been in fostering better working relations with Native Americans. Despite the considerable progress that has been made, there is room for improvement and better trust on both sides. The SAA has acknowledged that ethics and values often differ between tribes and professional archaeologists (Dongoske et al. 2000). Still, archaeologists are becoming more sensitive of tribal concerns and today, applied anthropology is integral to what we do. Some predict that "an honest dialog between Native Americans and archeologists will fundamentally alter the practice of archaeology" (McGuire and Zimmerman cited in Kelly 2000:101).

Forging better partnerships has proven successful for those who have invested the time to make it work. In Nevada, the Departments of Energy and Defense have well-established Native American programs. (Figures 9-10). Seventeen tribes with ancestral ties to the Nevada Test Site, Yucca Mountain, and Nellis Air Force Range comprise the Consolidated Group of Tribal Officials (CGTO). For more than a decade the CGTO has participated in CRM by reviewing cultural resource inventory reports and participating in NAGRPA consultations, rock art studies and applied anthropological research. Nellis Air Force Base is also credited with launching one of the first Nevada programs where Native Americans participate in cultural resource inventories.

Tribal input and participation is frequently sought for interpretive and educational purposes as well. A good example is Gene Hattori's "Under One Sky" Exhibit at the Nevada State Museum, aimed at bringing the Native American voice to Great Basin prehistory. In southern Nevada, the Bureau of Reclamation included a greeting from the Fort Mojave Tribe at the Inscription Rock interpretive site near Laughlin. The tribe's request that visitors respect this site may help to ensure its preservation (Figure 11).

Future challenges to CRM are many. By now we have learned that collaborations of professionals, including the academic community, the public, and tribes is crucial if we are to maintain the momentum to preserve our nation's heritage. With the rampant growth in the West, protecting threatened cultural resources and traditional landscapes will be a cultural resource managers's greatest challenge (Diamant et al. 2007:6). Public support is necessary to increase funding for shrinking federal agency staffs and budgets.

In summary, archaeologists are learning to be more politically-savvy by making CRM more relevant to the lives of the American public, and by involving Native Americans in the process. As Goddard (2002:208) stated: "Just transmit the commitment to archaeology shared by a few, into something that moves the many…" We must continue to use science and also explore new theoretical approaches in the pursuit of the research we all hold dear. As Brian Fagan (2005:257) reminds us, "archaeologists are not the only people with a tale to tell…" The bottom line is that CRM professionals must open the door to others in order to ensure a bright future for CRM.

Figure 1. University of Utah students Keith Anderson and Don Fowler worked on the Glen Canyon phase of the Upper Colorado River Basin Archaeological Salvage Project in 1958 (Courtesy of Don D. Fowler).

Figure 2. Nevada State Museum Archaeologist, the late Mary K. Rusco, overlooks a Rye Patch Reservoir site awaiting excavation, ca. 1977 (Courtesy of Nevada State Museum).

Figure 3. Ethnographer Penny Rucks listens intently to Washoe Tribal elder Jean Nichols during a visit to a bedrock mortar site in the Sierra foothills (Courtesy of Penny Rucks).

Figure 4. Archaeologist Anne DuBarton demonstrates flintnapping at a Las Vegas Springs Preserve Cultural Fair in 2004 (Courtesy of Nevada State Office of Archaeology and Historic Preservation).

Figure 5. Student Archaeologists Dick Ross (left) and Don Fowler (right) recording rock art at the mouth of Smith Creek Canyon in 1959 (Courtesy of Don D. Fowler)

Figure 6. Site Steward Coordinator Sali Underwood recruiting new volunteers at Earth Day Festivities in Las Vegas in 2006 (Courtesy of the Nevada State Office of Archaeology and Historic Preservation).

Figure 7. College students and members of the community advanced their knowledge of archaeology by volunteering to help excavate a Comstock Saloon in Virginia City (Courtesy of Ron James)

Figure 8. Bureau of Reclamation Archaeologists and Historic Preservationist Kurt Schweigert escorted a group of interested citizens to the Hoover Dam World War II "pillbox" during an Archaeology Week "Hoover Dam Outback" event sponsored by the Bureau in 2005 (Courtesy of Renee Corona Kolvet)

Figure 9. The Consolidated Group of Tribal Officials (CGTO) is shown reviewing cultural resource data records at Nellis Air Force Base (Courtesy of Keith Myhrer).

Figure 10. CGTO members examine artifact lists during a Native American Graves Protection Act (NAGPRA) consultation at Nellis Air Force Base (Courtesy of Keith Myhrer).

Figure 11. The Fort Mojave Tribe prepared the "welcome" sign for visitors at the Inscription Rock interpretive park near Laughlin, Nevada. Photo courtesy of the Bureau of Reclamation, Lower Colorado Regional Office.

3
Walking and Running in the Sierra Tarahumara: A Reflection on Pedestrian Mobility and the "Known World" in Desert West Culture History

C. Melvin Aikens

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Walking defines the human way of life. It's built into our anatomy going back at least to the time of the Australopithecines. By one million years ago, humans had walked as far from their African beginnings as southern Europe and eastern China. By the end of the Pleistocene they had walked to the tip of South America. Humans are not fast, compared with many other animals, but their long, strong legs, sturdy biomechanical feet, and comparative lightness make them very durable travelers, as either walkers or runners. The current world record for the marathon (26.2 miles) is 2 hr., 6 minutes. A cheetah can run far faster, but couldn't remotely manage 26 miles in one go. A horse is far slower and thereby much more durable than a cheetah, but even horses can't match human foot travelers over the long haul in the tradeoff between speed and endurance.

By 40,000 years ago, people had crossed significant distances over water on boats or rafts to reach Australia, and other over-water crossings are known by 20,000 years ago from Japan and offshore islands in the southwestern Pacific (Erlandson 2002). Prior to about 7000 years ago, however, wherever humans went on land, they walked. In the Old World after that time, commerce, war, and other overland travel relied increasingly on animal power and wheeled vehicles. In the New World, Andean camels were used as pack animals going back at least several thousand years, and the use of dogs to drag sledges or travois, or carry packs--as they did in ethnohistoric times in the North American Arctic or Plains--was surely ancient as well. But wherever people themselves went overland before 15th century Spaniards brought the horse back to the Americas, they walked--or ran.

CONTEMPORARY PEDESTRIAN MOBILITY IN THE SIERRA TARAHUMARA

In the rugged mountains and valleys of northwest Mexico's Sierra Madre Occidental, modern Uto-Aztecan Raramuri (Tarahumara) people follow a traditional rural way of life. They live in small communities, many since the 1600s centered on Christian churches, and in

widely dispersed household clusters, now predominantly of adobe casitas. The social web is very broad. As everywhere in small communities, the rule of exogamy encourages marriage outside the home settlement, and in a sparsely settled landscape new spouses often come from far away. Anciently, and even now, a web of family stretched across hundreds of square miles was an important form of social security that buffered people against local shortages and other problems. On a daily basis, men, women, and children commute on foot to their various tasks, often far from the family household. In a rugged and steep landscape that remains almost roadless even in the 21st century, they use a web of well-beaten footpaths as they farm, herd, hunt, collect, or go into town for school, jobs, shopping, and selling crafts and produce. Multigenerational families walk long distances together to attend Saints Day gatherings, weddings, and other community festivals, and to participate by personal invitation in social gatherings or work parties hosted by friends. There are, of course, also many Raramuri who live and work in the Mexican towns of the region, drive cars and trucks, talk on cell phones, watch satellite television, and do all the things townspeople do, but for the purposes of this discussion I focus on the more traditional life in rural settings.

The Raramuri have deep roots in their sharply "vertical" homeland of cool upland plateaus and hot desert valleys. Their ancient history is shown by many archaeological sites that are interspersed among -- and often exist within -- modern settlements. Ethnographic and archaeological research by Bennett and Zingg (1935; Zingg 1937, 1940) in the headwaters of the Rio Urique and Rio Batopilas established a record that extends from pre-pottery Basketmaker times up to the 20th century. Future research will surely establish a greater time depth of human occupation in the region, comparable to that known on both sides of the Sierra Madre Occidental. Both historically and ecologically, the Raramuri way of life fits comfortably within the range of socioeconomic patterns established by their Uto-Aztecan relatives over a vast reach of western North America. It offers an evocative ethnographic perspective on thousands of years of Uto-Aztecan cultural history, as suggested further below.

RARAMURI RUNNING AND FOOT RACING

When Europeans first entered the Americas, they were impressed by the great running prowess of the Indian tribes.

The long-distance messengers of the Inca Empire are a famous example, but in fact running was ubiquitous, both for practical purposes and as a sport. Over time, with disease, dispossession, the horse, and now trains, cars, and planes, much of this tradition has been lost, but it has survived in the remote and roadless Sierra Tarahumara to the present day.

In traditional Raramuri foot races, two teams race many circuits around a long and rough cross-country course, chasing a wooden ball all the way (Lumholtz 1902). In men's races, the ball is kicked; in women's races, it is tossed with a forked stick. Raramuri races are major social and economic events, planned and looked forward to, where teams from different villages race against each other. Each team has a manager, and preparations begin about 2 weeks in advance of the event—which are, of course, scheduled long before that. People gather from miles around. Feasting, drinking corn beer, and serious betting provide fun, engender social cooperation and sharing, and foster the exchange of valuable goods and products.

Outside their home country, Raramuri runners competed in the 1993 Leadville Colorado Trail 100 ultra-running event with spectacular results (Williams 1993). This race follows a rugged, rocky course from Leadville to Winfield, Colorado and back, starting at 10,000 feet elevation and crossing 12,600 ft. Hope Pass twice. It attracts elite ultra-marathoners from all over the United States and beyond, who seek to complete the 100 miles in less than 30 hours. Six Raramuri participants were sponsored by Richard D. Fisher, a publisher from Tucson, Arizona who knows the people and their country well. The six men ran in regular Raramuri rubber-tired sandals, which didn't hurt their feet like the high-tech running shoes they were offered. They started at the end of the lineup because they were shy and wanted to avoid the crowds present for the start of the race. In the end…

- Victoriano Churro, 55, finished first, with a time of 20 hours, 2 minutes, and 33 seconds. His age also made him the oldest winner in the history of the Leadville 100.
- Cerrito Chacarito, 38, finished second, with a time of 20 hours, 43 minutes, and 6 seconds.
- Antonio Palma, 28, finished fifth, with a time of 21 hours, 26 minutes, and 9 seconds.
- Benjamin Nava, 21, was the youngest finisher in the history of the Leadville 100.

• Only one member of the Raramuri team, Felipe Torres, 22, failed to cross the finish line. He dropped out at 93 miles because of painful blood blisters, caused by new sandals that weren't sufficiently broken in.

And remarkably, unlike the world-class ultra-marathon runners they competed against, who were regulars at the sport and had been in training for years, *these Raramuri men didn't really train for the race at all.* They just rode up from Chihuahua in their sponsor's Suburban a few days before the race, ran the course once to see what it was like, made themselves some new sandals out of old tires they got in Leadville, and went for it. *One could reasonably ask: how was such a feat possible?*

The answer is simple, actually. The hard-working lifestyle and demanding environment of these Raramuri men had them routinely walking long distances over steep terrain in their vast, roadless country, and they also ran from time to time in traditional footraces. Their normal way of life kept them at a level of physical fitness that even highly trained yuppie ultra-marathoners could scarcely match! *Walking* is the Raramuri key to making a living, and it kept these men in shape to do *running* just for sport![1]

Let's contemplate the Raramuri countryside a bit further. Places suitable for cultivation are widely scattered. The vertical range is roughly a mile, from about 2000 feet elevation in the hot canyon bottoms to 7500 feet or so on the cool plateaus above. The traditional mixed farming/herding/hunting/collecting economy takes the Raramuri all over this country on a daily and seasonal basis, as they draw their food and working materials from the highly diverse biota that the extreme altitudinal variation gives rise to. The Raramuri custom of taking care to marry non-relatives has also assured that they have family members and small inherited parcels of land spread out over considerable distances, which gives them both a social security system and continuing incentives to travel. People of the Urique-Batopilas headwaters region, for example, traditionally summered on the 7500-ft. plateau and wintered in the barrancas 5000 ft. below, though under modern economic conditions this is no longer the dominant pattern (Bennett and Zingg 1935).

Carl Lumholtz (1902) traveled in the Sierra Tarahumara during the 1890s, and wrote the first detailed account of the Raramuri. He described a cross-country racecourse near Carachic that covered a 14-mile circuit, and commented that 12 circuits might be run on such a course without stopping. Do the arithmetic: 168 miles! His account of Raramuri (Tarahumara) running grips one's attention (Lumholtz 2000:51):

"No doubt the Tarahumares are the greatest runners in the world, not in regard to speed, but endurance. A Tarahumare will easily run 170 miles without stopping. When an Indian is sent out as a messenger, he goes along at a slow trot, running steadily and constantly. A man has been known to carry a letter in five days from Guazapares to Chihuahua and back, a distance of nearly 600 miles by the road. Even considering shortcuts, which he no doubt knew, it was quite a feat of endurance; for he must have lived, as the Indians always do while traveling, on pinole and water only.

"Where the Indians serve the Mexicans they are often employed to run wild horses into the corral. It may take them two or three days, but they will bring them in, the horses thoroughly exhausted, while the men, who of course economize their strength, and sleep, and eat pinole, are comparatively fresh. In the same way they will run down a deer, following it for days through snow and rain, until the animal is cornered and easily shot with arrows, or until it is overtaken utterly jaded and its hoofs dropping off."

Lumholtz gives an equally arresting account of Raramuri foot racing contests. After describing the initial preparations, he notes (2000:52-53):

"The scene is one of great animation. As many as 200 people may assemble, among them women and children. At the gathering-point, which is called in Tarahumare "the betting-place," all the bets are made, and here the race is started and concluded…. At the given signal, quick as lightning, the runners throw off their blankets, and one man in each party, previously selected, throws his ball as far as he can, and all the runners start after it…. They do not run at an extraordinary speed, but very steadily, hour after hour, mile after mile…. Good runners may make forty miles in six or eight hours…. The public follows the race with great enthusiasm from beginning to end, the interest growing with each circuit. Many begin to follow the runners, shouting to them and urging them on…. The wives of the contestants heat water

and prepare pinole, which they hold out in drinking-gourds to the men as they pass…. As darkness comes on, torches of resinous pine wood are lighted and carried along to illuminate the path for the runners, that they may not stumble, making the scene one of extreme picturesqueness, as these torch-bearers, demon-like, hurry through the forest. One contestant after another drops out. The excitement becomes wilder; more and more people join accompanying the few runners left…. And at last the best man comes in, generally alone, the others having either given up the contest or being far behind. There is no prize for the winner himself, except for the golden opinions he earns among the women; and his father may accept presents from lucky bettors…. The race over, the wagers are immediately paid and the Indians quickly disperse, soon to arrange for another contest."

WALKING AND RUNNING IN DESERT WEST CULTURAL HISTORY: ECONOMICS, SOCIAL SECURITY, AND SPIRITUALITY

It is important to the points offered from here on to emphasize that the case of the Raramuri runners is by no means unique. It is simply the best-documented example of practices that in aboriginal times were surely prevalent throughout western North America -- and probably the New World as a whole.

Also of key importance is to recognize that traditional running contests among American Indians were just the tip of an iceberg. Done in sport or ceremonial contexts, and functioning to promote social solidarity, running contests were certainly of special significance, but still just one important part of a broad array of foot travels –running and walking – that were undertaken for widely varied purposes.

Travel, of course, is a central element of nearly everything that people living in a traditional rural economy do in the conduct of their lives. Native populations throughout the Desert West have characteristically relied on a high degree of mobility, whether they were people like the Raramuri -- and many others of the Greater Southwest -- whose economies combined both cultivation and hunting-collecting, or whether they were predominantly hunter-gatherers, like many populations of the Great Basin and elsewhere farther north. Runners carried important news between communities, and running was a routine mode of certain kinds of long distance travel, with parties of men on working, trading, or raiding

errands often running simply "to get there faster." A key element of social security for everyone was to have friends and relatives at a distance in various directions, so there would be familiar others to rely on for help in the event of local trouble or shortage. Keeping up these all-important social ties through visiting and cooperative activities was an important reason for both task groups and whole families to travel regularly over considerable distances. Trade in special materials and crafted items over both short and long distances was a major force, important and pervasive everywhere. Indeed the same social dynamics remain important today, although many details of technology and economy have changed.

The lifeway of the Raramuri offers a good example among peoples who traditionally practiced a mixed agricultural and hunting-gathering economy, as was common in the Southwest and adjacent Mexico over the past 3000 or so years. A good illustration of mobility's importance for predominantly hunting-gathering people, which means everyone in times earlier than about 3000 years ago, and down to the 19th Century in the northern part of the Intermontane West, is that of the Harney Valley Paiute band, the Wadatika, or Wada Eaters of north-central Oregon. They are distant relatives of the Raramuri, like them speaking one of the many Uto-Aztecan languages common across the desert west.

The Wadatika, who still live in their traditional region today, wintered around Malheur Lake. From there they moved northward in spring to the Crow Camp Hills and Stinkingwater Pass to harvest roots and groundhogs. They continued on to the headwaters of the Malheur River near Drewsey to catch spring salmon, and farther north into the uplands north of the John Day River. From there they worked their way west and south through the Silvies and Silver Creek drainages collecting and hunting as the summer wore on. Late summer and early fall would find them on Steens Mountain, in the Alvord Desert to the east of Steens, in Catlow Valley west of Steens, and harvesting the Wada (*Sueda depressa*) seed crop around Harney Lake, the sump into which Malheur Lake drains. By late fall they would be settling in for the winter at long-favored localities along the edges of Malheur Lake and the lower Blitzen River (Whiting 1950, Couture et al. 1986). On the map of eastern Oregon this is a circuit of about 350 miles, and that figure affords only a very minimal calculation of the people's actual foot travel over the

period of a year, given all the daily comings and goings between camps and working localities as they made their way around this course. Archaeological evidence shows that people have followed a generally similar way of life in the region over the past 10,000 years, although it will take much more data to detail the specifics of prehistoric occupation patterns throughout this span of time (Aikens and Greenspan 1988, Elston and Dugas 1993, Musil 1995, Oetting 1990, 1999, O'Grady 2006).

In addition to fundamental subsistence and social security motivations, there were also important spiritual reasons for people to undertake major journeys on foot, and it was probably necessities of this sort that engendered some of the most sustained and distant journeys. Hopi narratives and Pima "tellings" of the past, for example, dramatically recall epic marches and/or foot races that figure centrally in the traditional histories of those peoples (Courlander 1982, 1987, Bahr 2001). Rock art sites all over the west, including places of surpassing power like the Great Gallery of Barrier Canyon in central Utah (Schaafsma 1971, 1980), or South Mountain near Phoenix (Bostwick and Krocek 2002), or the Coso Mountains of southern California (Grant 1968, Whitley et al. 1999), among many others, remind us also of the likelihood that pilgrimages of faith and the pursuit of personal power were other major motivators of individual or small group travel (Griffith 1992). Such an awe-inspiring place as Barrier Canyon might well have attracted pilgrims from all over the west.

Further relating to the spiritual realm, special items and materials brought from afar also functioned importantly in religious observances at home. Distinctive items from places far away have mysterious properties. The fact that extreme efforts on the part of individuals were required to obtain them was in itself important to their ritual power and significance. Ethnographic accounts relating to Native American cosmology and spirituality establish definitively that travel to distant realms was everywhere a key to the power and knowledge needed to heal the sick, regain what was lost, and deal with the future (Campbell 1988, Eliade 1964). Still today, people of recognized wisdom and spiritual power are widely known within the Native American community and travel long distances at the invitation of others who request their help and guidance.

THE PERVASIVENESS OF LONG-DISTANCE TRAVEL BY EARLY

NATIVE AMERICANS OF THE DESERT WEST

As noted above and discussed further below, we know conclusively from both traditional histories recounted ethnographically, and from archaeological specimens, that long-distance travel routinely spanned hundreds and even thousands of miles across the Desert West -- in fact throughout Native North America. In evidence of trade we have sourced and dated obsidian, marine shells, copper, turquoise, quartz crystals, the feathers of tropical birds—and even the birds themselves. The list goes on and on.

Ethnohistorians and archaeologists have long believed that aboriginal trading was dominantly carried out between trading partners who lived at no great distances from one another. Goods tended to travel long distances by being passed hand-to-hand, but people themselves tended to keep to a smaller circuit. Surely that was true to an important degree, and no doubt there was a great deal of this kind of trade, but I suspect that scholars have been too reluctant to acknowledge more distant forays, or have sought to explain known examples as the result of White influence. Instances such as those of Walla Walla groups who traveled and traded from the eastern Plateau into central and southern California (Davis 1961), or Colorado-New Mexico Utes and Apaches raiding deep into central Mexico, or the very considerable trade up the Columbia River and across the Rockies (Stern 2003) are often "explained" as something new, elicited by the enhanced mobility brought by Spanish horses, or the use of water transport. In the cases just mentioned horses were in fact used, but journeys as long were surely possible on foot as well.

Modern scholars, most having little if any experience of horses and riding, and the care of the animals involved, readily take it as obvious that the coming of the horse would have greatly improved people's ability to travel long distances. Yet Lumholtz (cited above) tells of a Raramuri man who in five days walked nearly 600 miles from his home to Chihuahua City and back to carry a message, and of Raramuri men on foot running herds of wild horses to exhaustion over a period of several days in order to corral them. In another place Lumholtz (1902 [2]: 367-70) describes a 19th Century Tarascan man who traded throughout his region over a period of 35 years. He carried a pack that weighed about 140 lbs. and was able to compete successfully with traders using pack mules because he could make 30 to 40 miles a

day carrying his pack, twice as far as a loaded mule. Horses and mules can carry more weight, where that is a crucial consideration, but healthy, fit people can go faster and farther on their own feet.

Thus, without contradicting the commonsense view that animal power (or water transport) is important when it comes to total volume of goods transported, it seems fair to conclude that even far back in time Native American people readily could have -- I would say surely *must* have -- traveled major distances on more than a few occasions, much more than is commonly envisioned by our down-the-line trading partner models. With road networks spanning vast regions, and even the entire continent, it seems just too dull to imagine that occasional parties would not have been beckoned on and on by the road forever stretching before them. There was always farther one could go, and always knowledgeable local people to tell of the route and what lay ahead.

We should wonder: did Northern Great Basin Paiutes of the 11th Century, for example, know about the stone-walled towns of Utah, Colorado, Arizona, and New Mexico? The huge cities and temples and "floating gardens" still farther south? The flourishing canoe-borne commercial world of the Santa Barbara Channel? The great longhouse communities of western Canada and Alaska's Inside Passage? The Rocky Mountains, vast plains and endless forests of the eastern U.S., with their many different peoples? I think they did. We tend to surmise -- if we even think about it--that local communities, in their isolation, didn't really have such information, or if they did know something, it must have been very little, and that little probably blurred by innumerable hearsay repetitions over distance and time.

But reflection on the Raramuri and Wadatika examples, and the clear demonstration they offer of the capability of healthy, fit foot travelers to routinely span great distances in very good time, makes me think we should throw off our general lack of wonderment about such questions. It seems highly likely that there were in every generation people in most locally interactive groups who themselves had personally seen and heard things hundreds and even thousands of miles away from home, and returned to friends and relatives with first-person accounts. Ancient Native American communities in general, self-sufficient as they for the most part were, were probably not as insulated within their own home ranges as has been surmised by most scholars, in whose

world foot travel over long distances is an extraordinary feat performed on special occasions by highly trained athletes, rather than a routine, everyday experience of ordinary people.

Current ethnological and archaeological evidence gives ample warrant for imagining major travel experiences for many individuals. We already have at hand a vast amount of archaeological information on the ancient travels of raw materials and artifacts across the length and breadth of North America, from 10,000 years ago into the 19th Century. Two major synthetic volumes on prehistoric exchange systems in North America provide systematic regional overviews based on hundreds of primary archaeological sources and many thousands of specimens (Ericson and Baugh 1993, Baugh and Ericson 1994), and many other works on the subject could be easily cited. Though there will always be more to learn, it is surely clear that long distance travel and trade have been abiding characteristics of Native American people since they first arrived in the New World. A few examples by way of closing will add some concrete perspective.

The great rendezvous at The Dalles of the Columbia River each year drew visitors from all over the Northwest. Anastasio (1972) compiled a very extensive list of processed commodities, raw materials, and craft products that during the 19th century were brought into The Dalles from one direction and carried out in another. A map developed by Wood (1972) shows a vast zone of exchange that extended up the Columbia River from the Pacific Ocean and across the Rockies into central Wyoming and the Upper Missouri. As noted above, it has been commonplace to attribute this great network of travel and exchange largely to contact-historic period Euro-American mercantilism and modes of transport. But archaeology gives clear evidence of much earlier long distance exchange in shell and obsidian across the Northwest that that goes back at least 8000 years (Galm 1994). Some of this extensive interchange surely moved by water along the Columbia and Missouri rivers and their tributaries, but equally clear is that much of it must have been carried overland on foot (Stern 1998).

Many Great Basin sites in Oregon yield marine shell from the Pacific Ocean, including distinctively made *Olivella* shell beads manufactured in the Santa Barbara Channel region of southern California. *Olivella* Grooved Rectangle beads characteristic of that region have been found at DJ Ranch in the Fort Rock

Basin, dating between 4000 and 5000 years ago (Jenkins and Erlandson 1996). We also find in some Oregon sites the little *Olivella dama*, which lives almost exclusively in the Sea of Cortez. In addition, long, slender *Dentalium* shell beads from Vancouver Island occur in sites of the Oregon interior. Largaespada (2006) documents 15 species and 17 types of Pacific coast shell beads found in central Oregon with dates ranging from 6000 BP to historic times. The great preponderance of specimens are *Olivella* bead types which correspond both typologically and in terms of local chronology to the parameters defined by Hughes and Bennyhoff (1986) and Bennyhoff and Hughes (1987) for the Great Basin as a whole. In a thoughtful analysis of the Fort Rock Basin context Jenkins et al. (2004) show how a millennial history of long-distance trade and communication was encouraged by ecological and social dynamics that created local demand for imported products.

Davis (1961) mapped from ethnographic as well as archaeological evidence a dense network of trade routes across the length and breadth of California. Brand (1938), Colton (1941) and others mapped a pervasive trade in Pacific Coast shell and other items across the whole of the Southwest throughout the Pueblo period. Ford (1983) gives a rich and highly specific account of voluminous ethnohistoric and prehistoric trade all across the Southwest, which reached the Gulf of Mexico at one extreme and the Pacific Ocean at the other. A sketch of routes developed from the cumulative evidence shows an impressively dense network of pathways, quite reminiscent of a modern highway map. Significant amounts of Hohokam and Anasazi pottery have been found at traders' camps in Southern California, and cotton blankets and other Southwestern crafts have also been identified there. Doyel (1991) documents for the Hohokam culture, centered around Phoenix, an intensive and far-reaching network of exchange during its heyday between about 700 and 1400 A.D.. Toll (1991) enumerates exotic materials from distant Mexican sources in Chaco Canyon, and emphasizes the major scope of exchange within the Chaco region itself. Farther south, Mexican tropical birds, pyrite mirrors, copper bells, and other items were traded into and out of Casas Grandes, and on into Arizona, New Mexico, and west Texas (Di Peso 1974, Kelley 2000). The volume of Southwestern trade obviously increased a great deal during the agricultural period of high populations and complex social

organizations, but items of long-distance trade are also found in much earlier sites.

On-the-ground remains of well-worn trail systems still remain visible in areas not heavily subjected to the earth-moving propensities of modern civilization, and elsewhere archaeologists have concluded that many such trails underlie the paths of our modern highway systems. From southern through northern California, and across the Sierra Nevada, a quite detailed set of routes has been mapped, many along the same courses taken by modern highways (Davis 1961). The famed Mojave Trail that ran through the Lower Colorado River region to join the Pueblo Southwest and southern California is still visible as a beaten track in many places, and cairns of pebbles dropped as offerings in passing mark its course in others (Farmer 1935, Rogers 1941). Fowler (2004) summarizes detailed ethnographic and ethnohistoric evidence for a dense network of Indian trails and alternate routes in Southern Paiute-Chemehuevi country within the same general region. She also calls attention to traditional songs telling of great journeys, which were sufficiently specific and detailed about springs and geographical features to serve as "mental maps" of routes, and were actually sung as people traveled along. At Bandelier National Monument in New Mexico, trails and stairways routing travel among Pueblo settlements have been worn by many footsteps over decades or centuries into the soft volcanic rock of the region (Snead 2005).

Dramatic roadways in northwest New Mexico's Chaco Canyon were first recognized in the early 1900s. More recently aerial photography and mapping, and some on-the-ground survey have identified many preserved road segments of varying lengths, and at least two continuous "main" roads that can be traced for more than 30 miles. These courses linked various communities of the region between about A.D. 1075 and 1150, when Chaco Canyon population was at its height (Roney 1992). Road and trail networks have surely existed everywhere in the New World for thousands of years, and just as surely were far more prevalent than we will ever be able to fully document (Trombold 1991).

All the travel that was incident to the ubiquitous dispersal of trade goods across North America as a whole implies a well-developed body of widely shared knowledge about the geography and extent of the Native American world. Like all durable and useful knowledge it was surely passed down the generations

by oral tradition, and renewed by ongoing experience. In fact, traditional Native American knowledge still maintained today testifies to the importance of the old travel and trail systems. Southern Paiute-Chemehuevi "traveling songs" have already been mentioned. Contemporary Hopi elders relate that small groups traditionally made treks from central Arizona to southern California for trading purposes (Courlander 1987).

Other Native testimony recounts Ute traditional knowledge of the "Old Spanish Trail" that extended from the mountains of New Mexico through Colorado, central Utah, and southern Nevada and California all the way to the Pacific Ocean. Goss (2003) relates an account shared with him in the early 1960s by Antonio Buck. Jr., a prominent Southern Ute elder. Buck told about a Ute man of about 1870, or before, who guided people on this trail and could from memory give directions and information about good stopping places along its whole upper segment, from New Mexico into northeastern Utah. The "Old Spanish Trail" is in fact the "Old Ute Trail," along which Ute guides escorted the Dominguez-Escalante Expedition of 1776 all the way from Santa Fe, New Mexico into northern Utah, and returned them southward to the Colorado along a course that continued down through western Utah before bending westward through the Las Vegas area into southern California. All of this was Ute country, or the country of closely related people speaking other Uto-Aztecan languages (Goss 1999, 2003).

In addition to narratives shared orally and passed down in memory, there were *ad hoc* native maps. Heizer (1958) quotes graphic accounts of "sand maps" that Northern Paiutes created on the ground for mid 19th Century white travelers, who later recorded the incidents in their journals. Thus John C. Fremont's account of an 1844 consultation with Northern Paiutes at Pyramid Lake:

"They made on the ground a drawing of the [Truckee] river which they represented as issuing from another lake [Tahoe] in the mountains three or four days distant, in a direction a little west of south; beyond which, they drew a mountain {Sierra Nevada]; and further still, two rivers [Sacramento and/or American or Feather or San Joaquin] on one of which [Sacramento?] they told us that people like ourselves traveled."

Another account from the 1850 journal of J. Goldsborough Bruff tells this story:

"An aged Indian visited their camp [at Honey Lake], and they made signs to him that they were in search of a deep-basined lake, where there was gold, and they showed him a small lump of the metal. The old savage then took a pair of macheres [large flat leathers to throw over the saddle] and sprinkled sand over them, drew a model map of the country there, and beyond it, some distance. He heaped up sand, to form buttes, and ranges of mountains; and with a straw, drew streams, lakes and trails; then adjusted it to correspond to the cardinal points, and explained it. He pointed to the sun, and by signs made them understand the number of day's travel from one point to another. On it he had traced…Mary's Humboldt River, Carson River, Pyramid Lake, and the emigrant routes—above and below. He moved his finger, explanatory of the revolutions of wagon wheels, and that white people traveled along, with guns, on the said routes. On his map, he had exhibited the lake they were then at, and another in a deep basin, with 3 buttes beside it, and said that gold was plentiful there; and also, that 10 months ago the whites had visited it, and fought with the Indians." (Heizer 1958: 460-461).

Manifestly, the native peoples of the desert west had detailed knowledge of a vast region, which they were accustomed to sharing collectively through customary means.

Glancing briefly beyond the American West, it is easy to find evidence that comparable knowledge was shared and used widely across the continent. Archaeology shows that as early as 8-10,000 years ago marine shells and native copper were being traded from the Northwest Coast, across the Plateau, over the Rockies, and into the Northern Plains and Great Lakes regions (Galm 1994). Later there is dramatic evidence for at least one extraordinary expedition about 2000 years ago, and arguably more than one, that carried hundreds of pounds of obsidian raw material some 1500 miles to Hopewell centers in Ohio from Rocky Mountain sources at Upper Fish Creek, Obsidian Cliffs, and Bear Gulch in Yellowstone Park. Knife River Flint from the upper Missouri also found its way in some quantity into the Great Lakes region and farther south (DeBoer 2004, Griffin et al. 1969, Hughes 1992). Other evidence shows that trade in Gulf Coast marine shells was pervasive in the Midwestern states, and that native copper from the Great Lakes region was traded widely throughout the Midwestern and eastern

states during the Hopewell and Mississippian periods (Caldwell 1964, Brose 1994). A detailed account based on ethnohistoric data maps a dense net of aboriginal trade and travel routes throughout the Southeast, which connected to others outside that area (Meyer 1928). Looking farther southward, a flaked stone scraper from the Spiro site in Oklahoma has recently been shown by X-ray fluorescence and instrumental neutron activation analysis to be made of obsidian from the great Pachuca source near Mexico City, about 1100 airline miles away (Barker et al. 2002).

Finally, the prevalence of serious foot travel can be followed back into deep time in western North America through archaeological evidence of woven footwear. Raramuri people now famously wear sandals made from automobile tire treads, but earlier they made sandals with soles of leather from the hides of deer and other animals. Sandals of woven plant fiber were made and worn cross the desert west as a whole in ethnographic times, and archaeology carries the record back to early Holocene times. The Northern Great Basin of Oregon is famed for having perhaps the oldest documented sandals in the world, the famed Fort Rock type, for which we now have an impressive number of examples and an impressively consistent series of AMS C-14 dates made directly on the specimens themselves, most of them exceeding 10,000 years (Connolly and Barker 2004).

Constructed footwear thus has a long history in North America, and the care and sturdiness with which even the west's oldest known sandals were made shows their great utility. People can grow tough feet, and they do all right going barefoot under many conditions, but where major distance and endurance are concerned, especially over rough terrain, shoes are required. The simple antiquity of sandals in the far west clearly supports the notion that the seemingly extraordinary feats of time and distance exemplified by contemporary Raramuri walkers and runners were commonplace across both space and time in the cultural history of the Desert West. Of course, though it is wholly in the realm of reasonable speculation rather than demonstrated archaeological fact, even the very first Americans had to have possessed very substantial footwear, no doubt leather moccasins rather than woven sandals, inherited from ancestors who had lived their way through many generations in the arctic north, where going without shoes is unimaginable.

CONCLUSION

So, is there anything in all the foregoing we didn't already know? In the simple sense, the answer is no. As anthropologists we know a lot about the high mobility of many Native American peoples, and a lot about the many items they exchanged over short and long distances throughout millennia. But we stand to gain additional perspective if we think further about the great fund of shared and inherited sociological and geographical knowledge that is implied by the vast scope of Native American travel and communication that we are already able to document. We should seriously ask ourselves the question, "What did they know?" I believe that the aboriginal world of the Native Americans could, with some well-placed synthetic effort and imagination applied to data already in hand, become much more clearly presented and acknowledged in our anthropological discussions as an active social network continental in scope and full of nations that knew each other through individual contacts and interactions repeated over many generations. I can imagine it was a world across which messengers, families, traders, pilgrims, raiding parties -- and, from time to time, bands of emigrants -- were frequently in motion on short and long journeys, and that they all knew where they were going and what it was like there, having well-beaten roads to follow and relatives or friends who had been there before.

4
The Avoided Past: Great Basin Rock Art in Archaeological Thought and Its Potential in the Study of Past Identity

Alanah Woody and Angus R. Quinlan

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Currently, the study and practice of Great Basin rock art predominantly occur outside the worlds of academic and professional archaeology, with avocational researchers and organizations playing a prominent role and making important contributions (Quinlan 2007b; Woody and Quinlan 2007). Few students write theses or dissertations on it, and formal programs teaching it at universities are rare in the region. The study of rock art has rarely, if ever, been at the forefront of the research questions that Great Basin archaeology seeks to address. Despite receiving the attention of pioneering archaeological researchers such as Julian Steward and Luther Cressman, Great Basin rock art has largely been avoided by professional archaeology, with a few notable exceptions (e.g., Robert Heizer and his students). Yet, rock art is a common, if under-reported, archaeological feature across much of the desert west, making its low profile in archaeological research hard to understand.

Today, the study of Great Basin rock art is mostly peripheral to the domain of mainstream archaeological research, with little or no communication between the two. By outlining the broad trends in the history of Great Basin rock art research we explore why the study of rock art has not played a greater role in archaeological thinking. We believe that the focus on lithic reduction of much Great Basin archaeology needs to be supplemented by considering the processes of identity construction (individual, social, cultural, sexual, etc.) through which cultural meaning was constructed and negotiated in the routines of daily life, and which the study of rock art has potentially much to offer. We do not wish to imply that the reasons for the archaeological neglect of rock art is simply the fault of archaeologists—much rock art research seems to be unrelated to the research concerns of Great Basin archaeology and is often poorly based in the anthropology of symbolism and religion.

EARLY GREAT BASIN ROCK ART STUDIES

Pioneering rock art studies in the late nineteenth and the first half of the

twentieth century laid the unfulfilled foundation for future research. The work of Mallery, Steward, and Cressman, among others, defined the object of western North American rock art, and established style definitions and terminology that still underpin much contemporary rock art research. Garrick Mallery's (1886, 1893) late nineteenth-century surveys of North American rock art, which reported a number of Great Basin sites, represent an early effort to synthesize existing data regarding Native American systems of visual communication. Mallery attempted to interpret North American rock art data, regarding it as a form of "picture-writing" that could be "translated" if only a "key" could be developed (not unlike the shamanistic approach). This misperception of what constitutes the "meaning" of rock art is not surprising given the infancy of anthropological studies of symbolic culture at the time that Mallery was writing. However, much contemporary rock art theory is challenged by the anthropology of symbolism, particularly regarding where "meaning" resides in symbolism (particularly by the work of Sperber 1975; Strecker 1988; Turner 1971). This misperception, that the cultural significance of rock art can be disclosed by attempting to identify the references of its imagery, remains widespread in much rock art interpretation and is one reason why rock art seems to be unarchaeological in its epistemology.

In the first half of the twentieth century, the work of Steward (1929) and Cressman (1937) was critical in developing rock art style classifications, their distributions and possible chronology. Anticipating future work in the 1960s, Cressman also realized the importance of considering the landscape context of rock art in understanding its past cultural significance. Both Steward and Cressman played important roles in the history of Great Basin archaeology; Steward is also particularly important for his contributions to theoretical anthropology on the relationship between culture and ecology, and Great Basin ethnography (Steward 1938, 1955). Both Cressman and Steward knew and valued the importance of material culture not directly related to economic practices in understanding the complexity of past human behaviors. Steward even admonished archaeologists to "set aside their spades" and pursue rock art as an avenue of research (1937:406).

Steward completed the first systematic study of the rock art of western North America, synthesizing a wide range of sources. His survey was complemented

by Cressman's research in Oregon (1937). Steward rejected the idea that rock art was a form of "art for art's sake" and argued that it was the residue of culturally meaningful practices in the past, probably connected with important prehistoric social practices (Steward 1929:225). However, Steward and Cressman avoided searching for the meaning of rock art imagery. Steward noted that "Pictures, symbols, and designs drawn on stone have no less variety of meaning, purpose, and style than those drawn on wood, skin, bone or other materials … It is futile to seek a single explanation of petroglyphs, for this art differed widely in purpose and style in each period and area" (Steward 1937:411). What Steward's (1929) study accomplished was the definition of terms, classification of rock art styles, and characterization of the spatial and temporal distributions of rock art styles, thereby providing a foundation for future rock art research (in particular, as built upon by Heizer and Baumhoff [1962]). His typology is, with some modification, still largely in use today, and he attempted to establish a style sequence that could lead to the development of a chronology of rock art in the desert west. His study identified the important research theme of the balance between schematic and naturalistic imagery in rock art assemblages as a characteristic of stylistic variation.

Heizer and Baumhoff (1962) believed, that in comparison to Garrick Mallery, researchers such as Steward and Cressman were more cautious and less ambitious in their inferences. They suspected that these studies "were undertaken not so much because of a burning interest on the part of the scholars but rather because the petroglyphs themselves, by sheer quantity, forced their way into the consciousness of archaeologists, whose duty it is to study prehistoric cultural remains" (Heizer and Baumhoff 1962:6). In defense of Steward, Cressman, and other early archaeologists who studied rock art, at least they did incorporate it in their work rather than just ignoring it.

In fact, the lack of interpretation of the "meaning" of rock art in these pioneering works is not surprising. In the absence of solid data, any explanation of rock art's cultural contexts and past social functions could only be speculative. These early studies were consciously first attempts at providing the descriptive data necessary for the foundation of future, more ambitious work. Additionally, the focus on explanation, rather than interpretation, meant that recovering some "original" meaning and exegesis of

rock art imagery was not perceived as the object of its study. This understanding of the balance between explanation and interpretation was shared with the mainstream archaeology of the day, and is one of the subtle differences between the work of Steward and Cressman and that of many rock art researchers today.

Early works, therefore, concentrated on documenting the characteristics and distributions of rock art to establish a level of knowledge which would allow fuller explanation in the future. For the most part, authors like Steward avoided the temptation to believe that the meaning of rock art could be apprehended solely by a subjective consideration of its imagery; i.e., that the themes and subjects of rock art are the sole locus of "meaning," if only we knew how to "read" them (e.g., Steward 1937:408-409). This offers another contrast with the modern trend of research that offers specific interpretations of imagery, without necessarily reflecting on the art's landscape context and its role in adding to site meaning, to infer rock art's past social contexts. In some cases, this becomes the search for the original "meaning" of rock art motifs, rather than trying to elucidate its sociocultural use-contexts.

THE SHIFT TO EXPLANATION AND INTERPRETATION

In the 1960s the focus of Great Basin rock art research shifted to an attempt to reconstruct the past social contexts and meanings of rock art. Robert Heizer and Martin Baumhoff, as well as their students, were at the forefront of this change in focus largely because they believed that understanding prehistory required that all the material expressions of the past should be taken into consideration, not just those that could be easily classified and quantified. Heizer and Baumhoff's seminal study *Prehistoric Rock Art of Nevada and Eastern California* (1962) carried the study of rock art further than earlier researchers by attempting to understand its motivation and social context, as well as refining Steward's (1929) style classification. Their work also seemed to offer the promise of integrating rock art studies with other archaeology, as their explanation of rock art's social functions made it relevant to subsistence-related themes in archaeological thinking. Further, Heizer and Baumhoff's work also drew upon site contexts as informing contexts for explanation, anticipating later trends in rock art research. However, the theory used by Heizer and Baumhoff may have contributed to subsequent archaeological disinterest in rock art.

Their variant of hunting-magic theory is specialized to the archaeology of religion, which has been a research theme of only passing interest among Great Basin archaeologists.

Heizer and Baumhoff (1962) argued that rock art was made and used in the context of hunting-magic rituals, i.e., the enlistment of supernatural aid in economic reproduction. They explored the archaeological and stylistic characteristics of 99 Nevada rock art sites, perceiving a strong relationship between rock art and ambush sites, hunting locales, animal trails, hunting blinds, etc. This apparent relationship with the archaeology of hunting led them to argue that Great Basin rock art was used in rituals that sought to ensure success in the hunt, increase numbers of game animals, or symbolically treat feared or prized animals. Although Heizer and Baumhoff used specific images (e.g., flayed sheep, people hunting, etc.) to illustrate their hunting-magic interpretation, it was site context that was most important in their thinking, an important contribution in its own right and an insight that anticipated current trends in rock art research outside the shamanic approach (e.g., Bradley 1997, 2000; Hartley 1992; Hartley and Vawser 1998; Taçon 1994).

The popularity of the hunting-magic approach in studies of the rock art of western US was solidified by Grant et al's (1968) interpretation of the Coso rock art complex, south-central California. Grant et al.'s approach is illustrative of what has come to be "traditional" epistemology for many avocational and professional students of rock art, being based more on subjective readings of imagery represented than on site contexts and archaeology. They used rock art representations of what they thought illustrated the transition from the atlatl to the bow and arrow to hypothesize that the florescence of rock art in the Coso was the product of a bighorn sheep hunting cult.

Illustrating the dangers of attributing interpretive labels to rock art motifs, is the motif Grant et al. (1968:18) called a "medicine bag." This motif resembles a "fringed sack with a handle." Other authors have treated this as an actual attribution of the signification of this image, and have argued that the portrayal of "medicine bags" or similar motif types demonstrates a rock art's connection with ceremonial practices. This illustrates the contingent nature of archaeological identifications of the subjects of rock art motifs and the problems of assuming that we can simply

understand what is represented by contemplating the motif itself.

One significant problem with hunting-magic theory it has little to say about abstract imagery. Heizer and Baumhoff's interpretation is silent about the abundant abstract imagery that makes up the most frequent element at most Great Basin rock art sites. For example, at the Lagomarsino site, northwestern Nevada, which played an important role in the evolution of their hunting-magic approach, Heizer and Baumhoff's only cited the specific imagery of three motifs (a bighorn sheep motif and putative pinyon cone motifs), largely ignoring the site's thousands of Basin and Range Tradition abstract motifs (Quinlan and Woody 2001:213), a problem repeated in their discussions of other sites (Whitley 1998c:135-136).

It can also be questioned why an art intended to increase the numbers of critical resources only portrays one or two types of game animals (bighorn sheep and deer), and rarely depicts seeds, roots, or small mammals; resources known from ethnohistoric and archaeological data to have been critical to economic reproduction in the Great Basin (Fowler 1986; Steward 1938). Of course, these resources may have been represented in abstract imagery that we cannot identify the references of. But this highlights the problem of falsification of hypotheses in rock art theory, another reason why Great Basin archaeology has tended to avoid the subject.

Heizer and Baumhoff (1962) also over-emphasized the presence of hunting-related archaeology and overlooked domestic archaeology associated with rock art; the latter criticism is also relevant to the shamanistic approach (see discussion in Quinlan 2007a). If site contexts and associated archaeology are used as informing contexts for interpretation, then all on-site activities indicated by archaeological data should be considered in interpretation (Bradley 2000; Quinlan 2007b; Quinlan and Woody 2003).

Although hunting-magic as an explanation is no longer that popular in rock art research, it still has adherents and has prompted important research on the relationship between rock art sites and their natural environments (e.g., Gilreath 1999; Matheny et al. 1997; Nissen 1982, 1995). Hunting-magic's fall from favor was partly based on dissatisfaction with its theoretical basis (e.g., Bahn 1991; Rector 1985), though as we have noted elsewhere (Quinlan and Woody 2001), these criticisms are somewhat misplaced as the concept of sympathetic magic, which

underlies hunting-magic theory, remains central to the anthropology of religion and hunting-magic rituals—albeit, not incorporating rock art—were observed by Great Basin ethnographers (e.g., Steward 1938). Rather, hunting-magic theory's central theoretical problem is that, as it was defined by its leading proponents, is that it is not capable of falsification. For example, there is nothing in Heizer and Baumhoff's (1962) theorization that makes hunting-magic ritual restricted to actual hunting locales—the same theory was applied to the art of the European caves after all. Likewise, its readings of the "meanings" of rock art imagery are not capable of falsification, just as the shamanic approach's are not (Layton 2000).

In retrospect, the introduction of hunting-magic theory can be seen as ensuring that rock art and archaeology would be studied as separate research fields with specialized theoretical frameworks. Hunting-magic was perceived as an over-arching and universal explanation for Great Basin rock art, indicating to archaeologists that rock art shared the same function and led to the misperception that there was no further need for its archaeological study. Also, the interest in prehistoric religion and ritual evinced by hunting-magic theory did not appeal to many Great Basin archaeologists, still grappling with more mundane and basic research issues such as chronology-building. Ambitious in its explanatory scope and not reflected in other kinds of archaeology, hunting-magic theory made rock art seem a highly specialized field of archaeology.

Since the late 1980s, rock art interpretation in the US has been characterized by approaches that seek to interpret rock art imagery through the framework of ethnohistorical accounts of shamanistic practices. The theory of this approach (the neuropsychological approach but now more simply known as the shamanic or shamanistic approach) was first outlined by Reichel-Dolmatoff (1972, 1978) and applied to California rock art (Applegate 1975; Blackburn 1977; Hedges 1976, 1983). However, the shamanic theory's popularization can be credited to South African researchers David Lewis-Williams and Thomas Dowson, whose theorization of the approach has proved the catalyst for a wealth of rock art research globally (Lewis-Williams and Dowson 1988).

Proponents of the shamanic approach argue that much North American rock art imagery portrays mental imagery (entoptic phenomena) experienced during shamanistic trance

states (Blackburn 1977; Hedges 1976, 1985). Geometric motifs are identified as representations of entoptic phenomena and figurative compositions are interpreted as depictions of shamanistic rituals, or associated with them because they apparently incorporate elemental entoptic forms (Lewis-Williams and Dowson 1988:205). In addition, the content of rock art imagery is explored for the expression of common shamanic themes. Avian imagery has been interpreted as a metaphor of shamanic soul flight or the transmogrification of shamans into birds (e.g., Hedges 1985; Schaafsma 1994). Ethnographic descriptions likening trance states to "dying" have led to images of death (e.g., hunting scenes, anthropomorphs falling, fighting scenes, etc.) being interpreted as visual metaphors for entering trance states (e.g., Lewis-Williams 1982, 1997).

The value of this shamanistic approach is that it aims to include indigenous theories of being in understanding rock art, by assuming that traditional shamanic practices recorded in ethnography provide an informing context for the interpretation of rock art imagery. However, this approach is less useful when it is based on speculative reinterpretations of ethnographic material (Quinlan 2007b:5).

In the western US, the shamanistic approach is exemplified by David Whitley's interpretations of Great Basin and California rock art, which couples a close attention to rock art imagery with the re-interpretation of ethnographic sources, to provide an explanation of the desert west's rock art (Whitley 1992, 1994, 1998c). Whitley has argued that the region's rock art was made by male shamans to record imagery experienced during trance states. Rock art sites were perceived as places were power could also be acquired and, therefore, also functioned as vision-quest locales. Because a shaman's spirit-helper contacted him during trance, giving the shaman instructions and various powers, some art also depicts spirit-helpers. For example, in the Coso Range, bighorn sheep motifs were interpreted by Whitley as the specific spirit-helper of rain shamans. Scenes of bighorn sheep apparently being hunted by anthropomorphs were interpreted as metaphors of shamanic trance because they portray dying (1994). The elaborate patterned-body anthropomorphs are argued to incorporate unique geometric motifs; hence, these are interpreted as portrayals of shamans wearing clothing decorated with designs of entoptic phenomena experienced during trance (1998c). Some Coso anthropomorphs

have "bird-claw feet and whirlwind faces," which are interpreted by Whitley as visual metaphors of trance (1998c:157). Because rock art sites are envisioned as vision-quest locales, they are interpreted as being some distance from settlement or domestic activity areas and would only have been visited by shamans (1998a).

Underlying this reading of Great Basin rock art imagery is a thorough re-interpretation of Great Basin and California ethnography. Much of this re-interpretation of ethnographic sources is highly speculative and often inaccurate, but presented as an authoritative reading. This paper is not the context to revisit this debate, for those interested see critical commentaries by Monteleone (1998), Quinlan (2000a, 2000b, 2001), and Hedges (2001), as well as Whitley's (2000a, 2000b, 2003) feverish responses that, tellingly, avoid addressing the specific criticisms made of his novel re-readings.

In common with hunting-magic, the shamanistic approach is challenged by the evidence of domestic archaeology closely associated with rock art. If rock art locales are remote vision quest locales, then why is settlement archaeology so near to it? Whenever domestic artifacts are directly associated with rock art, it is argued that the artifacts were used at different times and rock art was purposely put there to exert male spiritual dominance over women's mundane daily activities (e.g., Whitley 1998b; Whitley 1998c), an argument reflecting the androcentric bias of some contemporary archaeologists rather than that of prehistoric groups (Cannon and Woody 2007).

The readings of certain rock art imagery as expressing shamanic themes are speculative and largely focus on representational imagery. Abstract imagery is cited to establish a precedent for a trance-based explanation of a corpus of rock art (because it is assumed to encode entoptic phenomena), but thereafter is largely ignored. As Robert Layton (2000) has pointed out, if rock art portrays shamanic spirit-helpers, then why is such a limited range of animals portrayed in the art? Again, any attempt to interpret the "meaning" of imagery is subject to the same problems of falsification as the hunting-magic approach's readings of rock art motifs.

The shamanic approach is rooted in visual assessments of rock art imagery, rather than also taking into consideration landscape and archaeological contexts of rock art. This focus on imagery at the expense of archaeological context is a contributing factor to the impression that

rock art has little to offer mainstream archaeology—not only does it seem to inform on areas of cultural life that are sometimes regarded as beyond archaeology's reach, it also is misconstrued as requiring non-archaeological methods to understand it.

PROBLEMS IN ROCK ART RESEARCH

We do not wish to imply that rock art's archaeological neglect is simply the fault of archaeologists ignoring an important component of Great Basin archaeology. In fact, there are a number of problems with rock art research that are contributing factors to archaeology's disinterest. Research driven by the interests of avocational rock art enthusiasts can be haphazard, un-reflexive, and decidedly quirky. Untestable and unsupported theories often overshadow the more methodical approach of archaeology, which gathers evidence and formulates hypotheses based on empirical observation, and attempts to develop criteria of falsification allowing theories to be verified. Additionally, there has been little development of stylistic issues since the 1960s. Styles have been casually defined on the basis of a single characteristic rather than on a suite of characteristics, resulting in a plethora of site-specific styles.

Complex questions of the construction of gender are generally overlooked in rock art research, and instead the search for depictions of women in rock art is regarded as "gender studies." As feminist archaeologists have found in other areas of research, just finding evidence of feminine presence is not enough and broader analysis must be made. Instead, simplistic interpretations of rock art sites as "female-gendered places … primarily (if not exclusively) used by male shamans" (e.g., Whitley 1998a:18) passes for a "gendered" analysis in some rock art research.

REDUCTIVE PURSUITS OF THE PAST

Great Basin archaeology's research interests have tended to be very different from rock art's, instead concentrating on addressing a set of research questions that largely revolve around the dating and circulation of flaked stone artifacts. This research focus is one that should be supplemented by data that informs on nonmaterialistic aspects of human culture, if for no other reason, to provide a more rounded view of prehistoric lifeways and to add an element of external critique. Indeed, attempting to reconstruct the social prehistory of the Great Basin through projectile point data and the detritus of lithic reduction

strategies seems somewhat unbalanced. These data provide information about specific technological behaviors and economic practices, and often reflect the androcentric bias of much archaeological research in the region. For example, it is an axiom of debitage analysis that reduction strategies at quarry sites focus on reducing toolstones to transportable dimensions, and that there is a strong relationship between distance to source and reduction stage (e.g., Beck et al. 2002; Elston 1992; Kuhn 1994; Shott 1986). Yet, Joan Schneider (2006) has reported in the Three Corners region milling tool quarries, from which heavy and bulky ground stone "preforms" (both handstones and slab milling stones) were transported distances up to 90 miles. Clearly, calculations about what constitutes "too heavy to transport" depend on the tool type, but Schneider's data indicate that heavy milling tools were not necessarily procured from on-site or near sources, as would be expected if we based our expectations of transport distances and object size on flaked stone artifact reduction strategies.

It is ironic given current Great Basin archaeology's focus on seemingly reducing prehistoric lifeways to the will to reduce toolstone, that rock art, itself predominantly a lithic reduction event in the desert west, has not been incorporated more in archaeological research. But, the focus on "lithic reduction events" (the terminology indicating an erasure of human agency and cultural meaning in the stone tool production) highlights that the goal of much contemporary research is to understand the distributions and ages of the products of stone tool production, not necessarily explain their sociocultural contexts, or go beyond the narrow view of culture as humanity's "extrasomatic means of survival" (Binford 1972). We suggest that this tendency of archaeology reflects the tropic disease, *lithicphilia*, which results in reductive and mechanistic reconstructions of prehistoric lifeways! Many of the unintended consequences of lithicphilia can be corrected by considering datasets that directly inform about the lived experience of daily life, injecting a sense of human agency into archaeological narratives.

ROCK ART AND SETTLEMENT—AN UNEXPLORED ASSOCIATION

Rock art potentially has much to offer archaeology because of its relationship to the lived experience of daily life, the construction of identity, and ritual. This potential has been demonstrated in studies that have addressed ethnicity, identity construction, and population change through rock art to

explore to the Numic dispersal and its material expression (e.g., Bettinger and Baumhoff 1982; Quinlan and Woody 2003). Further, rock art may prove useful in determining a chronology for the development of prehistoric territoriality, particularly that accompanying Late Archaic population growth and resource-use intensification (Bettinger 1999).

Rock art and settlement archaeology are often closely related. Researchers are increasingly observing that domestic archaeology or, more broadly, the settled landscape is the characteristic context of much Great Basin rock art (see Cannon and Ricks 1986, 2007; Green 1987; Quinlan and Woody 2003; Ricks 1995; Woody 2000). As rock art has employed interpretive perspectives that have little purchase in mainstream archaeology, one would expect that rock art would have been well documented if under-interpreted in archaeology. Yet, this has not been the case and the discourses of temporal distanciation that are used to separate rock art from its spatial and archaeological contexts have served to both marginalize it and make its documentation a cursory affair by some archaeologists (for discussion of this see Cannon and Woody 2007).

This misperception is also evident in rock art research; as noted above, both shamanic and hunting-magic approaches have also misconstrued the relationship between rock art and the settled landscape. Even where the two are directly spatially related, it is assumed that either settlement archaeology or rock art belong to different periods, or were used at different times in the year (e.g., Whitley 1998b). For example, Pendegraft (2007:61, 63), working in the Spanish Springs area, northwestern Nevada, has discussed how previous archaeological surveys employed a strategy of temporal distanciation to explain away the co-occurrence of rock art and settlement archaeology.

ROCK ART AND IDENTITY

Because of rock art's apparent association with the settled landscape and daily routines, it may productively be used to supplement understandings of Great Basin prehistory regarding the construction of identity and the constitution of daily life. We conclude this paper by outlining a social archaeology of identity that can be explored through Great Basin rock art.

While the construction of identity is constitutive in daily practice, the representation and manipulation of the

body is the most visual way to construct identity. Consequently, the presentation of self in daily life is seen as an important way in which individuals achieve self-identification as a member of a social group(s) (Fisher and Loren 2003). The problem with a focus on the body is that it is largely invisible archaeologically, except through ideological presentations such as burials and artistic representations of the human subject. Daily life is not the only social context where identities (social, sexual, age and cultural) are negotiated and formed. Ritual practice is also frequently an important context for identity formation and negotiation (Barth 1987), as it provides a context for protected social communication, and adds a moral dimension to the social and cultural identities created and reproduced through it.

Material culture constitutes the lived experience of social and cultural identity. This constitutes the representation of identity, not its experience or embodiment which are lived out in the experience of daily life. As Fisher and Loren (2003:227) noted, the social identities constructed in social praxis create a social memory exceeding individual experience, while at the same time aiding the individual to reflect on their own identities and social lives. Rock art is one way that the ephemeral actions of ritual performance survive in time/space, becoming a visible sign of past performance to future social agents, and cited by them in their own performances.

We have previously argued that Great Basin rock art can be obliquely used to address issues of cultural identity because the production and use of rock art is a variable expression of hunter-forager theories of being (Quinlan and Woody 2003). Where social and cultural identities are reproduced through the medium of ritual, subtle variations in ceremonial practice are often cited as signs of radically different cultural practices and can be important in constructing group and social identities (Barth 1987:3–6). The close relationship between ritual and the constitution of social praxis is further suggested by social structure, in Radcliffe-Brown (1952)'s sense, being manifested largely in ritual contexts. As Maurice Bloch (1977:286) observed, certain rituals provide "the rare occasions when it is possible actually to hear people giving lists of rights and duties, and even quite literally to see roles being put on individuals." In addition, the experience of ceremonial performance can give individuals a commentary on their social

lives, shaping their reflections on their daily experiences.

We have suggested that rock art potentially provides a powerful symbolic resource that can be incorporated into ritual performance and sustain competing ritual discourses (Quinlan and Woody 2003). Because monuments are often reused and given novel cultural meanings despite discontinuities in use (Bradley 1993, 1998, 2000), once created, rock art would have shaped subsequent populations' experience of the landscape, because much of it is situated in places encountered during social and economic routines. Its landscape context indicates that much Great Basin rock art was encountered by a broad cross-section of society in the course of their daily routines (Quinlan and Woody 2003). Even the Coso Range rock art complex has been shown by Gilreath and Hildebrandt's research to be closely associated with milling features, open-air habitation sites, and hunting features (Gilreath 1999; Gilreath and Hildebrandt 1997). It is this relationship between habitation and rock art that suggests the rituals associated with it were embedded in the social reproduction of its makers and users, since the "meanings" of space are inscribed by the actions recurrently performed there (Ricoeur 1981:204—206).

Symbolism often becomes the object of a special knowledge, and control of that knowledge a potential source of power The form that rock art imagery takes is one means by which access to its "meanings" or commentaries may be controlled. Schematic or abstract imagery can require commentary to identify its referential subject(s) and meanings. Layton (1991:139-40, 186) noted that in Aboriginal art, geometric motifs are often confined to secret paintings because they have both less resemblance to the things they depict, while at the same time have more power to depict several things simultaneously because of schematism's ambiguity. An emphasis on abstract imagery allows for the creation of a hierarchy of meanings and interpretations, requires commentary to identify its referential subject(s) and meanings, and thus is a potential source of power.

The character of much Great Basin rock art suggests that it was associated with rituals that managed social praxis and negotiated social identities, and its landscape context suggests that it shaped the lived experience of daily life. Great Basin rock art exhibits a strong preference for schematism, with a heavy emphasis on geometric forms. The earliest rock art throughout the Great Basin is abstract

(Schaafsma 1986), with figurative elements such as anthropomorphs rare or absent. This is exemplified by the Long Lake rock art site in southern Oregon, securely dated to before 6800 BP (Cannon and Ricks 1986; Ricks and Cannon 1993). Its rock art is characterized by very deeply engraved, complex, abstract designs which are directly associated with milling stones, house rings and other settlement debris. Likewise, at Grimes Point (northern Nevada) much of the art is completely revarnished and is predominantly abstract in form.

The temporal dimensions of Basin and Range Tradition art are difficult to determine, partly because of the absence of direct dating and partly because its abstract character is extremely challenging for relative dating. Basin and Range Tradition motifs show such considerable variation in form that only very basic geometric forms—such as circles, triangles and vulviforms—can be readily re-identified. The motifs employed constitute the basic vocabulary of visual expression, explaining their presence at the vast majority of Great Basin rock art sites, and their apparent temporal duration from the Pre-Archaic through Archaic times. The general emphasis on abstract modes of expression suggests that exegesis would have had to accompany rock art's production and use to clarify its references. Its interpretive difficulties would have served to demonstrate the privileged position of those individuals authorized to interpret it, and may imply a concern with internal social communication rather than between different cultural groups (Quinlan and Woody 2003).

The wide spatiotemporal distribution of Basin and Range Tradition motifs should not be seen as evidence of an attempt to construct a shared regional identity. The abstract imagery that comprises the Basin and Range Tradition is universal in its distribution and not restricted to rock art. However, the shared practice of making and using rock art could be interpreted as constructing a shared identity through common practice, and perhaps at a local level this allowed neighboring groups to identify with each other.

Naturalistic imagery seems to be a later development, perhaps associated with novel ritual forms and social changes accompanying growing population densities, infilling of the landscape, and in the eastern and southwestern Basin, the development of semi-agricultural economies. It takes the form of regionally distinctive anthropomorphs and zoomorphs which occur in relatively large

numbers. As Bachand et al. (2003:239) observed, the representation of human figures is culturally variable and therefore "the deployment of images of the human body [is] a significant exercise of agency, making choices to depict, and to patronize the depiction of idealized models of human bodily being." Interestingly, anthropomorphs engaged in an activity are usually depicted as simple transitional stick figures, though there are some elaborate active anthropomorphs.

In Utah and the southwestern Basin the development of elaborate anthropomorph types seems to be associated with the development of subsistence systems with a variable reliance on horticulture and harvesting of wild resources. Broad-shouldered anthropomorphs depicted with horns or other elaborate headgear, are a characteristic motif in Fremont rock art and are very similar in style to unfired ceramic figurines that are a distinctive part of its material culture. These Fremont anthropomorphs share formal characteristics with Western Kayenta style anthropomorphs associated with Puebloan culture.

The distinctive Pahranagat style also seem related to the development of a semi-agricultural economy. This style is restricted to southeastern Nevada in the mountains surrounding the Pahranagat valley. Its anthropomorphs are square or rectangular forms with heads that are not distinguished from the body. They are often portrayed next to so-called blanket figures, which are rectangular shapes with the interior divided by vertical lines.

In contrast, Coso style anthropomorphs were the work of hunter-forager populations in eastern California. These take the form of elaborate rectangular pattern bodied anthropomorphs which feature headgear and earrings. Monteleone and Woody (1999) have suggested that as the majority of Coso rock art seems to have been made more recently, in an apparent explosion of ritual activity, it may be related to a revitalization or millennial movement. These types of movements are organized attempts to construct a more satisfying culture based on a return to a mythic past, with early rock art interpreted as a tangible sign of the past. Traditional ritual forms are invigorated through the introduction of new imagery and practices and therefore later Coso rock art may represent the material residues of these new ritual forms.

Although there are formal differences between these regional anthropomorph types they do share common features, most importantly the

apparent display of clothing. This may explain their rectangular or broad-shouldered form, as simple stick figures are too narrow to be "dressed." This representation of clothing may depict ceremonial garb associated with new ritual or social positions in these areas. The ritual positions, as well as the rituals themselves may have been legitimated through rock art's connection to past performance. Further, the artistic representations may have functioned as precedents for citational performance, recording the appropriate dress, bodily postures and movements of the ceremonial participants. These inscriptional practices may also have played a role in the daily presentation of self and the negotiation of identity, with anthropomorphs perhaps functioning to provide idealized versions of bodily self-presentation and socially correct postures. In the case of Pahranagat, Fremont, and Puebloan rock art, it may reflect changes in the social and ritual practices that accompanied the evolution of horticultural economies. Continued use of abstract imagery in these style areas also suggests that rock art was perhaps still used to negotiate internal social practices (Quinlan and Woody 2003).

Some rock art sites seem to have been more specialized in the kinds of identities they negotiated. Vulviforms are widely distributed and usually occur in small numbers at Great Basin sites. However, in central Nevada at several sites vulviforms dominate, and are primarily placed on volcanic tuff. Woody and McLane (2000) suggested these sites, restricted in distribution and with a careful selection of rock type, represent the residues of a cult of affliction centering on female reproductive disorders that required ritual treatment. Such cults are sometimes a strategy for women to achieve social status in contexts where they are denied access to social prestige and/or are denied a ritual role (Lewis 1989). Alternatively, the central Nevada vulviform sites may have functioned to simply provide a magical treatment for health disorders, rather like some cupule-dominated sites in California which were used in the treatment of infertility (Barrett 1908; Loeb 1926).

CONCLUSIONS

Great Basin archaeology provides an interpretive space that can be used to explore broad themes in anthropology, much the same way as Julian Steward used his experience in the Great Basin to examine general theoretical issues in the relationship between culture and ecology (1955). We believe that rock art has much potential for addressing the ideological

representation of social and cultural identities in Great Basin hunter-forager societies. The domestic site context of much Great Basin rock art suggests that it shaped the experience of social and economic routines by manifesting the presence of past ritual performances in daily life. As the residue of ceremonial practices, rock art is also the result of inscriptional practices that made permanent fleeting actions and allowed them to be referenced in future performances. The past is an important resource in legitimating practices, with the authority of performance signaled by manifesting the past in the present (Bloch 1977; Boyer 1990). Rock art represents a tangible index of the past in the present, and may have served as a source of citational precedents for social agents to reference and re-interpret.

We started this paper with an exploration of why archaeologists have generally been reluctant to incorporate rock art in their research. A contributing factor is that rock art often is a palimpsest of past actions, difficult for traditional archaeological narratives to manage. But rock art provides an important reminder that the importance of an object does not end with its creation, original use and subsequent discard. Many archaeological features and artifacts, particularly rock art, become in a very important way a part of the landscape in which they were created and used. Rock art remains in the place where it was intended to be used, becoming a point of articulation in space and in time for all who encounter it, from the time it was made, even until today when it continues to shape the experiences of those who encounter it. For many Native Americans it often represents a tangible sign of their cultural connections to the landscape.

5
Holocene Elk (*Cervus elaphus*) in the Great Basin

Donald K. Grayson and Jacob L. Fisher

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The Great Basin has one of the best late Pleistocene and Holocene small mammal records available for anywhere in the world, thanks to abundant depositional settings conducive to the preservation of bones and teeth combined with researchers dedicated to the proper excavation and analysis of material from those settings. As a result, we have exquisite histories for such Great Basin small mammals as pikas (*Ochotona princeps*), yellow-bellied marmots (*Marmota flaviventris*), bushy-tailed woodrats (*Neotoma cinerea*), and pygmy rabbits (*Brachylagus idahoensis*) (Grayson 2005, 2006a). Valuable on their own, these histories can be arrayed against, and incorporated into, a wealth of conceptually powerful biogeographic analyses produced by a wide variety of ecologists concerned with modern animal distributions within the Great Basin (e.g., Brown 1971, 1978, Lawlor 1998, Rickart 2001).

The situation for large mammals is less impressive. In certain parts of the world, including western Europe, the rich and stratified samples of large mammal remains that help fill the deposits of caves and rockshelters have allowed the construction of detailed species histories (e.g., Delpech 1999). In the Great Basin, however, this is not the case, presumably the result of some combination of low predator and prey densities, perhaps coupled with the distance of caves and rockshelters from the places where people were hunting their large mammal targets (Grayson 2006b). As a result, building compelling large mammal histories for this part of the world must largely be accomplished by amassing individual records from multiple sites across space and through time (e.g., Lupo and Schmitt 1997; Livingston 1999; Grayson 2006b).

Ultimately, such censuses will provide us with far more detailed information on individual large mammal species histories than is currently available. This information is, in turn, crucial to understanding past human history in this region as well as the histories, and possible futures, of the mammals themselves.

These histories would also allow us to test various hypotheses that currently exist concerning large mammal history in the Great Basin. To take one example, Byers and Broughton (2004; see also Hockett 2005, McGuire and Hildebrant

2005) have argued that artiodactyls in Utah's Bonneville Basin were more abundant during the late Holocene (the last 4500 years or so) than they were during the early Holocene (ca 10,000 – 8000 years ago). Since artiodactyls are unlikely to have been abundant during the hot and dry middle Holocene, this allows them to argue that artiodactyl abundances in the Great Basin reached their Holocene peaks during the last 4500 years.

Although the analyses presented by Byers and Broughton (2004) appear impeccable, their conclusions concerning low early Holocene artiodactyl abundances in the Great Basin, including the eastern Great Basin, run counter to our understanding of other aspects of Great Basin environmental history. In particular, they run counter to a wide range of data suggesting that early Holocene climates in the Great Basin, including the Bonneville Basin, were cool and moist (e.g., Grayson 2000, Wigand and Rhode 2002). These climates allowed small mammal species richness in the northern Bonneville Basin to be higher during the latest Pleistocene and early Holocene than it has been since then (Grayson 1998). Given that, as Byers and Broughton (1984:238) note, "environmental productivity and forage quality are positively correlated with effective precipitation and soil moisture in the arid West", it follows that the same cool and moist landscape that supported elevated small mammal richness values during the early Holocene should have supported expanded artiodactyl populations as well. Since it is not just the Bonneville Basin that suggests a cool and moist early Holocene (Grayson 1993, 2006a), it follows that artiodactyls should have been relatively abundant throughout the Great Basin during this time.

Although we do not question the analyses provided by Byers and Broughton (2004), we do wonder whether the three Bonneville Basin sites that they analyzed adequately monitored artiodactyl abundances on the surrounding landscape. The small mammal data suggests they did not. If this is the case, then one of the reasons might relate to the fact that early Holocene human population densities in the Great Basin appear to have been quite low. That, at least, is one of the implications of the large human foraging territories inferred for the early Holocene Great Basin by Jones et al. (2003). If human populations were low during the early Holocene, then one of the most obvious mechanisms for introducing large mammals into caves and rockshelters was correspondingly rare. For instance, the

fact that the vast majority of bison sites in the Great Basin are late Holocene in age most likely reflects human history in this region as much or more than it reflects the changing abundances of bison themselves (Grayson 2006b). Thus, human population histories may well account for much (though not all) of the evidence provided by Byers and Broughton (2004) for low early Holocene artiodactyl densities in the Great Basin.

We mention Byers and Broughton (2004) simply to emphasize that, unlike the situation for many species of Great Basin small mammals, our understanding of the histories of large mammal in this region is hazy indeed. The only way to remedy this situation is by following the lead established by Thomas (1970), Pippin (1979), Lupo and Schmitt (1997) and Livingston (1999) and synthesizing the very scattered archaeological and paleontological large mammal records. For the reasons we have discussed, this approach may, given current data, provide secure histories only for the late Holocene but even those histories would represent a significant advance over our current knowledge. Here, we continue this process for Great Basin elk (*Cervus elaphus*).[1]

ELK IN THE GREAT BASIN: AN INTRODUCTION

Reviews of the distribution of elk in western North America suggest that these animals were rare in the Great Basin during early historic times. Indeed, one of the most influential maps of the early historic distribution of elk in North America, produced by Murie (1951) and followed by many others (e.g., Bryant and Maser 1982, O'Gara and Dundas 2002; see Figure 1) excludes nearly all of the Great Basin from its territory. Archaeologists have concurred, observing that elk appear to have been uncommon in this region for much, if not all, of the Holocene (e.g., Grayson 1988, Janetski 2006). This is the case even though there has never been a thorough review of the archaeological and paleontological data for elk in the Great Basin.

MAPPING WESTERN ELK

While the map of the early historic distribution of elk in western North America produced by Murie (1951) has been highly influential, a second version of that distribution has been equally influential (Figure 1). That version was provided by Hall and Kelson (1959) and repeated, with minor modifications, by Hall (1981). While many naturalists have

adopted Murie's map, many others have adopted the Hall version (e.g., Verts and Carraway 1998, Zeveloff and Collett 1988).

As Figure 1 shows, the two maps differ substantially. Most importantly from our perspective, unlike Murie (1951), Hall (1981) places elk in the northern portion of the Great Basin and in nearly all of Utah. The reasons for this are quite straightforward. Bailey (1936) provided several records for elk in the Steens Mountain area of southeastern Oregon, while Hall (1946) and Murie (1951) provided records for the Snake Range of eastern Nevada and the Bruneau Range of far north-central Nevada (Figure 1). Murie downplayed both sets of records, suggesting that the Oregon "animals were probably stragglers, as the arid districts evidently were not normal elk range" (1951:76), and that "it may be said with confidence that elk did not occupy Nevada in any considerable numbers" (1951:32). Murie (1951) also observed that elk had been reported from Utah as far southwest as Willis Creek (Figure 1), near the Arizona border. Nonetheless, he drew his map in such a way as to exclude these marginal records, concluding that "much of the Great Basin of the West . . . appears to have been unoccupied by elk" (1951:20). Bryant and Maser (1982) and O'Gara and Dundas (2002) followed this approach closely.

Hall and Kelson (1959) and Hall (1981), on the other hand, accepted all of these marginal records and drew their map to take them into account. Importantly, Murie's map produced a substantial geographic gap between far western elk populations and those to the east (Murie 1951:20; O'Gara and Dundas 2002). That gap corresponds almost perfectly with the Intermountain West, the region between the Sierra Nevada and Cascades on the one hand, and the Rocky Mountains on the other. The Hall and Kelson (1959) map, on the other hand, shows no such gap.

Lyman (2004a, 2004b; see also McCorquodale 1985, Dixon and Lyman 1996) has already shown that the archaeological record for eastern Washington strongly suggests that elk were to be found throughout this area during the past 2000 years and that the biogeographic gap implied by the Murie map appears not to have existed during late prehistoric times. In this paper, we ask whether the situation was the same for the Great Basin.

Finally, we note that Murie (1951:32) also said that C. Hart Merriam had told

him that elk had once been found in the "Charleston Mountains of Nevada". Since Charleston Mountains is an alternative name for the Spring Mountains of far southern Nevada (McLane 1978; see Figure 1), this record, if correct, would place elk to the immediate west of Las Vegas, albeit at far higher elevations. Although this report has been referred to by more recent authors (e.g., O'Gara and Dundas 2002), no one, to our knowledge, has used it to suggest that elk were to be found in the far southern Great Basin during historic times.

THE PREHISTORIC DISTRIBUTION OF ELK IN THE GREAT BASIN

Murie (1951) carefully noted that the historic records available to him could not be complete. He was, of course, correct. Indeed, Nevada Division of Wildlife (1997:5) mentions, without providing publication details, newspaper accounts of elk at Lake Tahoe and Honey Lake Valley, on the California-Nevada border west of Reno, and in both the Jarbidge and Independence Mountains in northeastern Nevada. While the latter two accounts are in the same area as the Bruneau Range record (Murie 1951; Figure 1), the Lake Tahoe and Honey Lake records are novel. Given the incomplete nature of available historic records, and the fact that those records refer only to the immediate past, we use the Great Basin archaeological and paleontological records to assess the prehistoric distribution of elk in this region.

In doing this, we followed the procedure outlined in Grayson (2006a, 2006b). We began with published syntheses of Great Basin archaeological and paleontological records, including FAUNMAP (1994), Jefferson (1991), Jefferson et al. (1994), Jefferson et al. (2002), Jefferson et al. (2004), Gillette and Miller (1999), Lupo and Schmitt (1997), Miller (2002), Kay (1990), and Janetski (2006). We augmented the results of this compilation with an extensive search of the literature and consultations with colleagues. As usual, there is no reason to think that the resultant list is complete, but it is certainly more complete than previous such compilations.

The results are provided in Table 1. In the table, the Age column assigns faunal assemblages containing elk to four general chronological categories, insofar as that is possible: late Wisconsinan (ca. 40,000 to 10,000 years ago), and early (ca 10,000 to 7,500 years ago), middle (7,500 to 4,500 years ago) and late (4,500 years ago to latest prehistoric) Holocene (all ages in

this paper are in radiocarbon years). In certain cases, associated radiocarbon dates or archaeological time markers allow a more precise chronological assignment. In those cases, the assignments are indicated in the "Date" column.

This table makes is clear that the available chronology for the history of elk in the Great Basin is quite weak. Of the 45 stratigraphically separate occurrences of elk listed in this table, nearly half—20—cannot be assigned to a general chronological category and only 14 can be placed in time with reasonable precision. However, most of those that can be so assigned date to the late Holocene in general, and to the last 1000 years in particular.

These data also make it clear that the perception that elk have never been common in the Great Basin is correct. They have been reported with certainty from only 20 Holocene-aged Great Basin sites, compared, for instance, to 77 that contain bison (*Bison bison*)—itself never an abundant animal in this region (Grayson 2006b). In addition, while bison were widespread in the Great Basin during the late Wisconsinan (Grayson 2006b), there are only two records for elk during this period. The 28 sites that report precise counts of identified specimens (NISP) for elk have provided only 126 such specimens, an average of 4.5 specimens per site and 3.4 specimens per assemblage. The near lack of late Pleistocene elk here matches the near lack of these animals throughout North America during this period (FAUNMAP 1994). Coupled with their scarcity during the Holocene, this record leaves little doubt that elk were never common in the Great Basin.

Figure 2 shows the distribution of all Great Basin archaeological and paleontological sites with elk and the abundances of elk in those sites. Figure 3 provides the same information for those sites that can be placed within the late Holocene.

Both the Murie (1951) and Hall (1981) maps can be supported by these distributions. On the one hand, no sites with more than one elk specimen fall significantly outside of the Hall (1981) boundary., while one (Figure 3) or more (Figure 2) such sites appear on or just within this boundary. Hall (1981:vii-viii) routinely drew his distribution maps to include marginal records and the prehistoric record suggests that he was successful in doing so for elk. If the goal of a distribution map is to indicate all those places in which an organism was found during late prehistoric times,

regardless of their abundance, then the Hall map meets this goal.

On the other hand, if the goal of the map is to indicate those places in which a species occurred more than occasionally, then the Murie map clearly meets that goal, even if the Utah boundary might be moved westwards. In short, both maps appear to be reasonably accurate for the Great Basin and to meet the goals the authors had in mind when they drew them.

The Murie map is perhaps best characterized as a source map, delineating those areas in which elk births exceeded elk deaths, and in which elk emigration exceeded elk immigration (Pulliam 1998). The Hall map, on the other hand, might be seen as a source and sink map, encompassing both those areas marked by elk reproductive surpluses and those which maintained elk populations only because they received emigrants from source areas. If this were the case, then the abundances of elk within those parts of the Great Basin that contained them—roughly the area between the boundaries of the Hall and Murie maps in this region—would be largely contingent on a combination of the health of elk populations within the Murie boundaries and the degree to which elk were able to reproduce successfully within the sink areas. The latter would in turn be in part dependent on the level of predation, including human predation, on those animals.

Finally, we note that that are no prehistoric records for elk in southern Nevada. As a result, we suggest that the record provided by Merriam for the Charleston Mountains was mistaken.

ELK IN NEVADA TODAY

There are now an estimated 8200 elk in Nevada, all of which are translocated or the offspring of translocated animals (Cox et al., n.d.; for a history of these translocations, see Nevada Division of Wildlife 1997). Most of these individuals are in the northeastern quadrant of the state and within the boundaries of the Hall (1981) distributional line. Some, however, are well south of it (Figure 4).

While it is not possible to say with certainty that Nevada now supports larger numbers of elk than it did during the past 40,000 years, the archaeological and paleontological records strongly suggest that this is the case. Certainly, elk are now far more widespread in Nevada than they were during that period. Some elk translocations were into areas in which elk

once existed under similar environmental conditions, and can thus be reasonably referred to as reintroductions. Current Bruneau River area and Snake Range populations provide examples.

Many, however, represent the introduction of animals into areas where they had never before occurred (compare Figures 2, 3, and 4). Indeed, most represent introductions into areas that are not known to have ever supported large cervids. Of the 19 now-extinct genera of large mammals known from the Great Basin, only one—*Navahoceros*—was a large cervid, and it is known from only three Great Basin sites (Grayson 2006a). Elk have thus now been introduced into significant portions of Nevada where neither they, nor anything like them, existed before.

Nevada is not the only place in the western United States where elk may now be far more common than they were in the prehistoric past. Exactly the same observation has been made for the Columbia Basin (McCorquodale et al. 1988, Martin and Szuter 1999), southwestern United States (Truett 1996), and the Yellowstone National Park area (Kay 2002 and references therein). For all of these areas, including Nevada, it has been argued that elk numbers are now much higher than they were during late prehistoric and early historic times at least in part because human predation pressure—and in particular Native American hunting pressure—has been drastically reduced or eliminated (e.g., Martin and Szuter 1999, Truett 1996, Kay 2002, Nevada Division of Wildlife 1997).

Kay (e.g., 1990, 1994, 1995, 1997, 2002) has made this argument most insistently. We strongly agree with those who have observed that his use of anthropological and archaeological data is disturbingly weak (e.g., Cannon 1992, Cannon and Cannon 2002, Lyman 2004a; see also Yochim 2001) but we do not disagree with the suggestion, also made by Truett (1996), Martin and Szuter (1999), and Lyman and Wolverton (2002), that the numbers of prehistoric elk in western North America were suppressed by human hunting. Indeed, given both the global (Grayson 2001) and western North American (e.g., Broughton 1994, 1997, 2002a, 2002b, 2004, Cannon 2003, Janetski 1997, Ugan 2005) evidence for such processes in action, we would be surprised had this not occurred.

On the other hand, we are struck by the fact that elk are now thriving in the Great Basin in places where they never existed before and where they therefore could not

have been subject to prehistoric human hunting. Since this is the case, their current abundances cannot be due to the fact that Native American hunting pressure has been removed. One might argue that elk would have been in these areas had ancient human hunters not prevented their arrival, but this is an argument that is hard to support for the Great Basin, with its low late prehistoric and early historic human population densities (e.g., Steward 1938:46-49). The argument is also hard to support because it is demonstrably false for bison in the eastern Great Basin. The numbers of these animals were highest during Fremont times (ca. 1600 – 600 yr BP), when human population densities were also high, and declined afterwards, coincident with a human population decline (Grayson 2006b).

This, in turn, suggests that increasing abundances of elk in western North America as a whole must have a more complex origin than simply reflecting the removal of Native American hunting pressure. This conclusion echoes that of Lyman and Wolverton (2002), who observed that there is no archaeological evidence to support the argument that elk would have been abundant in southeastern Washington had it not been for human hunters and that more complex models are needed to understand the history of large ungulates in the intermountain west.

Footnotes

[1] Because the term "elk" is used in Europe to refer to *Alces alces*—the moose in American usage—North American *Cervus elaphus* has often been referred to as "wapiti" (e.g., Hall 1981, Geist 1998; see Bryant and Maser 1982 and Geist 1998 for an historical review of these terms). Here, we follow current formal usage (Wilson and Cole 2000, Wilson and Reeder 2005) and retain the term "elk" for this animal.

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Table 1. Prehistoric Great Basin sites containing the remains of elk. LW = Late Wisconsinan; EH = = early Holocene (10,000 yr – 7,500 ^{14}C yr BP); MH = middle Holocene (7,500 – 4,500 ^{14}C yr BP); LH = late Holocene (4,500 ^{14}C yr BP – latest prehistoric); ND = cannot be placed in the tripartite sequence; NP = No provenience. N = NISP or MNI; MNI counts in bold; + = present. Artifacts made from elk skeletal material are not included in the list (e.g., Aikens 1970, Janetski 1986).

Site and Excavation Level	Map No.	Elevation (M)	Age	N	Date	References
26WA5649, Dry Valley, NV	1	1420	LH	1		1[a]
35LK497	2	1318	ND	1	-	2
American Fork Canyon Cave, Wasatch Mountains, UT	3	1890	ND	+	-	3
Baker Village, Snake Valley, NV	4	1603	LH	1 cf	980 – 680 yr BP	4
Barrel Springs, Kamma Range, NV	5	1387	LH	1	-	5
Bear River 1, eastern Great Salt Lake Valley, UT	6	1285	LH	2[b]	1065 yr BP	6
Bear River 2, eastern Great Salt Lake Valley, UT	7	1285	LH	1[c]	995 yr BP	6
Bronco Charlie Cave, Ruby Mountains, NV: 210-215 cm	8	2134	ND	1	-	7
CA-LAS-206/15, Secret Valley, CA	9	1362-1390	LH	1		1
Connley Cave 4, Fort Rock Basin, OR: Stratum 3	10	1356	ND	8	-	8
Connley Cave 4, Fort Rock Basin, OR: Stratum 4	10	1356	ND	13	-	8
Connley Cave 5, Fort Rock Basin, OR: Stratum 3	10	1356	ND	3	-	8
Connley Cave 6, Fort Rock Basin, OR: Stratum 2	10	1356	LH	1	-	8
Crystal Ball Cave, Snake Valley, UT	11	1760	LW	1 cf	-	9[d]
DJ Ranch, Fort Rock Basin, OR, Upper Block	12	1317	ND	2	-	10
Five Finger Ridge, Clear Creek Canyon, UT	13	1829	LH	5	840-650 yr BP	11
Fort Rock Cave, Fort Rock Basin, OR, Stratum 1	14	1355	ND	1	-	12

Gatecliff Shelter, Toquima Range, NV: Stratum 1, H1	15	2319	LH	1	470 – 550 yr BP	13
Goshen Island North, Utah Lake, UT	16	1370	LH	2	<600 yr BP	14
Hanging Rock Shelter, Hanging Rock Canyon, NV: Stratum 2/4	17	1725	ND	2	-	15
Hanging Rock Shelter, Hanging Rock Canyon, NV: Stratum 4	17	1725	ND	18	-	15
Hanging Rock Shelter, Hanging Rock Canyon, NV: Stratum 5	17	1725	EH	14	-	15
Heron Springs, Utah Lake, UT	18	1369	LH	6	650-440 yr BP	16
Injun Creek, eastern Great Salt Lake Valley, UT	19	1285	LH	5 [e]	585-345 yr BP	17
Last Supper Cave, Hell Creek Canyon, NV, Midden	20	1645	ND	6	-	18
Last Supper Cave, Hell Creek Canyon, NV, Stratum 2	20	1645	ND	1	-	18
Last Supper Cave, Hell Creek Canyon, NV, Stratum 3	20	1645	ND	1	-	18
Last Supper Cave, Hell Creek Canyon, NV, NP	20	1645	ND	1	-	18
Orbit Inn, Great Salt Lake Basin, UT	21	1286	LH	3	570-300 yr BP	6
Porcupine Cave, Uinta Mountains, UT	22	2835	ND	2	-	19
Rock Springs Bison Kill, Curlew Valley, ID, Bone Bed 3	23	1660	LH	1	370 yr BP	20
Sandy Beach, Utah Lake, UT	24	1369	LH	8	510-450 yr BP	21
Smith Creek Cave, Snake Range, NV, Grey Silt et al.	25	1950	ND	2	-	22
Smith Creek Cave, Snake Range, NV: Reddish-Brown	25	1950	LW	>2	-	22
South Fork Shelter, South Fork, Humboldt River, NV: 30-36”	26	1555	LH	3	-	23
South Fork Shelter, South Fork, Humboldt River, NV, 48-54”	26	1555	LH	1	-	23
South Fork Shelter, South Fork, Humboldt River, NV: 54-80”	26	1555	LH	6	-	23
Spotten Cave, Goshen Valley, UT: Zone 5	27	1466	LH	**2**	-	24
Weston Canyon Rockshelter, Weston Canyon, ID, Stratum 4-5	28	1590	LH	**3**	-	25
Weston Canyon Rockshelter, Weston Canyon, ID, Stratum 6-8	28	1590	LH	**3**	3740 yr BP	25

Weston Canyon Rockshelter, Weston Canyon, ID, Stratum 9	28	1590	ND	**1**	**-**	25
Weston Canyon Rockshelter, Weston Canyon, ID, Stratum 12-13	28	1590	ND	**1**	**-**	25
Weston Canyon Rockshelter, Weston Canyon, ID, Stratum 14-15	28	1590	ND	**1**	**-**	25
Weston Canyon Rockshelter, Weston Canyon, ID, Stratum 16-17	28	1590	MH	**2**	7200 – 7300 yr BP	25
Weston Canyon Rockshelter, Weston Canyon, ID, NP	28	1590	ND	**5**	**-**	25
Woodard Mound, Utah Lake, UT	29	1384	LH	4	**-**	24

References: 1: Carpenter 2002, pers. comm.; K. McGuire pers. comm.; 2: Pettigrew 1985; 3: Hall 1983; Hansen and Stokes 1941; Miller 2002; 4: Hockett 1999, Wilde and Soper 1999; 5: Thomas 1972; 6: Lupo and Schmitt 1997; 7: Spiess 1974; 8: Grayson 1979; 9: Heaton 1985; Hockett and Dillingham 2004; 10: Singer 2004; 11: Talbot et al. 2000; Janetski 1997; 12: Grayson 1979, Cressman 1942, Bedwell 1973; 13: Thomas 1983; 14: Nauta 2000, Creer, Van Dyke, and Newbold 2007, Janetski and Smith 2007; 15: Grayson and Parmalee 1988; 16: Janetski 1990, Creer and Van Dyke 2007b, Janetski and Smith 2007; 17: Aikens 1966; Lupo and Schmitt 1997; 18: Grayson 1988; 19: Haman 1963, Heaton 1988; 20: Arkush 2002, Walker 2002; 21: Janetski 1990; Creer and Van Dyke 2007a, Janetski and Smith 2007; 22: Mead et al. 1982; Miller 1979; 23: Heizer et al. 1968; Spencer et al. 1987 ; 24: Cook, 1980; 25: Miller 1972; Arkush 1999.

[a] Carpenter (2002) mentions three specimens of elk from the Tuscarora Pipeline and Alturas Transmission line projects. Two of these were from the former project but . although Holanda (2000) notes one specimen of elk from the Alturas Project, the individual reports for this project provide no evidence for elk (McGuire 2000), suggesting that this might have been a typographic error carried over into Carpenter (2002).

[b] NISP given as 173 in Aikens 1966; reidentified by Lupo and Schmitt 1999

[c] NISP given as 9 in Aikens 1967; reidentified by Lupo and Schmitt 1999

[d] Hockett and Dillingham (2004) note that this tentatively identified specimen may pertain to the extinct genus *Navajoceros*

[e] NISP given as 1 in Aikens 1966; reidentified by Lupo and Schmitt 1999

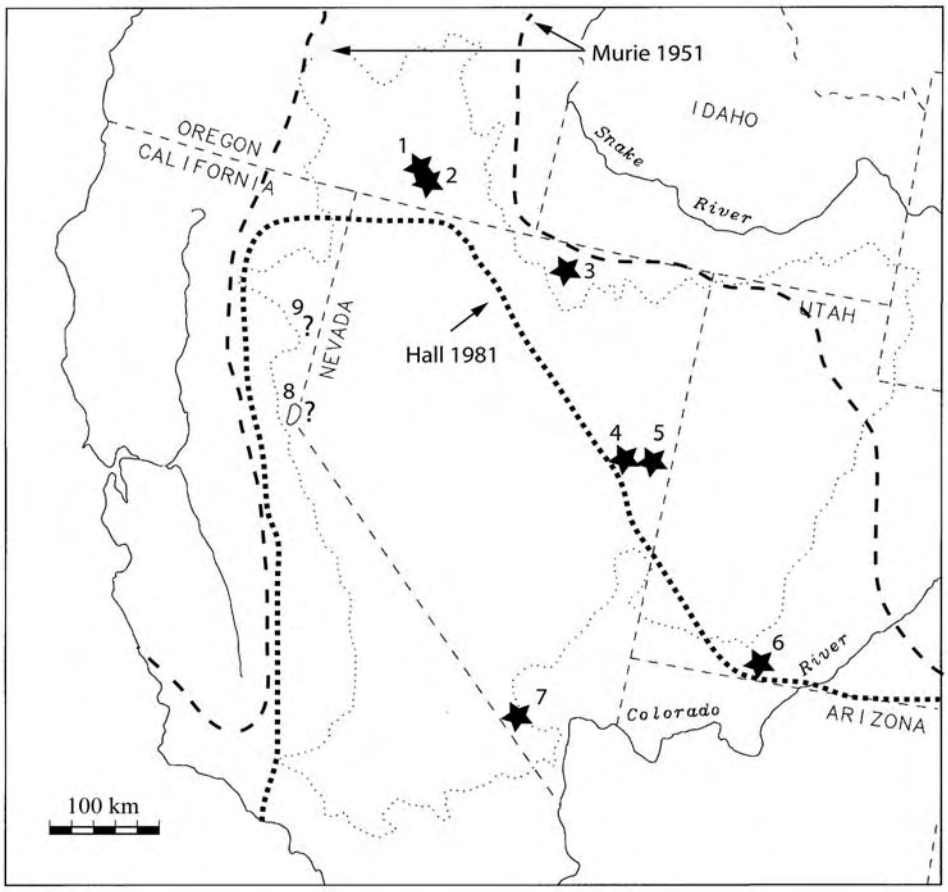

Figure 1. The early historic distribution of elk in the Great Basin according to Murie (1951) and Hall (1981). The numbered stars plot the location of early historic records for elk in the Great Basin as provided by Bailey (1936), Hall (1946), and Murie (1951): 1) Blitzen River. Oregon; 2) Steens Mountains, Oregon; 3) "Wild Bruneau Mountains" near Mountain City, Nevada; 4) Schell Creek Range, Nevada; 5) Snake Range, Nevada; 6) Willis Creek, Utah; 7) Charleston Mountains, Nevada. Unverified newspaper records from Lake Tahoe and Honey Lake Valley are indicated by question marks (Nevada Division of Wildlife 1997).

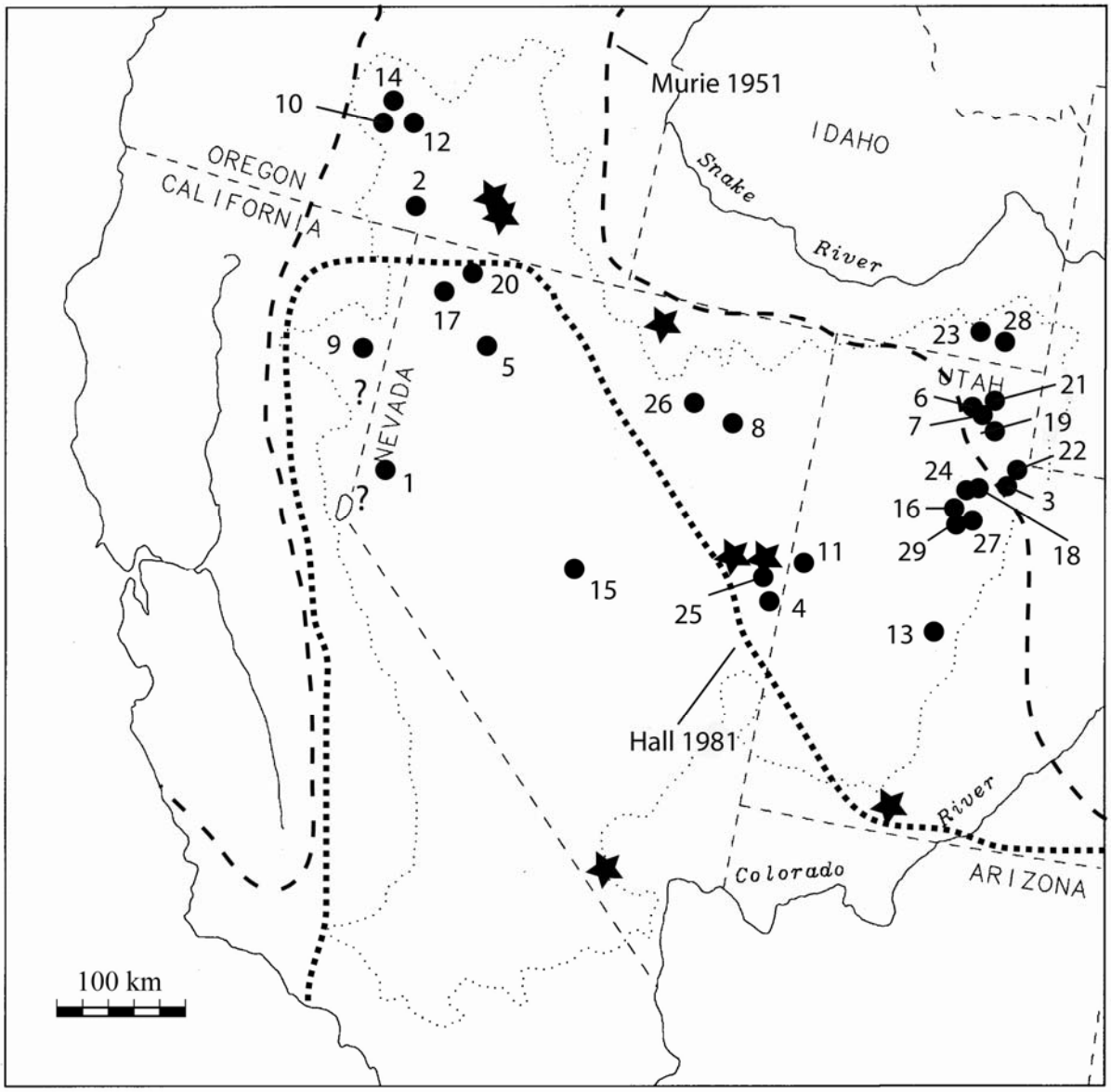

Figure 2. The distribution of Great Basin archaeological and paleontological sites that have provided elk remains. Letters indicate sites (see Table 1 for key); numbers indicate the number of identified elk specimens (in roman type) or the minimum number of elk individuals (in italic type). Stars indicate early historic records (see Figure 1).

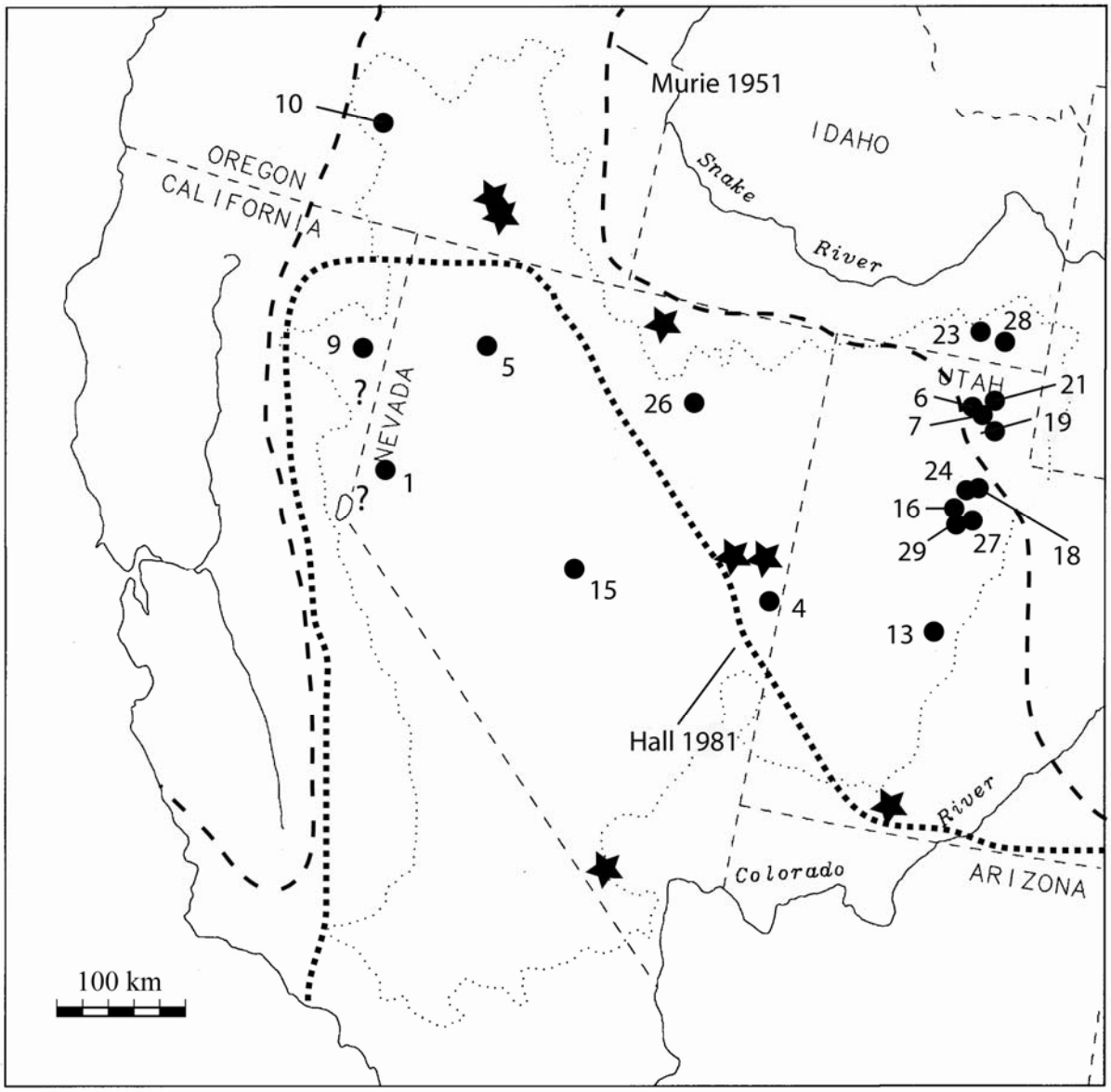

Figure 3. The distribution of Great Basin archaeological and paleontological sites that have provided elk remains and that have been dated to the late Holocene (see Figure 2 for key).

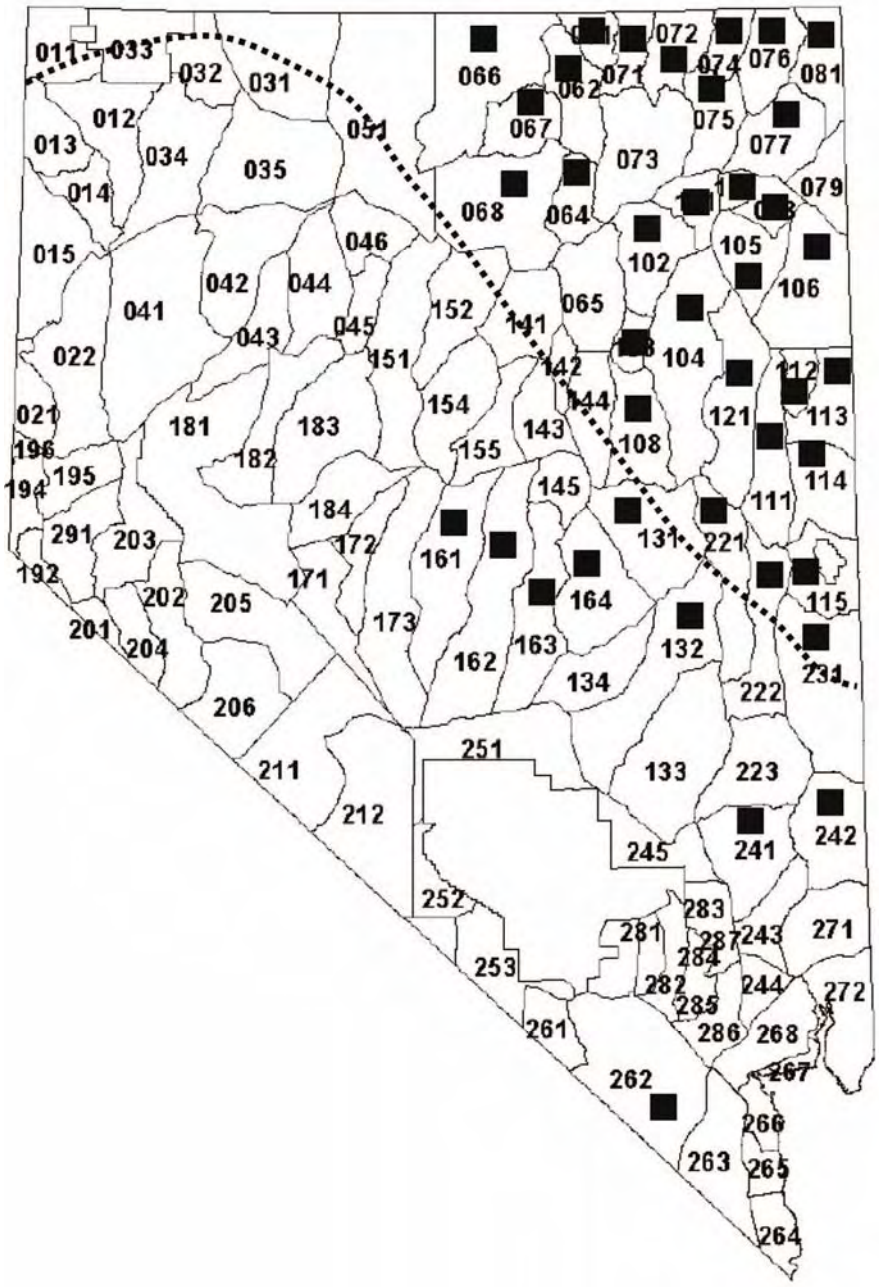

Figure 4. Nevada big game hunting unit management areas, showing those units to which elk have been introduced (black squares). Map modified from Cox et al. (n.d., A-50). Dashed line shows approximate location of Hall's (1981) southern elk boundary in Nevada.

6
Netting, Net Hunting, and Human Adaptation in the Eastern Great Basin

J. M. Adovasio, R. L. Andrews, and J. S. Illingworth

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In the present context, netting denotes a class of open work fabrics built up by the repeated interworking of a continuous element with itself (Emery 1966:30). Netting therefore includes all non-twined, open-textured, single-element fabrics with meshes of fixed dimensions. These meshes may be secured by knots or they may be the product of linking or looping (Emery 1966:30). Nets produced with an open mesh secured by knots may be called knotted netting while knotless netting may be used to designate nets produced by some form of linking or looping (Davidson 1935:117–134; Emery 1966:46).

While netting may be made with elements of animal origin such as skins, intestines, sinews, or hair, the usual medium of manufacture is vegetable fiber, generally in the form of cordage. Netting may be made entirely with the hands alone, which is generally the case in most forms of knotless netting, or a variety of implements may be employed in the production process. These implements range from an unmodified stick, which can be used as a bobbin around which the basic animal or plant fibers may be wound, to quite sophisticated needles, netting shuttles, and spacers or netting meshes (see Maclaren 1955).

THE ANTIQUITY OF NETTING

Recent and still ongoing research on fired clay impressions from the Gravettian sites of Pavlov I and Dolni Vestonice I and II in the Czech Republic provides explicit evidence of the production and use of at least 9 types of cordage and 12 types of textiles and/or basketry by no later than 29,000–24,000 B.P. (uncalibrated) (Adovasio, Hyland, and Soffer 1997; Adovasio, Hyland, Soffer, and Klíma 1998; Adovasio, Soffer, and Klíma 1996; Soffer, Adovasio, and Hyland 1998, 1999; Soffer, Adovasio, and Klíma 1996; Soffer, Adovasio, Hyland, and Klíma 1998; Soffer, Adovasio, Hyland, Klíma, and Svoboda 1998). Significantly, this assemblage also includes the oldest evidence for the production of knotted netting on earth. Additionally, analysis indicates that rather than being unique or precocious technological anomalies, the Pavlov I and Dolni Vestonice I and II specimens have analogs at other Gravettian sites like Kostenki I and Zaraisk in Russia (Soffer et al. 2000), as well as Khosoutsy in Moldova and Mezirich in Ukraine (Adovasio et al. 1992).

Even further afield, plant-fiber-based cordage and/or basketry/textile technology

has also been documented at Ohalo II on the Sea of Galilee (Nadel et al. 1994), Lascaux in France (Glory 1959; Leroi-Gourhan and Allain 1979; Leroi-Gourhan 1982; Soffer et al. 2000), and Gönnersdorf in Germany (Bosinski 1979, 1995; Soffer et al. 2000), all in Upper Paleolithic contexts. Only slightly later, but still of late Pleistocene ascription, evidence of fiber artifact production appears at the threshold of the Bering Land Bridge in the Russian Far East (Hyland et al. 2000; Zhushchikhovskaya 1997). This evidence collectively attests not only to the widespread distribution, if not ubiquity, of early plant fiber-based technology in late Ice Age settings in the Old World, but also corroborates the suggestion made long ago (Adovasio 1970) that such technology was doubtless part and parcel of the armamentarium of the first populations who entered the New World.

PREHISTORIC AND ETHNOGRAPHIC NETTING IN THE GREAT BASIN

Not surprisingly, particularly given its venerable pedigree, netting appears at the beginning of the occupational sequence in the Great Basin. Indeed, the oldest known netting in western North America is from Sand 1, Level I at Danger Cave, Utah (Jennings 1957). This specimen of knotted netting is illustrated and labeled simply as cordage in Jennings (1957:230, Figure 209). It is actually the corner of a net of undetermined shape. The net mesh is constructed with what appears to be two-ply, Z-spun, S-twist cordage. The net uses lark's head knots. The Sand 1, Level I netting fragment dates between 10050 ± 50 B.P. (Beta 169848) and 10310 ± 40 B.P. (Beta 168656) (Rhode et al. 2006). While the specimen is not directly dated and there is some indication of disturbance, this net fragment is probably minimally 10,000 years old. Later levels at the site yielded numerous knotted netting fragments tied with square, sheet bend, and weaver's knots. These net fragments are made from a variety of fibers including dogbane or hemp (*Apocynum* sp.), juniper (*Juniperus* sp.), flax (*Linum* sp.), sagebrush (*Artemisia* sp.), rush (*Scirpus* sp.), and milkweed (*Asclepias* sp.). Few pieces of cordage—and, by inference, netting— from Danger Cave are "large" with the notable exception of a complete casting net of *Apocynum* sp. recovered from Level D III that dates to ca. 5000 B.C. (Jennings 1957:227). The cordage gauge and mesh size of this and most of the other Danger Cave knotted netting specimens suggest that they were used to trap rabbit-sized or smaller game.

Some 80.5 km (50 mi) northeast of Danger Cave, Hogup Cave (Aikens 1970) also produced abundant knotted netting virtually throughout its long occupational sequence. The earliest of the 138 netting fragments from the site are from Stratum III with an

associated date of 6850 ± 200 B.C. (Aikens 1970:29). Unfortunately, knot type is not reported for these or for any of the later specimens at the site. Aikens (1970:125) does indicate that the netting is typically of fine gauge, two-ply cordage with mesh diameters averaging 40–50 mm.

Interestingly, one of the Hogup Cave knotted netting fragments exhibits a very open mesh with an average diameter of nearly 64 mm. This specimen was produced with a shuttle and utilizes rows of sheet bend knots exhibiting alternating knot faces. The specimen is made of unusually small diameter cordage and closely resembles a modern "mist" net. It may have been employed to ensnare bats.

Hogup Cave also produced a spectacular, though undated, complete net measuring ca. 42.7 m (140 ft) in length by 1.2 m (3.9 ft) in width (Aikens 1970:125). The complete Hogup Cave net (Aikens 1970:129, Figure 88) is made of two-ply, Z-spun, S-twist cordage. The ca. 40–50 mm mesh is constructed with fixed knots of unspecified type. Exact provenience of the net in the site is unknown as it was removed by non-professionals. Aikens (1970:125) notes that "when found, the net…was tightly wrapped over two ca. 18 in long, use polished sticks. It has been doubled back and forth across the sticks and then tied with a heavy cord of two-ply, S twisted cordage made of shredded sagebrush bark."

The complete Hogup Cave net is not unlike the remarkable specimen recovered from a small rockshelter in the Sheep Mountain area of Wyoming (Frison et al. 1986). This specimen has been directly radiocarbon dated to 6910 ± 170 B.C. It is a complete rectangular hunting net which, like the complete Hogup Cave net, was found wrapped around sticks, which in this case numbered three. The Sheep Mountain net is also made of two-ply, Z-spun, S-twist cordage but uses juniper (*Juniperus* sp.). The cordage is of variable diameter (0.70–5.20 mm) with a variable mesh gauge ranging 7.1–30.1 mm. Unlike the Hogup Cave net, which was clearly intended for small game, the Sheep Mountain net is interpreted to be the earliest archaeological example of a large-game hunting net from North America.

Another site to produce comparatively early knotted netting is Cowboy Cave (Jennings 1980) on the western edge of the Canyon Lands of the Colorado Plateau province. According to Hewitt (1980), this site yielded 12 specimens assignable to at least 5 types of knotted, generally narrow gauge (average cordage diameter: 1.4 mm; mesh: 40–120 mm) netting made of two-ply, S-spun, Z-twist cordage. Both *Apocynum* sp. and *Asclepias* sp. are reported as raw materials.

Represented knots include sheet bend, lark's head, square, overhand (?), and slip (?). The earliest netting from this site derives from Unit III, Stratum F, which is ca. 5000 B.C. in age (Jennings 1980:24–25). Thereafter, netting (12 specimens in all) occurs sporadically throughout the site deposits. The netting would have been suitable for taking small game.

Comparatively late knotted netting is also known from Swallow Shelter (Dalley 1976) in the Goose Creek-Grouse Creek area of northern Utah, from the Promontory Caves (Steward 1937) on the northern margin of the Great Salt Lake, and from Etna Cave (Wheeler 1973) in southeast Nevada. Swallow Shelter yielded four fragments, possibly from the same net, made of two-ply, Z-spun (?), S-twist cordage of unspecified diameter or raw material. Mesh size and configurations are not identified. The specimen is of Fremont culture ascription (A.D. 830 ± 110) according to Dalley (1976: 20).

The Fremont-age knotless netting fragment from Promontory Cave No. I is described by Steward (1937:35) as made of "...soft fibers, 2-ply-twisted clockwise, each 1/16" in diameter." This specimen is probably a bag fragment, and not a hairnet as proposed by Steward (1937:35).

Etna Cave, in Lincoln County, Nevada, produced three specimens of knotted netting apparently made of narrow gauge *Apocynum* sp. or *Asclepias* sp. two-ply, Z-spun, S-twist cordage tied with sheet bend knots (i.e., weaver's knots). According to Wheeler (1973: 22), mesh size ranges from 32–64 mm. It was thus suitable for taking small game. The specimens are of unknown age but almost certainly are of Basketmaker II ascription.

Elsewhere in the Great Basin, netting is also well documented often in massive quantities but space precludes even a cursory summary of this copious data base. The interested/obsessed reader is advised to consult Andrews et al. (1986) for additional references.

Great Basin Net Hunting in the Recent Past

While the archaeological record of the Great Basin and the Eastern Great Basin, specifically, is essentially mute on the specific techniques and applications of nets in subsistence-related contexts, the ethnographic record of net making and use is fortunately abundant.

Within the Great Basin and Plateau physiographic/cultural provinces, extensive ethnographic data attest to the importance of nets in the procurement of small mammals, specifically the jack rabbit. The gray blacktail

jack rabbit (*Lepus californicus*) inhabited most of the Great Basin excluding portions of Idaho and northeastern Utah (Steward 1938: 38). Due to the jack rabbits' inherent "speed and ability to hide" (Steward 1938: 38) as well as its relatively large size, net drives proved a most efficient means of capture. Indeed, it is not surprising that the use of nets (borrowed from farther south) quickly followed the appearance of jack rabbits in the Promontory Point area of Utah and portions of Idaho (Steward 1943: 267). Rabbit drives (with or without nets) were apparently practiced wherever there were relatively unforested areas and an abundance of rabbits (Steward 1941: 222).

Rabbit nets were often made and owned by men, either individually or cooperatively. The cordage for the nets, however, was sometimes produced by women. Mesh gauges of 5.1 cm (2 in) or less are reported for the Deep Creek Gosiute (Egan 1917: 235-237). Among the Washo (Kroeber 1953: 572), a mesh gauge of 7.6 cm (3 in) is recorded while the Surprise Valley Paiute (Kelly 1932: 88), Promontory Point Shoshone, Deep Creek and Skull Valley Gosiute (Steward 1943: 267) are said to have used meshes approximately the size of a rabbit's head. Generally, such rabbit nets were constructed of hemp (*Apocynum* sp.), milkweed (*Asclepius* sp.), sagebrush (*Artemesia* sp.) or juniper (*Juniperus* sp.) fibers using overhand, square and weaver's knots.

Net owners among most Basin-Plateau groups were usually males of unspecified status; however, among the Grouse Creek (Steward 1938: 176), Beatty and Belted Mountain Shoshone (Steward 1938: 98) only elderly males owned rabbit nets. Virtually every Washo (Downs 1966: 27) and Deep Creek Gosiute (Egan 1917: 235-237) family owned one or more nets, and nearly every male of the Pyramid Lake and Fallon Paiutes owned a net in the "old days" (Lowie 1924: 198).

Single rabbit nets could be used for small catches throughout the year by individuals or family units. In fact, only individual nets were used by the Kaibab Paiute (Sapir 1910: 70). Net hunting was most productive, though, when individual nets were joined together during cooperative hunts at which kills of up to 400 to 500 rabbits per day have been reported (e.g., Washo; Lowie 1939: 327).

Communal rabbit drives took place at slightly different seasons among certain tribes, but tended to cluster in the fall and winter. Fall drives were usually correlated with the pine nut harvest among the Washo (Downs 1966: 27), Nevada Shoshone (Steward 1941: 222), and the Beatty and Belted Mountain

Shoshone (Steward 1938: 97). They might also be conducted specifically during the fall festival among the latter two of these groups (Steward 1938: 98), as well as among the Deep Springs Paiute (Steward 1938: 60) and the Fish Lake Valley Paiute (Steward 1938: 66). Rabbit drives were associated with the performance of the circle dance among the Fish Springs and Fish Lake Valley Northern Paiute (Steward 1941: 222). In the fall, rabbits were particularly plump from summer feeding and proved a valuable food source.

Winter drives (e.g., among the Washo, Price 1962: 42 and Southern Paiute, Kelly 1964: 50) were probably conducted to take advantage of the maturation of fine rabbit pelts used in making winter blankets and to obtain additional meat stores after the conclusion of summer fishing and gathering (Price 1962: 42). The Surprise Valley Paiute (Kelly 1932: 88), Honey Lake Paiute (Riddell 1960: 38) and Battle Mountain Shoshone (Steward 1938: 163) conducted drives throughout the fall and winter seasons. These could last from as little as one-half day among the Gosiute (Malouf 1974: 49) to as much as one month among the Death Valley, Morey and Hamilton Shoshone (Steward 1941: 273). Such drives involved cooperative effort among as few as several families (Deep Creek Gosiute; Egan 1917: 235-237) or as many as a maximum of 40 people among the Battle Mountain Shoshone (Steward 1938: 163).

Width of individual rectangular nets measured from 0.6 m (2 ft) among the Surprise Valley Paiute (Kelly 1932: 88), Little Lake and Koso Mountain Shoshone (Steward 1938: 82) to 1.2 m (4 ft) reported for the Washo (Lowie 1939: 327), Lemhi and Fort Hall Shoshone (Steward 1943: 267) and the Bannock Northern Paiute (Steward 1943: 267). Net length ranged from 3.1 m (10 ft) for the Small Creek Shoshone (Steward 1941: 329) to 182.9 m (600 ft) among the Battle Mountain Shoshone (Steward 1941: 329) and Mill City Northern Paiute (Steward 1941: 329). Over time, the length of Washo nets gradually increased (Price 1962: 42).

The manner in which nets were employed also varied from group to group. A single Gosiute net could be stretched across a rabbit trail (Malouf 1974: 21) or, as among the Duckwater Shoshone, combined with a maximum of 20 to 30 others (Steward 1941: 239). The shape which the net enclosure assumed could be a straight line (e.g., Northern Paiute, Anell 1969: 45; Deep Springs Valley, Fish Lake Valley, Little Lake and Koso Mountain Shoshone, Anell 1969: 46; Surprise Valley Paiute, An ell 1969: 47), a straight line with "crooked" ends (e.g., Washo, Lowie 1939: 237; Southern Paiute, Kelly 1964: 50), "U"-shaped (e.g., Gosiute, Malouf 1974: 21), semi-circular to circular (e.g., Owens Valley Paiute, Steward 1933:

253; Steward and Wheeler-Voegelin 1974: 136; Northern and Gosiute Shoshone, Steward 1943: 267; Southern Paiute, Kelly 1964: 50; Surprise Valley Paiute, Anell 1969: 47) or rectangular (e.g., Pyramid Lake and Fallon Paviotso, Lowie 1924: 198). Some groups constructed "V-shaped wings" or funnels (Egan 1917: 235-237) of either two extra nets (e.g., Deep Creek Gosiute, Egan 1917: 235-237) or sagebrush (Artemesia sp.) fences at the opening of the net corrals (e.g., Lemhi, Fort Hall and Promontory Point Shoshone, Steward 1943: 267; Bannock Northern Paiute, Steward 1943: 267). The Deep Creek Gosiute (Egan 1917: 235-237) sealed in their rabbit prey by drawing in the V-shaped wings at the entrance of the impoundment.

Among the Nez Perce "Lines of men and boys were stretched out in a long line leading to a net like a seine which was set up on poles and which ended in a corral" (Spinden 1908: 214). The Washo (Lowie 1939: 327) sometimes used two intersecting nets set at an angle.

Individual nets were either joined together with knots, juxtaposed on stakes or simply held by elderly males (e.g., Owens Valley Paiute, Steward 1933: 253). Single nets were sometimes suspended from understory vegetation (e.g., Washo, Lowie 1939: 327; Walker River Paiute, Johnson 1975: 11).

Additional vertical stability for hunting nets was attained among some groups by using small sticks positioned along the length of the net at intervals; these were not implanted in the ground (e.g., Washo, Price 1962: 42; Little Lake and Koso Mountain Shoshone, Steward 1938: 82; Nevada Shoshone, Steward 1941: 329; Honey Lake Paiute, Riddell 1960: 38). Riddell's (1960: 38) informant reported that these sticks served as a type of trigger mechanism for nets supported on stakes; when displaced, they caused the net to fall, thus entangling the rabbits. The Promontory Point Shoshone draped nets over stakes so that they would collapse onto the prey when triggered by a line.

The organization of a rabbit drive varied throughout the Great Basin and contiguous areas. Drive leadership might be provided by a hereditary(?) rabbit chief (e.g., Washo, Lowie 1939: 327), by functionaries variously termed district chiefs or headmen, a rabbit drive chief or a rabbit hunt director or leader known as poinabi (e.g., Battle Mountain Shoshone, Steward 1938: 163; Steptoe Valley Shoshone, Steward 1938: 122; Owens Valley Paiute, Steward 1933: 253; Southern Paiute, Kelly 1964: 51; Walker River Paiute, Johnson 1975: 11). Net drives also could be organized by one or several net owners (e.g., Little Lake and Koso Mountain Shoshone, Steward 1938: 83) or by a

competent hunter (Northern Paiute, Steward 1941: 329; Surprise Valley Paiute, Kelly 1932: 88).

Rabbit drive "beaters" included groups of adult males (e.g., Little Lake and Koso Mountain Shoshone, Steward 1938: 83; Beatty and Belted Mountain Shoshone, Steward 1938: 98; the Nevada Shoshone in general, Steward 1941: 222; Southern Paiute(?), Kelly 1964: 50-51; Skull Valley Gosiute, Steward 1943: 267; Owens Valley Paiute(?), Steward 1933: 254; Pyramid Lake and Fallon Paviotso, Lowie 1924: 198), men and women (e.g., Surprise Valley Paiute, Kelly 1932: 88), women and children (e.g., Northern Paiute, Anell 1969: 45), boys and girls (e.g., Grouse Creek Shoshone, Steward 1943: 267) or a group of unspecified composition, probably men, women and children (e.g., Washo, Downs 1966: 27; Honey Lake Paiute, Riddell 1960: 38; Walker River Paiute, Johnson 1975: 11; Deep Creek Gosiute, Steward 1943: 267).

The Surprise Valley Paiute (Kelly 1932: 88) drove rabbits into the waiting net one or two at a time. Rabbits driven toward the net(s) might also be shot with bow and arrow (e.g., Southern Paiute, Kelly 1964: 51; Washo, Lowie 1939: 327 and Price 1962: 42). They could also be plucked from their holes with sticks (e.g., Washo, Price 1962: 42) or killed at the net using various techniques that varied from group to group. These included clubbing, strangling, neck wringing, stroking the sides strongly between the thumb and forefinger until the heart burst (e.g., Kaibab Paiute, Sapir 1910: 70), pressing the soft spot on the rabbit's head, crushing the temples or grabbing the hind legs and hitting the head on a stump or log.

The "net-side executioners" included net owners (e.g., Washo, Price 1962: 42; Owens Valley Paiute, Steward 1933: 253; Little Lake and Koso Mountain Shoshone, Steward 1938: 83), "a boy" (e.g., Washo, Lowie 1939: 327), unspecified males (e.g., Honey Lake Paiute, Riddell 1960: 38; Northern Paiute, Anell 1969: 45) or girls (e.g., Surprise Valley Paiute, Kelly 1932: 88). Once rabbits were impounded inside the net corral of the Deep Creek Gosiute, the beaters themselves dispatched the animals (Egan 1917: 235-237). Rules by which prey was divided also varied widely from group to group.

The net drive was certainly not the only method used to capture rabbits in and near the Great Basin. They also were driven into brush corrals, lured with whistles and "kissing sounds" (Riddell 1966: 38), hunted with bow and arrow, pulled from burrows with a stick, dispatched with clubs, surrounded by fire or by groups armed with clubs, simply run down on foot or taken with

a variety of traps such as the noose snare. Some tribes or tribal divisions also used a diminutive bag-like net secured over a rabbit's burrow (Fowler and Fowler 1971: 48) or arranged along their runs in the snow (Anell 1969: 47).

Among the groups previously discussed, only a very limited range of small animals other than rabbits was procured by net hunting. Sage hens were netted (sometimes using old rabbit nets) by most Nevada Shoshone (Steward 1941: 222), Northern and Gosiute Shoshone (Steward 1943: 267), Northern Paiute (Stewart 1941: 368) and Uintah Ute (Smith 1974: 60).

NETTING IN THE DESERT SOUTHWEST

As in the Great Basin, groups in the American Southwest also conducted communal rabbit drives. This is recorded for certain groups of Hopi (Strong 1979: 403; Bodine 1979: 265) and Zuni (Schroeder 1979: 252). Although communal rabbit hunting is and was a vital part of the economic, ritual and to a lesser extent political structure of pueblo life, the hunting net was not a technological component of these drives. The preference here appears to have been for labor-intensive communal drives employing the rabbit stick. Hunting nets are not documented for other pueblo groups, nor for the Navaho, the Havasupai, Papago, the Cocopa or any Apachean groups except the Llanero (Anell 1969: 47; Spier 1928: 112, Note 1). The Walapai, Maricopa and Mojave apparently also used nets to take rabbits, but most of these appear to have been bag-like in appearance (Anell 1969: 47).

Archaeological data from dry caves and rockshelters in southeastern Arizona and southwestern New Mexico (Kaemlein 1970), however, do document the use of large hunting nets in the later prehistoric Southwest. Among these, Cummings (1953) records the recovery of net fragments from Nitsie Canyon in northern Arizona, and there are two fragments of yucca nets (possibly from the same net) from this cave in the collections of the Arizona State Museum (Kaemlein 1971: 48, Table O). Guernsey and Kidder (1920) describe a 73.2 m (240 ft) long and 1.1 m (3 ft 8 in) wide Apocynum sp. And human hair hunting net from White Dog cave, also in northern Arizona. Attached to this 12.7 kg (28 Ib) net are possible amulets in the form of an olivella bead, stone beads, feathers and the paw of a small animal (Guernsey and Kidder 1921: 77). Cave 10 (Guernsey and Kidder 1921) and High Cave (Guernsey 1931) are two other northern Arizona caves to produce archaeological examples of hunting nets. The single fragment reported from High Cave is especially interesting since it is composed of both yucca and human hair.

In central Arizona, Clarkdale Cave produced an 81.3 cm (32 in) long by 66 cm (26 in) wide fragment of a yucca net that was found covering a cache of yucca quids (Kaemlein 1971: 48, Table 1). An agave (*Agave parryi*) net fragment is known from Montezuma Castle, also in central Arizona (Kent 1954).

Various small fragments of nets were recovered from Ventana Cave (Haury 1950) in southern Arizona which are made of yucca and utilize sheet bend knots (Emery 1966: 38). Indeed this knot type seems to predominate in the archaeologically known hunting net specimens from the Southwest. Square knots and weaver's bend knots, however, are also found.

Kaemlein (I971) offers some of the only comparative qualitative and quantitative data on hunting nets from this area. She describes five hunting net specimens or net fragments in the collections of the Arizona State Museum, four of which are made of yucca. The fifth net, from the Baboquivari area, is of human hair (Birkby 1971) which Kaemlein (I971: 38) estimates would have required 99 heads of hair to fabricate. This distinctive net is similar in many respects to another human hair hunting net reported from U-Bar Cave in southernmost New Mexico (Lambert and Ambler 1961) though the U-Bar Cave net utilizes square knots rather than the sheet bend and weaver's knots found in the Baboquivari net. The former net is also of more regular construction, shows no evidence of having been used and is shorter but wider and lighter than the Baboquivari net (Kaemlein 1971: 38).

Two of the five Arizona State Museum net specimens discussed by Kaemlein (1971), that from Chevlon Creek Cave just southwest of the Little Colorado River, and that from Cave Creek near the southeast corner of Arizona, are of special interest for the interpretation of the Sheep Mountain net since they contain wooden objects associated with their manufacture or use. These artifacts include an eyed netting needle (Chevlon Creek) and a bundle of 27 wooden stakes from Cave Creek that were probably used to support the net in a free-standing position. Two of the wooden stakes from Cave Creek are nocked at one end but show dull points at the opposite end. Either the mesh of the net or the foundation cord probably rested in the nock of the stakes (not unlike a bowstring fits the nock of an arrow). The opposite or pointed end of the stake was probably stuck in the ground. It is conceivable, however, that the Cave Creek net support mechanism may have been designed to allow the net to collapse on top of game driven against it in the manner that nets are said (Anell 1969: 46) to have been used, as

noted above, by the Promontory Point Shoshoni and the Honey Lake Paiute (Riddell 1960:38).

NETTING IN CALIFORNIA

West of the Desert Southwest and the Great Basin, rabbit nets are, not surprisingly, well-represented in contiguous portions of California. Drucker (1937: 7) observes that rabbits were driven into long (rectangular?) nets among the Serrano, Desert, Pass and Mountain Cahuilla, the Luiseno, Mountain, Western and Desert Diegueno and the Chemehuevi. The Desert, Pass Cahuilla, Luiseno, Mountain, Western and Desert Diegueno and the Chemehuevi (Drucker 1937: 7) also used shorter nets of unspecified shape in rabbit hunting. None of these southern California groups took other terrestrial or avian fauna with nets (Drucker 1937: 7).

According to Anell (1969: 37), the Modoc netted rabbits in bird nets. The Nomlaki, Wintun, Achomawi and Atsugewi drove them against long nets. Other northern California tribes did not employ nets for rabbits or birds(?) although several Pomo groups, the Mountain and Foothill Nisewan, the Foothill and Valley Maidu and the Hill and River Patwin did (Anell 1969: 37).

In the Central and Southern Sierra Nevadas, Driver (1937: 61) states that two groups of Western Mono ensnared rabbits with long nets as did at least two Yokut groups. Driver (1937: 11) further indicates that the Kern River Bankalachii, Tuba Tulabal and Ute-Chemehuevi-Kawaiisu hunted rabbits with nets as did the Yokut, Panamint and Owens Valley Paiute. Several of these groups also took quail (Mono, Yokut, Ute-Chemehuevi-Kawaiisu) as well as ducks or geese (Western Mono, Yokuts) with nets.

Some Central Sierran populations used long nets for rabbits and/or quail. The Yokut of the Valley Speech division as well as the Northern Miwok net hunted rabbits and quail; the Mono and Plains Miwok may also have taken both species with nets (Aginsky 1943: 396). A number of Central Sierran groups (e.g., Yokuts of Valley Speech division, one Mono group and the northern Miwok) also set out nets of unspecified shape to drop over springs or ". . . near low water where birds drink" (Aginsky 1943: 396). Drop nets may also have been known by the Plains Miwok.

NETS AND THE HUNTING OF LARGE GAME

In marked contrast to the abundant references to the hunting of small game,

particularly rabbits, with nets, documented ethnographic occurrences of the capture of large land mammals with this method are not numerous in the anthropological literature, yet neither are they as scarce as might first be thought. Coon (1971: 98), for example, indicated that he could find only three documented cases of "net hunting for land animals worldwide." (Presumably, he meant larger land animals and not rabbits.) One can complement Coon's (1971) three examples with certain of the native Californian groups discussed previously as well as with some interior Salish tribes of the Plateau.

Coon's (1971) three examples of net use are, nonetheless, instructive in attempting to understand the wider implications of this hunting technique. These cases include the Australian aborigines from one heavily forested portion of Queensland, certain branches of the Mbuti Pygmies of the Ituri forest and the Birhor of the Chota Nagpur plateau in the Indian state of Bihar. In the case of the aborigines, Coon (1971: 98) found that he could give neither "details nor verification" save for the report that these people were using nets to capture wallabies "nearly a century ago."

The Mbuti Pygmies use nets approximately 1.2 m (4 ft) wide and 30.5 m-91.4 m (100 ft-300 ft) in length (Coon 1971: 99); they obtain at least some of these nets from neighboring Bantu tribes, who also are part-time net hunters (Coon 1971: 98-99). Between seven and 30 nets may be set up in a semi-circle tended by men; older men are positioned toward the center of the net, younger ones at the net margins. Once the nets and hunters are in place, women drive the game toward the nets, and the hunters wait with spears or with bows and with arrows tipped with the poison stropanthus (Coon 1971: 100).

The Birhor of the Harzibagh District of India (Williams 1974) are a nomadic people who live on a high, rocky plateau above the Gangetic Plain that is covered with thick scrub forest. Formerly, they hunted langurs and macaques by trapping them with nets. Both animals were hunted for food, and at least the langur was important for its hide which was traded to Ghasi drum-makers (Williams 1974: 84). *Cervus muntjac*, the small barking deer also was formerly hunted with nets. Coon (1971: 102) adds the sambur deer (*Cervus unicolor*) and the axis deer (*Cervus axis*) to the Birhor's netted prey. Both the deer and monkey populations, however, were severely depleted by the time of Williams' (1974) field work; these animals were then taken in only limited numbers. The primary netted game at that time was the hare, which was often captured alive and traded to neighboring villages in exchange for rice (Williams 1974: 84).

The nets of the Hazaribagh District Birhor are made from cordage fashioned from the inner bark of trees of several species as well as the lama vine (Williams 1974: 84). They are 10 m-18 m (32.8 ft-59.1 ft) in length, usually about 1.5 m (ca. 5 ft) in width and are designed to fall on the prey which is driven into them. Net cordage fibers are soaked in mud to darken them. When the completed net is arrayed, visibility of the dark cords is diminished (Williams 1974: 85). The stakes which support the nets are light in weight and engage the foundation cord at the top of the net. Hunting takes place primarily in the dry season of the year (February through May).

In North America, ethnographic accounts of the hunting of large land mammals with the aid of nets are few, geographically restricted, and quite removed from the eastern Great Basin. The practice is documented among certain tribes of California and interior Salish tribes of the Plateau in British Columbia (Anell 1969: 36,45). None of the southern California tribes used nets to take deer (or anything else of comparable size), but the practice is known for both the Central and Southern Sierra Nevadas. According to Driver (1937: 61), two groups of Western Mono and two groups of Yokut took deer with long nets. Aginsky (1943: 396) records that the Valley Speech division Yokut and perhaps also the Western Mono and Plains Miwok hunted deer using nets. Other documented California tribes known to have used the net in deer hunting include the Atsugewi, Foothill Maidu, Klamath, Nomlaki, Hill Wintu of Paskienta, Yokaia Pomo, Kabedile and Mukanno Porno, Patwin, the San Joaquin River, Choinimni and the Kocheyali Yokut (Anell 1969: 31, 36-37). The last three Yokut groups drove deer against long, rectangular nets as did some groups of Western Mono. Interestingly, the Koi band of Porno are said (Anell 1969: 37) to have taken elk and even bear with nets used in combination with snares.

In the Western Plateau country where rabbit nets are sparsely represented (e.g., Umatilla, Tenino), hunting nets toward which larger game were driven are reported for the Klikitat and Umatilla (Anell 1969: 31). Some ethnographic particulars are available on large-game net hunting among several of the groups noted above (i.e., the Hill Wintu of Paskienta, Miwok, Klamath and Nomlaki, Anell 1969: 36), documentation, however, is rare. Don Tuohy (personal communication 1984) has observed that netting of larger land animals was also practiced in Baja California, but published ethnographic descriptions of the practice in this area have not been identified.

One of the few ethnographic accounts of net hunting for deer is given by J. A. Teit (1900) in his description of the Thompson

Indians of the Fraser, Thompson and Nicola river valleys of British Columbia (Teit 1900: 167). The practice apparently had died out by the time of Teit's visit at the end of the 19th century (Teit 1900: 248) for he speaks of it in the past tense. The Thompson Indians were known to the Hudson Bay Company as the Couteau or Knife Indians (Teit 1900: 167). Those on the Upper Thompson River had no knowledge of the Coastal Salish, who also hunted deer (but not with nets) and among whom nets of any kind were few (Barnett 1955). The Thompson Indians' nets were made of Indian hemp (*Apocynum cannabinum*); they were 13.7 m-182.9 m (46 ft-300 ft) in length and ca. 2.1 m (7 ft) wide with large meshes. Teit 1900: 248) specifically ascribes this method of hunting to the Spences Bridge and Nicola bands of the Thompsons. The nets were set out in the evening (no doubt a factor in making the nets less visible to the game) in "open patches, between clumps of bushes" and across deer trails (Teit 1900: 248). The next morning often found deer within the net corral; these were then shot with arrows by hunters who entered the enclosure. The hunters sometimes drove the animals already impounded by the enclosure into the nets to entangle them. Animals also could be driven into the net enclosure ". . . by men, women, and children who formed a large half-circle, and gradually drove towards the entrance of the net" (Teit 1900: 248).

Net hunting for larger land animals was also particularly well-developed among the Okanagon who bordered the Thompson Indians on the southeast. Although nets were often used, the Okanagon hunting repertoire included a variety of other techniques such as "still hunting," hunting with dogs, driving to bay, driving to streams, drives into corrals, snaring, the use of calls and disguises, drives over cliffs, shooting from trees and pits, etc. (Teit 1930: 243). The Okanagon hunted deer and sheep in the spring of the year; a longer (up to two months) late fall hunt was held for both of these animals in addition to elk. In mid-winter, a deer hunt took place, and a sheep hunt occurred in late winter (Teit 1930: 243). When out from camp, hunting parties often carried nets ". . . for corralling deer in bushy parts of the country" (Teit 1930: 245). The net method was particularly effective for capturing white-tailed deer (*Odocoileus virginianus*) which could not jump as high as mule deer (*Odocoileus hemionus*) and were therefore more likely to be restrained by the nets (Teit 1930: 246). Teit's (1930: 245) account of an Okanagon deer hunt using nets is an excellent description of how the net was employed.

If fresh tracks were seen entering a clump of bushes, nets were set in the surrounding woods in the form of a half-moon, or sometimes, if it could be managed, in a circle. The shape and size of the corral

varied according to the size of the area to be set, the arrangement of the bush patches, and the number of nets at hand. They were stretched across the open glades, the ends being fastened to trees and bushes. In places where the open ground was wide, and the net could not be drawn tight enough, the middle parts where the net sagged were held up and kept taut with light poles placed at intervals. Any space left open, owing to shortage of nets or because too inconvenient to be closed, was guarded by two men with bows and arrows, concealed one at each side. If no men were available, a woman lay down in the center of the opening, and if the deer approached, she jumped up and shouted, thus driving them back. The places where deer were most likely to run were netted first. When all was ready, one or two hunters entered the corral and started the deer out of the bushes. Sometimes this was done with dogs. The hunter let them loose on the fresh scent, and followed them on the run; or he simply let them go and remained at the opening of the corral. The other people hid here and there a short distance away. As soon as a deer was caught in the nets, they clubbed, speared, or shot it. In daylight, and when not too much rushed, deer sometimes did not attempt to pass through the nets, but ran around the corral until they came to the opening, where they were shot by the hunters.

Not all of the-Salish neighbors of the Okanagon and Thompson Indians used nets in the hunt, however. The Lillooet, to the west of the Thompson Indians, occasionally bought nets from the Thompsons ". . . but merely for the bark twine contained in them" (Teit 1905: 226). Similarly, the Shuswap, located north of the Thompson Indians are said (Teit 1909: 521) to have employed all of the hunting methods of the latter except the deer net. Nevertheless, the Shuswap did construct deer corrals built out into a body of water. These had chute-style exits blocked by bag-like nets "in which the deer often became entangled" (Teit 1909: 522).

The Coeur d'Alene were another Plateau group that did not employ the deer net (nor pitfalls or corrals), and the Flathead were said to have been able to obtain a sufficient meat supply by solitary hunting so that its use was unnecessary (Teit 1930: 104, 130).

Teit (1930: 347) infers that the Blackfoot (with whom, among other Plains tribes the Plateau groups maintained trading relationships after the introduction of the horse) may at one time have used nets as well as corrals and pounds; at least Teit's Plateau informants believed this to be the case.
The Blackfoot, and some other tribes to the north and west, were known to employ some or all of these methods; but it is thought this

must have been because game was scarcer in their countries, or harder to hunt.

Wissler (1910), however, does not include nets as a documented hunting technique for the Blackfoot; he mentions only the use of snares for deer and smaller game (Wissler 1910: 38). Textiles as a whole were few among the Blackfoot of the Piegan and Blood divisions studied by Wissler (I 910); however, there is a faint reference to the former making of bark cordage (Wissler 1910: 53). Obviously, one of the overwhelming effects of the introduction of the horse was to obliterate reliable evidence for previous hunting techniques (Wissler 1910: 41).

It is difficult to determine what may have caused the deer net to fall out of use with the Thompson Indians, an event that apparently occurred well before Teit's contact with them; however, the advent of firearms and the horse (an 18th century introduction to the Plateau tribes which was first used as a source of food), the concomitant rearrangement and extension of trade routes as well as alterations in hunting techniques (Teit 1930: 250-251) may have played a significant part. Horses came to the Okanagon by way of the Columbia, Sanpoil and Colville Indians. The earlier trade routes moved north through the Lake Okanagon territory to the Shuswap and thence south again to the Thompson Indians (Teit 1930: 252). After the arrival of the horse, the Thompson Indians became a more direct trading partner than the Shuswap, and the focus of culture contact switched east from southern Columbia and The Dalles toward the Plains. This helps to explain the introduction of trade goods from the Nez Perce and other Plains groups such as the Blackfoot into the material culture of the Plateau Salish tribes. Indian hemp (*Apocynum cannabinum*) as well as the cordage manufactured from that raw material was an important element in this increasingly active trade arrangement (Teit 1930: 254-255). It is therefore conceivable that the horse may have contributed to the demise of Plateau net hunting in two ways, i.e., by introducing a new method of individual and small-group hunting and by facilitating increased long-distance trade in both hemp and cordage, the raw materials of netting. The disappearance of the California hunting net for larger game may well be due to contact-related stresses with concomitant disruption of aboriginal subsistence strategies.

OVERVIEW

The archaeological an ethnographic data summarized above indicate that the production of nets and net hunting have been a vital part of Great Basin lifeways for the duration of human occupation of this vast area, as well as for many other groups. This elemental fact is eminently verifiable in the

recent past and the ubiquity and quantity of nets in the archaeological record coupled with an abundance of faunal remains of small to medium-sized animals at virtually all net-yielding sites provides a conclusive "signature" for net hunting in the past.

The reasons behind or underlying the long persistence of this techno-behavioral complex are much less obvious than its sheer existence. When viewed from a cost/return perspective, the "price" of net making and net hunting appears to be formidable, as the following points illustrate.

1. Net making and net hunting is very labor-intensive compared to the stalking of game by solitary hunters or small groups of hunters. Indeed, the production of even relatively small nets can require weeks of labor, while the manufacture of large nets like the remarkable and complete specimen recovered in a Basketmaker II context from White Dog Cave in northern Arizona would have taken months of intensive work. According to Gurnsey and Kidder (1921:77–78), the White Dog net, described above, employed 19,587 ft or 3.75 miles of cordage with more than 30,000 knots.

2. Additionally, as detailed earlier, net drives with large or small nets require increased co-operation among a large group of individuals. The actions of those who operate the nets must be carefully coordinated with the actions of those who drive the game where this common variation of net hunting is practiced. After capture, the entrapped game must then be dispatched and processed. The size of some of the ethnographically documented kills or harvests suggests that this part of the process was no small task.

Though prohibitive, the costs of net hunting are substantially outweighed by the following returns.

1. Nets are far and away the most effective technique for harvesting game in areas of moderate and low vegetation cover, which abounds in many parts of North America such as the Great Basin. This cover reduces the visibility of individual game to the solitary hunter, but it also reduces the visibility of the nets to the prey.

2. Nets function in the converse of individual hunting—that is, game comes *to* the hunter who employs a net. Nets also retard the probability of game flight and sharply increase the chances of a successful short-range kill in what is potentially the maximum number of animals within the hunt area. Time and energy-consuming (and potentially fruitless) pursuits of wounded animals are thereby avoided. Put most simply, hunting with nets turns the flight response of animals to the best advantage of the hunters.

3. Hunting with nets , as opposed to solitary hunting, may increase dietary diversity. Although rabbits, hares, and animals in the 3–20 kg range are the usual target of nets, smaller game (including insects, bats, and birds) as well as much larger game (like deer and mountain sheep) have been taken with nets (Andrews and Adovasio 1980; Frison et al. 1986). Additionally, with groups of "hunters" spread over a wide area, the potential of encountering other edible foodstuffs, including plants, is also sharply enhanced.

4. The effect of net hunting is not unlike that of brush corrals or impoundment areas fenced with other, more permanent materials. Netted animals, however, cannot be impounded for extended periods of time. The portability of the net is probably its greatest asset. A poor catch using a permanent corral can only be compensated for by expending time and energy to build another corral in another area or by waiting until game is once again plentiful near the corral. The wonderful simplicity of a net is that it can be dismantled easily, carried to another hunting area, and again erected.

5. More basically, net hunting is a *communal* effort which because of the relative lack of *individual* expertise necessary for success as well as the minimal physical danger involved in such a non-confrontational harvesting technique can and does utilize the labor of the *entire* co-residential social unit (Satterthwait 1986, 1987; Steward 1938; Turnbull 1965; Wilke and Curran 1991). Not surprisingly, it is, in fact, the *one* hunting method strongly associated with the labor of females, juveniles, and the old of both sexes (Murdock 1937; Murdock and Prevost 1973).

6. Finally, net hunting is often associated with mass harvest in very short periods of time and, thus, with the production of surplus (Satterthwait 1986, 1987). Although such surplus in some non-North American ethnographic cases is associated with a market economy (e.g., the Ituri Forest pygmies [Wilkie and Curran 1991]), in several Great Basin cases, again as noted earlier, it is associated with and facilitates large gatherings, feasting, and ceremonialism (Andrews et al. 1986).

Considering the advantages or benefits outlined here, the ubiquity and persistence of net making and hunting in places such as the Great Basin becomes eminently more understandable, if not explainable. Indeed, it is suggested in closing that this techno-complex and attendant behavioral suite was as important and vital an adaptation to the rigors of Great Basin life as the much more often discussed harvesting, parching, grinding, and preparation of small seeds or the gathering and processing of pine nuts.

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This contribution is based in part on two unpublished manuscripts (Adovasio 1973, Andrews et al. 1985). The late R. L. (Rhonda) Andrews was one of the foremost students of prehistoric plant-fiber artifacts from the Great Basin, specifically, and North America, generally. More germane to this context, she was friend, colleague, and collaborator with Don and Kay Fowler. Rhonda would have been proud to contribute to this volume. The manuscript was edited by D. R. Pedler.

7
Recent Advances in Great Basin Textile Research

Eugene M. Hattori and Catherine S. Fowler

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Early Holocene textiles from the Great Basin exhibit surprising variety and a high degree of technological and aesthetic sophistication that went largely unrecognized until relatively recently. The majority of these specimens were recovered between 1940 and 1960. Many of these specimens were previously reported but rarely dated because to do so would have consumed much, if not all, of the specimen. In some instances, however, direct conventional radiocarbon dates were obtained on fragmentary textiles which necessitated consuming an entire fragment or consuming multiple fragments from several different artifacts for a single, average age determination (Hattori 1982, table 2). Textile age assignments based on dated stratigraphic associations are fraught with potential errors caused by bioturbation of the highly organic deposits frequently found in dry caves and shelters in the Great Basin.

AMS (Atomic Mass Spectrometer) dating, developed in the 1980s, permits direct dating of a textile while conserving its integrity, thus allowing us to assess it within an accurate chronological context. Successful age determinations for textiles are now routinely obtained on samples weighing less than 20 mcg and as little as 3 mcg, a far cry from the 3 to 5 gm for conventional radiocarbon dating.

Much of the research on early textiles is only known to a small cohort of textile specialists. This overview is an attempt to summarize a portion of our findings for a broader audience, as the data have important implications on prehistoric cultures that extend well beyond their textile assemblages.

PREVIOUS AND CURRENT TEXTILE RESEARCH

Pioneering research by Cressman (1942), Rudy (1957), Rozaire (1969, 1974), Adovasio (1970a, 1970b, 1977, 1986) and others, greatly facilitated our research through their thorough technological analyses, photographs, illustrations, and comparisons. They were constrained in their interpretations by lack of a chronological framework based upon directly dated textiles. In some instances, their reliance on associated stratigraphic dates led to errors in interpretation. (Connolly et al. 1998). Our contributions are largely derived from direct dates obtained on many of the artifacts that they described.

An informal group of researchers including William J. Cannon, Lakeview, Oregon, BLM District; Thomas J. Connolly, Oregon Museum of Natural History;

Catherine S. Fowler, University of Nevada, Reno; Susan McCabe, Nevada BLM; Eugene M. Hattori and James P. Barker, Nevada State Museum; Edward Jolie, University of New Mexico; and James M. Adovasio, Mercyhurst College have undertaken AMS dating and systematic analysis of archaeological textiles. In particular, the Lakeview District BLM has specifically supported dating archaeological textiles in order to provide regional chronological baselines applicable to the prehistory of the northern Great Basin. All ages in the following sections are presented in uncalibrated radiocarbon years B.P., but calibrated ages are presented in Table 1.

TEXTILES AS CULTURAL MARKERS

Textiles are sensitive cultural markers, especially given the potential for directly dating the artifact and sourcing the region of origin for the plant fibers (Benson, et al. 2006). Textile manufacture is an additive versus reductive (lithics) technology where one or more types of plant fibers are plaited (plain weave), twisted (twined), and/or sewn (coiled) together to produce an object with specific form and function. Additionally, some of the work was often directed at decorating the textile, allowing additional choices in executing a particular motif. The possible variations in fabricating and decorating textiles are incalculable, but archaeological specimens cluster remarkably well, with occasional, distinctive, unique artifacts falling outside of the major clusters or types. Culture worked remarkably well constraining or guiding methods of manufacture and end products of prehistoric Great Basin weavers.

Cultural stability is reflected by textile technologies that exhibit little change over hundreds and even thousands of years. Some changes in textile technologies in the archaeological record appear rather suddenly across a broad spectrum of functional types. Dramatic changes in textile assemblages may represent wholesale replacement of incipient cultures. If change is gradual, then a case for stylistic change within an incipient culture through time likely occurred. There are also combinations of both significant introductions concurrent with maintenance of existing textile types that may reflect integration of cultures through trade or migration.

An interesting facet of textile analysis concerns seemingly small details such as the spin and twist used to fabricate cordage and the relative weft orientation or slant of stitches in twined textiles. These are basic mechanical skills that are greatly governed by culture, and believed by some to override other diagnostic attributes of textiles.

Finally, ethnographic Great Basin and California textiles were almost exclusively fabricated by women. If their ancestral cultures followed a similar pattern, then textiles also function as an important gender marker.

EARLY HOLOCENE TEXTILES

Spirit Cave, Nevada, is, perhaps, best known for a mummified human burial dated to about 9415 14C yrs. B.P. (Figure 1). In fact, the cave contained two inhumations and a cremation dating between 9040 and 9415 14C yrs. B.P. (Tuohy and Dansie 1997, table 1; Table 1). Textiles accompanying these burials proved a major turning point in Great Basin textile research because of the textiles' great antiquity and surprising sophistication (Fowler, et al. 2000). Although excavated in 1940, textiles from the site were originally believed to be around 2000 years in age until directly dated in 1994 as a control for AMS dating human hair from an early site in the Pacific Northwest (Wheeler and Wheeler 1969; Tuohy and Dansie 1997:26). Our previous view of early textiles was colored by a 9540 14C yrs. B.P. date on utilitarian whole shoot open twining, probably from a burden basket (Hattori 1982, table 2). Based on this solitary early dated specimen, many of us believed that the textiles from this period would be utilitarian and undecorated, and that any basketry would be more coarsely wove than what were believed to be the earliest finely woven textiles, pre-Mazama Catlow Twine from Fort Rock Cave and Paisley Cave, No.1, Oregon (Connolly et al. 1998:90-93). The Spirit Cave textile assemblage clearly represents a high point in Great Basin weaving, and, arguably, the most sophisticated weaving assemblage in the entire region.

Warp Face Plain Weave

The three, early Spirit burial assemblages are technologically and culturally linked by distinctive warp face plain weave mats and/or bags accompanying each burial (Fowler et al. 2000, table 2; Figure 2). Two mats and two bags, one large and one small, were fabricated from folded, tule strip (*Schoenoplectus* sp.) warps and paired *Apocynum* cordage (Z/ss) wefts. The smaller, plain weave bag was decorated with a series of horizontal dark bars and vertical leather strips. The latter may have been used as ties and were possibly ochre stained. The large size of one of the mats, 1.7 m^2 and the larger bag, coupled with the presence of anchoring edge cords, almost certainly reflect use of a frame or ground loom to assist with weaving.

The two, plain weave bags and the two, twined cordage bags are mat-based flat bags, that is, they were initially woven as a rectangular, flat textile; then folded across the shorter axis; and, finally, the lateral edges

whip stitched to close the sides. However, half of one surface was decorated and the other half undecorated, in order to present the bags' decoration on only one side of the completed bag, probably, the surface displayed to the outside of the bearer.

The regional distribution of the Spirit Cave, warp face, plain weave technology includes two east shore sites in the Winnemucca Lake basin, Elephant Mountain Cave west of the Black Rock Desert playa, and three sites in the Grimes Point and southern Stillwater Range in the Carson Desert (Figure 1). The age range on these textiles is between 8720 and 9470 14C yrs. B.P. a span of 1100 calibrated years. These other examples of warp face plain weave are undecorated and some are clearly from large mats. The technology represented is remarkably stable throughout the interval of use. This technology is presently the oldest, fine weave textile in the entire Great Basin. The dated fragment from Hidden Cave extends use of that site back to 9329 14C yrs. B.P. (Thomas 1985:272, fig. 93b; Figure 1, Table 1).

Plain Twine Cordage Bags

The remaining two Spirit Cave bags associated with the small plain weave bag were feather decorated, fringed, plain twine cordage (Z/ss) bags with stitch slant down and to the right (Z-twine) (Fowler et al. 2000:134-136). The association of these three bags is indisputable due to the fact that the three bags contained a single, cremated individual (Wheeler and Wheeler 1969).

One, Spirit Cave twined cordage bag was close, plain twine with a distinct color change midway, along the vertical (weft) axis of the bag (Fowler et al. 2000, figure 9). One half of the bag is off white and the opposing half grades from light red to off white. Several small feathers are horizontally inserted beneath wefts on one surface. Although in remarkable condition, given its great antiquity, this bag displays considerable use wear in that the surface is slightly abraded, only the shafts and a few barbs of the feather decoration remain, and all but one of the warp-end fringes are mostly worn away. This specimen was dated to 9040 14C yrs. B.P. (Table 1).

The other Spirit Cave fringed bag is open, plain twine, and it retains most of the warp-end fringes. Feather attachments are similar to the close twine specimen, and this bag is also decorated with a false embroidered, vertical leather strip (Fowler et al 2000:134-136; Figure 3).

Approximately 900 years after the Spirit Cave cordage bags, bags displaying stylistic and raw material changes and related simplification of manufacture appear across

the northern half of the Great Basin. This evolution is particularly close in the western Great Basin where a nearly complete, fringed, feather decorated, mat-based cordage bag is dated to 8200 14C yrs. B.P. at Horse Cave, Winnemucca Lake (Rozaire 1974:64; Figures 1 and 4). In this specimen, Indian hemp cordage warp is replaced by loosely spun (z) bitterbrush warp and two-ply Indian hemp weft (unspun, splices Z-twist) with stitch slant down and to the right (Z-twist).

At Danger Cave, Utah, an open, plain twine, cordage bag or mat fragment was recently dated to 6586 14C yrs. B.P. (Rudy 1957, figs. 220b &221, upper; Figure 1). This bag has a two-ply sagebrush cordage warp (Z/ss) and a two ply Indian hemp weft (Z/ss) with stitch slant down and to the right (Z-twine). This age determination extends Jennings' (1957, table 11) level D-II dates upward by nearly 1000 years and helps bracket level D-III.

At Hogup Cave, Utah, Adovasio (1970b, figure 96b) describes an open, plain twine, mat-based, cordage flat bag fragment with sagebrush cordage warp (Z/ss) and Indian hemp cordage weft (Z/ss) with stitch slant down and to the right (Z-twine; Figure 1). Body construction parallels Winnemucca Lake specimens but the remaining edge is sewn with a running stitch and the corner may have tabs and not fringes as decoration. This specimen was recently dated to 6217 14C yrs. B.P.

Catlow Cave, Oregon, yielded a fragment of a plain, open twine flat bag or mat with a warp tentatively identified as sagebrush and a loosely spun cordage weft(s) of an unidentified "silky," bast fiber (Jones 1942:150; Cressman 1942:40, figure 87d). Stitch slant on this fragment is down and to the right (Z-twine). Similar mat or bag fragments were reported from Dirty Shame Rockshelter, Oregon (Adovasio et al. 1986:20-21). None of the Oregon specimens have been directly dated.

These flat bags appear to be an early, long-lived, widely distributed, fiber-based container in the northern half of the Great Basin with an age range of about 3300 calibrated years between 9040 and 7128 14C yrs. B.P. Although details of fabrication vary, they are basically flat bags produced by open and close twining, using cordage or spun fiber warp and cordage or spun fiber weft, twining with stitch slant down and to the right (Z-twine), and based on a mat preform that was folded and stitched along opposing edges to form the bag. Variation between regions and through time may be the result of stylistic changes from an early, finely twined, fringed cordage bag to later less time consuming variants.

Fine, Open Plain Twine

A finely woven, open simple twine tule matting is recognized from only one Great Basin site, Shinners Site A at Winnemucca Lake (Figures 1 and 5). The four fragments from this site are distinctive enough to be classified as a unique technology. One fragment was dated to 8530 14C yrs. B.P. Three of the four fragments have alternating rows of false embroidery on both surfaces. Stitch slant is down and to the right (Z-twine). What distinguishes this technology from other forms of open twine tule warp and weft matting is the extremely small diameter of the warp and weft, approximately 2-5 mm, the relatively close spacing of the weft rows between 6 and 20 mm apart, and the structural decoration. These specimens are so fragmentary that it is not presently possible to determine function, but this fabric would be amenable to flat bag or mat construction.

Catlow Twine

Catlow Twine is a distinctive, extremely long-lived finely woven textile type with very close technological and raw material connections with ethnographic Klamath and Modoc textiles and possible ties with other northern California groups. Catlow Twine was defined as a type by Alex D. Krieger as close, simple twining utilizing tule cordage warp (typically Z/ss) and a tule weft with stitch slant down and to the right (Z-twine) (Cressman 1942:33). Catlow twine is frequently decorated utilizing overlay techniques, false embroidery, triple weft twining, and/or substitution of weft fibers. Its core distribution is limited to the northern and western Great Basin, but it may have been traded to prehistoric cultures in western and southern California (Peck 1950; Baumhoff 1958). It's absent from Danger and Hogup caves, Utah. It is the dominant technological type throughout most of the northern Great Basin's prehistory where its earliest occurrence is 6560 14C yrs. B.P. at Fort Rock Cave, Oregon (Figure 1). During its long interval of manufacture, this prehistoric weaving technology was used to fabricate a wide variety of artifacts including bowls, burden baskets, mats, trays, and pouches (not mat based).

Catlow Twine is an early component of western Great Basin textile assemblages where its earliest dated occurrence is 8370 14C yrs. B.P. at Fishbone Cave (26Pe3e), Winnemucca Lake (Figure 1). This small, body fragment is undecorated, but it is unknown if the remainder of the form possessed any decoration. At present, this fragment is the earliest known example of this technology.

The next oldest, dated occurrence is a remarkably early, nearly intact, decorated rectangular mat from Horse Cave (26Pe2),

Winnemucca Lake, nearly a meter square (Figures 1, 6, and 7). This mat is also of particular interest in that it possesses an Indian hemp edge cord which we believe indicates use of a frame or ground loom in its manufacture. This mat is decorated with regularly spaced rows of single and double bars produced by overlay and false embroidery using a dark fiber, similar to the overlay decoration on the warp face, plain weave Spirit Cave tule warp bag. A question concerning the decline of Catlow Twine in the western Great Basin after 4000 14-C yrs. B.P. was whether it was traded into that region from the northern Great Basin. A fragment from this mat was subjected to strontium isotope (86Sr/87Sr) and oxygen (16O/18O) isotope analyses to determine the most likely water source used for the tule's growth (see Benson, et al. 2006 for a discussion of the method). The isotope values are 87Sr/86Sr, 0.705702 and δ 18O, 21.9 $^{0}/_{00}$. Based on the 18O value, the mat was most likely made from tule that grew in running (river vs. lake or marsh) water (Benson et al. 2006:1591). The strontium value, however, is in the lowest of all of our archaeological samples (n=42), but still within the range of water, sediments and granite influenced by Sierra Nevada bedrock (Benson et al. 2006:1591, table 1). The closest source of this tule would have been the Mud Lake Slough connecting the Truckee River with Winnemucca Lake.

Another significant Catlow Twine fragment from Shinners Site-A (26Wa198) at Winnemucca Lake is an extremely finely woven (5 stitches per cm X 8 warp rows per cm) specimen that was completely overlaid with porcupine quill (Figures 1 and 8). This specimen dates to 8140 14C yrs. B.P. Bird quill false embroidery is noted by Cressman (1942: 41-42) for northern Great Basin Catlow Twine, and ethnographic Klamath utilized porcupine quill for overlay designs on baskets (Spier 1930:191).

Twill Twine

Twill twine using loosely spun tule (*Schoenoplectus* sp.) strips for both warp and weft with stitch slant down and to the right (Z-twine) appears roughly coeval with Catlow Twine, and may, indeed, be technologically as well as culturally related to Catlow Twine.

A curious twill twine variant from Shinners Site A (26Wa198) at Winnemucca Lake is the earliest example of twill twining in the Great Basin, but this technology is unique (Figures 1 and 9). The warp and weft are tule (*Schoenoplectus* sp.) and sized similarly to warp and weft used in Catlow Twining. The semi-flexible warp and patterned shift of the warp row produce the illusion of an opposite weft row orientation for both surfaces. The weft regularly alternates over two warps, but the warps also shift over one row in the adjoining weft row. Five small fragments of this weave

were recovered from Shinners Site A at Winnemucca Lake. These undecorated fragments are too small to accurately determine the original textile form. Two fragments were dated to 8250 and 8265 14C yrs. B.P. Based on these ages, the possibility of all fragments being from the same mat or container cannot be ruled out.

The Nicolarsen Site, Winnemucca Lake, yielded a nearly complete twill twine, columnar container with a constricted neck and slightly flared rim that was closely associated with a 6360 14C yrs. B.P. date on a Catlow Twine fragment (Barnes 2000:55, figure 5-3; Figure 1). This basket, possibly a water or seed container, was decorated with false embroidery, feather strips, and feather quills. Although this container was not directly dated, its potential significance warranted its inclusion here. The age determination, however, should be viewed with some caution due to potential mixing of dry cave deposits and the circumstances concerning this site's excavation (Barnes 2000:2-3).

In southern Oregon, diagonal twine, finely woven tule textile technology is relatively common and sub-dominate to Catlow twining (Cressman 1942:40; Adovasio et al. 1986:21). The Oregon fragments are often decorated with overlay and false embroidery using a light colored grass (Cressman 1942, tables 3 and 4). In Oregon, this technology currently was dated to 6950 14C yrs. B.P. at Dirty Shame Rockshelter (Connolly et al. 1998).

A possible variant of this weave, or of Catlow Twine, from Hogup Cave, Utah, was fabricated from tule with alternating rows and bands of diagonal and plain twining (Adovasio 1970b:134, figure 95a).

Coiling

Coiling is dated to 7200 yrs. B.P. at Bonneville Rockshelter, Nevada in the eastern Great Basin, but this date does not necessarily mark its introduction into the region, as very few pieces have been directly dated (Jolie and Burgett 2002:3; Figure 1). Adovasio (1970:150) reports coiled basketry from Hogup Cave, Utah, Level 3, and the level is believed to date sometime around 7800 14C yrs. B.P. (Aikens 1970:26-27, table 2). These ages are roughly coeval with open twine mat-based flat bags from this region. Coiling does not appear in the northern Great Basin until about 3200 14C yrs. B.P. and 4000 14C yrs. B.P. in the western Great Basin.

DISCUSSION

The western Great Basin's earliest Holocene textile assemblage is characterized by an extremely wide variety of skillfully executed fine weaves. These finely woven

textiles are sensitive indicators of technological and cultural changes. Likewise, important attributes persist from one technology to another technology reflecting aspects of culture continuity.

The Spirit Cave burial assemblages are particularly important toward understanding the region's earliest textiles because they reveal a fully developed, mat-based weaving technology at 9415 14C yrs B.P. Whether there are earlier textiles yet to be discovered regionally or not, there is undoubtedly a rich developmental history that preceded the appearance of the plain weave and twining from Spirit Cave. Tule (*Schoenoplectus acutus)* and hemp (*Apocynum* sp.) used in the textiles fabrication are widely available in the northern hemisphere, including northern Asia and Europe. Distinctive, warp faced plain weave tule warp mats with *Apocynum* weft persisted unchanged until at least 8720 14C yrs. B.P. After that date, the technology disappears from the Great Basin until a variant appears at 540 14C Yrs. B.P. at Roaring Springs Cave, Oregon, and historically with the ethnographic Klamath and other northern California groups (Fowler et al. 2000:131, figure 7.9). Although possibly the result of independent invention, it also appears ethnographically with Midwestern Fox and Northeastern Algonquian groups (Fowler et al. 2000:133).

Manipulating a myriad of thin tule strips and binding them tightly together with paired threads to fabricate the large plain weave mats is not only physically challenging, but extremely time consuming without the aid of a vertical frame or ground loom. The Spirit Cave plain weave mats almost certainly utilized a frame or ground loom for fabrication as did an 8300 14C yrs. B.P. Catlow Twine mat from Horse Cave at Winnemucca Lake.

The 9040 14C yrs. B.P. twined Indian hemp cordage bags from Spirit Cave are archetypes for later sagebrush and bitterbrush warp, open twine bags recorded in the northern and eastern great Basin. Regionally this relationship is particularly close and chronicled in an 8200 14C yrs. B.P. fringed bitterbrush bag from Horse Cave at Winnemucca Lake. There is a notable decline in the degree of preparation of the warp and weft fibers, although it's difficult to attribute this to a decline in a culture vs. stylistic change. In either case the later bag's durability would be lessened due to the use of a more friable, less processed and unspun fiber.

On a higher level of comparison, Z-twining, stitch slant down and to the right, dominates twist direction during this entire early period. Exceptions to this observation can probably be accounted for by left-

handedness within the population. This is significant because of the change in twine direction, and in dominance of diagonal twine, with the ethnographic Numa in the western, northern, and eastern Great Basin sometime after 1000 14C yrs. B.P. The ethnographic Washoe in the western Great Basin utilize Numic-style close diagonal twine for water bottles, and burden baskets. They do, however, continue with Z-twine for whole shoot, open twine burden baskets, sifters, and cradleboards.

Tule is the common warp and weft fiber throughout this period for several fine weave technologies including the following: warp faced plain weave matting and bags; fine open twine matting; twill twining; and Catlow Twine matting and basketry.

CONCLUSIONS

Directly dating Great Basin textiles is changing our views of textile evolution for some of the earliest well documented inhabitants of the region. In 1986, Adovasio proposed a series of attributes that characterized early textile assemblages for the western sub-area. He chronicled technological change in regional textile complexes, although many were poorly dated at the time, to form a useful baseline for prehistoric cultural reconstructions. For the western Great Basin, Adovasio (1986:197) proposed that Stage I textile complexes (9000 – 4500 B.C.) were all twined, but richer in types than in the northern Great Basin. Mats and flexible bags were characteristic products, but semi-flexible containers of several shapes were also present. Basketry in simple close twining with S-slant wefts (Z-twine) appears at the end of the stage along with diagonal twining. There is elaboration of simple twining from earlier forms. Structural decoration is known from this period, but not common, and there is no coiling or plaiting present.

Although pieces of this picture remain intact, other details have changed markedly. Early plain weave technology was not included in this complex, nor was feather decoration or false embroidery until the Spirit Cave materials were dated by AMS. The importance of mats and bags has been affirmed for the early period across the northern half of the region. Diagonal twining also seems to be present by at least 8300 B.P. Technological variety is much greater than initially documented, and the presence of frames or ground looms as a mark of a sophisticated weaving technology was entirely missed until recently. This stage seems to end rather abruptly with the demise of several of key types at a date earlier than the 6500 B.P. dates originally proposed. The transitional phase after roughly 8000 B.P. and into the middle Archaic is characterized in the western

Great Basin by increasing importance of Catlow Twining as well as other twined complexes (including sandals, nets, etc.). Details, however, remain to be worked out, as do additional artifact correlations. Finds of good lithic associations with these earliest materials are rare, but suggestive of varieties of stemmed points and other stone tools. Grinding equipment does not seem to be present.

One thing seems clear: based on the materials commonly used in the manufacture of these early textiles, people were spending a considerable amount of time near and around marshes or shallow lakes in the western Great Basin and perhaps elsewhere They had become very familiar, even by 9400 years ago, with the plants that grew in these settings, including their fiber properties, and were well aware of how to turn them into exceedingly finely woven and useful textiles. They chose to decorate these materials, with water bird feathers and other plant materials from marshes. Their use of caves was more for caching and burial than for living quarters, but, thus far, the remainder of their settlement and subsistence systems is less than clear. Although our studies have focused for the most part on the early textiles, we feel that the results to date have been very rewarding. Given the richness of the textile inventories in the western Great Basin, and the Great Basin in general, we feel that continued concentration on them will go a long way toward better defining and characterizing the sequence of adaptations and interconnections of peoples in the region during this very early interval.

Table 1. Selected AMS Dated Textiles from Nevada, Utah, and Oregon.

Textile Reference	Site	Specimen No.	C-14 BP	Lab		
Plain Weave Mat/Bag	Grimes Shelter, NV	26Ch1c/13-G-8	9470±60	UCR-3477	10813±171	Tuohy et al. 1997
Plain Weave Mat	Spirit Cave, NV	26Ch1f/1-20-2	9430±70	UCR-3323	10690±99	Tuohy et al. 1997
Plain Weave Mat/Bag	Hidden Cave, NV	26Ch16/2-30349	9329±50	UCR-3635	1054±78	Fowler et al. 2000
Plain Weave Mat	Spirit Cave, NV	26Ch1f/1-20-60	9270±60	UCR-3480	10440±99	Tuohy et al. 1997
Plain Weave Mat/Bag	Cow Bone Cave, NV	26Pe3c/18	8720±40	Beta-214524	9681±74	
Close Twine Fringed Bag	Spirit Cave, NV	26Ch1f/1-20-5A	9040±50	UCR-3478	10215±23	Tuohy et al. 1997
Open Twine Mat/Bag	Shinners Site-A, NV	26Wa198/617a	8530±40	Beta-214528	9519±19	
Open Twine Fringed Bag	Horse Cave, NV	26Pe2/451aa	8200±50	UCR-3909	9163±86	
Open Twine Bag	Danger Cave, UT	42To13/23683.3	6586±51	AA-64984	7499±47	
Open Twine Bag	Hogup Cave, UT	42Bo36/24302	6217±51	AA-64982	7128±87	
Catlow Twine	Fishbone Cave, NV	26Pe3e/321c	8380±50	UCR-3910	9398±64	
Catlow Twine	Horse Cave, NV	26Pe2/451.5	8270±40	UCR-3965	9270±98	
Catlow Twine	Paisley Cave No. 1, OR	100BP, 1-5344	6560±70	AA-19153	7481±57	Connolly et al. 1998
Diagonal Twine	Shinners Site-A, NV	26Wa198/473	8265±40	UCR-4003	9264±96	
Diagonal Twine	Dirty Shame Rockshelter, OR	404,A3-6/1-B68	6950±110	AA-19154	7798±105	Connolly et al. 1998
Diagonal Twine Bag/Bottle	Nicolarsen Site, NV	T-56	6360±30	Beta-137953	7298±25	Barnes 2000
One-rod Coiling	Bonneville Estates Rockshelter, NV		7190±50	Beta-164230	8023±50	Jolie & Burgett 2002
Three-Rod Coiling	Kramer Cave, NV	26Wa196/1602	3830±30	UCR-3969	4240±59	
Three-Rod Coiling	Roaring Springs Cave, OR	I-8623b	2710±51	AA-66193	2822±42	Connelly 2006

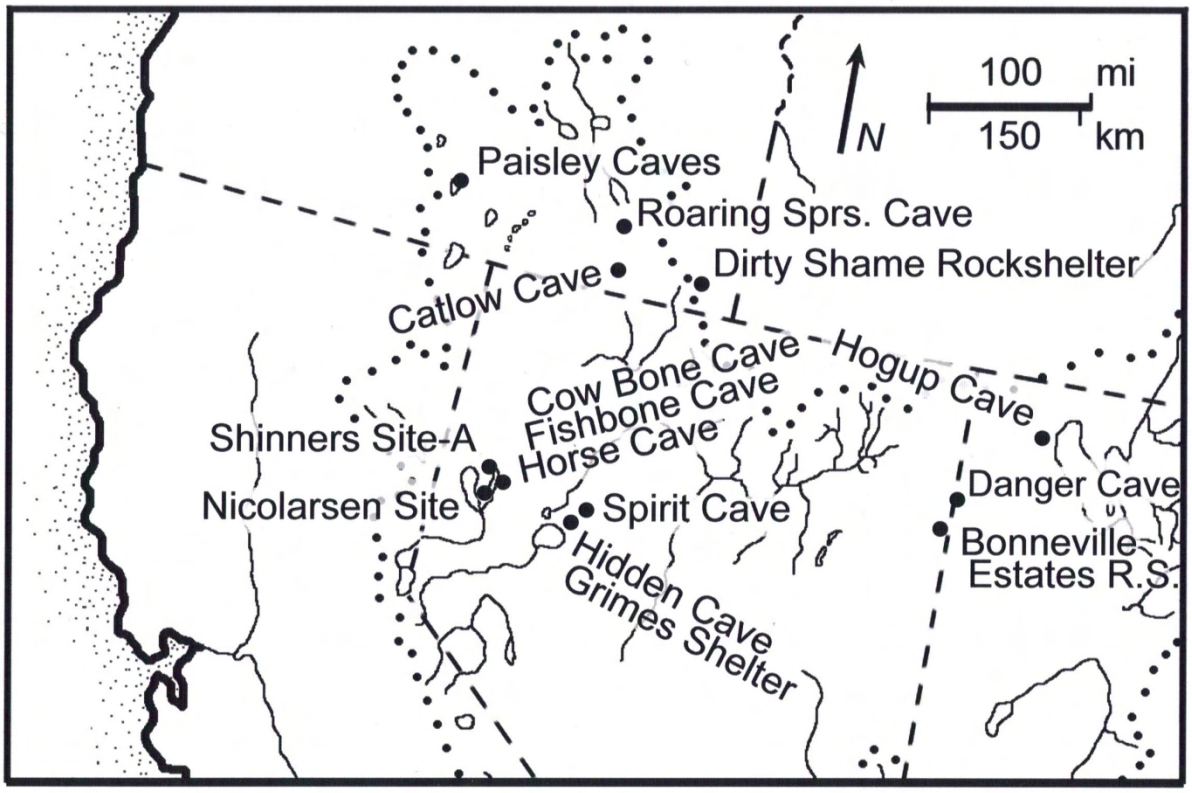

Figure 1. Map showing archaeological site locations.

Figure 2. Warp face plain weave bag from Spirit Cave.

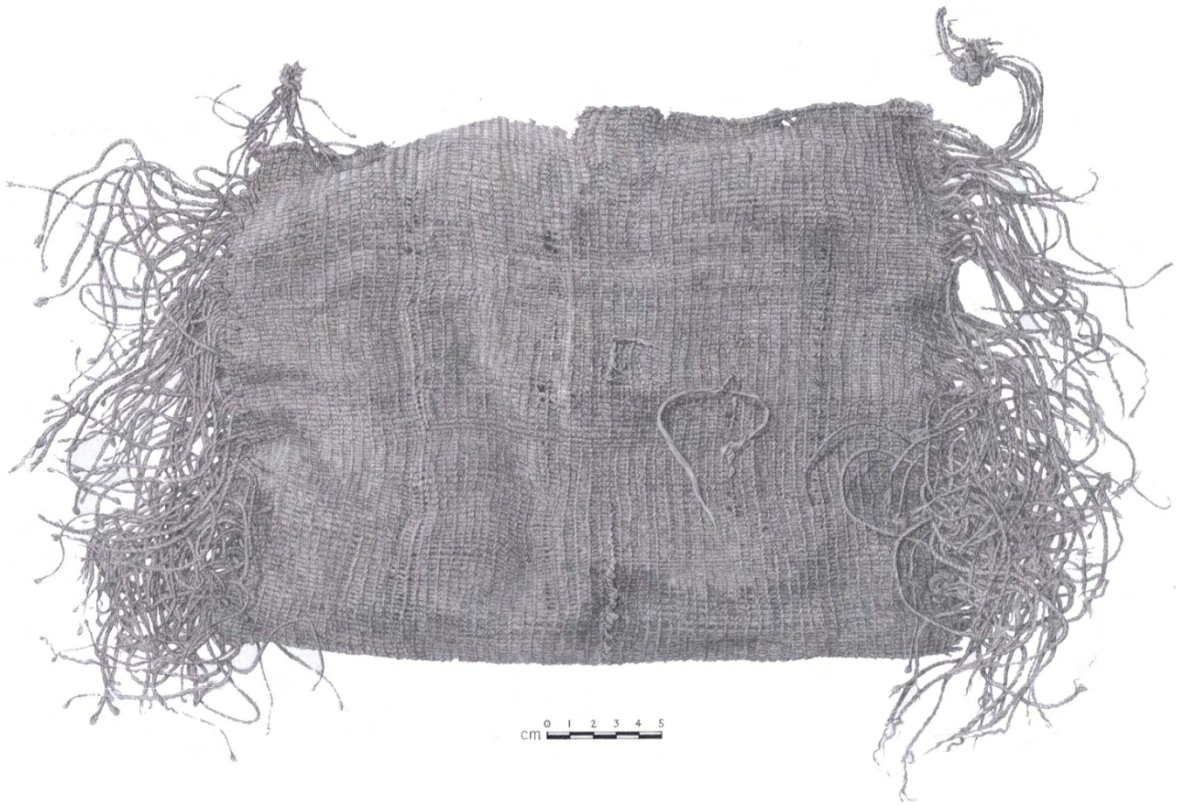

Figure 3. Open simple twine bag from Spirit Cave.

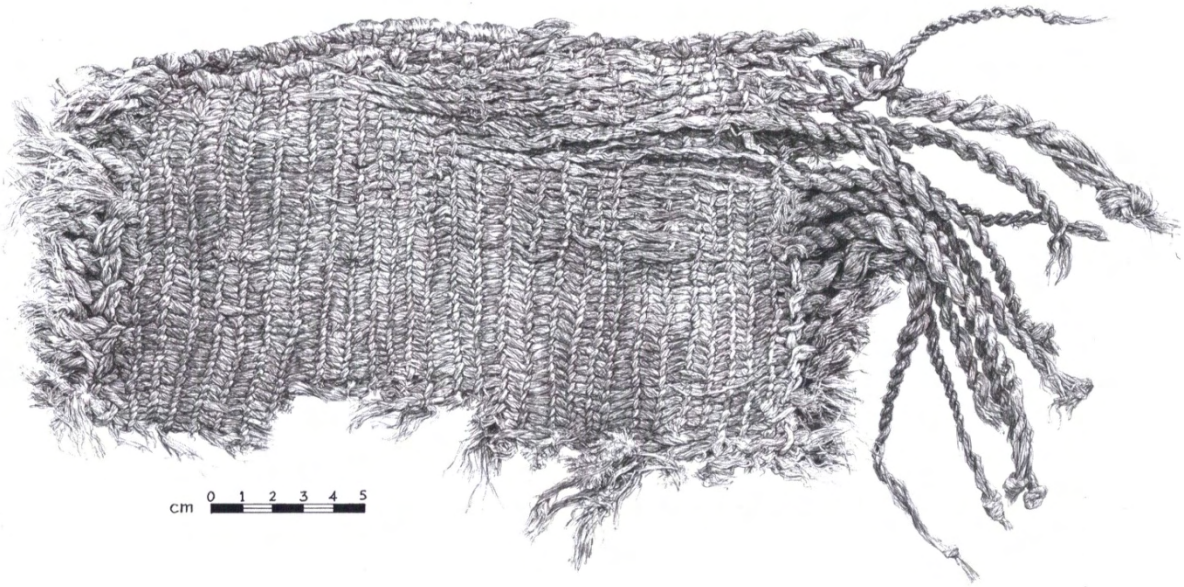

Figure 4. Open simple twine bag from Horse Cave.

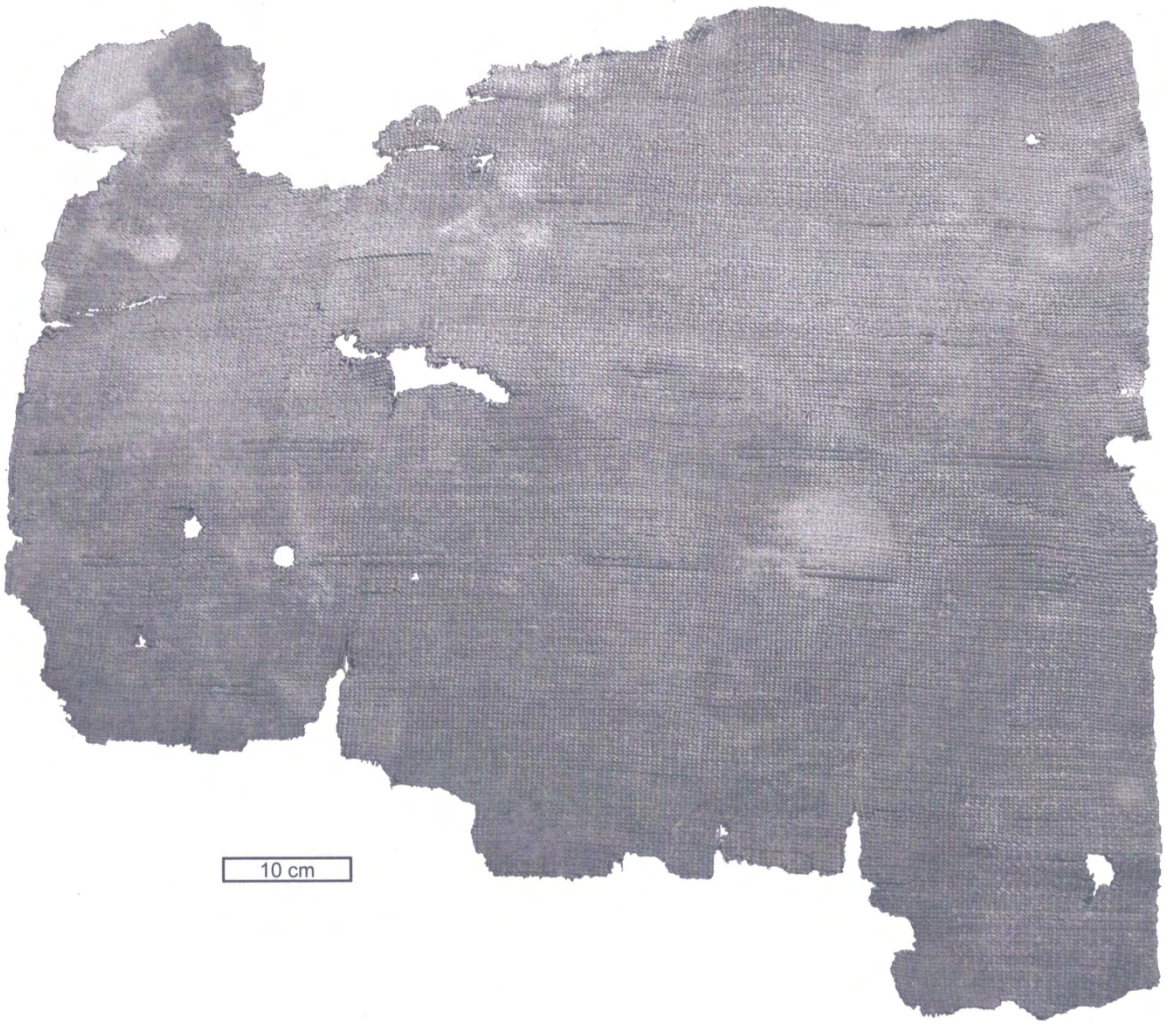

Figure 5. Catlow Twine mat from Horse Cave.

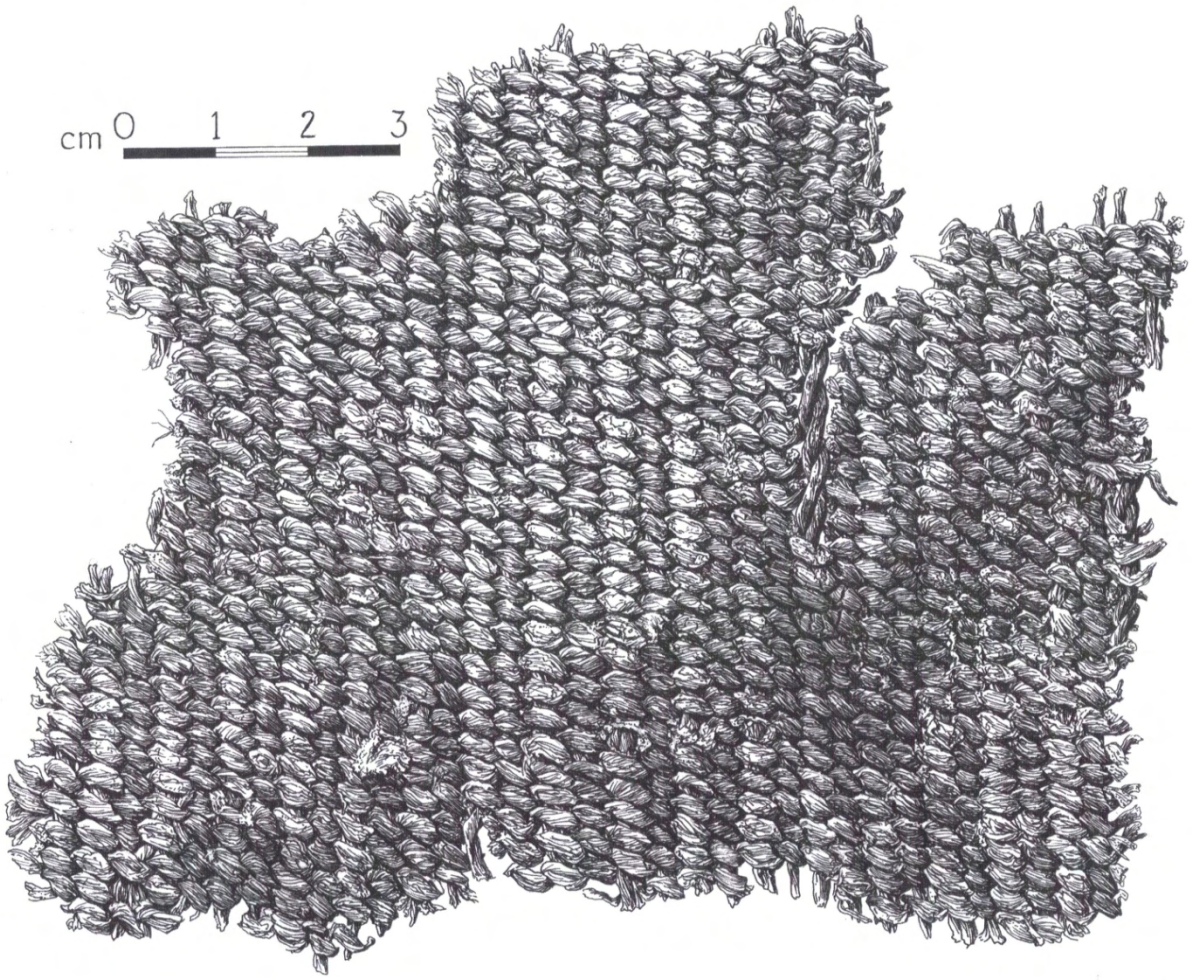

Figure 6. Catlow Twine fragment.

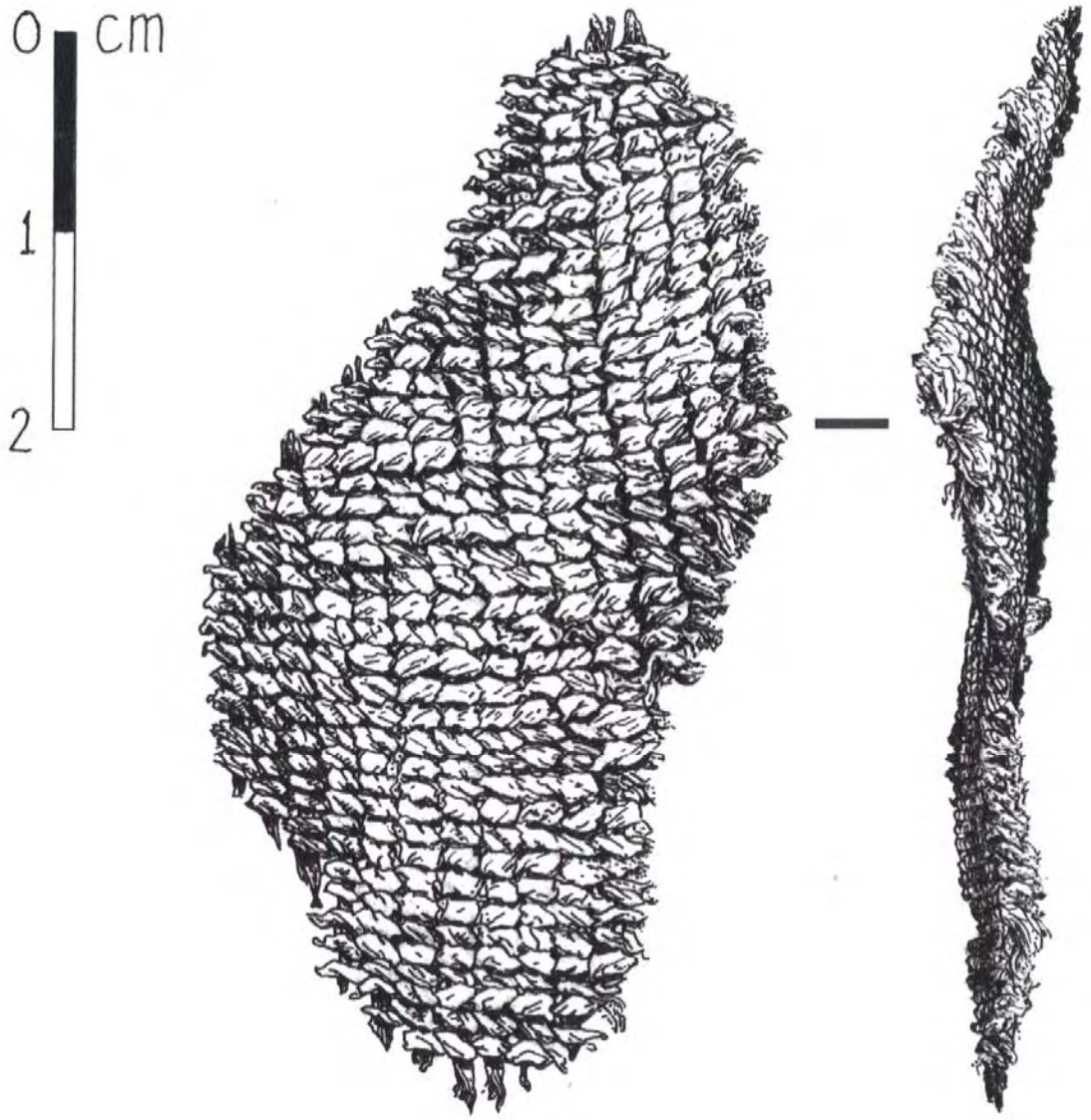

Figure 7. Catlow Twine with quill overlay.

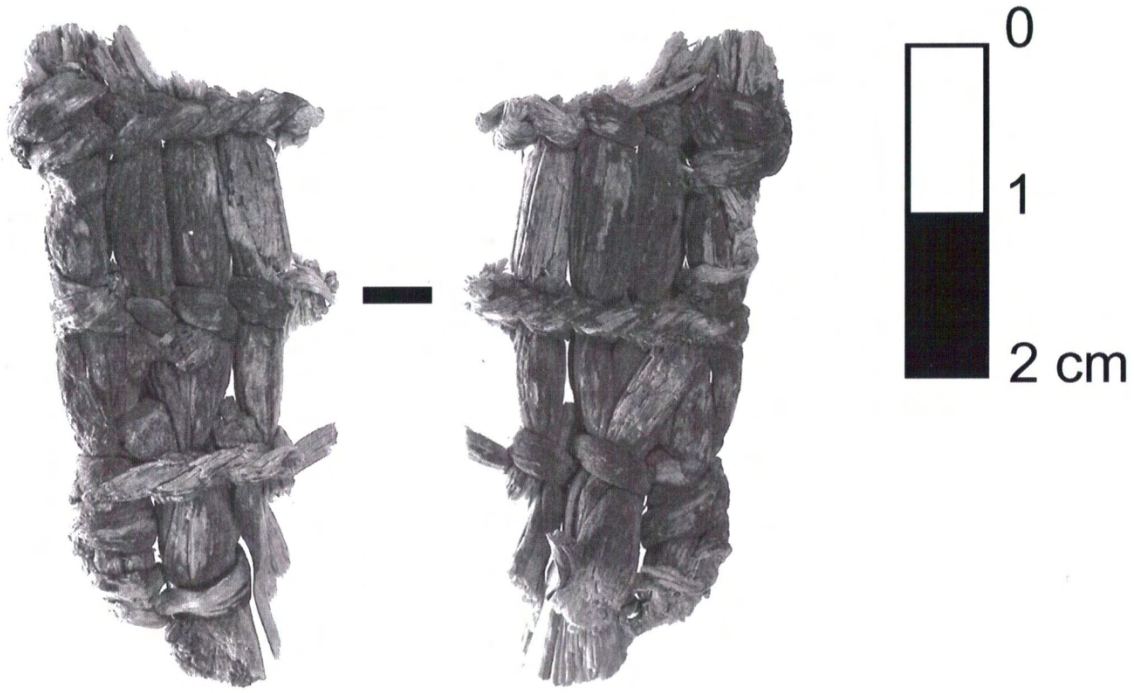

Figure 8. Open twine tule mat or bag fragment.

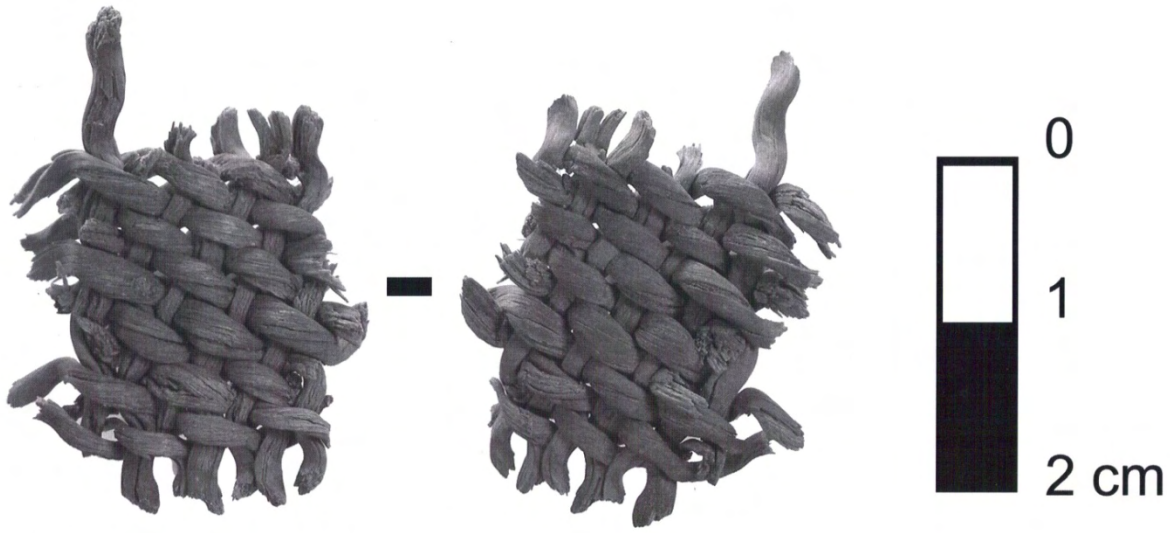

Figure 9. Twill twine fragment.

8
Woven Sandals as Boundary Markers Between The Great Basin and Southwest Culture Areas

Pat Barker

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Prehistorians tend to look at the archaeological record in terms of the Culture-Area Concept and define these areas by drawing a boundary around peripheral sites that share relevant attributes of sites in the core area. The idea, first proposed by Boaz and elaborated by Mason, Wissler, Kroeber, and others, is that there is an interesting broad relationship of subsistence, technology, sociopolitical organization, and culture with the environment in these areas (Trigger 1989:122-123; Bettinger 1991:36-40; 44-45). Later these areas were seen as reflecting broad ecological adaptations that changed through time (Steward 1955). Culture Areas tend to be defined so that they are more similar internally than they are externally. As is common with these kinds of broad conceptions, consensus about them is strong in the core of the Culture Area and diminishes towards the periphery until some consensual boundary, possibly geographic or environmental is established between areas. The same processes work on the culture area temporal boundaries (also known as Age Area boundaries).

However, this has not been true of basketry, including archaic woven sandals, where some archaeologists argue that they define an absolute technological boundary between the Great Basin and the Southwest as well as marking group boundaries within each Culture Area. Basketry, in its broadest sense, is a relatively plastic medium that allows much variation in structure and style. It is a learned craft, passed from one generation to the next, and thus it has been useful in considering cultural patterns that relate to the continuity (or discontinuity) of traditions through time, as well as to the geography of ethnic relationships (Adovasio 1986; Adovasio and Andrews 1986; Adovasio and Pedler 1994; Fowler 1994). For example, in the best documented large-scale ethnographic case, Petersen and others (Petersen et al. 2001:249) have shown strong correlations among very simple textile attributes – spin, twist, and twining stitch slant – and tribes in greater Amazonia.

Sandals, as a form of basketry, should also inform us about social boundaries, group identity, and continuity or discontinuity through time. Geib (2000) and McBrinn (2005) argue that southwestern sandals do just this. In New Mexico, sandals are thought to mark the boundary between the Mogollon Rim and the Tularosa Basin (McBrinn 2005:61-68). On the Colorado Plateau sandals may mark the boundary between the

northern and southern areas (Geib 2000: 511) and are seen as clear markers of temporal boundary between the Archaic and later periods (Geib 2005:519). They may well be markers between the Colorado Plateau and adjacent Great Basin (Geib 2005:520).

Before looking at sandals in the Great Basin and Southwest, there are two issues that need to be kept in mind. One is a taxonomic problem created by trying to export internal consensus type names across external boundaries. Taxonomy can create boundaries where none exist empirically when an underlying form is given a different name in adjacent culture areas. Likewise, taxonomy can obscure boundaries when fundamentally different underlying forms are given the same name in adjacent culture areas. On geographic (physiological) boundaries of culture areas, such as between the Great Basin and the Southwest for example, the dividing lines can be relatively clear. However, defining the cultural boundary between culture areas and making it approximately the same as the geographic boundary is more difficult. This is so because some attributes, primarily basketry, appear to stop at the boundaries; while others, primarily ceramics, overlap a little, and still others, like lithics, do not respect boundaries at all. Single lithic shapes cross and blur culture area boundaries when interloping artifacts are physically identical in both areas but have different names in each. Basketry may not suffer from this problem (Petersen et al. 2001:226-227).

The second issue is that there are several ways in which the basketry archaeological record could mark boundaries in a context where several other attributes (lithics, ceramics, geography, etc.) are also used to mark the boundary. A strongly marked boundary would be one in which none of the forms or types from one culture area are found in an adjacent area and vice-versa. On the other end of the spectrum, if all of the forms or types found in one culture area are found in an adjacent one and vice-versa there is no boundary marked by basketry. These two cases are easily distinguished. However intermediate cases in which some forms or types respect the boundary while others do not are more problematic. There is no standard for defining weakly marked boundaries. Is there still a marked boundary if 10% (25% or 50% or 75%) of the forms or types overlap?

With these issues in mind we can now turn to the Great Basin and Southwest Culture Areas (Map 1) and search for boundary markers among prehistoric and ethnographic woven sandals from both areas.

THE NORTHERN AND WESTERN GREAT BASIN ARCHAEOLOGICAL SANDALS

Three stylistically distinct sandal types are commonly found in the northern and western Great Basin (Map 2). These have been called Spiral Weft, Multiple Warp, and Fort Rock-style sandals (Figure 1). The former two are named for features of construction, and the Fort Rock type named for the site from which they are best known. Rarer types from this area include V-twined sandals (Figure 5a, b, c) known from Lovelock Cave in western Nevada (Connolly and Barker 2004).

Fort Rock-style sandals are named for the Fort Rock Cave Site that contained more than a hundred sandals buried beneath the approximately 7,600 year old Mazama volcanic ash. All were made of a consistent style, having a flat close-twined sole with five rope warps that were formed into an arc at the heel and extended to the toe (Figure 2a, b, c). Twining proceeded back and forth across the sole from heel to toe, where the thick warps are subdivided into finer cords and turned back to form an open twined toe flap. The tie system involved a series of interlocking loops fixed to one edge of the sole and at the heel, then looped with a tie rope attached to the other edge, and cinched tight around the ankle. There was no heel pocket and apparently no grass or shredded sagebrush bark lining.

Sandals of the Fort Rock type have been found in a number of other northern Great Basin sites including Cougar Mountain Cave, Catlow Cave, Roaring Springs Cave, Dirty Shame Rockshelter, and Antelope Overhang in southeast Oregon, and in Horse Cave, Elephant Mountain Cave, and Last Supper Cave in northwestern Nevada. While nearly all of the Fort Rock-style sandals currently known are made of sagebrush bark, two from Cougar Mountain Cave, and one from Horse Cave were made of tule. A suite of 13 direct radiocarbon dates, from five sites, on these sandals indicates an age range about 10,500 cal. BP to about 9300 cal. BP.

Multiple Warp sandals (Figure 3a, b, c) are close-twined from heel to toe, but have from eight to more than a dozen warps that–rather than forming a flat sole–are twined around the heel to form a pocket (Cressman 1942:58). Loose warps are bent back from the toe as a toe cover, but are rarely twined. Tie loops are built into the sole, typically by extending wefts beyond the last warp and twisting them into a corded loop, then returning as sole wefts; a cord was then run through the loops and tied across the top of the foot or cinched at the ankle. Some examples were lined with grasses or shredded sagebrush bark. Heizer and Kreiger (1956:63-64) report on four Multiple Warp sandals from Humboldt Cave in Western Nevada that have a singe warp in the center of the sole, as

do Fort Rock-style sandals, surrounded by four U-curved warps to give nine warps in the sole. Unlike Fort Rock-style sandals, Multiple Warp sandals have heel pockets. Materials used include tule, sagebrush bark, and grasses.

Multiple Warp sandals have the widest geographic distribution among all types and a well-documented temporal distribution from more than 9000 cal. BP to less than 300 cal. BP, based on 16 direct fiber dates (Connolly and Barker 2004). At the older end of the scale, Multiple Warp sandals from Elephant Mountain Cave have direct ages of about 9400 cal. BP and about 7820 cal. BP, one from Dirty Shame Rockshelter dates to about 7820 cal. BP, and one from Winnemucca Lake in western Nevada is ca. 8000 years old (Connolly and Barker 2004; Connolly and Cannon 1999).

Nine of the seventeen direct dates range from about 3400 to 1000 cal. BP. These are from Roaring Springs Cave, Catlow Cave, Paisley Caves, Connley Caves, and Redmond Cave in Oregon, and several western Nevada sites in the Winnemucca Lake Basin (Connolly and Barker 2004). Multiple Warp sandals in museum collections from Winnemucca Lake have produced direct fiber dates of about 3380 cal. BP and 1230 cal. BP.

At the near end of the age range are dates of about 730 and 600 cal. BP on tule sandals from Warner Valley (Fowler and Cannon 1992), an age of about 850 cal. BP on a child-size sandal from Catlow Cave (Connolly and Cannon 1999), and an age of less than 300 years from Elephant Mountain Cave (Connolly and Barker 2004).

Spiral Weft sandals are made from sagebrush bark or tule with warps running perpendicular to the axis of the foot (Figure 4a, b, c). Wefts are radially twined in a spiral pattern, like a basket start, beginning along the centerline of the foot. Tie loops are formed by extending the warps beyond the edge of the sole and a cord was then run through the loops and tied across the top of the foot or cinched at the ankle. Spiral weft sandals lack toe covers and some have attached twined heel pockets while others do not (Andrews, et al. 1986:110-116). Spiral Weft sandals were not lined.

Spiral Weft sandals have been found in the extreme southeast Oregon caves (Catlow, Roaring Springs, and Dirty Shame) and in Nevada's Elephant Mountain and Last Supper caves (Barker 2006, Laboratory Notes).

We now have thirteen direct radiocarbon ages from Spiral Weft sandals, four from Dirty Shame Rockshelter, three from Elephant Mountain Cave and two each from Catlow Cave and Roaring Springs Cave. The

four Dirty Shame specimens range in age from about 9490 to 8600 years old, and those from Elephant Mountain Cave are consistent with these, ranging from about 9420 cal. BP to about 8460 cal. BP (Connolly and Barker 2004).

The other dated Spiral Weft sandals have ages between about 1860 cal. BP and about 1550 cal. BP (Connolly and Barker 2004). In general, Spiral Weft sandals are contemporaneous with Multiple Warp sandals, with both early and late Holocene examples. However, the gap between the early and late sets is more pronounced with the Spiral Weft sandals, having a gap of more than 6000 years separating the dated modes.

V-Twined Sandals (Figure 5a,b,c)are made by twining a heel pocket around a circular start, and then open or close twined with alternating rows of clockwise and counter-clockwise weft twists from side to side to produce a V pattern, and finishing with an un-twined toe flap (Loud and Harrington 1929:54-56). Loud and Harrington (1929:54-56) identified both a fine type and a course type with the only difference being materials. Fine sandals were of made with sagebrush bark and course were made of tule. As with Multiple Warp bindings, tie loops are built into the sole, typically by extending wefts beyond the last warp and twisting them into a corded loop, then returning as sole wefts; an integral cord was then run through the loops and tied across the top of the foot or cinched at the ankle. Some examples were lined with grasses or shredded sagebrush bark.

These sandals have only been found at Lovelock Cave in western Nevada, but appear to be made in the same way as woven bags from Humboldt Cave (Heizer and Krieger 1956:60-61). Two of the V-twined sandals in the Nevada Sate Museum collection from Lovelock Cave, have direct AMS dates indicating an age range between 500 cal. BP to 0 cal. BP (Connolly and Barker 2004).

SOUTHWESTERN ARCHAIC SANDALS

There are two types of sandals attributed to archaic times from the Colorado Plateau (Map 3) in the Southwest known as open twined and warp-faced plain weave (Geib 2000: 511-513; Hays-Gilpin, et al 1998:37-39). As described by Phil Geib (2000: 511), "both styles are made from whole yucca leaves and their warp is identical, consisting of folded leaves. Weft Treatment is the distinguishing characteristic: open Z-twining vs. simple over-one under-one plain weaving."

The earlier simple open-twined type (Figure 6a, b) has been found at 13 sites on the Northern Colorado Plateau – southwestern Utah, southwestern Colorado,

and northeastern Arizona with an age range of roughly 8000 to 5400 cal. BC. (Geib 2000:511). After around four hundred years of overlap in use (sometime after about 5800 cal. BC) warp-faced plain weave (Figure 7a, b) began to replace open-twined ones. Geib (2000:511-513) noted that "A few rare sandals from the region exhibit aspects of both construction techniques, with a first pass of twining, shifting to plain weave. These examples provide good evidence that the two sandal types represent a continuum, with plain weave style developing out of the preceding open twined style." The latest dates for warp-faced plain weave sandals on the northern Colorado Plateau are late archaic, at roughly 1450 cal. BC (Geib 2000:513).

Geib (2000:513-514) also noted that open-twined archaic sandals were virtually unknown in the Southern Colorado Plateau, while nineteen warp-faced plain weave examples were recovered from Sandal Shelter at the southern edge of the Colorado Plateau in eastern Arizona. Geib (2000:515-518) describes these sandals as being made with a "range of fabric density from open to compact. Both warp and weft are of whole yucca leaves, untreated in any way except for occasional trimming of tip and butt ends. The leaves for the warp are folded in half and laid over a leaf or two forming the weft at the toe. One side of the toe weft is woven back and forth across the warp in a widely spaced, simple, over-one under-one fashion. Weft passes vary from 5 to 8. In several cases an extra leaf is woven across the heel, evidently as reinforcement. He also noted that "ties consist of whole, unmodified yucca leaves, laced in a crisscross tie system that is a version of toe-heel attachment that is common to the Southwest during [later] Basketmaker and Puebloan periods" and that "contrasts with the tie method for plain weave sandals from the northern Colorado Plateau." The northern method consisted of Yucca leaf cords started at the toe and looped across the foot to be stitched around the selvage warp and looped the back again.

Geib (2000:519-520) obtained direct AMS dates from the six whole sandals from Sandal Cave (with an uncalibrated range of 8300+/-60 BP to 5575+/-50 BP) and was surprised to learn that the southern Colorado plateau warp-faced plain weave sand were 1500 years earlier that those from the northern Colorado Plateau. They were more contemporaneous with the northern open twined sandals than the northern warp-faced plan weave ones. He then argues for a northward spread of plain weave-sandals at the end of the early archaic and based on technological differences, that the spread was not the result of population movement (Geib 2000:519-520).

McBrinn (2005):61-71) discusses two sandal types that she attributes to pre-ceramic

components in three sites (Tularosa Cave, Bat Cave, and Fresnal Shelter) from southeastern New Mexico. Unfortunately these sites all lack reliable stratigraphic associations and none of the sandals have been directly dated. The type she calls Four-Warp Plain Weave is made with close twining from a toe start. They are also weft faced; a trait that Geib associates with later Basketmaker and Puebloan sandal types. Winslow (Harry Reid Center 2004: 317) describes an adult Four-Warp plain weave sandal from Black Dog Cave that is close twined with a toe start and weft faced. She states that it is "more typical of Anasazi plain weave sandals found throughout the prehistoric Southwest." If this is the case, it may be similar to the Four-Warp Plain Weave sandals McBrinn describes. Black Dog Cave also yielded a child's weft-faced plain weave sandal with six warps and a toe start that is also typical of Anasazi throughout the Southwest, but not similar to those McBrinn (2005:61-71) describes because it has six-warps. Both of the adult and child's close twined sandals from Black Dog Cave are attributed to Basketmaker II times, but neither has been directly dated (Harry Reid Center 2003:317). Since this type is post-Archaic in other places (Hays-Gilpin et al. 1998:37; Geib 2000:523) it is more likely that the Four-Warp plain weave sandals from New Mexico are also post-Archaic.

SOUTHERN ARCHAEOLOGICAL SANDALS

Post-Archaic (Basketmaker and Puebloan) archaeological sandals in the Southern Great Basin) include densely woven yucca yarn sandals with complex designs on the soles, weft-faced plain weave sandals and braided (plaited) sandals (Hays-Gilpin et al. 1998:37) Except to note that these sandals were started at the toe, a southwestern characteristic, and that they appeared during Basketmaker II and stopped being made before the Spanish Entrada (Hays-Gilpin et al. 1988:37) considering them further is beyond the scope of this paper because they are associated with Anasazi intrusions from the east and do not derive from local sandal traditions.

Non-intrusive archaeological sandals in southern Nevada, Arizona, and New Mexico (Map 4) include woven yucca shoes (moccasins) from Etna Cave and plain weave yucca sandals known as Figure-Eight sandals from numerous sites including Etna Cave, Black Dog Cave, and Ventana Cave.

Woven Moccasins: Wheeler (1973:17-18) excavated Etna Cave in 1934-37 and found seven "twined-woven type" sandals, in the first 15 inches of deposit, that "were fabricated with uppers and might justifiably be termed "shoes" or "yucca-fiber moccasins."(Figure 8a, b) In his description of

these sandals "the warp elements were laid parallel and pairs of woof elements twined back and forth. The woof courses are about a quarter of an inch part. At the toe the ends of the warp were folded back over the top of the sole and were held in place by a lacing of yucca which passed around the outer warp of the sole. Between this folded-back warp and the sole was placed a longitudinally-folded mat of juniper bark, half being above the foot and the other half under the foot as a pad. It appears that two of the extended warp elements were brought back, passed around the outer warp at the sides of the heel, or through a heel loop, and tied in front of the ankle."

Figure-Eight Sandals were first identified as "wickerwork sandals" by Kidder and Guernsey (1919:101-107) at Cliffhouse in northeastern Arizona. In 1934-37, S.M. Wheeler also found similar sandals at Etna Cave in Meadow Valley Wash and labeled them as the Figure-Eight Type (Figure 9a, b). As described by Wheeler (1973:18-19) "First, a loop slightly smaller than the finished sandal was formed of loosely twisted yucca string. This loop was the frame upon which the woof was woven, over and under the opposite sides. The frame was tied at the toe, a square knot being used in all except two of the specimens, in which the latter tie was made with a simple overhand knot. The general method of attachment to the foot was to bring the ends of the frame up between the toes, cross the string on top of the foot, pass them through a heel loop, and tie them in front of the ankle. In two cases were found figure-eight-woven sandals with uppers formed by lacing to the frame loop a mat of juniper bark similar to those in the twined-woven type. This general method was used top attach these to the foot. In fact, it would appear that the upper was attached to an ordinary sandal, possibly for use in cold weather. Reinforcement of the heel by wrapping the last three or four figure-eights with unshredded yucca is indicated on three specimens."

The Figure-Eight style sandals found at Black Dog Cave are similar those recovered from Etna Cave (Harry Reid Center 2003:315-323). As described by Winslow, they "are bundled into two warps, around which a weft is woven in a figure-eight pattern. The remains of fiber ties on the two complete sandals indicate a toe-heel fastening system "are constructed from warps that are predominantly flatleaf elements tied into knots at the heel and toe. In a knotted start, two, four, six, or more warps are aligned parallel to each other and then tied into one or more knots at the toe. In a knotted finish, warps are tied together at the heel with one or more knots. These are bundled into two warps, around which a weft is woven in a figure-eight pattern. The remains of fiber ties on the two complete sandals indicate a toe-heel fastening system."

Figure-Eight sandals are abundant in southern Great Basin collections (Harry Reid Center 2003:316). The dating on this type is unclear due to a limited number of direct dates. Temporal assignments run from the late archaic (Fowler and Madsen 1986:173-174) through Pueblo III (Harry Reid Center 2003:316-317). The only directly dated Figure-Eight sandals are from Black Dog Cave, with AMS dates of 1550+/-50 BP and 1580+/-40 BP (Harry Reid Center 2003:317).

Winslow sees the Figure-Eight style sandals from Black Dog Cave as being "most definitely Anasazi in affiliation" (Harry Reid Center 2003:317). However, in lower Ventana Cave, Haury (1950:432-435) found Figure-Eight sandals associated with Hohokam pottery and argued, without direct dates, for an age range from about A.D. 1 to AD 1700.

In addition, McBrinn (2005:61-71) discusses "pre-ceramic" Two-Warp sandals from southwestern New Mexico. These appear to be the same as Figure-Eight sandals except that some are started with a heel knot from which extends two cords that become heel loop or an ankle cinch. Others have toe starts with warps that become toe loops. While definitely not located in the Hohokam area, problems with the stratigraphy and dating at the sites in New Mexico make it difficult to accurately place them in time and culture.

Also, Wheeler (1973:21) found Figure-Eight sandals throughout the deposit in Etna Cave and argued that "they obviously represent a type familiar to all occupants of the cave, from earliest to the most recent. Wheeler also noted that "The Paiute of this region are reported to have used this form." This report is substantiated by Figure-Eight sandals collected from Southern Paiute weavers in the early twentieth century.

COMPARISONS

If a class of artifacts is useful for marking boundaries between cultural entities, without knowing the relevant cultural characteristics in advance, say from ethnographic description, it is good if the variability within a unit is less than the variability between units. With the available sandal data it is not clear if the variability within either the Southwest or the Great Basin is less that than the variability between them.

In comparing four archaeological sandals types (Table 1) from the Great Basin: Fort Rock (FR), Multiple Warp (MW), Spiral Weft (SW), and V-Twined (VT) with four archaeological types (Table 2) from the Southwest: Open Twined (OT), Warp Faced Plain Weave (WFPW), Figure-Eight/Two-

Warp (F8/TW), and Woven Moccasins (WM) some immediate intra- regional and inter-regional differences stand out.

Three of four Great Basin sandals types (FR, MW, VT) were started at the heel; one (SW) was started at mid-foot; and none were started at the toe. Both Archaic Southwestern sandal types from the Colorado Plateau (OT and WFPW) were started at the toe; one knotted (WFPW) and one (OT) not. One post-archaic Southwestern sandal type (F8/TW) was started at the toe by knotting and the other post archaic type (WM) may have been started at the heel. Some of the F8/TW sandals from New Mexico had knotted heel starts.

Two Great Basin types (FR and MW) were started with twined cordage loops at the heel, one (SW) with an oval start at mid foot and one (VT) with a circular basket start; none were knotted. Each type from the archaic Southwest (OT and WFPW) used different starts: one (OT) was started at one edge of the warps with an integral weft twined across the toe and the other (WFPW) was started by knotting two wefts at one edge of the warps and weaving across the toe. One post archaic type (F8/TW) was started with a knot at the toe to form both warps and the bindings. The other (WM) appears to have been started with open twining at the heel and finished with knotted warps at the toe.

All four sandal types from the Great Basin were twined with three of four types (FR, SW, and VT) limited to close twining and one (MW) with both open and close twining. Southwestern Sandals were more diverse with two open twined types (OT and WM), one plain weave type (WFPW), and one type (F8/TW) with over-under weave.

Three of the four Great Basin types (FR, MW, VT) have toe flaps made from shredded warp and one type (SW) does not. Southwestern sandals do not have toe flaps. Three of the four Great Basin types (MW, SW, VT) have heel pockets and one type (FR) does not. None of the Southwestern types have heel pockets.

DISCUSSION

There are several ways the distributional record for sandals could look in regard to geographic, cultural, or temporal boundary markers. If they do not marker boundaries, then there would be a one-to-one correspondence among types in one region and types in the other. All four types from the Great Basin, and only those types, would also be found in the Southwest or vice-versa. The same would be true with temporal boundaries. In the strongest case for marking boundaries there would be no overlap in time and space among regions. None of the four

types from the Great Basin would be found in the Southwest and none of the four types from the Southwest would be found in the Great Basin. Numerous intermediate cases, accounting for all possible combinations are also possible. For example, three of four Great Basin types could be limited to the Basin while one is also found in the Southwest, or vice-versa., or two each in each area, etc.

In looking at geographic boundaries, Geib (2000:520-521) argued that archaic sandals from the Colorado Plateau the have "no known close counterparts in adjoining regions such as the Great Basin, the southern Basin and range in Mexico, or the southern Plains." This is an example of a strongly marked boundary. None of the Great Basin sandal types are found on the Colorado Plateau and none of the Colorado Plateau types are found in the Great Basin. This review of sandals from both regions generally supports Geib's conclusion that there is an approximate technological boundary along hydrographic boundary (western Colorado River drainage) between Southwest and the Great Basin. If one looks at a series of sandals from both culture areas, it becomes clear that they represent different sandal making traditions.

Each tradition is internally homogeneous in appearance, style, and technique and the external differences in appearance, style, and technique are obvious from even casual observation. Each tradition also has sufficient variability to that allow typological distinctions to be made that have both geographic and temporal significance. The same appears to be true for F8/TW and WM sandals. The known distribution for these sandals matches the hydrographic boundary between the Great Basin and Southwest.

The evidence for sandals as temporal boundary is less convincing. The available data shows that some sandal types cross the temporal boundary between the Archaic and later periods while others do not. Geib noted that "there are no known archaic forms that could be antecedent to later Basketmaker and Puebloan sandals" (Geib 2000:521). This may be true for the Colorado Plateau, but it is not true in other parts of the Southwest. If McBrinn is correct, then there are Four-Warp weft-faced plain weave sandals that cross the Archaic/Basketmaker divide in New Mexico. In addition, other sandal types, not found on the Colorado Plateau, namely Figure-Eight/Two-Warp sandals appear to cross the cultural and temporal Great Basin/Southwest boundaries in Southern Nevada.

The evidence relating to cultural boundaries does not support sandals as good cultural boundary markers. All of the sandal types in the Southwest, except WM, are also found within the boundary of the Cultural

Great Basin. In the Great Basin, the observed changed in sandal types are not well correlated with changes in lithic technology, other textiles, or the environment. Fort Rock Sandals could represent the people who first occupied the western Great Basin some 10,000 to 11,000 years ago. It is unclear however, what happened to these people and what produced the demise of Fort Rock sandals and their replacement with Multiple Warp and Spiral Weft sandals. Also Multiple Warp and Spiral Weft sandals overlap in time and space, often being found in the same sites at the same time. There are no clear functional differences between these types and no reason to assume a gender or status difference either.

Sandals may not be useful in looking at the boundaries of the historic Numic population in the Great Basin (Madsen and Rhode 1994:103-113). The appearance of V-Twined sandals at Lovelock Cave in the Late Prehistoric may be associated with the Numic expansion. However, their very limited geographic distribution suggests otherwise. Unfortunately, except for ethnographic Klamath sandals from the northwestern Basin and ethnographic Figure-Eight sandals from southern Nevada, the available ethnographic sandals from Numic peoples are all memory models and except for a preference for twining sagebrush bark appear to have more in common with modern shoes that they do with prehistoric sandals. Within the Cultural Great Basin, Figure-Eight sandals are associated with the Southern Paiute in late Prehistoric and ethnographic times. Unfortunately, they are also found in southern Arizona and southwestern New Mexico well beyond Southern Paiute territory.

In the Southwest, Geib (2000:520-521) concluded that the archaic sandals from the Colorado Plateau demonstrate cultural continuity throughout the archaic while there are multiple changes in projectile point styles. He sees simple open twined sandals as a better boundary marker between the northern and southern Colorado Plateau than projectile points. However, this is hard to reconcile with the distribution of warp-faced plain weave sandals that appear to cross the north/south boundary.

CONCLUSION

This review started with the assumption, often cited in the literature, that textiles are better and more consistent archaeological boundary markers than lithics or other artifact classes (Adovasio 1986; Adovasio and Andrews 1986; Adovasio and Pedler 1994; Fowler 1994, Geib 2000; McBrinn 2005). The sandal data used in this review shows that sandal typology can suffer from some of the same problems as lithic typology. Just as with projectile points that are morphologically

identical but have different labels across artificial boundaries, morphologically similar sandals are labeled as Figure-Eight type in Southern Nevada and as Two-Warp Type in southwestern New Mexico.

In the Great Basin, some projectile point types (Desert Side Notched or Elko) and delimited in space or time while others (Humboldt for example) are not. The same is true for sandals. In the Great Basin, Fort Rock and V-twined sandals have well delimited temporal ranges and are useful for locating sites or site components in time. These sandals may also define group boundaries. Multiple Warp sandals have an extensive temporal distribution and, like some projectile points, are not useful for locating sites or site components in time. Multiple Warp sandals are also widely spread across the landscape and this limits their usefulness in establishing group boundaries. Spiral Weft sandal dating is problematic because they seem to have a distinctly bimodal distribution that limits their value as temporal markers.

Continuity in sandal production varies through time in each region. In the Great Basin there is continuity in some styles and production methods from the early archaic to the Late Prehistoric, and possibly into the ethnographic. In the Southwest the situation is less clear, in part because of a lack of directly dated sandals. There is apparent continuity within the Archaic and, possibly, a clean stylistic and technological break between Archaic and later sandals. This is muddied somewhat by Figure-Eight (Two-Warp) sandals in New Mexico that may cross the Archaic/Basketmaker boundary. In Southern Nevada, Figure-Eight sandals appear around AD 500 with no clear links to either local archaic sandals or contemporaneous densely woven yucca yarn sandals associated with the Anasazi. Densely woven yucca yarn sandals are clearly associated with Basketmaker and Puebloan people and not derived from earlier archaic examples (Geib 2000:521; Hays-Gilpin et al. 1998:39). If the Figure-Eight dating problem is resolved and the New Mexico examples turnout to be contemporaneous with similar sandals from Southern Nevada, then sandals could provide a clear boundary marker between archaic foragers and later agriculturalists.

Sandal production in each region begins in the early Archaic and extends into ethnographic times for some types but not others. Sandal production in the Southwest is thought to have ended sometime between about AD 1300 and the Spanish Entrada (AD 1540) when woven sandals were replaced by hide moccasins (Hays-Gilpin et al. 1998:39). However, based on direct dates, Figure-Eight sandals from Southern Nevada appear around AD 500 and continue into ethnographic

times. They are not similar to sandals in either the Great Basin or the Southwestern traditions and may be indicators of a prehistoric entrada into southern Nevada. This may also be true of the woven moccasins found in Etna Cave. It can be argued that ethnographic Klamath sandals are a continuation of Multiple Warp sandal into ethnographic times.

McBrinn (2005:68) sees both Two-Warp (Figure-Eight) and Four-Warp sandals as boundary markers between the Mogollon Rim and the Tularosa Basin. This is somewhat difficult to reconcile with Figure-Eight sandals from southern Nevada that appear to be the same as those from New Mexico.

One problem that emerges in the sandal data, but is not limited to it, in defining the regions or culture areas to be compared. If we base the analysis on the hydrographic boundary between the Great Basin and Southwest, then sandals are good boundary markers. If however, we focus in the cultural boundary then sandals are not good boundary markers. If we simply look at sandal distributions without regard to either the Great Basin or the Southwest, it makes more sense to think about the relationships among three sandal groups (Map 5). These are a Great Basin Group found in northwestern Nevada and southeastern Oregon composed of FR, MW, SW, and VT types; a Colorado Plateau Group centered on the Four Corners area and composed of OT and WFPW types; and a Southern Group found southern Nevada, southern Arizona, and southern New Mexico and composed of F8/TW types.

However, even if the regional definition problem is solved (pick an *a priori* definition and stick to it), the major problem with using sandal typology to mark boundaries remains. The insurmountable problem is that sandals are sufficiently complex so that one can always find empirical distinctions that create modern typological distinctions that likely have no relevance to how, where, why, and by whom sandals were made in the past. Given a sufficiently close analysis all woven artifact classes can devolve into individual unique specimens unrelated to each other. McBrinn (2005:40) clearly recognizes this problem when looking at textiles in general but fails to recognize it in her sandal analysis. The trick is to find a level of analysis that allows meaningful discussion of the archaeological record and the cultural processes that created it without falling to the trap of building typology that reflects the observer's acuity rather than the archaeological record.

Table 1: Great Basin Summary

Great Basin	**Fort Rock**	**Multiple Warp**	**Spiral Weft**	**V-Twined**
Material (not diagnostic)	Sagebrush bark, tule,	Sagebrush bark, tule, grasses	Same	Same
Start	At the heel	At the heel	Mid-foot	At the heel
Start technique	Arched loops	Arched loops	Oval basket	Circular basket
Sole technique	Close twining	Open/Close twining	Close twining	Close twining
Sole Warps	Along foot	Along foot	Across foot	Along foot
Binding type	Selvage loops/cord lace, ankle loop	Weft Loops/cord lace, ankle loop	Warp Loops, cord lace, ankle loop	Weft Loops/cord lace, ankle loop
Binding Attachment	Tie loops built into sole	Same	Same	Same
Toe flap	Yes, Open twined shredded warps	Same	No	Yes, Open twined shredded warps
Heel Pocket	No	Yes	Occasional, Attached	Yes
Age Range	8550-7350 BC	7500BC–AD 1100	7540BC–AD 500	After AD1400
Time Period	Early Archaic	Mid to Late Archaic	Mid or Late Archaic	Late Prehistoric

Table 2: Southwest Summary

Southwest	**Open Twined**	**Warp-faced Plain Weave**	**Figure-Eight**	**Woven Moccasins**
Material (not diagnostic)	Yucca	Same	Same	Same
Start	At toe	Same	At toe, rare heel	At Heel (?)
Start technique	Integral Twining	Knotted	Knotted	Arched Loops
Sole technique	Open Twined	Warp-faced plain weave	Over-Under	Open twined paired wefts
Sole Warps	Along foot	Same	Same	Same
Binding type	Weft Loops, cord lace, ankle loop	Toe/Heel - South, Lateral laces north	Toe/Heel	Cord lace ankle loop
Binding Attachment	Tie loops built into sole	Built into sole	Built into sole	Tie loops built into sole or Cord under last warp
Toe Flap	No	Same	Same	Bundled Unshredded Warps
Heel Pocket	No	No	No	No
Age Range	8030 to 5440 BC	5800-1450BC	AD400-1930	AD900-1600 (?)
Time Period	Early Archaic	Mid-Late Archaic	BMIII to PIV	PII to PIV (?)

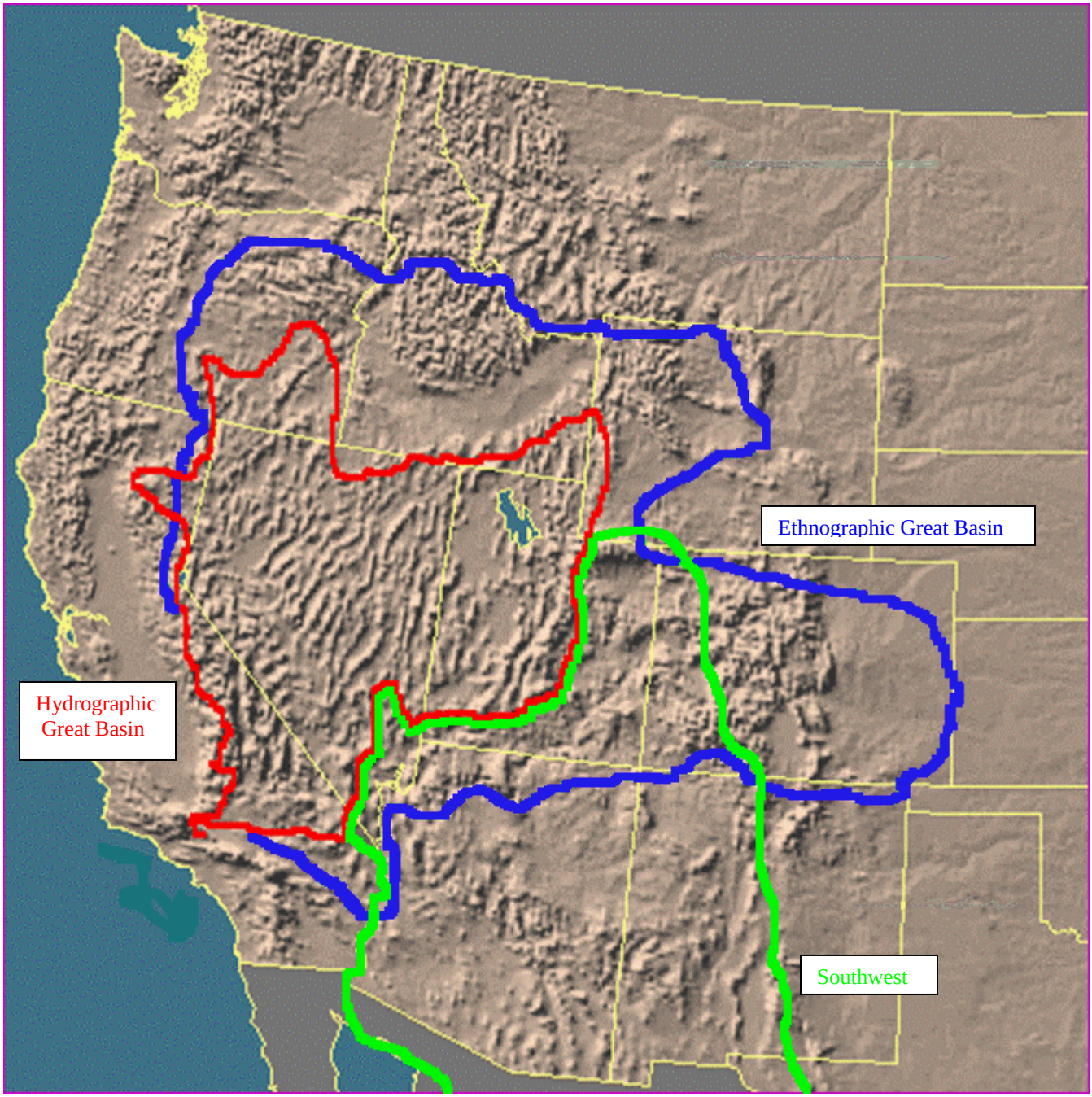

Figure 1. Great Basin-Southwest Boundaries

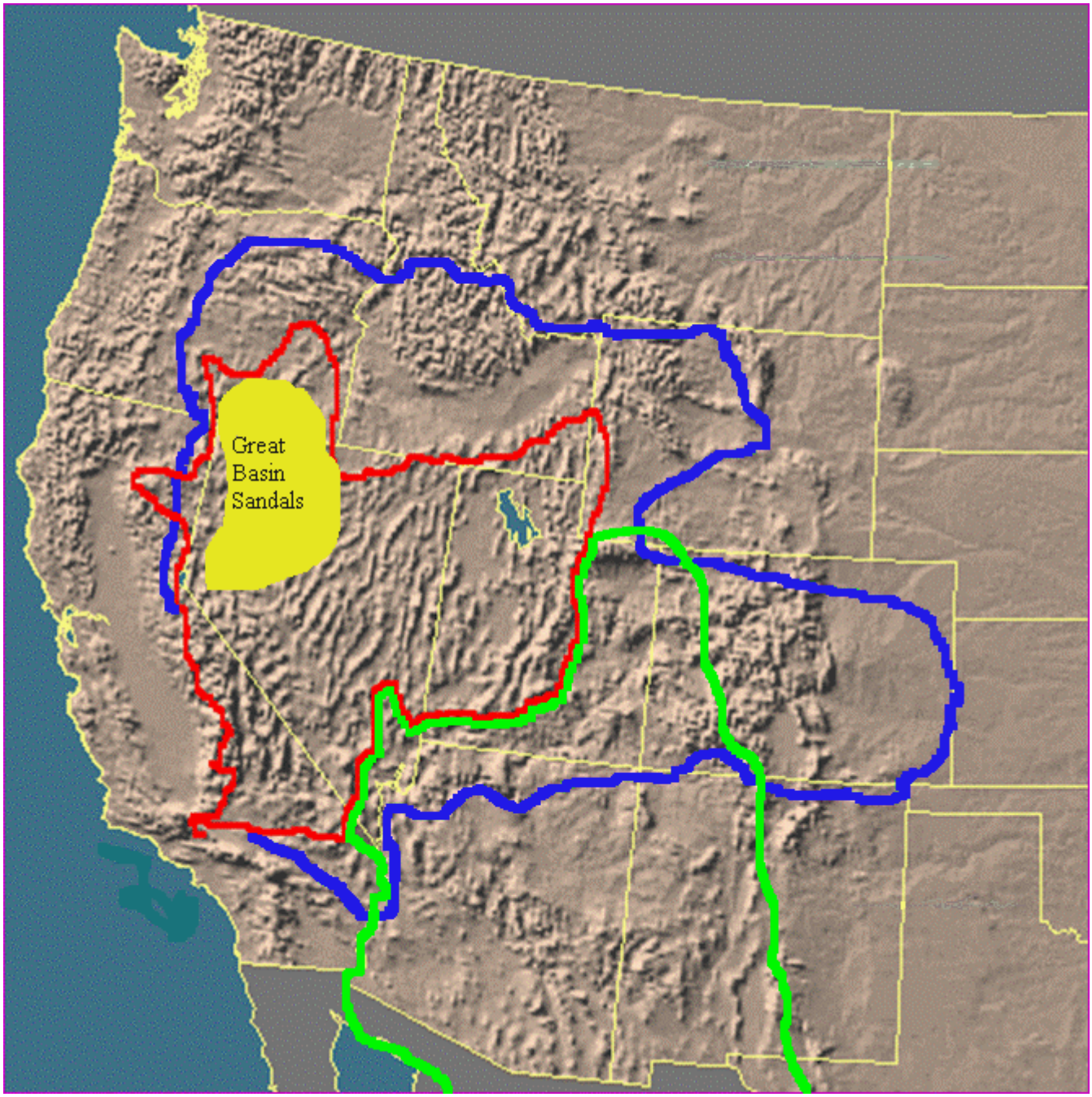

Figure 2. Great Basin Sandal Distribution

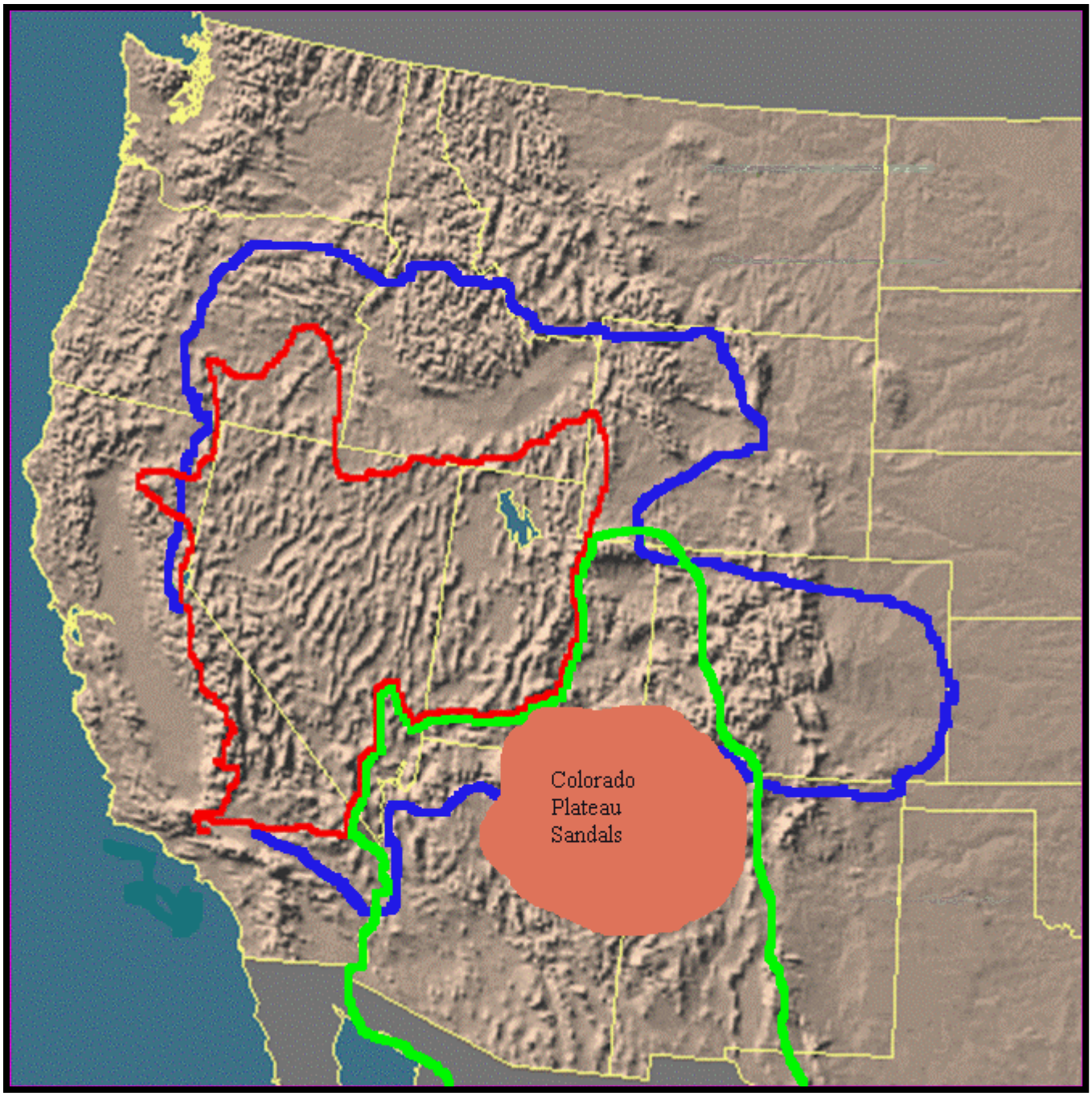

Figure 3. Colorado Plateau Sandal Distribution

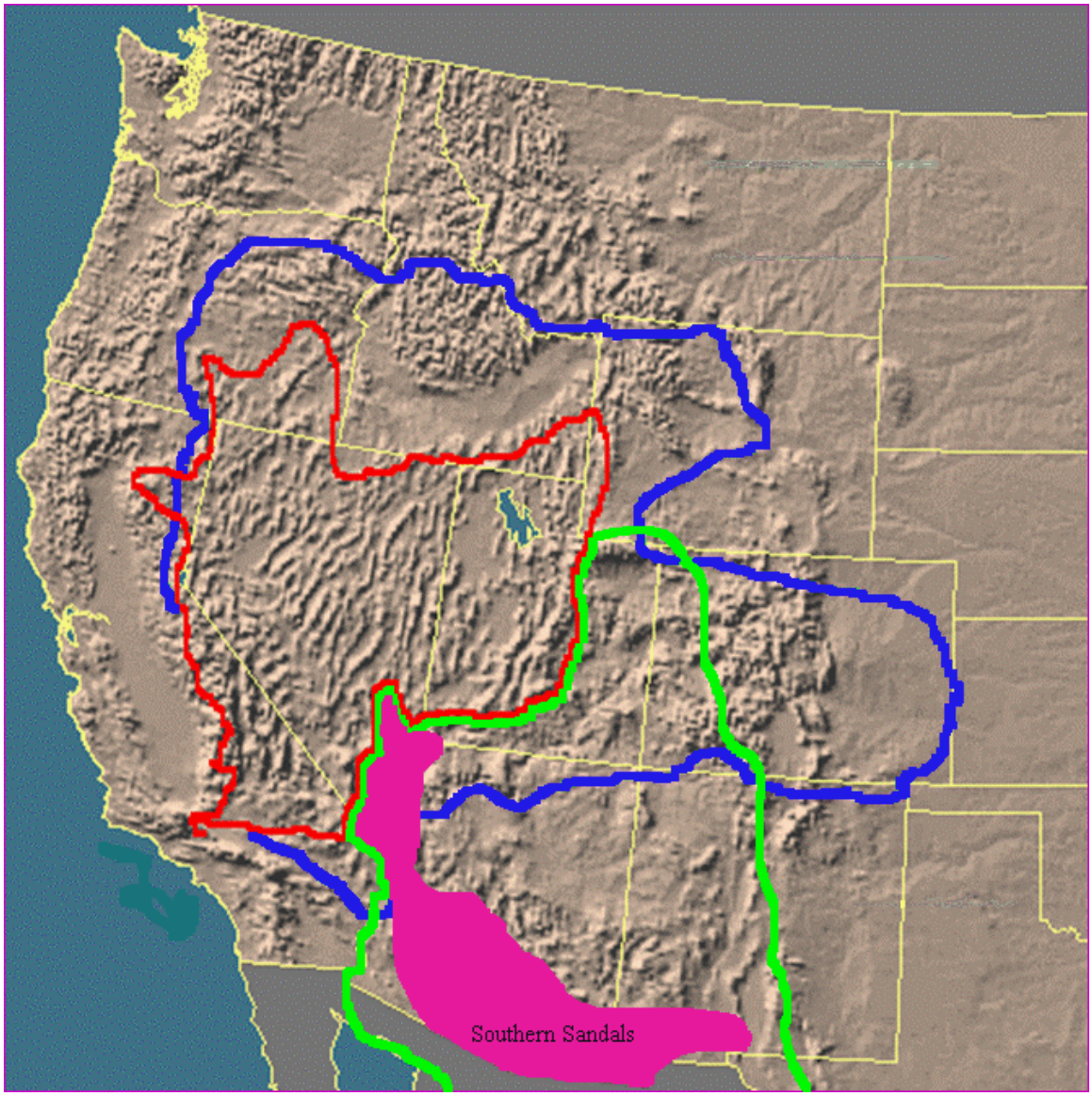

Figure 4. Southern Sandal Distribution

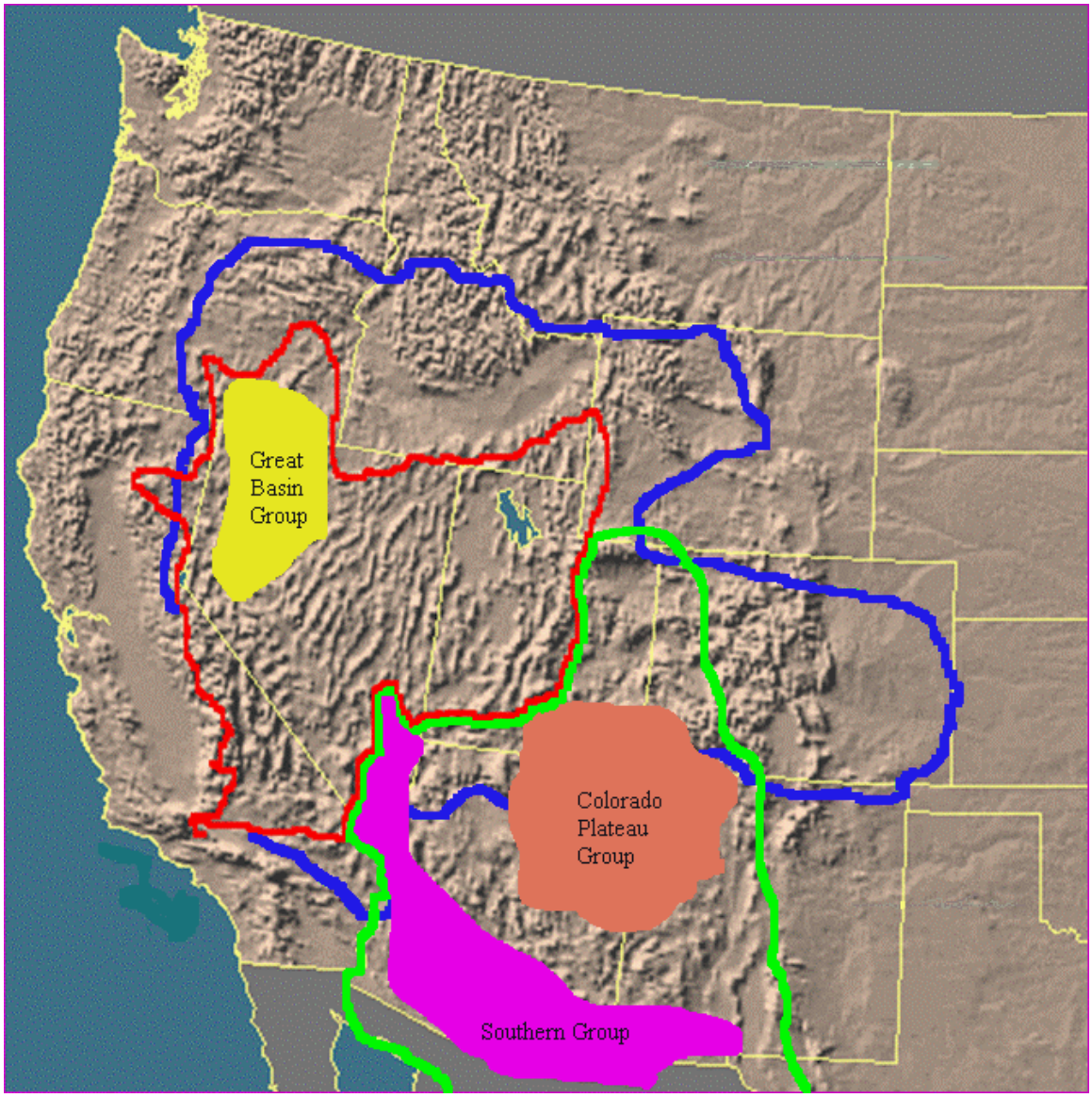

Figure 5. Summary Sandal Distribution

9
Asking Why in Great Basin Lithic Studies

Daron Duke and Gregory Haynes

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To proficiently garner data from flaked stone artifacts is to have command of the near entirety of the prehistoric material record. This fact is easy to forget when presented with the innumerable technicalities of artifacts that change with every strike of a hammer, but therein lies a record of decisions unparalleled in other artifact classes. This record is accessible when the right questions are asked. The right questions vary with the times and trends in archaeology, but usually turn on regional data needs. We believe it is a good time to reorient ourselves toward new challenges in lithic studies, and to reassert the value of lithic data to Great Basin archaeological research.

This paper is more about the goals of lithic studies than it is the models and means we have for elaborating them. Much is now known about the basic principles of stone tool reduction but more direction is needed. There is an implicit assumption in this statement that the Great Basin lithic record is up to the task. Vast basins and rugged uplands provide a distributional playground for researchers interested in hunter-gatherer ecology. This is also a reflection of this region's greatest weakness; its record is largely a surface one with only occasional stratigraphic detail. That said, it would be inaccurate to describe the Great Basin as lacking chronological control. Buried sites, especially caves and rockshelters, provide temporal resolution to the archaeological trends in nearly every corner of the region. Surface lithic analysis maintains unrealized potential for refining this resolution wherein whole technologies can be compared and cross-dated when diagnostic elements and relationships are defined (Lewarch and O'Brien 1981; Redman and Watson 1970; Thomas 1986a).

To see this potential through we have to think about stone tool reduction creatively. Over the last four decades archaeologists have developed and relied on lithic reduction models and settlement-subsistence relationships that now seem to reinforce themselves; a sign that, as we see it, technical lithic analysis is going stale. With exciting work being done in X-ray fluorescence (XRF) sourcing (e.g., Haarklau et al. 2005; Jones et al. 2003; Reed et al. 2005; Young 2008), this represents an analytical void that can undermine these advances. There are surely several reasons for this but we focus on one: a failure, as we see it, to carry over the how-to generalizations of stone tool manufacture into more interactive why-for types of studies that integrate reduction strategies as flexible aspects of lithic economy. We envision an analysis program that draws out variability

from artifacts to address integrative research issues, emphasizing lithic resource use as the primary avenue for relating local socioeconomic considerations to large-scale adaptive strategies (Figure 1).

AN HISTORICAL SKETCH

Anthropological research in the Great Basin has historically been important to hunter-gatherer studies (e.g., Jennings 1957; Steward 1938; Thomas 1983). Lithic studies in the region have not only kept up with trends but they have set many. The roadblocks are typical of those in lithic analysis in general (see Amick 1999; Thomas 1986a), but Great Basin archaeologists have contributed seminally to issues of typology, chronology, and economy[1]. Now looking back on the agendas of the New Archaeology it is clear why the statistical potential in lithic assemblages was such a draw to archaeologists looking for new methodologies.

At their best, Great Basin lithic studies maintain a processualist ethic of connecting data to broader theoretical concerns via middle-range research questions. Common research domains include mobility, subsistence, and technology, with interpretations stated in cultural ecological terms. Work in the central Nevada by Thomas (1983a, 1983b; also see Thomas and Bettinger 1976) is a benchmark for this approach in the Great Basin. Asking if it is possible to identify prehistoric land use patterns *as they varied* from those we know about ethnographically, Thomas looked to the form, function, and distribution of stone tools as material indicators of hunter-gatherer land use priorities. The particular value in this approach, to which lithics research can contribute significantly (see Amick 1994, 1999; Torrence 1994), is that it exposes aspects of the past that may have no ethnographic precedent.

When artifacts are shown to vary in unexpected ways they lead us toward new insights. Thomas (1981, 1983b) standardized central Great Basin projectile point typology through the development of a metrical key anchored by items and dates from Gatecliff Shelter. Despite Thomas' own cautioning, the key is repeatedly criticized in project reports and conference presentations when there are discrepancies. Deviations in relation to distance from central Nevada, toolstone availability, and land use priorities should be expected, even sought. Other critiques are aimed at the key's efficacy altogether. Based on experimental replications, Flenniken and Raymond (1986) charge that there is such variability among types, especially dart (i.e., Elko series) points, as a result of reuse and resharpening that it is inadvisable to produce a type call so distantly and then extend its

presumed date range to the many surficial archaeological contexts of the region. This provoked an acrimonious debate (Bettinger, O'Connell, and Thomas 1991; Thomas 1986a, 1986b; Wilke and Flenniken 1991) in which Thomas and others responded by asserting primarily that, for one, flintknapping replications do not necessarily reflect past behavior, and secondly, that technological vagaries are irrelevant to the chronological task if certain types can be associated with certain times. In this sense, deviations are trivial unless systematic, regardless of their potential relevance to some other technological issue.

That said, identifying reduction strategies is perhaps the most underestimated and underutilized aspect of lithic analysis in the Great Basin. When they are detailed, the analyses are usually buried in specialized report sections and used for descriptive or classificatory purposes. This is a hurdle analysts need to get over (see Amick 1999). Thomas and colleagues' harsh criticism of the rejuvenation hypothesis may represent one setback in this regard that is in need of rethinking. Thomas' (1986a) reply to Flenniken and Raymond (1986) abstractly maintains that it does not matter how points acquired their forms, only that these forms can be associated with certain time frames. This is not arguable, but carries an implicit assertion that we should not worry about the reliability of the Monitor Valley key because technological quirks are incorporated. This unfortunately detracts from the key's utility as a measure of all kinds of variability, none of which is chronological unless dates are known. Technological factors are critical starting points for both recognizing and understanding patterned deviations from the key. Resharpening may be the least of these factors when basin-specific raw material considerations can so easily affect projectile point form.

Reduction strategies are critical to the goal of assessing typological standards as they pertain to specific areas, and relating stone tools to lithic resources and land use priorities; this goes for projectile points as much as any other tool type. They are, in fact, the primary source of insight for how a host of issues, especially lithic resource use, but lend themselves to unnecessary elaboration when these issues are not clearly defined. We agree with Amick's (1999:162) statement that lithic analysts "…often seek to achieve processual goals with descriptive tools," and would add that these processual goals are often too artifact-oriented. This has produced a compartmentalization of lithics research that erodes its perceived utility. Over-reliance on established models and assumptions—e.g., biface stages, distance-decay, all-purpose debitage categories—only aggravate the problem when they are so far from accurate in

some cases that even their innocent use as heuristic devices is crippling.

Middle-range research, as it was pitched (see Bettinger 1991), has produced a slew of such generalizations about how tools are made and how they should relate to land use systems that are now the meat and potatoes of Great Basin lithic studies (e.g., Andrefsky 1994; Binford 1977, 1979; Callahan 1979; Goodyear 1979; Kelly 1988; Kelly and Todd 1988). We know, however, that these can quickly turn on local resource structure and related settlement and scheduling strategies. Recent lithic studies couched in behavioral ecology effectively cope with this problem because they begin with explicit microeconomic constraints that move from us from functional interpretations about how things are related to evolutionarily grounded explanations of cause and effect (e.g., Elston and Raven 1992; Elston and Kuhn 2002; Kuhn 1995). These studies examine behavioral variability by identifying a currency, usually energy, and then processing the archaeological record through a set of expectations that isolate that behavior in relation to explicitly defined influencing factors. Expectations and models are conceived with the assumption that reproductive fitness will be maximized by rational human behavior; as Elston (1992:32) states "…ancient people…judged the costs and benefits of lithic procurement well enough to recognize risks, payoffs, and losses in order to make informed decisions most of the time." At the Tosawihi chert quarries in north-central Nevada, Elston (1992; also see Elston and Budy 1990) finds the lithic production to reflect decision factors, especially how procurement, extraction, and processing were tailored to the characteristics and availability of stone. This defines an approach to flaked stone analysis that asks why, at a broad economic level, people behaved way they did, even if their specific cultural reasoning is lost to us.

TWO CASE STUDIES IN LITHIC RESOURCE USE

Two case are discussed below as examples of lithic resource use studies, one from the vantage point of a single site and the other from a broader use area. These cases represent a scale of research on par with the potential we see in most Great Basin studies (e.g., CRM projects, student research). Acknowledging that project funding and scheduling are limiting factors, analysts can always work toward establishing a decision-making context by providing as much detail as possible in terms of decision variables, especially for raw material characteristics (i.e., source, quality, and availability) and reduction strategy options. In this sense, lithic resource use is meant to convey the primacy

of local raw material constraints to broader aspects of lithic economy.

Middle Archaic Biface Technology in the North-Central Sierra Nevada

Just north of Lake Tahoe, the Squaw Valley site is situated at the mouth of Squaw Valley near the Truckee River (Figure 2). The site is typical of Middle Archaic, or "Martis," sites in the region containing crude basalt bifaces alongside exorbitant amounts of biface reduction debitage. Martis has always been interesting to researchers for its uniqueness to the upland Tahoe-Sierra (e.g., Elsasser 1960; Elston 1971; Heizer and Elsasser 1953), but we believe this distinctiveness only goes as far as certain typological and technological traits (e.g., Martis point styles, crude bifaces) which are incidental to a reliance on locally abundant basalt. The Washoe ethnographic pattern for this area was to use the mountains in the summer (Downs 1966; Price 1962), and a similar pattern is expected for Martis groups, but since about 1,200 years ago people never needed so much rock, and nearly left basalt alone (Elston et al. 1994). The prevailing interpretation of this pattern has been a production-oriented one that such a copious lithic record is the expected byproduct of the inherent difficulty in reducing basalt (e.g., Edwards 2000; Elston et al. 1977; Rondeau 1980, 1982), but this tells us nothing about what role this technology played for Martis peoples, or why.

The Squaw Valley site provided an opportunity to scrutinize these interpretations (Duke et al. 1998). The site is located one quarter mile west of the Truckee River and several large Martis habitation sites (Elston et al. 1977). Radiocarbon dates cap the site at 1,200 years ago, the estimated end of the Middle Archaic (Duke et al. 1998). What is most unique about the site are its situation and setting. Primary deposits are located on a steep 15 to 25 degree slope set squarely within a spring complex and dense riparian zone; sites in the Tahoe-Sierra are rarely found on slopes over 8 to 10 degrees. The assemblage is classic Martis at its minimum containing crude broken bifaces and biface reduction flakes but few other tool types. The essential question for the site is one of site function: is this a task-specific tool use site associated with the spring complex, or is it another of many Martis biface-making workshops? The important Sawtooth Ridge basalt source is located only a few kilometers to the east and the reduction of early stage bifaces clearly was a priority at nearby residences.

There was plenty of basalt around so why not waste it? A better question might be that there is plenty of basalt around so why spend time wasting it. The physical characteristics and availability of this material

are important to consider (Duke 1998). Basalt is coarse-grained, at least relative to other preferred toolstones such as obsidian and chert, it is not sharp, and it is brittle, which makes bifaces easily broken by end shock and miss hits. Its chief strong suit is that it is durable, in large part because of its crystalline nature. For tool use, basalt's interlocking grains provide this durability, but for flaking this trait only compounds difficulties because increased force must be applied to detach flakes, increasing the potential for error. When used as a tool, basalt's effectiveness is restricted to tasks that do not stress a sharp edge as it is not only grainy, but its matrix is actually relatively soft and dulls more quickly than most other toolstones, thereby requiring comparatively frequent resharpening (Richards 1988). This last trait necessitates an abundant resource, which is definitely a strong suit of basalt in the Tahoe-Sierra. People focused stone procurement on a few primary sources, supplemented by smaller ones dispersed throughout the area between Lake Tahoe north to Sierra Valley (Day et al. 1996; Duke 1998; McGuire et al. 2006). Not only is basalt highly available, but its frequent occurrence as angular to tabular cobbles and boulders containing few irregularities is ideal for flintknapping. An obvious expectation follows that careful biface thinning would not be the most effective way to utilize basalt resources or save time and energy.

Maybe Martis bifaces are simply crude tools. To test this obvious alternative was straightforward enough but required abandoning a standard reduction model. Studies have thus far relied on biface stages as an interpretive framework, leading researchers to puzzle over why finished items could hardly be found. Defaulting to the intractable nature of basalt, the primary interpretations have been that mass waste would be expected in the production of bifaces either for trade (Elston et al. 1977) or for transport away from the source (Rondeau 1980, 1982). Recent XRF studies now show us where the primary basalt sources are, and other work demonstrates that roughed out bifaces characterizes assemblages quite far from them; distant bifaces do not get proportionately thinner and are frequently made from flake blanks transported to these areas (Duke 1998). The implication is that not only can Martis bifaces be tools in any form, but biface manufacture is so limited in importance that we should expect little of what we find off-quarry to have anything to do with manufacture beyond knocking out resharpenable tools from transported flake blanks of required thicknesses.

A simple experiment and use wear study was conducted at the Squaw Valley site to address the problem (Duke et al. 1998). Basalt use wear experiments by Richards (1988) indicate that a rounded edge, which

looks almost melted under magnification, is the most common type of damage on basalt because it is essentially soft upon contact with materials. This being the case, green and woody plants are the most likely candidates for materials being worked. A replicated basalt biface was used to debark a sagebrush branch and resharpened as necessary until it was too small to use easily. The goal was simply to see if casual resharpening produced a similar biface and to simulate the rounding observed intermittently along the margins of archaeological bifaces. The resharpening debitage was collected and analyzed for rounding on the platform-bearing flakes. Of 243 flakes, 44 possessed platforms and only seven, or 16 percent possessed rounding. A sample of 164 pieces of archaeological debitage was then analyzed for comparison and resulted in 59 platform-bearing flakes with nine, or 14 percent, possessing rounding. These are not large samples but they are consistent, and meaningful in that they provide some insight into why people would generate extensive debitage on a relatively steep slope in a riparian thicket.

The interpretation of crude bifaces as plant processing tools at this site opens us up to a much richer view of technology as it relates to daily life for Martis people, one that puts them on the landscape with a purpose and relates them to land use dynamics beyond the site itself. Small task-oriented groups are envisioned leaving residences along the Truckee River to gather plant materials here on routine daytrips. The riparian zone is full of various small trees, shrubs, and forbs, that could have served as a nearby source of manufacturing materials and food resources, with our emphasis on the former as indicated by use wear. It is not unreasonable to assume that these groups consisted largely of women and children if regional ethnographies are any indication (e.g., Downs 1966; Price 1962; also see Zeanah 2004). In any case, determining whether roughed out bifaces are a Stage 2, 3, or 4 carries little meaning compared to discovering further reduction and use variability throughout the Squaw Valley area and beyond. A fruitful research path might focus on how we can identify different types of bifacial tools and how they are distributed across resource procurement sites; for example, do bifaces look the same at sites where we expect that people were conducting other activities, such as fishing or hunting? Does their occurrence rate alongside other tool types such as flake tools and projectile points pattern out according to these site types? What are the cost-benefit expectations for these sorts of variability? Even single sites can be used to robustly address these issues.

Paleoindian Tool Types and Assemblage Structure near Yucca Mountain

Our second study is landscape level in nature using data from several sites in

southern Nevada. This analysis starts from the basic hypothesis that different raw materials contain different physical properties, and that the unique physical properties in different rock types will be better suited for certain functions. If this hypothesis is correct, then we should find that toolstone selection in the archaeological record is patterned according to tool type (Andrefsky 1994; Torrence 1983). This premise lends itself not only to gross tool morphology, but also to edge modification as well. An important component in testing this hypothesis comes from laboratory-based materials analyses that measure certain physical properties in rock types.

The association of different rock types with morphologically distinct tool types at Paleoindian assemblages across the Great Basin has been tentatively identified by a number of independent researchers (Amick 1993, 1995; Basgall 1993; Beck and Jones 1990, Jones and Beck 1999). Their inferences, however, are confounded by the fact that spent, non-local obsidian and/or cryptocrystalline silicate (CCS) tools are typically replaced by locally available volcanic rocks (i.e., rhyolite, basalt, andesite, tuff, etc.). Yucca Mountain, located in southwestern Nevada, is an excellent location to address this issue because it contains an abundant Paleoindian record, and because obsidian, CCS, and rhyolite are all available in the immediate area. This study enables us to examine lithic resource use by investigating which toolstones are preferred for different kinds of tools without the complication of differential toolstone availability. This case shows that people not only made different kinds of tools from different kinds of stone, but these patterns of use structure the lithic assemblages found at Paleoindian sites across Yucca Mountain in interpretable ways.

A quick review of assemblage data obtained from Paleoindian sites at Yucca Mountain confirms our expectation that tool morphology does, in fact, vary based on raw material. Tables 1, 2, and 3 break down assemblage data. Table 1 shows that, out of a total of 74 Great Basin Stemmed (GBS) points obtained from nine sites, about three quarters are made from obsidian (74%), with those remaining made from rhyolite (16%) and CCS (10%). Similar results are observed among 170 specialized scrapers and gouges, but in these cases CCS is the favored material, at over 50 percent compared to 37 percent rhyolite and 16 percent CCS (Table 2). It is noteworthy that when site 26Ny1011—an incredibly dense rhyolitic quarry—is removed from examination, the percent of scrapers and gougers made from CCS increases to 71 percent (n=76), with rhyolite and obsidian splitting the proportional difference.

The last table presents the use choices for rhyolite, cross-tabulated with tool types at different sites across the region (Table 3). Of the 889 rhyolite tools, 91 percent are either in the form of cores (unprepared tools) or early biface forms. Also, at non-quarry Paleoindian sites, the overwhelming majority of rhyolite tools, or 88 percent, are found at sites located along Fortymile Wash. At the Fortymile Wash sites, 91 percent of rhyolite tools are also cores (unprepared tools) or biface stage forms, as opposed to projectile points, scrapers or gougers. Conversely, at the four Paleoindian sites found away from Fortymile Wash, rhyolite is primarily in the form of specialized scrapers/gougers and projectile points.

Laboratory-Based Raw Materials Analyses

Archaeologists commonly conduct experiments where they make and use copies of the stone tools they seek to understand. A large body of literature now exists on flintknapping and the identification of material residues preserved on tools, among other kinds of actualistic investigations. Only limited research, however, has been conducted on the physical properties of different lithic materials and how these properties affect stone tool manufacture, function and use life (but see Amick and Mauldin 1989; Elston 1990, 1992). Over 20 years ago, Torrence (1983) identified this as an important research domain for understanding lithic technology, yet Odell's (2000) review of lithic analyses at the end of the century devoted no more than three sentences to this topic. Obviously, this is a research domain that needs further attention.

Archaeologists generally rank knappable rock types by observing textural quality (Crabtree 1967). The finest quality rock, in terms of texture, is obsidian because it is glassy and lacks a crystalline structure. Cryptocrystalline silicates, such as chert and chalcedony, exhibit a great deal of textural variability, ranging from microcrystalline to grainy. Mafic rocks, like rhyolite, basalt and tuff, are typically coarse grained when compared to obsidians and many types of CCS. These determinations, though, are only relative and do not specify the particular physical properties that make certain rock types better for certain functions.

Flintknappers prefer rocks like obsidian because they are characterized by high elasticity and resilience, coupled with low hardness and fracture toughness values (Table 4). These kinds of rocks do not have to be hit hard to remove flakes, and conchoidal fractures are easily controlled. What this means from a material standpoint is that these stone types easily deform and rebound back into their original shape unless there is a catastrophic failure. Low hardness and fracture toughness values identify why

obsidians are so brittle and, associatively, why they are ideal for use on relatively soft items. When obsidians are used on harder items, like wood or antler, such treatment will quickly dull or damage these tools, requiring a steady supply of raw material.

Associated with a wide range in texture, CCS also exhibits wide ranges in other physical properties. Some CCS varieties show elasticity and resilience values comparable to obsidian (Table 4); no doubt these toolstones exhibit a microcrystalline texture. Tensile strength and fracture toughness values are, in many cases, also comparable to obsidian. Conversely, most CCS types have greater compressive strength and transverse bending values than obsidian, although hardness values are more comparable. Those CCS types that exhibit the highest compressive and transverse bending values tend towards a macrocrystalline texture. In general, scores for elasticity and resilience, as well as fracture toughness, show that CCS falls between obsidians and tuffs; however, like tuffs and other mafic rocks, most CCS is not overly susceptible to catastrophic failure when pushed, pulled and twisted (compressive/transverse strength). As Jones (1979) points out, CCS bifaces are the best tools to use when raw material is at a premium, because they can be resharpened over and over again, while still maintaining a sharp edge. The engineering tests, along with experimental studies, show why CCS is a good, general purpose lithic material.

Most mafic rocks, including tuffs and rhyolites, exhibit the lowest elasticity and resilience values of all three rock types (Table 4). This means that these rocks do not easily deform or rebound back into shape when hit. On the other hand, engineering tests show that tuffs have the highest fracture toughness values, which means that they retain their stiffness and overall morphology up to the point of catastrophic failure. Combined with hardness values that are more similar to obsidian than CCS (Table 4), these tuffs tend to be soft and allow for penetration. Taken as a whole, engineering tests show that tuffs and rhyolites can absorb shock or high-intensity use by allowing penetration (low hardness values) and retaining overall form (high toughness values), which combined constitute the least potential for catastrophic failure. Leaving aside a need for extremely sharp edges, flakes and tools made from these mafic rocks represent the best material for high-intensity and/or long-term use; i.e., they are durable.

Interpreting Assemblage Structure across the Yucca Mountain Paleoindian Habitat

So, how do the physical properties of obsidian, CCS and rhyolite relate to the differential manufacture of stone tools? The straightforward explanation is that GBS

points are made from obsidian because it contains a glassy texture, is relatively weak, and has elastic/resilient qualities that allow it to be shaped into sharp points. Specialized scrapers and gougers are made from CCS because this material has very high compressive and transverse bending values that enable it to withstand various kinds of compression and bending forces encountered during various food processing and manufacturing activities. Finally, rhyolite is found primarily in the form of cores, rough biface forms, and utilized flakes because tools made from mafic rock are best suited to heavy-duty and/or high-intensity processing activities.

While these common-sense answers may be on the surface correct, they do not fully explain the overall distribution of rhyolitic tools across Paleoindian sites at Yucca Mountain. Nor do these answers adequately explain why obsidian and CCS cores and bifaces are found in such large numbers at these sites. Knowing something about the physical properties inherent in each of these raw material types allows for a better understanding of overall lithic assemblage structure and how humans organized their activities across a landscape. Rhyolite tools will be the focus of this discussion.

Looking at the distribution of tool types across Yucca Mountain (Table 5), GBS points and CCS unifacial scrapers/gougers are common at all of them; however, only assemblages along Fortymile Wash contain abundant rhyolite. In fact, nearly 50 percent of the artifacts found at Fortymile Wash sites are made from this material (n=150), while a full one-third of all tools found at these sites are rough bifaces (n=103). Conversely, only 10 percent of the artifacts found at non-quarry sites away from Fortymile Wash are made from rhyolite (n=18) and only one percent of these are bifaces (n=2). The implication is that rhyolite is being used at sites along Fortymile Wash for specific purposes relating to its particular physical properties, that is, those suited to high-intensity, heavy use tasks that demand durability over tool sharpness. This means that intensive processing activities were common at sites along Fortymile Wash, but rare at other sites in the complex.

The superabundance of tuff indicates that people had low residential mobile in Fortymile Wash, and is one of a number of patterns suggesting that the Fortymile sites sites represent a hub in the Yucca Mountain area. In this reconstruction, Paleoindian groups were centered on Fortymile Wash, working along it on a day-to-day basis. Sites away from the wash represent the location of other point specific patches or resource collection spots within the area. The small size of these sites, coupled with assemblages composed of curated tools, suggests higher

levels of mobility and short-term occupancy. This organization entails a foraging strategy for groups along Fortymile Wash, while sites beyond Fortymile represent some form of logistical component in the overall settlement-subsistence strategies practiced in this specific area.

CONCLUSIONS

It is important to remember when doing lithic analysis that stone tools were made to be used, and that each one is the summary of a very practical human event. This is easy to forget when confronted with piles of artifacts and the host of ways in which there are to process and describe them. In this chapter we have stressed the importance of asking questions that pertain to the "why-fors" of technological behavior rather than continued emphasis on the "how-tos" of stone tool manufacture. We believe this is best done by focusing on the dynamics of lithic resource use where the energetic costs and benefits of technological options are addressed, and the potential to integrate findings into broader research goals is enhanced. Lithic resources, like any other, are consumed from the landscape by necessity and planning, and when considered in this way their unique ability to indicate to us the technological connection people had to their environment comes forward.

Recent studies in lithic sourcing have produced intriguing results and a concerted approach to realizing the potential of these data is needed. Cultural resource management projects are generating new XRF sourcing results almost daily which are often coupled with hydration rim values in the case of obsidian. Most primary obsidian sources are now identified, and the search for new sources has turned to basalt and related volcanics (e.g., dacite, andesite). The rush for these finds is spurred by their inherent appeal as direct indicators of people's movements and preferences. The concern here is that many studies are moving forward without any behavioral control. For example, Great Basin peoples did not use all toolstones equally (Beck and Jones 1990); sometimes stockpiled stone in various forms at residences (Duke and Young 2007); did not necessarily include the whole group in stone acquisition (Elston and Zeanah 2002; Zeanah 2004); and may have emphasized trade items over their own functional needs (Gilreath and Hildebrandt 1997). Each of these variables alters the effective distance between sites and lithic sources.

There has been no mention thus far of the organization of technology, as current lithic studies are often referred (cf. Carr 1994a; Nelson 1991). This is partly because we are not focusing on the nuts and bolts of lithic analysis, and we consider this to be

more of a middle-range methodological thrust than a theoretical direction in its own right. In particular, the emphasis on procurement-to-discard reduction strategies and the differential distribution of stone tools across site types relate directly to lithic economy, but with connections between lithic studies and ecological theory continuing to strengthen (e.g., Elston 1990, 1992; Elston and Brantingham 2002; Kuhn 1995; Brantingham 2003) there seems to be less need for the distinction. In a 1994 review, Torrence briefly discusses an unpublished statement by Carr about distinguishing "how" versus "why" sorts of questions in organizational studies and sees argues that there was no theoretically meaningful difference between the two at the time. Carr (1994b:2) further states: "It is likely that future studies of technological organization will be more explicitly guided by evolutionary ecology as a theoretical orientation." Fifteen years later we believe there is good reason to distinguish them as many organization-of-technology studies have tended to focus on generalizing technological behavior away from specific cases (e.g., reduction stages, curation vs. expediency, design features) without clarifying what rational human beings would be expected to do in certain contexts. The latter perspective is more explanatory and enlightening of peoples' technological problems and solutions.

Our position is ultimately practical: we want to know why people made certain choices so we can infer something about what their lives were like and how they survived. These choices were made locally. This sounds particularistic, but it is in an evolutionary grounding that gives this variability a role to play in broader issues. That is to say that there is no better lithics question in the Great Basin right now than one that is directed at a non-lithics issue. Following of a development flurry of lithic analysis methodologies, we are faced with the need to put them to good use. The potential that lies in the Great Basin lithic record can be aggressively pursued if these methods are utilized as tools of the trade rather than as their own redundant outcomes.

NOTES

1. To discuss the state of lithic studies in the Great Basin is to acknowledge at the outset that most work is done in a cultural resource management (CRM) context. We see no reason in this day to formally distinguish it from academic research, and the issue has been thoroughly covered elsewhere (e.g., Elston 1992b; Gilreath 1999). Cultural resource management work in the western U.S. is vital and vibrant, producing project reports that go far beyond simple data dumps in gray literature. Extensive public lands have given Ph.D. and M.A. degreed professionals eminent regional experience with archaeology in diverse settings, and in many instances these individuals represent an essential core of researchers who work, publish, and play alongside academic colleagues. For their part, academic departments also cooperate with state and federal agencies to provide inexpensive CRM support that gives students valuable experience and research opportunities. The distinction now even seems played out as important advances have been made in both realms, as cited throughout this chapter.

Table 1. Great Basin Stemmed Projectile Points by Material Type (all nine sites.)

	Obsidian	CCS	Rhyolite
Counts	**55**	7	12
Frequency	**74%**	10%	16%

Table 2. Bifacial and Unifacial Scrapers/Gouges by Material Type.

	Obsidian		CCS		Rhyolite	
Counts	18	(16)	**91**	**(76)**	61	(15)
Frequency	10%	(15%)	**53%**	**(71%)**	37%	(14%)

[1] Values in parentheses do not contain 26Ny1011, a rhyolite quarry

Table 3. Rhyolite by Tool Types at Different Paleoindian Sites near Yucca Mountain.

	Projectile Points	Bifacial/ Unifacial Tools	Unprepared/ Staged Tools
All Sites (n=9)			
Counts	15	64	810
Frequency	2%	7%	91%
Fortymile Wash (n=3)			
Counts	9	5	140
Frequency	6%	3%	91%
Other Non-Quarry Sites (n=3)			
Counts	6	10	5
Frequency	29%	48%	23%

Table 4. Results of Physical Properties Tests by Raw Material Type.

	Obsidian	CCS	Tuff[d]
Elasticity/Resilience 1 (Shore Scleroscope)[a]			
Range	101-121	93-111	64-105
Mean	110.2	99.6	88.5
Elasticity/Resilience 2 (Poisson's Ratio)[b]			
Score/Range	6.80	0.09-0.16	*
Hardness Test 1 (Rockwell Superficial Hardness Tester)[a]			
Range	58-96	84-96	75-94
Mean	89.1	92.3	87.6
Hardness Test 2 (Shore Monotron)[a]			
Range	16-38	23-40	29-32
Mean	24.9	33.9	30.7
Hardness Test 3 (Shore Scleroscope)[b]			
Score/Range	94.8	99.6-165.5	*
Fracture Toughness 1 (Paige Impact Test)[a]			
Range	3-10	6-15	*
Mean	6.94	10	19
Fracture Toughness 2 (megaNewtons/m^2)[b]			
Range	12.9-13.4	1.04-35.8	
Compressive Strength 1 (no test name or units of measure given)[b]			
Score/Range	0.15	173.1-365.5	*
Compressive Strength 2 (MegaPascal)[c]			
Range	300.8-745.2	295.67-1273.93	*

Transverse Bending (megaNewtons/$m^{½}$)[b]			
Score/Range	0.08	45.5-117.9	*
Tensile Strength (megaNewtons/m^2)[b]			
Range	214.5-345.5	21.2-360	*

[1] Tuff is a proxy for rhyolite and other toolstone-quality mafic rocks

[a] Goodman 1994

[b] Luedtke 1992

[c] Domanski et al. 1994

Table 5. Overall Tool Counts by Material Type at Paleoindian Sites near Yucca Mountain.

	Obsidian	CCS	Rhyolite	Totals	
Quarry Sites					
Cores/Hammerstones	23	229	359	611	(47%)
Biface Stage Forms	125	102	333	560	(43%)
Unifacial Tools	3	25	36	64	(5%)
Bifacial Tools	2	3	14	19	(1%)
Projectile Points	41	3	5	49	(4%)
	194	362	747	1303	
Fortymile Wash Sites					
Cores/Hammerstones	6	4	37	47	(15%)
Biface Stage Forms	69	10	103	182	(59%)
Unifacial Tools	5	18	3	26	(8%)
Bifacial Tools	1	4	2	7	(2%)
Projectile Points	35	8	5	48	(15%)
	116	44	150	310	
	(37.4%)	(14.2%)	(48.4%)		
Other Non-Quarry Sites					
Cores/Hammerstones	0	15	2	17	(9.5%)
Biface Stage Forms	39	20	2	61	(34%)
Unifacial Tools	2	33	9	44	(24.5%)
Bifacial Tools	4	5	0	9	(5%)
Projectile Points	34	9	5	48	(27%)
	79	82	18	179	
	(41.7%)	(43.4%)	(10%)		

Figure 1. Five Elements of Lithic Resource Use.

5 Elements of Lithic Resource Use

Geologic Sources

+

Toolstone Characteristics

+

Functional Context

+

Reduction Strategies

+

Case Specific Question

=

LITHIC RESOURCE USE

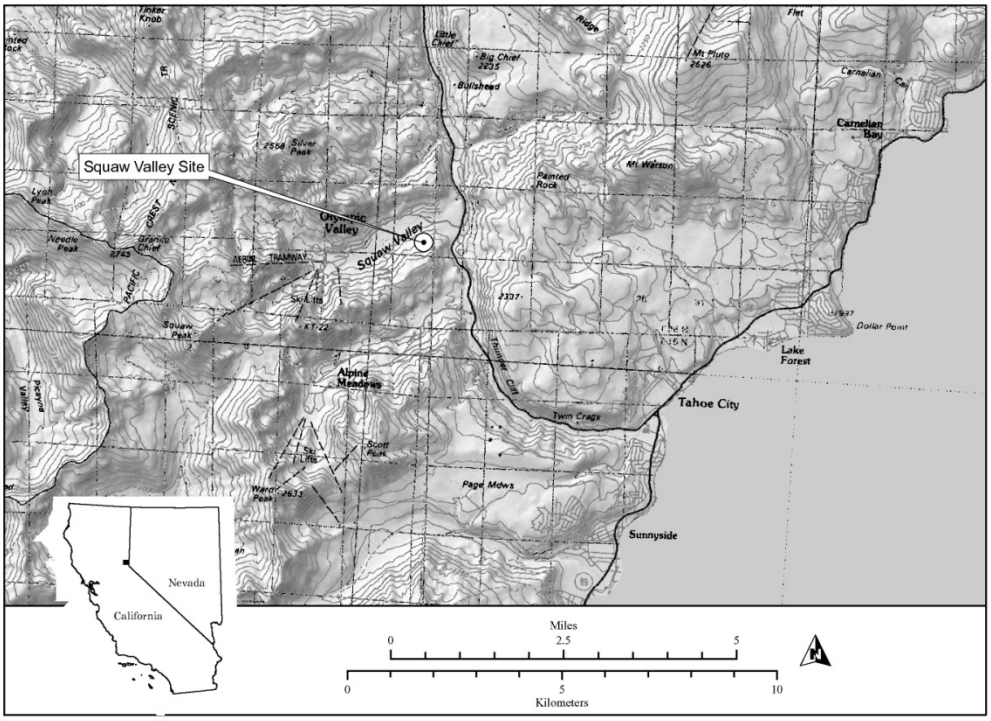


Figure 2. Location of the Squaw Valley Site.

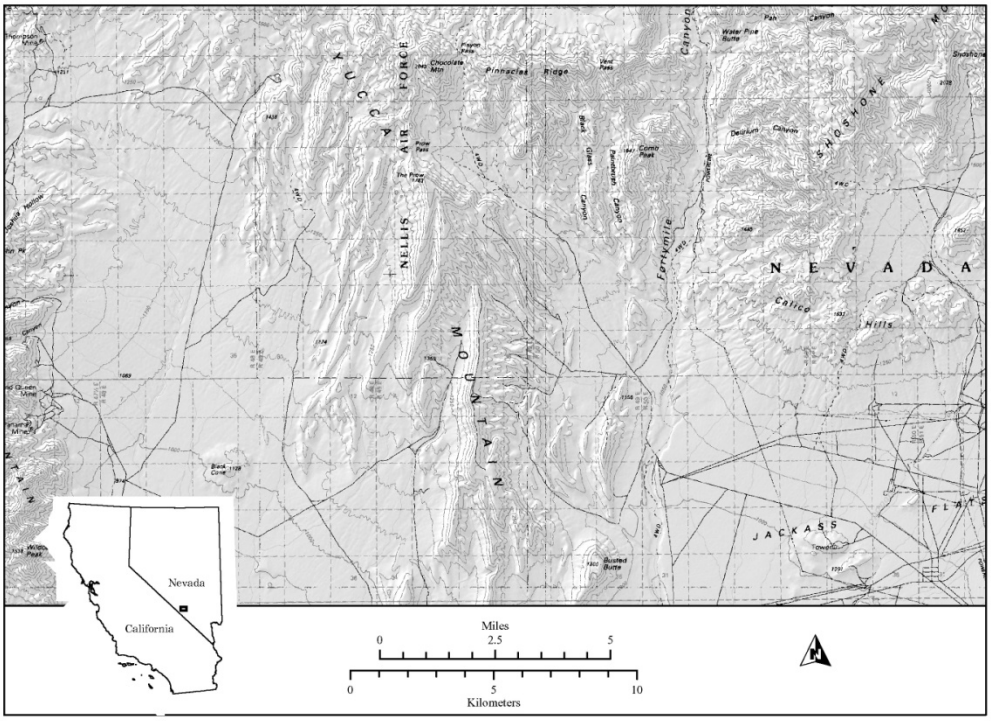


Figure 3. Location of Yucca Mountain Study Area.

10
13,000 Years of Large Game Hunting in the Great Basin

Bryan Hockett

*

Large game animals (e.g., artiodactyls and extinct megafauna) have played a pivotal role in understanding the subsistence behaviors of ancient Great Basin foragers. Questions that have been asked most frequently include: (1) Did the first inhabitants of the Great Basin hunt now-extinct megafauna?; (2) What role did large game play in the overall subsistence economies of Great Basin foragers?; (3) Did the degree of large game hunting vary through time? If so, was it related to changes in climate, technology, forager preference, or other factors?; (4) Did the degree of large game hunting vary in proportion to the degree of small game hunting?; and (5) What is the relationship of large game hunting to the health and well-being of ancient foragers?

In the 1920's, the exciting discoveries of fluted spear points in direct association with the skeletons of ancient bison in the American Southwest generated an enthusiasm to find similar discoveries across western North America. In the Great Basin, Mark Harrington (1933, 1934) argued that artifacts recovered alongside sloth bones at Gypsum Cave and artifacts associated with horse bones at Smith Creek Cave probably indicated that humans hunted now-extinct megafauna in the Intermountain West. Additional claims of human-megafauna interaction in the Great Basin were subsequently made at the Paisley Five-Mile Point caves by Cressman (1946), and at Fishbone Cave by Orr (1956).

Prior to 1960, other important Great Basin sites were excavated that lacked now-extinct megafauna, but nevertheless contained long chronological sequences that documented thousands of years of human subsistence practices. Jennings (1957) devoted a single page to the evidence for subsistence on animal resources at Danger Cave. In this discussion, Jennings noted that 3,179 bones could be assigned to one of the five stratigraphic levels he defined based on work from the 1949 and 1950 field seasons. Jennings (1957:224) summed up large game hunting at Danger Cave this way: "The chief game resource appears to have been the ungulates".

Also during the 1950's, Julian Steward interpreted large game hunting in the Great Basin through his concepts of cultural ecology and multilinear evolution. Steward's thoughts were

intertwined with the basic notions of fissure and fusion of forager societies based on the location and abundance of plant and animal resources within an unpredictable Great Basin environment. Because patterns of rainfall were unpredictable from year to year, so, too, were Great Basin foraging settlement patterns at that scale. For Steward, large game hunting such as driving pronghorn into corrals occurred wherever these animals happened to be abundant in any given year, and took place among many cooperating nuclear families because to do so increased the per capita harvest of meat. This was contrasted with seed and berry harvesting which occurred amongst individuals and nuclear families rather than cooperating groups because the "per capita harvest", a phrase that would be renamed "net caloric return rates" three decades later by optimality theorists, would be greater amongst individual foragers.

Beginning in the 1960's and continuing into the 1970's, Robert Heizer and Martin Baumhoff began questioning the purported chronological and behavioral associations of artifacts and bones of extinct megafauna in the Great Basin (e.g., Heizer and Baumhoff 1970). This debate continued into the early 1980's (e.g., Cressman 1966; Tuohy 1968; McGuire 1980; Gruhn and Bryan 1981; also see Watters 1979 for a detailed treatment of the debate prior to 1980).

As taphonomy gained a foothold in archaeological analyses during the mid-to-late 1980's, many of the so-called behavioral associations between humans and megafauna in the Great Basin faded into obscurity. By the late 1980's, realizing that no human group likely relied on large game for the bulk of their subsistence in the Great Basin – including Late Pleistocene and Early Holocene-aged foragers – Willig and Aikens (1988) coined the term "Paleoarchaic" to refer to the broad-based subsistence strategies of these early foragers.

Studies of diachronic patterns in large game hunting throughout much of the 1980's, 1990's, and the early 21st century, however, have been dominated by optimality models. These approaches continue a tradition of deductively-based analysis that focuses on ideal types or optimal representations of reality created by the researcher in order to compare these 'ideals' to a test case. This method of analysis can be traced at least as far back as the economic and social writings of Adam Smith (1963/1776), John Stewart Mill (1967/1836), and Max Weber (1920). Currently couched in Darwinian terms, these studies aim to test

whether ancient human foragers made subsistence decisions based on a principle of maxima and minima in nature, and more specifically on the belief that selection favors individuals who obtain maximum calories with a minimum of effort. In these models, large game serves as the ultimate fitness-enhancing caloric package (e.g., Broughton and O'Connell 1999; Ugan 2005), and optimality practitioners argue that foragers always pursue big-game when encountered, despite the potential abundance, reliability, and nutritional benefits of smaller game and plant food resources because of a perceived reproductive advantage afforded to those who pursue such a foraging regime.

More recently, studies have shifted the focus on why human foragers pursue large game from net caloric return rates to show-off or prestige hunting, in which the better hunters of large game differentially gain access to better mothers, thereby gaining a reproductive advantage (e.g., Hildebrandt and McGuire 2002). These models represent a simple shift in ideal currency within an optimality framework while maintaining a reductionist focus on reproductive success in Darwinian terms.

More recently still, Jonathan Haws and I argued for a holistic approach to the study of ancient subsistence behaviors and demography that focuses on current knowledge about the ways various food items, including large terrestrial mammals, contribute essential nutrients to the health and well-being of humans (Hockett and Haws 2003, 2005). This approach represents our vision of nutritional ecology, and it seeks to break free from the tautological nature of optimization approaches (e.g., Jennings 1986:119) to interpret archaeological patterns.

One common thread in all of these studies, however, is the reliance on bones of large game animals to interpret patterns of big-game hunting in the Great Basin. Certainly, bones represent the most direct evidence we have for large game hunting. Nevertheless, faunal remains may be biased in a number of respects. First, bones generally do not preserve well in open-air contexts in the Great Basin unless they are rapidly buried following the death of an animal; as a result, caves and rockshelters preferentially preserve faunal remains. Second, it's probably safe to say that, in most instances, large game kills were made away from caves and rockshelters, most of the time. Third, of those few cave and rockshelter localities that preserve a long record of human hunting of large game at a specific place,

the number producing reliable evidence has been reduced further either by looting or by the fact that many sites were excavated so long ago that the excavation methodology employed now minimizes their data potential.

The upshot of all of this is that archaeologists interested in large game hunting in the Great Basin should utilize all data at their disposal in order to understand and interpret the archaeological record. With this in mind, I wish to discuss large game hunting in the Great Basin over the past 13,000 calendar years by using both projectile point density values and artiodactyl density values in tandem. This approach illuminates some interesting diachronic patterns in large game hunting in the Great Basin that may serve as a baseline for further research and testing.

PROJECTILE POINT DENSITY VALUES FOR OPEN-AIR SITES

I compiled projectile point density values for 20 areas spread across the northern, central, and southern Great Basin (Figure 1). For consistency, I use the phase names developed for the Upper Humboldt region to order the points in chronological sequences (Table 1), although others could be used as readily as these because corresponding phases in other parts of the Basin encompass similar time frames. However, in some regions such as south-central Oregon in the extreme northwestern corner of the Great Basin, Elko points are commonly found as early as 5,000 BP (Jenkins et al. 2004), while these points generally date no older than 3,500 BP throughout the central and southern regions. As a result, the density values for the Oregon samples during the corresponding James Creek Phase are likely overly generous. Likewise, Elko points may also be found in Maggie Creek Phase assemblages – albeit in much smaller numbers than during the previous James Creek Phase. Thus, the density values calculated here are estimates of general trends; I have attempted to alleviate any egregious errors by purposively including survey areas from all regions of the Great Basin (except the eastern sector), and only included survey data in which a minimum of 100 typable points have been recorded. In some cases, over 1,000 typable points have been recorded in a single study area. Overall, the 20 samples encompass nearly 10,000 typable points (Table 2).

To obtain the raw data, I followed the methodology first established by Bouey and Rusco (1985), and later used by Elston (1986), Bettinger (2003), and

Kautz and Simons (2006), among others. Specifically, I simply divided the total number of each point style recorded in each study sample by the amount of time each style was manufactured, and then multiplied that value by 100 in order to produce values that represent the "number of projectile points per century" for each cultural phase. The results of this exercise are displayed in Table 2.

I assume here that points as archaeologically defined tools were manufactured primarily to kill large game. Points were sometimes used for other purposes, including knives for cutting meat and other items, as well as for hunting smaller game, but the majority of them were likely used to shoot at large game. I therefore take changing density values as a proxy measure of the relative intensity of large game hunting through time in the Great Basin.

The projectile point values per century may reflect the intensity of large game taken but not necessarily their respective contribution to the diet. This is because of shifting population densities through time, and we have no concrete values to use to adjust for this effect. Put another way, more mouths to feed would have required more food to procure, so we could document twice as many projectile points in one phase compared to another but in reality both groups may have consumed the same amount of meat and marrow on a per person basis during individual lifetimes. So more points probably mean more intense artiodactyl hunting, but it may or may not mean greater reliance on large game in the overall subsistence diet.

The 20 samples of projectile point density values produce six distinct patterns (see Figure 2). Below is a summary of these six patterns, together with a brief description of each:

Pattern 1

The "Valley-Mountain" pattern is the most common, and is seen in eight of the 20 (40%) samples. Bald Mountain, Honey Lake, Little Boulder Basin, Alturas-Reno, Steens Mountain, Truckee Meadows, Fort Rock Basin, and Cheuwacan-Abert characterize this pattern. The Valley-Mountain pattern is created by either relatively stable, modest declines, or slight increases in density values from the Dry Gulch to Pie Creek phases, followed by an increase through the Maggie Creek Phase, terminating in a decline during the Protohistoric. There are, however, two subtypes within this pattern. In subtype "a", the decline in point density values during the

Protohistoric suggests a 50% drop in large game hunting compared to the preceding Maggie Creek Phase (1300 – 600 BP), but the values are still higher than at any other time in prehistory (10,500 – 1300 BP). In subtype "b", the Protohistoric values drop below one or more of the pre-Maggie Creek phases, suggesting an even greater reduction in large game hunting from Maggie Creek to Eagle Rock times.

Pattern 2

The "Bull Market" pattern is seen in four of the 20 (20%) samples. Owens Valley, Monitor Valley, Carson Desert-Stillwater, and Cortez characterize this pattern. The Bull Market pattern is created by a relatively steady increase in projectile point values throughout prehistory. The Protohistoric Period has the highest point density values of any time in prehistory.

Pattern 3

The "Double Mountain" pattern is seen in three of the 20 (15%) samples. Reese River, Massacre Lake, and Newark Valley characterize this pattern. The Double Mountain pattern is created by a relatively steady increase in projectile point values from the Dry Gulch through the South Fork phases, followed by a drop during the James Creek Phase, an increase during the Maggie Creek Phase, and a final drop during the Eagle Rock Phase. The final drop during the Protohistoric is not dramatic, suggesting that large game hunting remained relatively stable throughout the Late Archaic.

Pattern 4

The "Big Dipper" pattern is seen in two of the 20 (10%) samples. Goshute Valley-Cherry Creeks and nearby Spruce Mountain characterize this pattern. The Big Dipper pattern is created by relatively stable projectile point values from the Dry Gulch to the Pie Creek phases, followed by a surge in density during the South Fork Phase. A steady drop in values is then witnessed during the James Creek and Maggie Creek phases, followed by a final increase during the Protohistoric Period.

Pattern 5

The "Double Valley" pattern is seen in two of the 20 (10%) samples. Fort Irwin and the Tosawihi Quarries characterize this pattern. The Double Valley pattern is created by relatively stable or drops in projectile point values from the Dry Gulch to the Pie Creek phases, followed by an increase during the South Fork Phase, a decrease during the James Creek Phase, an increase during the Maggie Creek Phase, and finally a surge

in point values during the Eagle Rock Phase.

Pattern 6

The "High Valley" pattern is seen in only one of the 20 (5%) samples. Pilot Valley characterizes this pattern. The High Valley pattern is created by relatively stable projectile point values from the Dry Gulch to the Pie Creek phases, followed by an increase during the South Fork and James Creek phases, a decrease during the Maggie Creek Phase, and a final increase in point values during the Eagle Rock Phase.

If all 20 areas are combined into a sample size of nearly 10,000 typable points, a macroscale Great Basin pattern is produced (Figure 3). There are several interesting implications generated by this exercise. Among them are the following: (1) Microscale patterns do not necessarily, and in fact most of the time do not match the macroscale patterning in Great Basin projectile point densities; (2) LSN points dating to the Middle Holocene (Pie Creek Phase) were made as frequently as Western Stemmed points in many regions. If a population decline occurred during the Middle Holocene (ca. 8,500-5,000 BP), then perhaps artiodactyls were more important to the diet of these foragers than Late Pleistocene/Early Holocene foragers; and (3) The intensity of artiodactyl hunting during the entire Late Archaic (ca. 1,300-150 BP), including the Protohistoric period, was as great or greater than during the first one-half of the Late Holocene (ca. 5,000-1,300 BP). It is quite possible that this spike, which is associated with the arrival of the bow-and-arrow in the Great Basin, had as much to do with technology increasing the success of large game hunts as climate or social customs.

Elaborating on this latter finding, projectile point density values increased in 16 out of the 20 cases (80%) after the adoption of the bow and arrow. In fact, the two Late Archaic phases occupied the top spot 18 of 22 times (82%), counting ties in greatest intensity twice. In addition, the Protohistoric (after 650 BP) showed the greatest intensity in seven of these 22 (35%) counts, indicating that artiodactyl hunting remained strong in many regions of the Great Basin until historic contact. In contrast, the entire early portion of the Late Holocene, represented by the South Fork and James Creek phases (ca. 5000 – 1300 BP), retained the top spot in only four of the 22 counts (18%). The James Creek Phase held the top count in only a single case (Pilot Creek Valley) during the heart of the cool and moist Neoglacial climatic

episode of 4,000-2,000 BP. Nevertheless, there was a spike in projectile point density values at the onset of the Late Holocene, which remained relatively constant until the adoption of the bow-and-arrow.

The projectile point data from open-air sites also produce interesting spatial patterns. Figures 4-9 show the six highest density locations of projectile points for each cultural phase in the northern, central, and southern Great Basin. These data suggest that artiodactyls were hunted most frequently during the Dry Gulch Phase in the northwestern, east-central, and southwestern sectors of the Basin (Figure 4). After ca. 7,500 BP, artiodactyl hunting was greatest along a NW-SE trending line from the northwestern to the east-central Great Basin (Figure 5). During the initiation of the Late Holocene after ca. 5,000 BP, artiodactyl hunting remained strong along this trend, but spread in a southwestern direction from it (Figure 6). No pattern prevails during the Neoglacial of 3,500 – 1,300 BP (Figure 7), suggesting that artiodactyl hunting was evenly spread throughout the Basin. The northwestern sector witnessed the greatest intensity of artiodactyl hunting after the introduction of the bow-and-arrow, during the Maggie Creek Phase (Figure 8). Finally, artiodactyl hunting shifted to the south and east during the last five-to-six centuries prior to Euroamerican contact (Figure 9).

PROJECTILE POINT DENSITY VALUES FROM CAVES AND ROCKSHELTERS

How do the values of projectile point densities from open-air contexts compare with those recovered from caves and rockshelters? The cave and rockshelter reports used for this analysis include Hogup Cave, Sudden Shelter, O'Malley Shelter, Camels Back Cave, Swallow Shelter, Gatecliff Shelter, Pie Creek Shelter, James Creek Shelter, Rampart Cave, and Bonneville Estates Rockshelter (see Table 3).

Table 4 shows the raw numbers of projectile points recovered from the caves and rockshelters. Figure 10 shows the average number of points per century recovered from these caves and rockshelters. Overall, the relationships of the values of the South Fork, James Creek, and Maggie Creek phases are similar to the open-air samples. Thus, the intensity of artiodactyl hunting did not appear to vary an appreciable degree between ca. 5,000-1,300 BP, or during the manufacture of Gatecliff, Humboldt, and

Elko points. The high projectile point density values recovered from caves and rockshelters in the Maggie Creek phase confirms the data generated from open-air contexts, suggesting that artiodactyl hunting intensified rather dramatically at the onset of the Late Archaic with the manufacture of Eastgate and Rose Spring points. Both data sets also suggest that while the intensity of artiodactyl hunting dropped during the Protohistoric, it rivaled the intensity seen earlier in the Middle Archaic.

The most glaring discrepancy between the cave and rockshelter values and those from open-air sites rests with the relatively high point values in caves and shelters during the Middle Holocene (Pie Creek Phase). A number of factors could account for this phenomenon, including the fact that increased erosion during the Middle Holocene (Nials 1999) may have differentially destroyed much of the open-air archaeological record from that time. It is also possible that Middle Holocene foragers occupied caves and rockshelters more frequently after artiodactyl kills than Late Holocene foragers. In addition, the raw data counts (Table 4) show that the large number of Middle Holocene-aged points principally come from three sites: Hogup Cave, Sudden Shelter, and Bonneville Estates Rockshelter. Other sites, such as Camels Back Cave and O'Malley Shelter, do not show as strong a tendency for large game hunting during the Middle Holocene. The degree of large game hunting near individual sites, therefore, varied considerably during the Middle Holocene.

ARTIODACTYL DENSITY VALUES FROM CAVES AND ROCKSHELTERS

In Great Basin caves and rockshelters, artiodactyls have been recovered on average in greater frequencies during the Pie Creek Phase of the Middle Holocene than in any other phase except Maggie Creek (Table 5 and Figure 11). These data generally match the projectile point frequency data. Both data sets produce a bimodal distribution (compare Figures 10 and 11), suggesting that the intensity of artiodactyl hunting was greater during the warm Middle Holocene (Pie Creek Phase) and the relatively warm Fremont era (Maggie Creek Phase).

PUTTING IT ALL TOGETHER: 13,000 YEARS OF LARGE GAME HUNTING IN THE GREAT BASIN

The faunal and projectile point data presented above suggest the following general patterns for the Great Basin:

(1) Artiodactyls constituted a relatively small part of the diet of Late Pleistocene/Early Holocene foragers who manufactured Western Stemmed projectile points. If that is the case, then there may be many more sites that date to the Late Pleistocene and Early Holocene that have gone unrecognized because most of them probably will not contain projectile points. One of the ways in which this issue can be addressed is through obsidian hydration analysis.

(2) Artiodactyls appear to have been very important to some of the subsistence economies of the Middle Holocene. This period represents the longest warm-dominated climate of the Holocene epoch.

(3) If populations were growing during the first one-half of the Late Holocene, after ca. 5,000 BP, then artiodactyls, while still important, may have played a lesser role in the overall diet than during the Middle Holocene. A caveat here that must be considered, however, is the evidence for the beginning of communal hunting during the South Fork phase in regions such as northeast Nevada (Hockett 2005). It is also possible that Pie Creek foragers of the Middle Holocene deposited their artiodactyl kills more frequently in caves and rockshelters, while later foragers deposited them more often in open-air contexts surrounding these communal kills, where faunal preservation was reduced. These suggestions are offered as hypotheses for further testing.

(4) Ironically, the projectile point and artiodactyl data sets suggest that large game hunting after ca. 5,000 BP did not spike during the James Creek Phase, or between 3,500 and 1,300 BP. This period corresponds to the cool and wet Neoglacial, when human populations were thought to have greatly expanded from earlier levels (Elston 1986). If a population boomed occurred, then these "Good Times" of the Neoglacial were not instigated by increased artiodactyl hunting per se; rather, they probably were partly sparked by an expanding and more readily available and diverse diet (e.g., Hockett and Haws 2003, 2005).

(5) The projectile point and artiodactyl data suggest that large game hunting was greatest between 1,300 and 600 BP than any other time over the past 13,000 calendar years. This period is associated with the manufacture of Eastgate and Rose Spring points, and the introduction of the bow-and-arrow into the Great Basin. It was also a period of extended warm climate in the Great Basin.

(6) The projectile point and faunal data, together with the large number of communal traps and corrals associated with the Protohistoric period in some regions (e.g. Hockett 2005), indicate that the final 600 years or so prior to Euroamerican contact witnessed reductions in artiodactyl hunting compared to the Maggie Creek phase, but the intensity was as great as the South Fork and James Creek phases. It is possible that the establishment of both bow-and-arrow technology and communal hunting by 1,300 BP contributed to the relatively high degree of artiodactyl hunting late in Great Basin prehistory.

CONCLUDING THOUGHTS

Large game hunting in the Great Basin probably was an important subsistence activity throughout the prehistoric occupation of the region. Its intensity varied through time, as well as from place to place. At a macroscale, large game hunting was not intensively pursued during the Paleoarchaic prior to 8,500 BP. The data presented here, as well as from sites such as Bonneville Estates Rockshelter (Hockett 2007), suggest that many foraging societies of this early time practiced a very broad-based subsistence regime. In contrast, during the relatively warm and dry Middle Holocene (ca. 8,500 – 5,000 BP), large game hunting probably varied dramatically across the Great Basin. Large game animals were more likely to be taken to caves and rockshelters for processing during the Middle Holocene compared to the Late Pleistocene or the Early Holocene, although the reasons for this behavior remain unclear.

The hunting of artiodactyls remained strong during the transition to the Late Holocene after ca. 5,000 BP, although fewer of them were processed in caves and rockshelters compared to the Middle Holocene. Nevertheless, larger numbers of projectile points per century have been recorded from open-air contexts dating to the early Late Holocene compared to their frequency during the Middle Holocene. This discrepancy between cave/rockshelter and open-air locales is puzzling, but may be related to erosion of open-air sites during the Middle Holocene. The frequencies of projectile point manufacture and deposition of artiodactyls in caves and rockshelters remained relatively steady throughout the Middle Archaic, or between 5,000 and 1,300 BP. The onset of the cool and moist Neoglacial, dating between about 4,000-2,000 BP, appeared to have little impact on the intensity of artiodactyl hunting in

the Great Basin. This changed, dramatically so, during the onset of the Late Archaic at ca. 1,300 BP. Frequencies of projectile point manufacture and deposition of artiodactyls in caves and rockshelters increased two-fold from earlier Middle Archaic levels. At least two unrelated events are associated with this increase: (1) the introduction of bow-and-arrow technology into the Great Basin, and (2) a climatic shift to warm temperatures and a summer precipitation pattern beginning about 1,600 BP. Either one of these events, or both, could have influenced the increase in artiodactyl hunting at this time. In any case, the period between 1,500 and 650 BP saw the greatest intensity of artiodactyl hunting at any time during the prehistoric occupation of the Great Basin. During the Protohistoric, after ca. 650 BP, the intensity of artiodactyl hunting decreased, but levels remained at least as strong as, or slightly greater than, Middle Archaic levels. This latter finding was perhaps the most surprising of any other. The Protohistoric Period in the Great Basin is often viewed as a time of intensive small game hunting and seed grinding. That may indeed be the case – but these late prehistoric foragers also took their fair share of artiodactyls, and may have enjoyed large game meat as frequently as did foragers who lived between 11,000-1,300 BP in the Basin.

At a microscale, there was much variability in the intensity of large game hunting across the Great Basin. Different valley-and-mountain systems witnessed various degrees of artiodactyl hunting through time. As Julian Steward (1955) noted over 50 years ago, these differences may well reflect the nuances of individual foraging decisions being made at the local level, where individual societies were making subsistence choices for a variety of reasons, some of which are likely meaningful but unknowable from the archaeological record.

And while we may not understand why all of these foraging societies made those subsistence decisions, the results remain interpretable through the projectile points they manufactured and the artiodactyls they butchered.

Table 1. Phase names used throughout this analysis and their approximate ages, durations, and associated projectile point types.

Phase:	~Date (BP)	~Duration:	Point Style(s):
Eagle Rock	650 -150BP	500 years	Desert Side-Notched; Cottonwood
Maggie Creek	1300 – 650BP	650 years	Eastgate; Rose Spring
James Creek	3500 – 1300BP	2200 years	Elko Series
South Fork	5000 – 3500BP	1500 years	Gatecliff; Humboldt
Pie Creek	7500 – 5000BP	2500 years	Large Side-Notched
Dry Gulch	10500 – 7500BP	3000 years	Western Stemmed

Table 2. Numbers of typable projectile points per century per phase from the 20 study areas. Data from Tosawihi Quarries, Spruce Mountain, Pilot Creek Valley, Goshute Valley/Cherry Creek Range, and Cortez has been compiled here for the first time primarily by the author. Data from other regions taken primarily from Bettinger (1999:70, Table 5.6) and Kautz and Simons (2005:53, Table 13).

Phase	Date	Point Style	Bald Mt.	Mon. V.	Cars. Des. / Still.	Trk M.	Alt. Reno	Hon Lk.	Tos	LBB	Spr Mt.	Plt. V.	Nw V.	Ft. Rk. B.	St. Mt.	Ow V.	Ft. Irw	Go. V./ Ch. Cr.	Ch. / Ab.	Mas Lk.	R. R.	Cor.
Eagle Rock	550-50 BP	DSN; CTND	8	21	23	10	14	3	21	16	23	6	1	8	9	10	40	6	1	5	7	8
Maggie Creek	1300-550 BP	EG/RS	11	14	16	20	33	6	5	33	15	4	2	45	37	6	16	4	26	6	8	8
James Creek	3500-1300 BP	ELKO	5	11	4	14	8	2	2	11	20	6	2	9	17	1	3	6	6	3	5	7
South Fork	5000-3500 BP	GTC/HUM	4	5	3	<1	3	1	3	8	30	3	3	3	11	1	13	7	3	5	7	6
Pie Creek	7500-3500	LSN	<1	1	0	0	1	<1	1	1	1	<1	<1	1	5	<1	<1	2	3	1	1	<1

	BP																					
Dry Gulch	10800-7500 BP	W. STEM	<1	0	0	<1	2	1	1	<1	1	<1	<1	2	<1	<1	5	2	1	<1	0	<1
N			300	548	374	518	621	138	270	716	1167	264	102	791	1204	135	769	376	460	240	328	354

Bald Mt. = Bald Mountain; Mon. V. = Monitor Valley; Cars. Des./Still. = Carson Desert/Stillwater Range; Trk. M. = Truckee Meadows; Alt. Reno = Alturas to Reno; Hon Lk. = Honey Lake; Tos = Tosawihi Quarries; LBB = Little Boulder Basin; Spr Mt. = Spruce Mountain; Plt. V. = Pilot Creek Valley; Nw. V. = Newark Valley; Ft. Rk. B. = Fort Rock Basin; St. Mt. = Steens Mountain; Ow V. = Owens Valley; Ft. Irw = Fort Irwin; Go. V/Ch. Cr. = Goshute Valley/Cherry Creek Range; Ch./Ab = Chewaucan/Abert; Mas Lk. = Massacre Lake; R. R. = Reese River; Cor. = Cortez Mountains

Table 3. Timing and durations of each occupation per phase for the caves and rockshelters used in this analysis.

Phase: Eagle Rock

Gatecliff Shelter, Horizon 1; 700 - 150 BP (550 years)

Camels Back Cave, Stratum 18; 470 – 150 BP (320 years)

Swallow Shelter, Stratum 11; 550 – 150 BP (400 years)

James Creek Shelter, Horizon I; 400 – 200 BP (200 years)

Bonneville Estates Rockshelter, Stratum 0; 400 – 80 BP (320 years)

Phase: Maggie Creek

O'Malley Shelter, Unit IV; 1600 – 900 BP (700 years)

Gatecliff Shelter, Horizons 2-3; 1300 – 700 BP (600 years)

Camels Back Cave, Strata 15a-17c; 1400 – 800 BP (600 years)

Swallow Shelter, Strata 9-10; 1150 – 550 BP (600 years)

James Creek Shelter, Horizons II-III; 1300 – 700 BP (600 years)

Bonneville Estates Rockshelter, Strata 1-3; 1400 – 950 BP (450 years)

Phase: James Creek

O'Malley Shelter, Unit IV; 3000 – 1600 BP (1400 years)

Gatecliff Shelter, Horizons 4-7; 3200 – 1300 BP (1950 years)

Camels Back Cave, Strata 14c-15b; 3200 – 1600 BP (1600 years)

Pie Creek Shelter, Component II; 2500 – 1600 BP (900 years)

Remnant Cave, Stratum 4; 3500 – 2400 BP (1100 years)

Swallow Shelter, Strata 4-8; 2850 – 1150 BP (1750 years)

James Creek Shelter, Horizons IV-VI; 3200 – 1300 BP (1900 years)

Bonneville Estates Rockshelter, Strata 4-9; 3500 – 1700 BP (1800 years)

Phase: South Fork

O'Malley Shelter, Units II-III; 4600 – 3700 BP (900 years)

Gatecliff Shelter, Horizons 8-16; 5000 – 3250 BP (1750 years)

Camels Back Cave, Strata 13a-14a; 4100 – 3600 BP (500 years)

Sudden Shelter, Strata 11-22; 5000 – 3350 BP (1350 years)

Pie Creek Shelter, Components III-IV; 4800 – 2750 BP (1750 years)
Remnant Cave, Stratum 3; 5000 – 3500 BP (1500 years)
Swallow Shelter, Strata 2-3; 4500 – 2850 BP (1650 years)
Bonneville Estates Rockshelter, Strata 10-13; 4800 – 3600 BP (1200 years)

Phase: Pie Creek
O'Malley Shelter, Unit I; 7100 – 6500 BP (600 years)
Camels Back Cave, Strata 3-12b; 7500 – 4650 BP (2850 years)
Sudden Shelter, Strata 1-10; 8400 – 5300 BP (2100 years)
Hogup Cave, Strata 1-7; 8100 – 6200 BP (1900 years)
Swallow Shelter, Stratum 1; 5500 – 4500 BP (1000 years)
Bonneville Estates Rockshelter, Strata 9 (East Block), 14, 16; 7,400 – 7,200 BP (200 years) + 6,200 – 6,000 BP (200 years) + 5,300 – 5,100 BP (200 years) [600 years total]

Phase: Dry Gulch
Bonneville Estates Rockshelter, Strata 17b-18b; 10,700 – 9,400 BP (1300 years)

Table 4. Raw numbers of projectile points per phase for each cave or rockshelter

	ER	MC	JC	SF	PC	DG
Swallow Shelter	5	66	106	21	-	-
Remnant Cave	-	-	2	9	-	-
James Creek Shelter	17	37	33	-	-	-
Hogup Cave	-	-	-	-	257	-
Pie Creek Shelter	-	-	10	10	-	-
Sudden Shelter	-	-	-	96	298	-
Camels Back Cave	8	4	11	4	5	-
Gatecliff Shelter	24	47	274	63	-	-
O'Malley Shelter	-	88	28	116	5	-
Bonneville Estates	21	45	49	48	33	11

Table 5. Raw numbers of artiodactyls (MNI) per phase for each cave or rockshelter

	ER	MC	JC	SF	PC	DG
Swallow Shelter	1	17	23	10	1	-
Remnant Cave	-	-	6	9	-	-
James Creek Shelter	0	5[1]	5[2]	-	-	-
Hogup Cave	-	-	-	-	63	-
Pie Creek Shelter	-	-	1[3]	2[4]	-	-
Sudden Shelter	-	-	-	35	104	-
Camels Back Cave[5]	1	2	1	1	1	-
Gatecliff Shelter	7	35	33	10	6	-
O'Malley Shelter	-	3	1	5	3	-
Bonneville Estates Rockshelter[6]	-	-	-	-	7	3

[1]based on two pronghorn, two bison, and one mountain sheep (estimated)

[2]based on two bison and three mountain sheep (estimated)

[3]based on one mountain sheep

[4]based on one deer and one mountain sheep

[5]values from Dave Schmitt, personal communication, 2006

[6]data not yet available

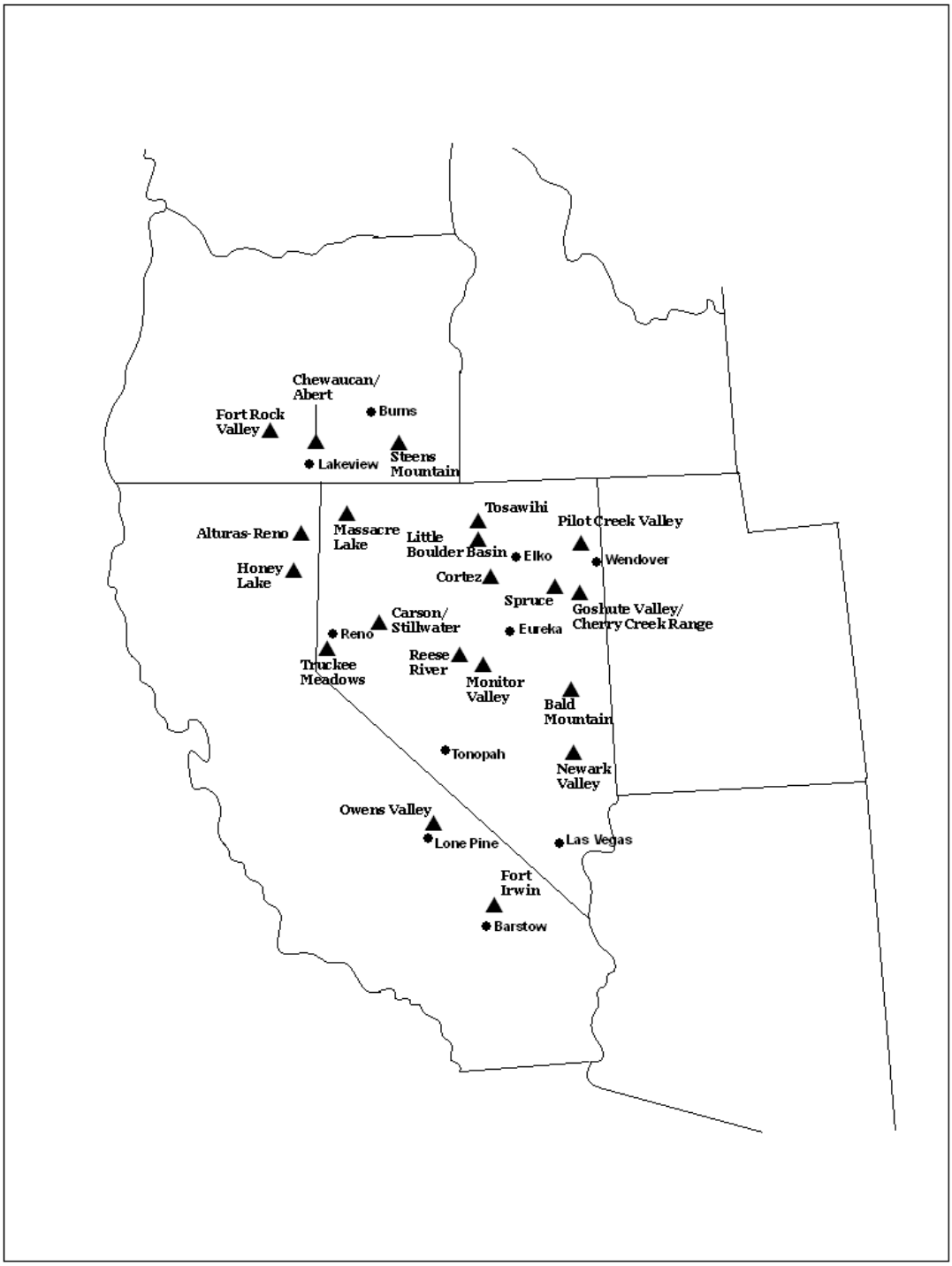
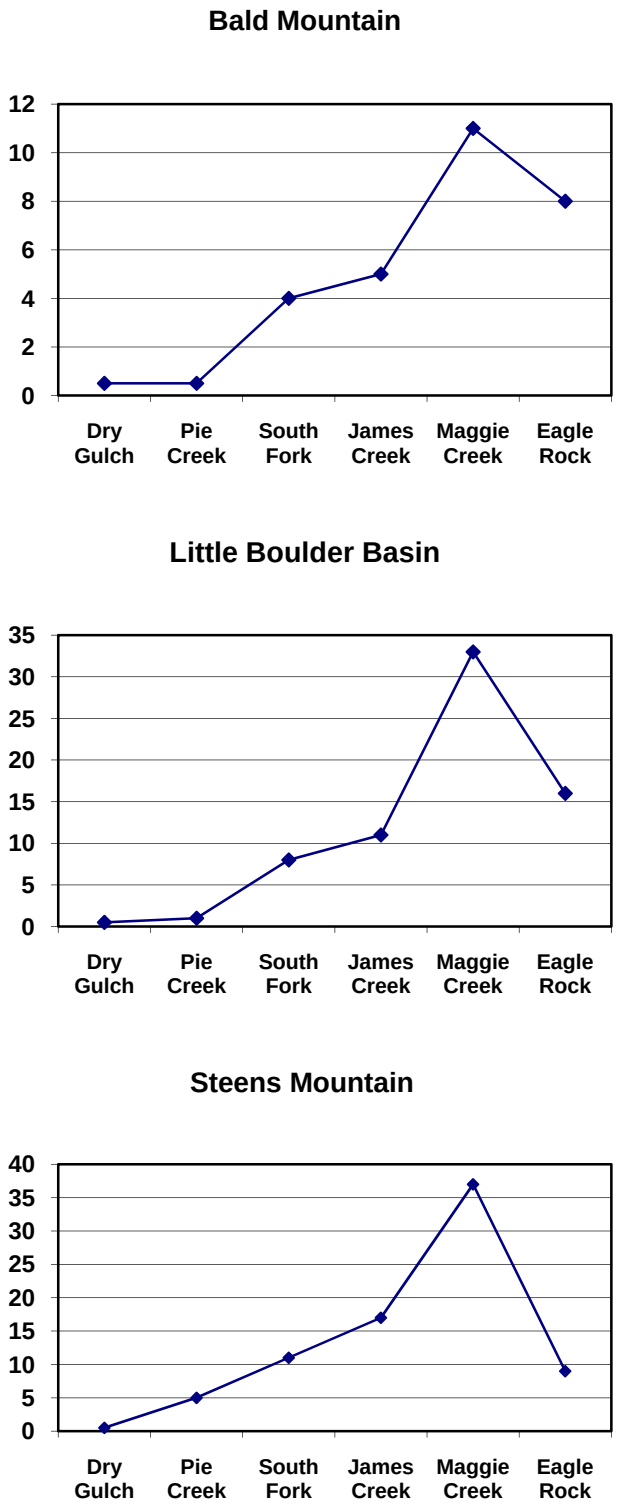


Figure 1. General location of the 20 study areas (triangles) used to compile the projectile point density values for open-air sites.

Figure 2. Projectile point density values per century for each of the 20 open-air study areas.



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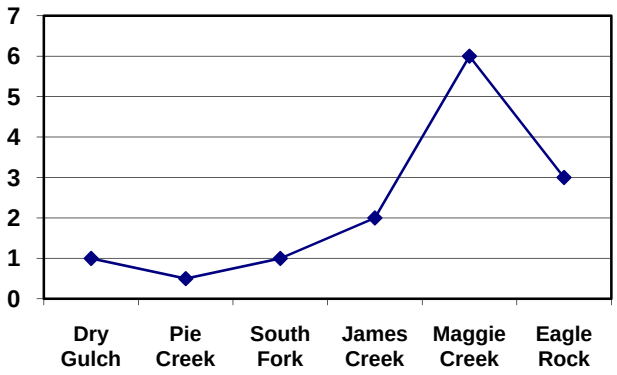
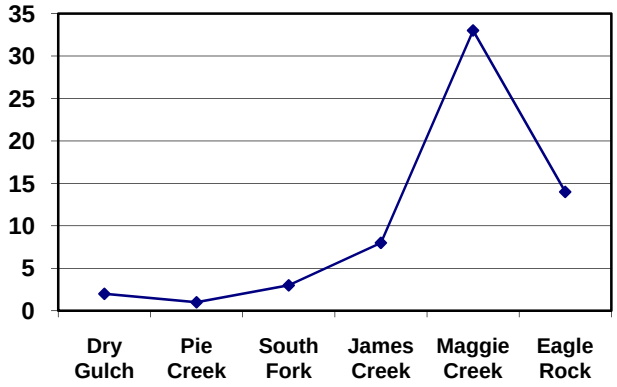
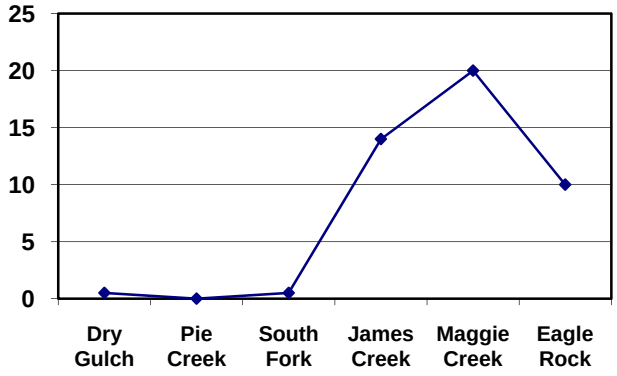
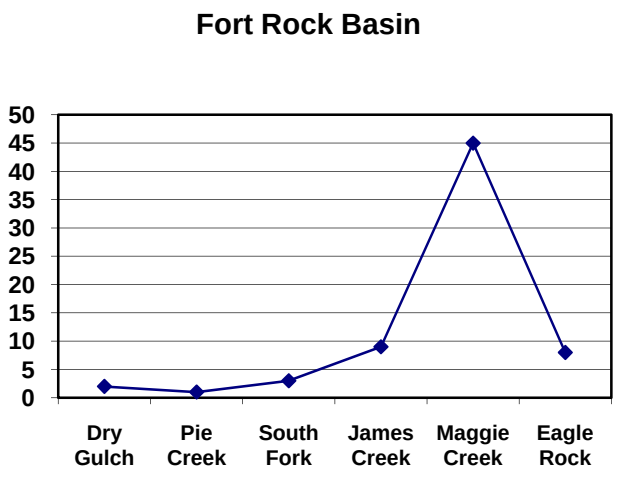


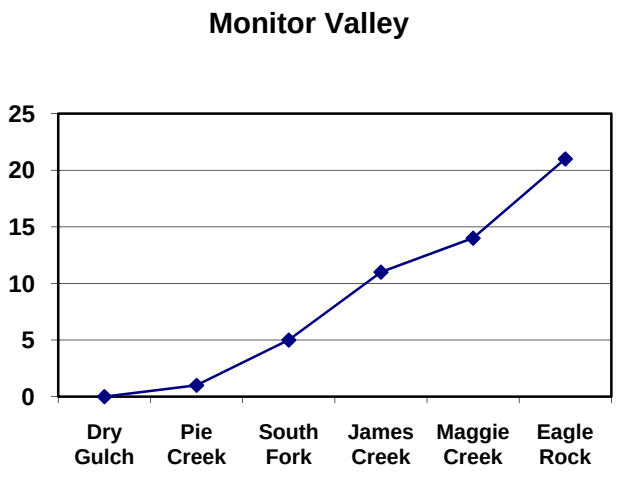
Alturas-Reno



Truckee Meadows




Fort Rock Basin
50
45
40
35
30
25
20
15
10
5
0
Dry Gulch
Pie Creek
South Fork
James Creek
Maggie Creek
Eagle Rock


Monitor Valley
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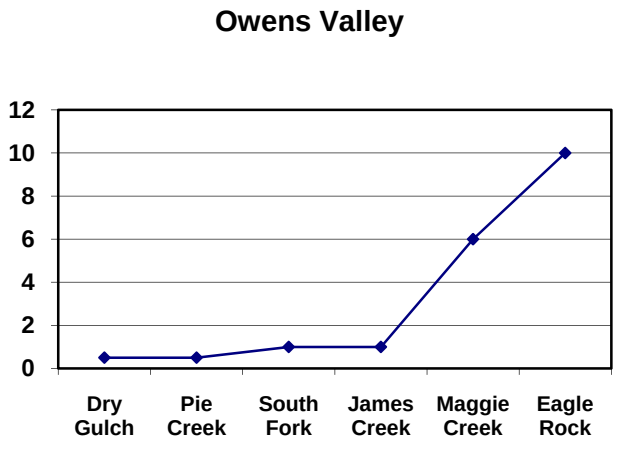
20
15
10
5
0
Dry Gulch
Pie Creek
South Fork
James Creek
Maggie Creek
Eagle Rock


Owens Valley
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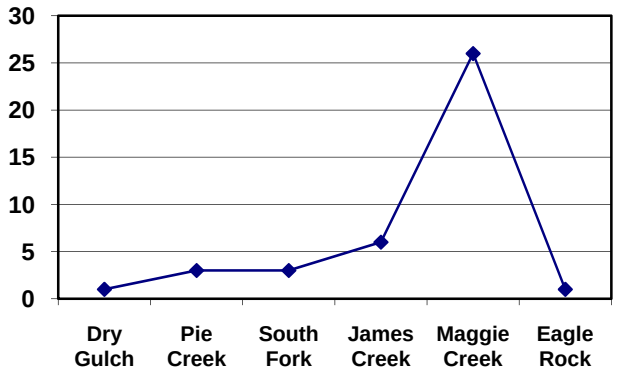
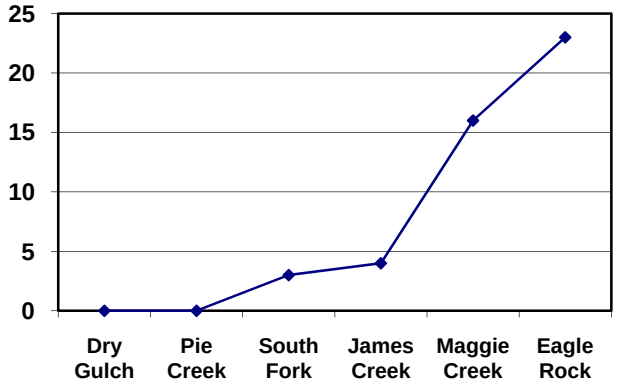
8
6
4
2
0
Dry Gulch
Pie Creek
South Fork
James Creek
Maggie Creek
Eagle Rock

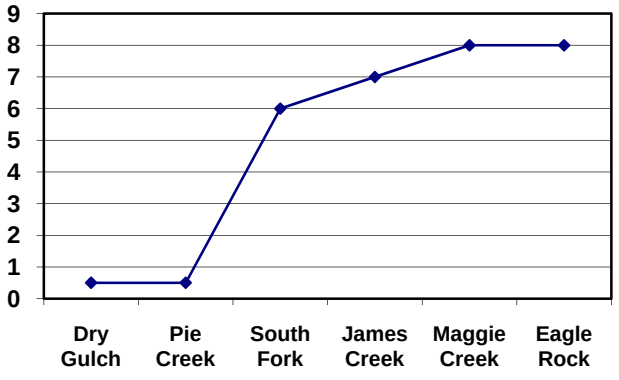
Cheuwacan-Abert

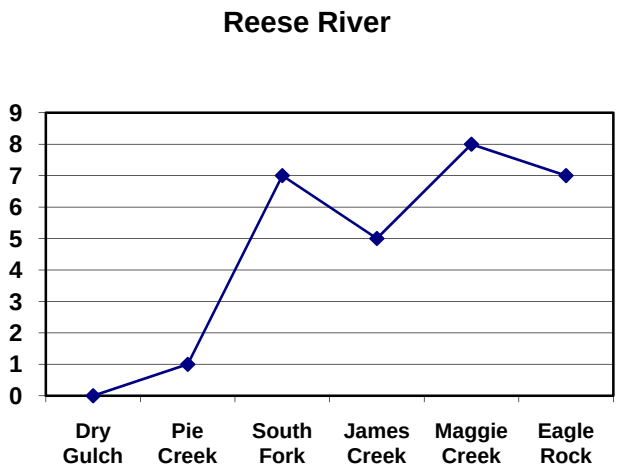


Carson Desert-Stillwater



Cortez




Reese River
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8
7
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5
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1
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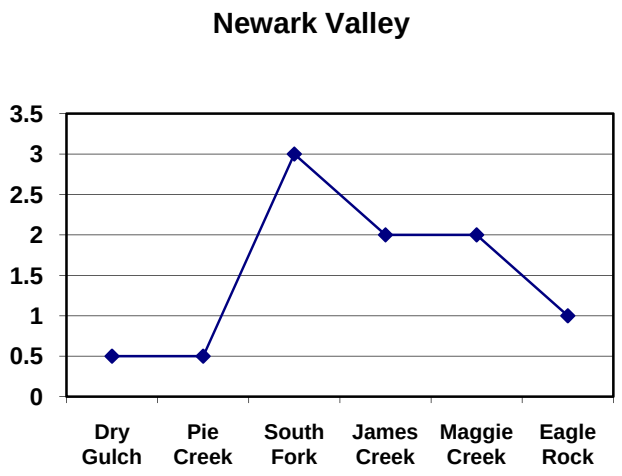
Dry Gulch
Pie Creek
South Fork
James Creek
Maggie Creek
Eagle Rock


Newark Valley
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2
1.5
1
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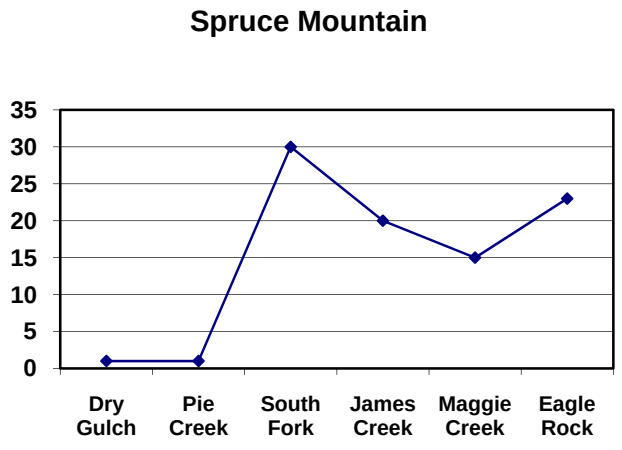
Dry Gulch
Pie Creek
South Fork
James Creek
Maggie Creek
Eagle Rock


Spruce Mountain
35
30
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15
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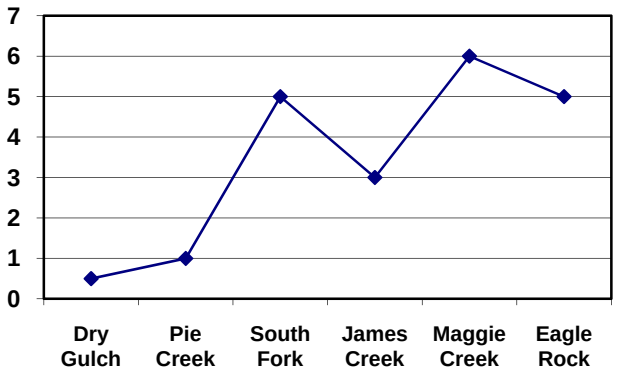
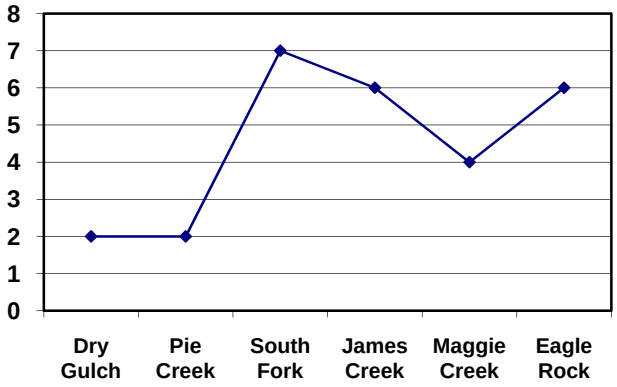
Dry Gulch
Pie Creek
South Fork
James Creek
Maggie Creek
Eagle Rock

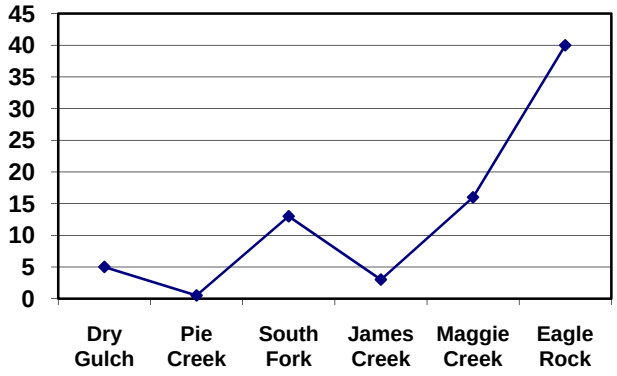
Massacre Lake

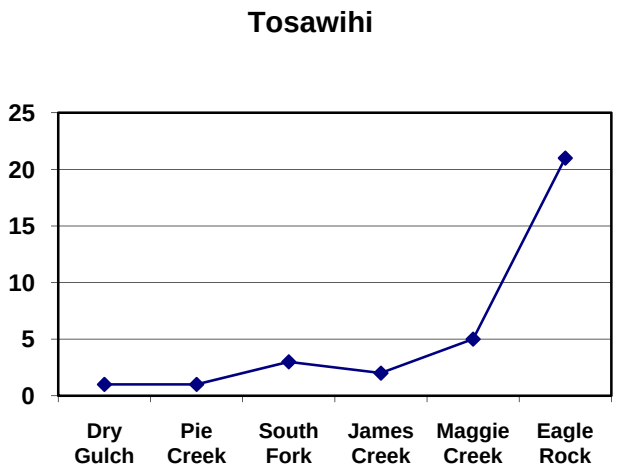


Goshute Valley-Cherry Creeks



Fort Irwin




Tosawihi
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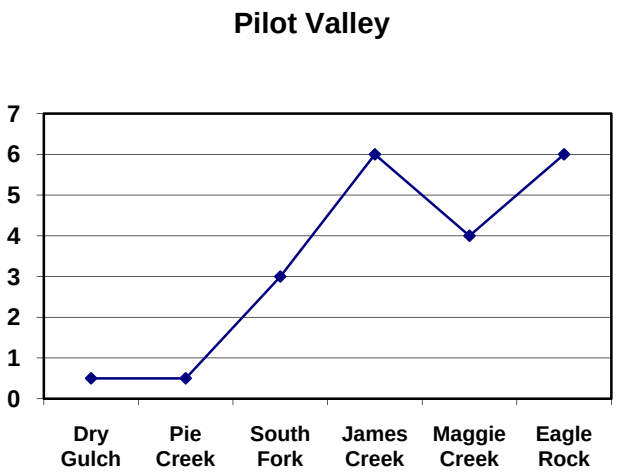
Dry Gulch
Pie Creek
South Fork
James Creek
Maggie Creek
Eagle Rock


Pilot Valley
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Dry Gulch
Pie Creek
South Fork
James Creek
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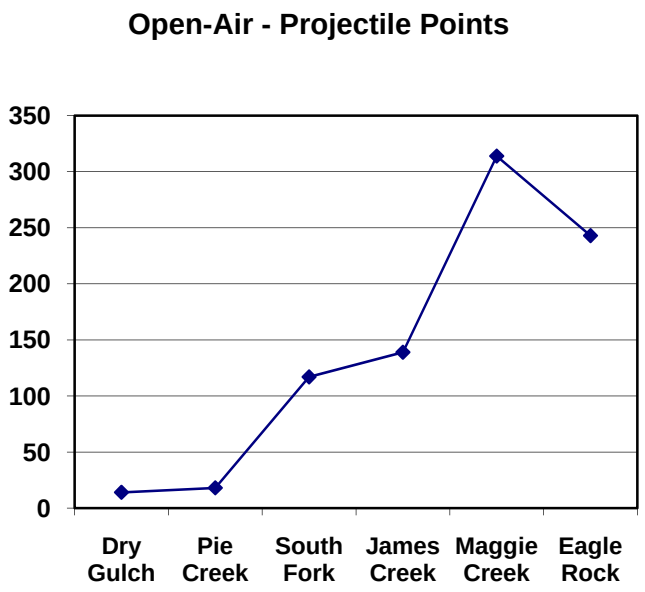

Figure 3. Average number of projectile points per century per phase for the combined 20 open-air samples.

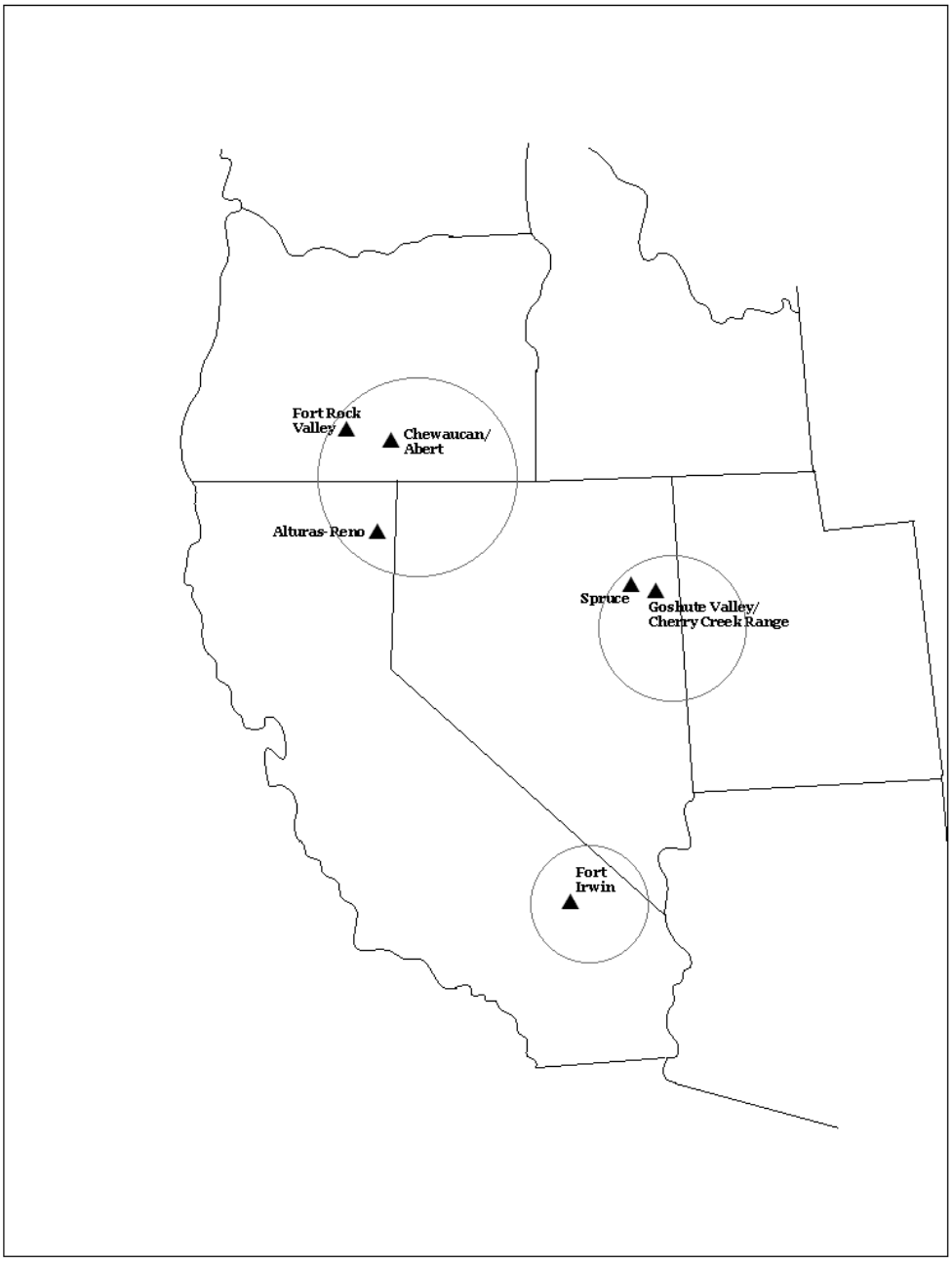

Figure 4. Location of the six highest density projectile point values for the Dry Gulch Phase (Western Stemmed Series).

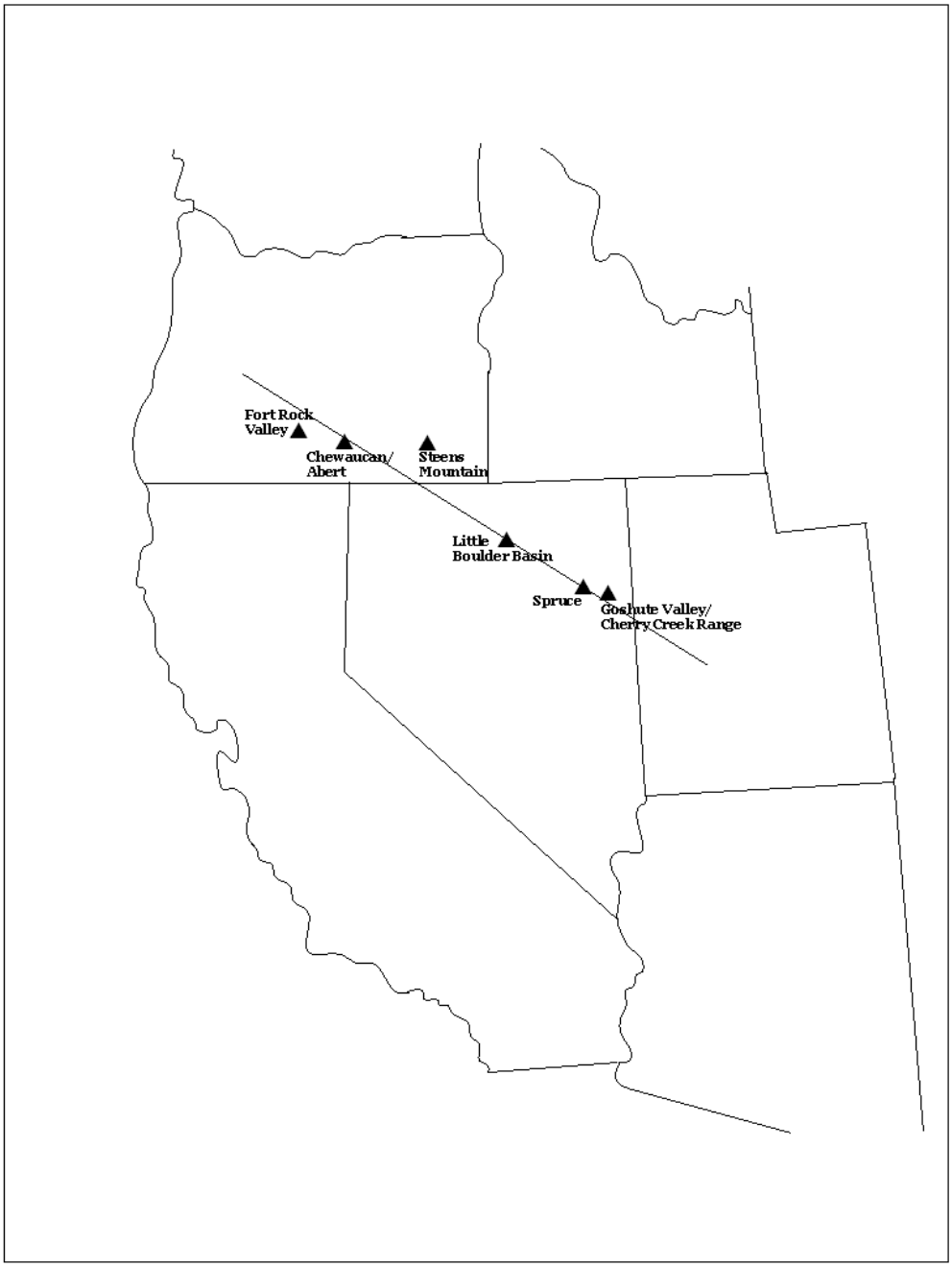

Figure 5. Location of the six highest density projectile point values for the Pie Creek Phase (Large Side-Notched Series).

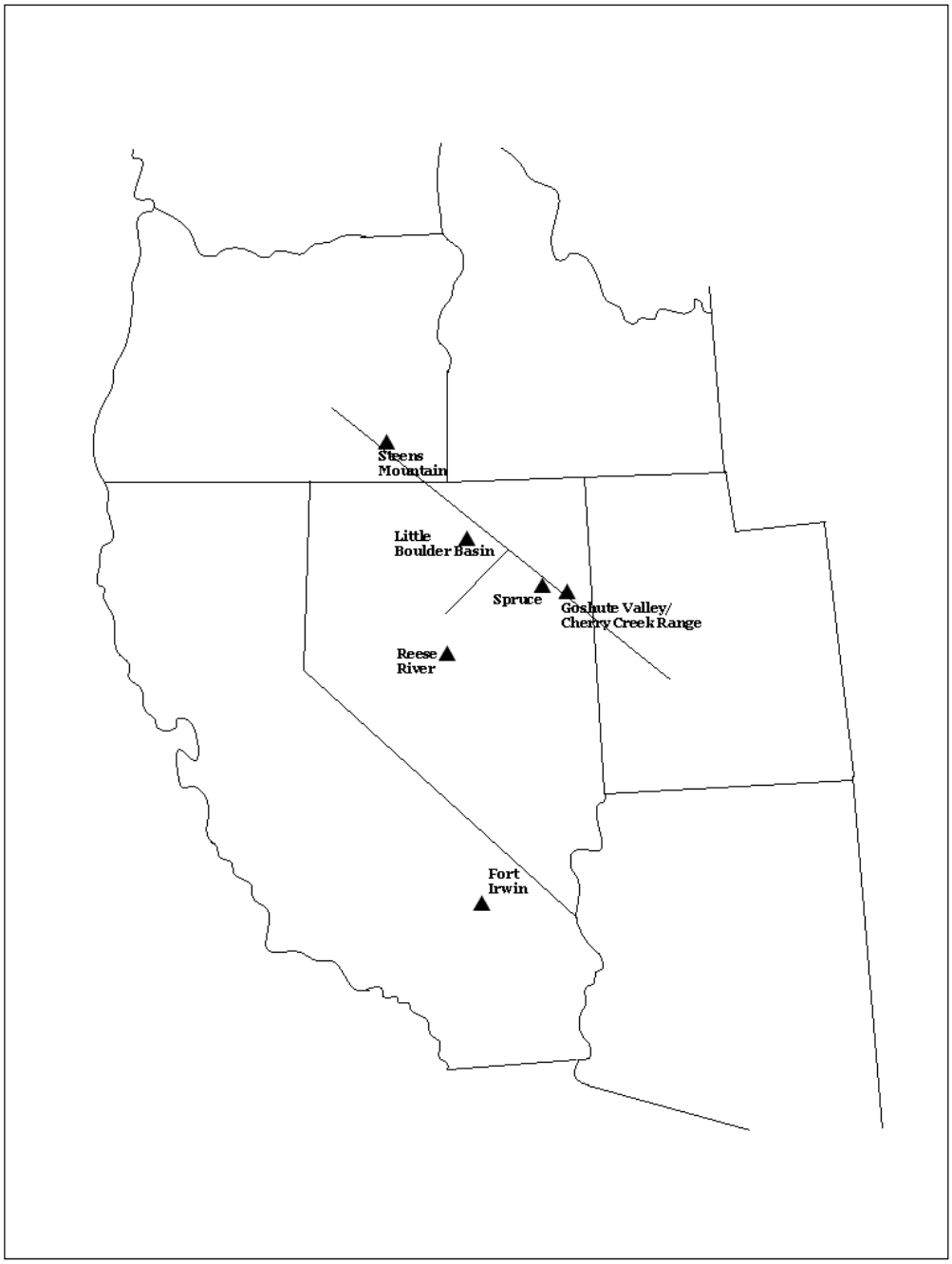

Figure 6. Location of the six highest density projectile point values for the South Fork Phase (Gatecliff and Humboldt Series).

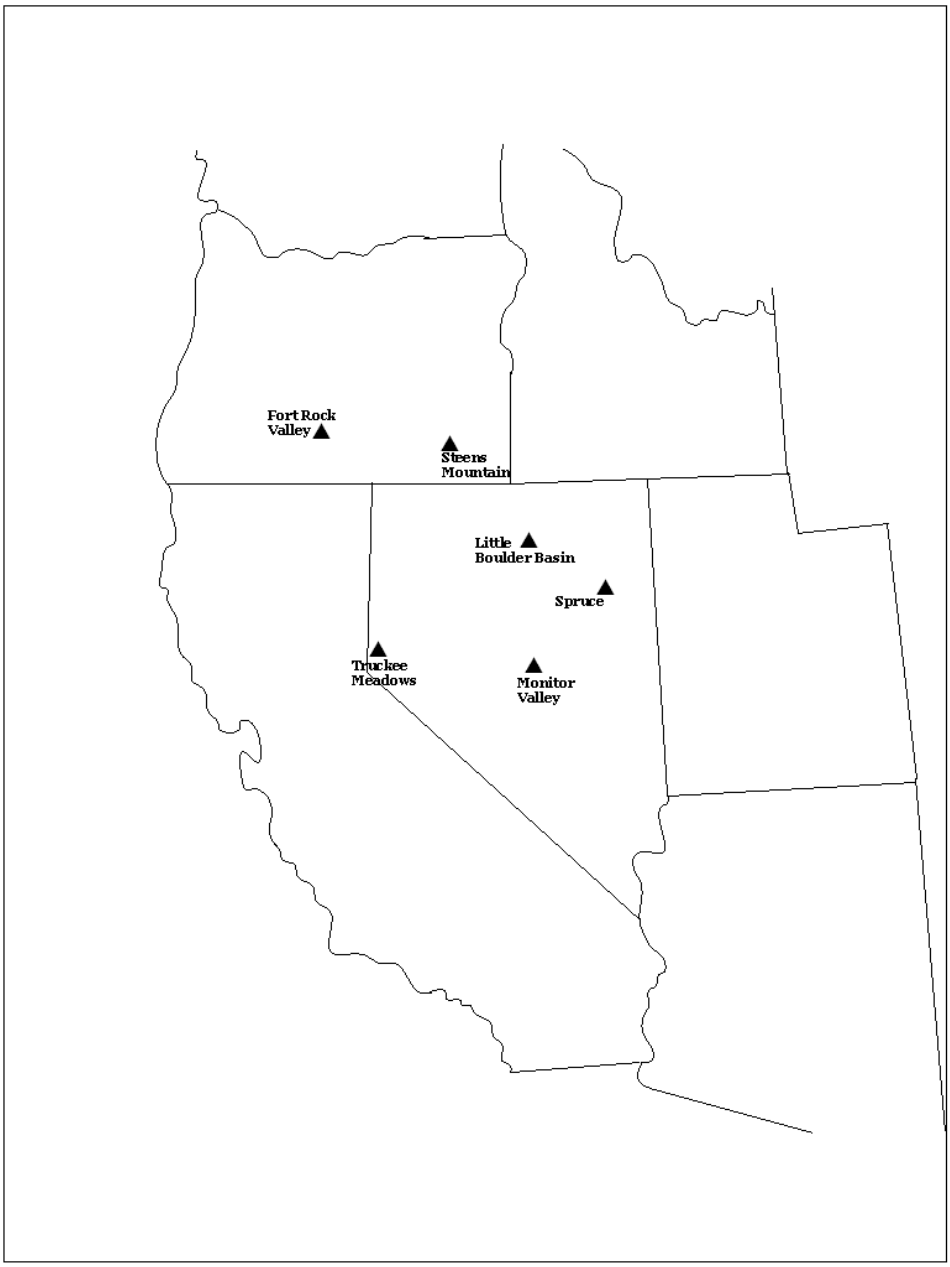

Figure 7. Location of the six highest density projectile point values for the James Creek Phase (Elko Series).

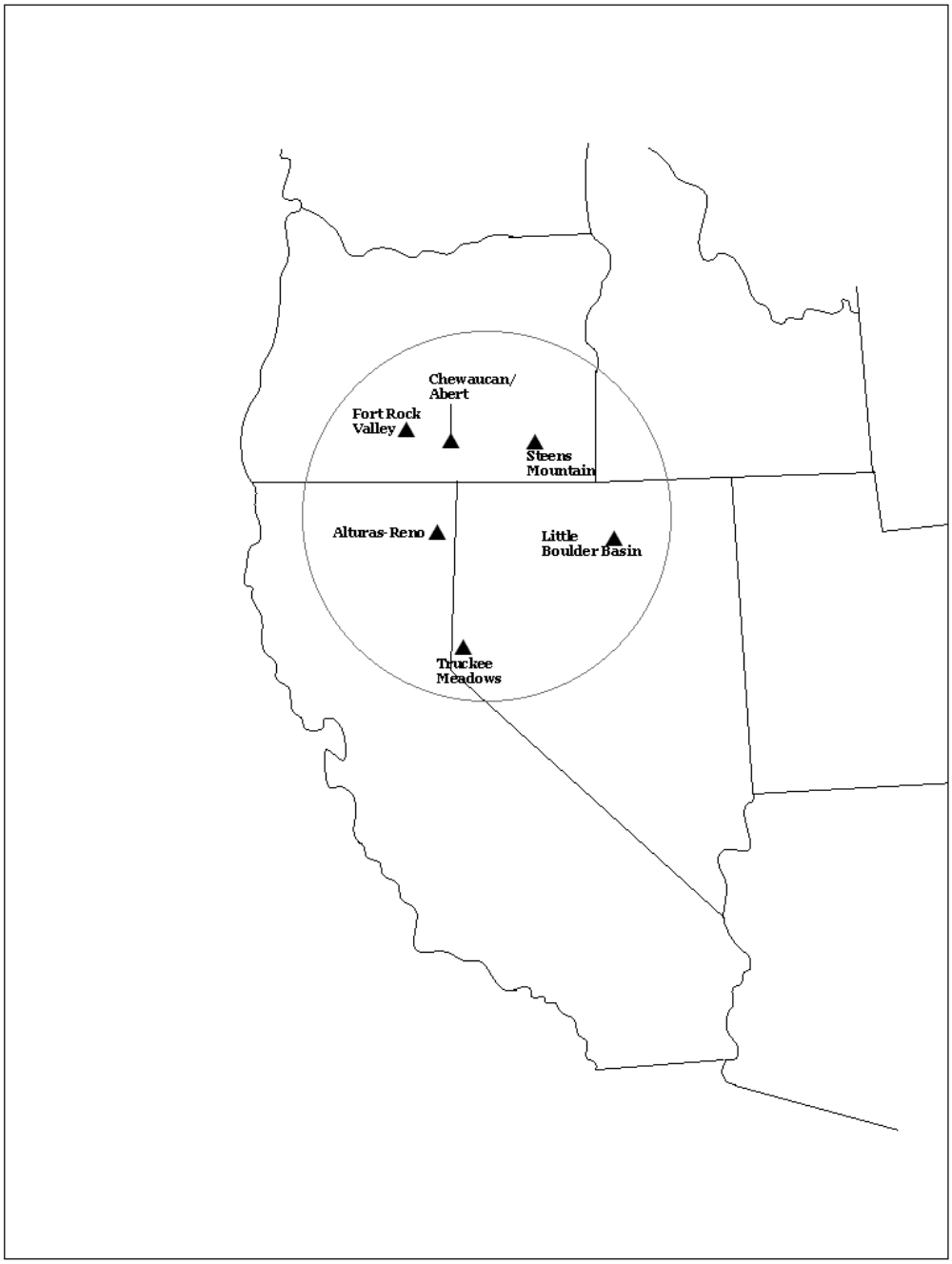

Figure 8. Location of the six highest density projectile point values for the Maggie Creek Phase (Rose Spring and Eastgate Series).

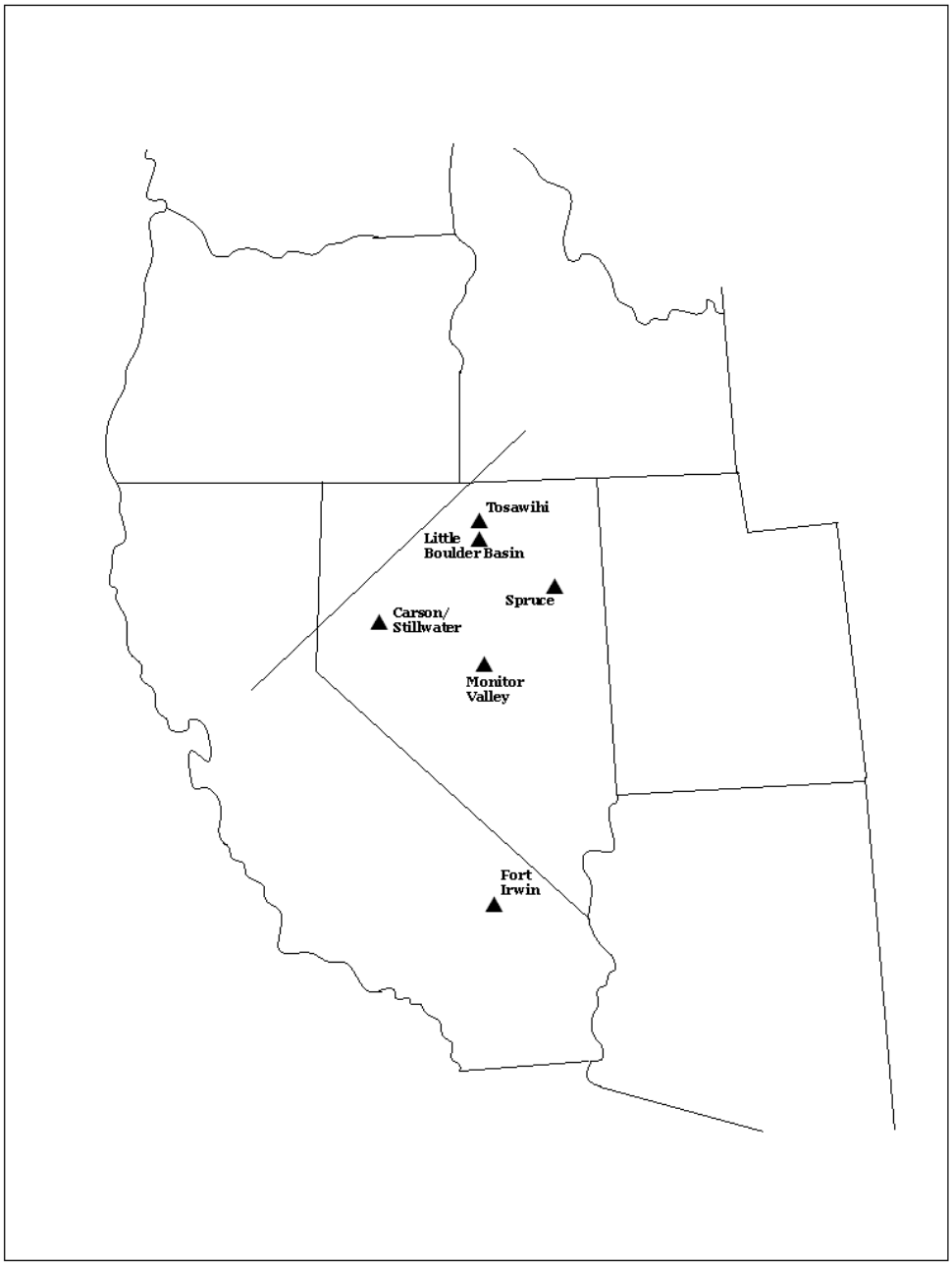

Figure 9. Location of the six highest density projectile point values for the Eagle Rock Phase (Desert Side-Notched and Cottonwood Series).

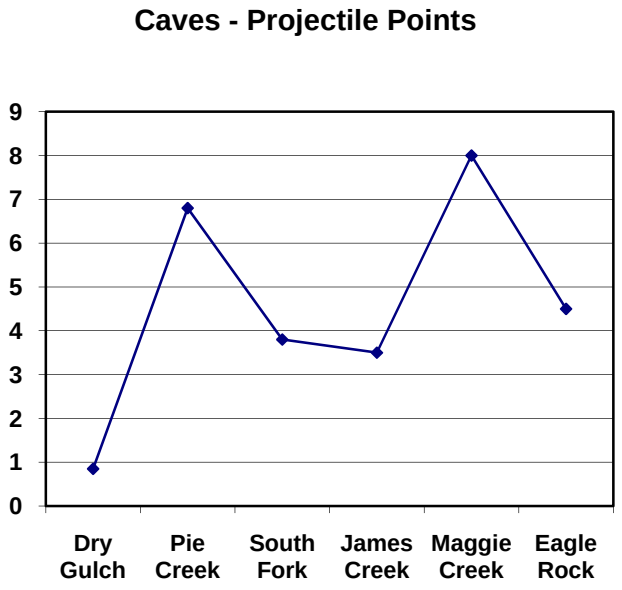

Figure 10. Number of projectile points per century per phase recovered from caves and rockshelters.

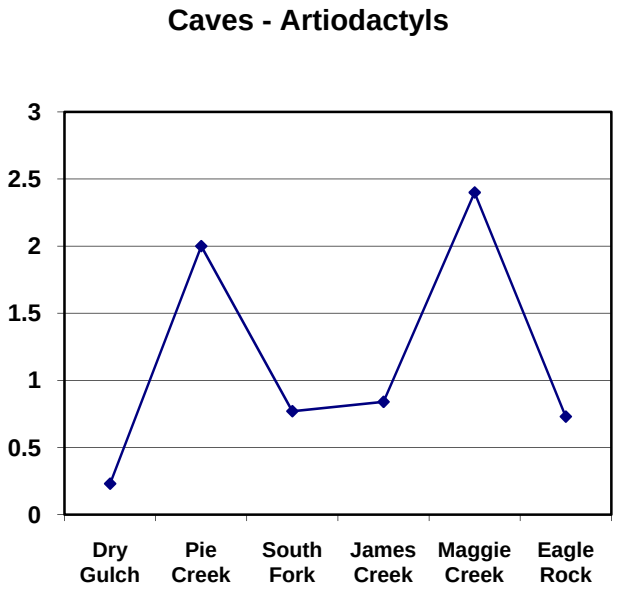

Figure 11. Number of artiodactyls (MNI) per century per phase recovered from caves and rockshelter.

11
Different Beginnings: A Great Basin View of the Younger-Dryas and the Pleistocene-Holocene Transition

D. Craig Young

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As a group archaeologists typically share two traits, long taught by Don D. Fowler at the University of Nevada, Reno: 1) the desire to seek out collaboration with other disciplines for interpretive foundations, theoretical directions, and field techniques, and 2) the ability to do so. Those of us fortunate enough to work in the Great Basin, for example, have enjoyed a long history of direct and indirect collaboration with limnologists and climatologists. The strength of this relationship, to some extent, derives from Basinists' relatively early realization that 19th and 20th century geographers had documented important aspects of extensive lakes throughout the region. Remnant lake features are often depicted in the notes and illustrations made by geographers as they accompanied early exploration and scientific expeditions: Henry Englemann (Simpson Expedition 1858–1859); J. D. Whitney (Field Expeditions 1860 – 1864); G. K. Gilbert (Wheeler Survey 1871–1872); Chester King (40th Parallel Explorations); and I. C. Russell (U.S. Geological Survey). Archaeologists have also benefited from an early acceptance of the precepts of cultural ecology, espoused by Julian Steward and others, emphasizing environmental constraints on behavior. Building on these foundations and maintaining viewpoints well beyond artifact and feature assemblages, archaeologists are using diverse data sets to help us understand the environmental contexts of the earliest human habitation in the Great Basin.

Reconstructions of paleolake elevations and past biotic communities by various disciplines, along with better resolution of many other climatic proxies, have continually outpaced the archaeologists' understanding of the late Pleistocene/Holocene transition. Much of the difference can be traced to climatologists' use of annular records (for example, ice and sediment varves and dendrochronology) in the development of many paleoclimate proxies. These records resolve the chronological limitations of the radiocarbon curve that keep archaeologists somewhat hamstrung when trying to date sites that fall at this transition (Stuiver et al. 1998). However, by threading high-resolution global records to specific environments, developed by a diverse set of scientific

endeavors, it may be possible to approach cultural and behavioral generalities that allow robust interpretation of local archaeological patterning. The goal of this paper is to highlight positive aspects of cross-discipline sharing and to illustrate several examples of the potential of threading climate to environment at the Younger-Dryas.

THE YOUNGER-DRYAS

Limnologists introduced the Younger-Dryas to Great Basin archaeologists by observing the presence of lacustrine landforms (e.g., shoreline terraces or beaches) that post-dated late Pleistocene highstands (Figure 1). Archaeologists focused their attention on these shorelines, but too often maintained the relatively spurious notion that shoreline assemblages represented use of lacustrine environments and must invariably be old. Larry Benson, Jonathan Davis, George Oviatt, and G. I. Smith, building on the work of many others, of course, presented paleolake elevation curves in the 1980s that archaeologists could resolve and apply to specific basins (Benson and Thompson 1987a, 1987b; Benson et al. 1990; Davis 1982, 1983; Oviatt 1988; Oviatt et al. 1992; Smith 1987). Benson and Oviatt focused attention on the Younger-Dryas as a clear reversal (of what?) during the early Holocene (Benson et al. 1990; Oviatt 1997). At the end of the 1990s, Madsen provided the most concise treatment to date of the significance of this climatic volatility at the Pleistocene/Holocene transition and set an operational foundation for Great Basin archaeologists interested in the transition to the early Holocene (Madsen 1999).

Broad collaboration between scholars has led to the recognition of a prominent paleoclimatic driver of landscape response, most apparent in lake basins: the Younger-Dryas climatic cycle that marks the opening of the Holocene. Centered on 12,200 calendar years ago (approximately 10,500 radiocarbon years ago), the Younger-Dryas was a climatic reversal that punctuated, at a millennial scale, the transition from late glacial, Pleistocene conditions to the warm variability of the Holocene. The Younger-Dryas can be described generally as a temporary return to cold conditions during the overall warming trend of the latest Pleistocene. To speak of a "cold" Younger-Dryas, however, fails to adequately describe the volatility of this relatively brief cycle. As David Madsen (1999) has described, ecosystems, and the people within them, experienced rapid changes in temperature and precipitation,

on a global scale, that were unmatched in the preceding and subsequent many thousands of years (Madsen 1999). If we hope to relate the early archaeological record of the Great Basin to this volatile climatic interval, we must look closely at how local environments and landscape structure may attenuate the volatility of rapid climatic change.

A GREAT BASIN VIEW

Describing the Great Basin as an equilateral triangle, Madsen purposefully avoided discussion of specific habitats, choosing instead to focus on the cultural ecology of volatile climates across the region (Madsen 1999:76). My goal is to look briefly at the three "corners" of that triangle where short-term reversals in lake regression, that is, increases in lake level and/or groundwater discharge, left a geomorphological signature and likely influenced archaeological patterning (Figure 2). The specific corners I focus on are the Owens River – China Lake system; the Wild Isle Delta, the Old River Bed, and Lake Bonneville; and the Quinn River arm of Lake Lahontan. Since being released into the Basin by Fowler, I have had the good fortune of being able to do fieldwork in each area, and, in so doing, I have followed in the footsteps of many earlier researchers.

Owens River – China Lake

The Owens River, in the orographic shadow of the Sierra, provides a southwestern Great Basin connection to global paleoclimate information. This drainage system threads the globally-recognized Younger-Dryas cycle to local environmental processes in the terminal basins at China Lake and Searles Valley. The terminal basins formed a series of pluvial pools where changes in hydrology, especially outflow from Owens Lake, are superimposed on intra-basin lake fluctuations. Sill levels provide elevational constraints for monitoring changes in the system.

During Pleistocene overflow from Owens Lake, China Lake filled rapidly to reach its sill level and overflow to the Searles basin. Once China Lake reached its sill elevation, it maintained a stable lake level until the two lakes, Searles and China, coalesced. This is simple to comprehend, but has profound implications for landscape response and patterning of the archaeological record in the China Lake basin. Tracing the thread from China Lake, through Owens, to the global climate record, we can begin to reveal some of the temporal patterns evident in the record of China Lake. Here, archaeologists are borrowing from

the climate/environment correlations developed by Benson and others (1997).

Turning to Benson's representations of isotope curves from Owens Lake and GISP2 cores (Figure 3), where global $\delta^{18}O$ is a proxy for air temperature and local $\delta^{18}O$ is a proxy for lake level, the Younger-Dryas event spans a complete cycle: a dry event (D3) bounded by two wet events (W3 and W4) (Figure 3). These isotope proxies provide chronological resolution to Younger-Dryas lake regressions and possible transgressions. The Younger-Dryas fluctuations (wet-dry-wet) likely had significant influence on landscape response (e.g., river-delta-lake interactions, 208eolian reworking, and soil formation) and occurred sometime after the earliest human habitation of the China Lake area. Recently, however, interpretation of geomorphic evidence in the Owens Lake basin suggests that the wet cycles bounding the Younger-Dryas, and W3 specifically, were not of a magnitude to reach the Owens Sill (Bacon et al. 2006). It is becoming apparent that what once was thought to have been a shallow to moderately deep lake environment, supplied by Owens River flows and stabilized at the level of the China outlet to Searles Valley, was more likely a wetland, shallow lake environment supported by groundwater discharge at the interface of the Sierran front alluvial fans and the China Lake playa. We continue to probe the margins of China Lake to clarify the drivers and character of the Younger-Dryas environments that influenced the patterning of the local archaeological record.

A look at the Terminal Pleistocene and Lake Mojave periods at China Lake, using large-coverage inventories and component data, provides important clues to landscape structure and resource patterning. The Terminal Pleistocene period is closely associated with the distribution of Concave Base projectile points (Warren 2000; Young et al. 2001). Most of the representative artifacts occupy the central portion of the basin, below the Lake China outflow sill. This pattern certainly indicates basin desiccation, recognized by Warren and others as the local expression of the Clovis Drought (Haynes 1991; Warren 2000). On the other hand, Lake Mojave Period assemblages, commonly including stemmed and crescentic artifacts, are distributed along and above the sill level elevation, suggesting association with relatively stable lake levels at or around the outlet elevation. Also, there is significant clustering of these sites in the

delta region of the Owens River and along washes of the Coso basin. There is a strong emphasis on what may once have been a well-developed distributary delta environment and shallow lake.

With the potential chronological resolution provided by ice cores, and by correlating this with lacustrine isotope records, we can begin to understand the low resolution of landscape change and human land use. Terminal Pleistocene components, common below the China sill level, were likely deposited as the basin dried during the Inter-Alleröd Cooling Period. But we also see that the basin may have been dry during the driest and coldest extremes within the Younger-Dryas. Is this a second drought for the southern Great Basin? Lake Mojave components, in contrast, are likely related to the W4, final Owens overflow, or increased groundwater discharge – a wet period and mesic rebound at the close of the Younger-Dryas.

Wild Isle Delta – Bonneville Basin

The Bonneville basin dominates the northeastern Great Basin from the Wasatch Mountains to the Nevada/Utah border. It is here, on landforms of the relic delta of the Old River Bed or Sevier River, that a relatively clear picture of archaeological patterning around the Younger-Dryas interval is taking shape. On-going studies on the paleo-delta of the Sevier River have focused on headward distributaries, where Oviatt, Madsen, and others are documenting very early sites, based on artifact types, associated with both high- and low-energy fluvial environments (Oviatt 1997; Oviatt et al. 1992; Oviatt et al. 2003). At the other end of the system, I have been working on understanding the large wetland patch of the Wild Isle Delta (Carter et al. 2003; Duke et al. 2004; Young 2002).

As Oviatt and others develop oscillation models for the Bonneville system (Oviatt et al. 2005), we continue to establish threads between global climate and local environment. Physical data sets and useful proxies, similar to the isotope records found at Owens Lake, are likely present within Sevier/Bonneville system; these will revise and strengthen the regional record. This is not my background and I am willing to borrow, as usual, to continue the thread from regional climate to local environment.

The paleo-delta of the Sevier River spreads northward from the Old River Bed, and remnant landforms are visible on the generally open playa of the Great Salt Lake Desert. Dunes and dune cores are anchored by channel and levee features of

the delta, remnants of which extend several kilometers into the basin. The oldest radiocarbon dates on organic deposits and terrestrial shell from under the Holocene-age Wild Isle dune system are constrained by the Younger-Dryas cold/wet lake transgression which formed the Gilbert stand of Lake Bonneville (the W3 period documented at Owens). This lake likely inundated the lower delta, but headward areas remained exposed and occupied by people. Later dates on similar materials point to the continuance of a productive resource patch in the distributary delta through the terminal phase of the Younger-Dryas (possibly the D4) and into the early Holocene. Oviatt and others have suggested that this marsh may have been maintained by groundwater discharge that kept the Old River Bed flowing (Oviatt et al. 2003). Sedimentary units in the Old River Bed and the latest date of approximately 10,000 calendar years ago on the delta distributaries support this position. It may also be the case, however, that the Younger-Dryas wet cycle, and associated Gilbert transgression, did not inundate the delta, so that the wetland interface transcends the Younger-Drays wet-dry cycle. This issue remains to be resolved.

Quinn River – Lahontan Basin

The Quinn River arm of the Lahontan system stands out because, with the exception of the Adams's work in the Carson sub-basin, there has been relatively little cross-disciplinary archaeological work focusing on the early Holocene in the Lahontan system. The Black Rock sub-basin of the Lahontan basin, north of Pyramid Lake and the Truckee River, was independent of Sierran hydrology relatively soon after the lake's regression from its late glacial highstand. Isolation of the Quinn River hydrology from the complexities of the Sierran drainages should allow the development of relatively high-resolution threads between late Quaternary climate, especially the Younger-Dryas, and local environment and archaeology. The Quinn lake/delta interface is well-preserved, although its chronology is poorly documented. Those of us who know something of the Black Rock/Lahontan region know that the archaeology is there. Military cultural resources programs have driven archaeological inquiry in the China Lake and Great Salt Lake Desert areas, but the Quinn River or East Arm of the Black Rock is designated wilderness and will require a concerted effort by institutions and land agencies. Students from the University of Nevada and elsewhere have initiated regional surveys and local

excavations in the area, and I am hopeful that the collaborative thread between climatologists, limnologists, and archaeologists can continue.

THREADING GLOBAL PATTERNS TO LOCAL LANDSCAPES

If the Younger-Dryas is a global phenomenon, are the Owens, Sevier, and Quinn environmental records comparable? Broadly speaking, yes they are. But the archaeological patterning of the first two deltas is very different because the local environmental effects of the Younger-Dryas cycles resulted in asynchronous landform responses. The wet cycles feeding Lake China produced a stable, shallow lake or wetland with a small lake/delta interface (Figure 4). We find Lake Mojave-period sites distributed across the delta and fan/playa interface (the area of potential groundwater discharge) but somewhat away from the lake basin. The intervening Younger-Dryas dry period finds sites in the basin bottom. In the Bonneville basin (Figure 5), the early record has been documented along the basin margin in the headward area of the lake/delta interface; there have been no finds of Paleoindian archaeology in the distal delta area. The Bonneville/Wendover-period archaeology of the distal fan was deposited in wetland and wetland margin environments as the lake regressed from a Gilbert highstand where reduced river inflow and on-going groundwater discharge maintained a broad resource patch well into the early Holocene. We should not expect the Quinn River archaeology to match the patterning of the China/Owens or Bonneville/Sevier systems, even as the climatic drivers are found to be the same.

Much of this variation is a simple matter of basin morphology and hydrologic budget, but we have relied on a common climatic/environmental driver, the Younger-Dryas, to guide much of our interpretation. Global moisture regimes have lower resolution than does the temperature record, which is recorded in any number of air and sea proxies. Air and sea temperatures are the climatic drivers, but moisture, in the Great Basin at least, is the environmental driver. Confusion arises as we create linkages between climate and local environment based on signatures of Pleistocene stades and inter-stades and map them onto high frequency fluctuations within ever-smaller events, for example the Younger-Dryas. The abruptness of climatic events is significant and fascinating, but overlooked in our search for patterns are the local influences of orographics, reflection, and cloud cover; that is, local conditions. For

example, ice-core records suggest that the Younger-Dryas was cold and dry in Greenland and maybe above much of the 50th parallel or so. This change in air and sea temperatures creates synchronous coolness in the Great Basin, but the moisture regime remains highly variable across the region. It is likely that orographics and evaporation have strong environmental (local-scale) influence when absolute moisture levels fluctuate at short intervals. That said, the lake basins at the corners of the Great Basin each appear to have had resurgent lake, groundwater, and marsh systems around the Younger-Dryas interval, albeit with very different results on the ground. Our challenge is to connect the realities (the squiggly parts on so many hard-earned graphics) with the generalities and proxies that become invaluable to archaeological interpretation.

It is appealing that the more we rely on the global climatic data and associated proxies, the more we focus on responses and conditions in specific basins. Making connections from paleoenvironments to geomorphic process, borrowing liberally along the way, gets us closer to actual relations between local environment, landscape response, and the archaeological records across the great triangle of the Great Basin.

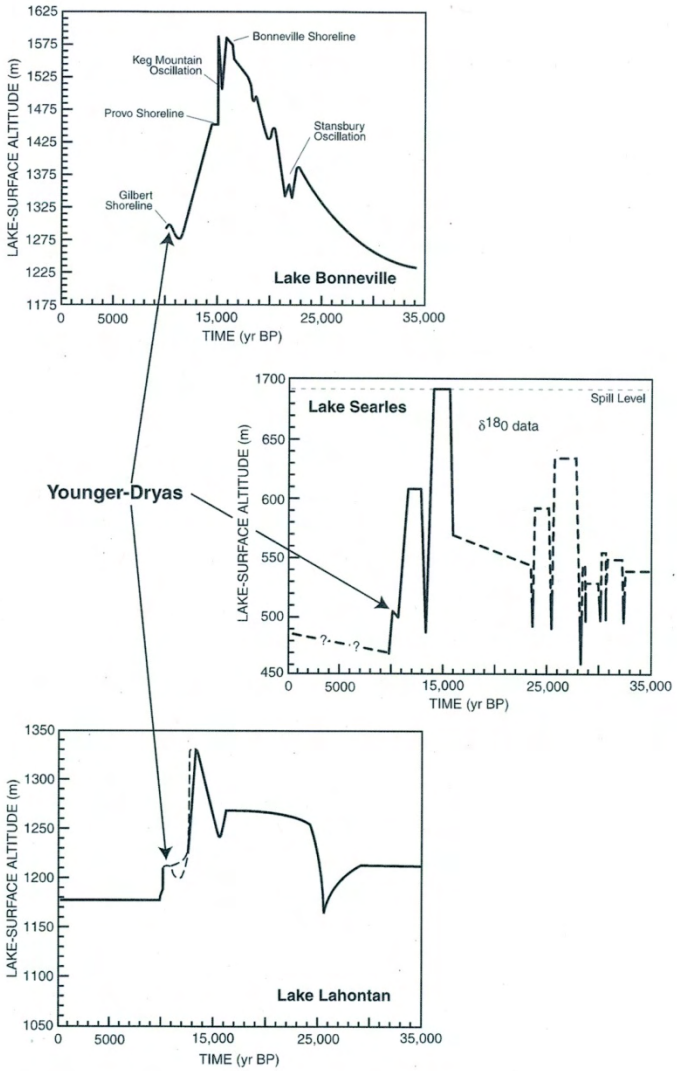

Figure 1. Early Lake Level Reconstruction and the Younger-Dryas Signature (from Benson et al. 1990).

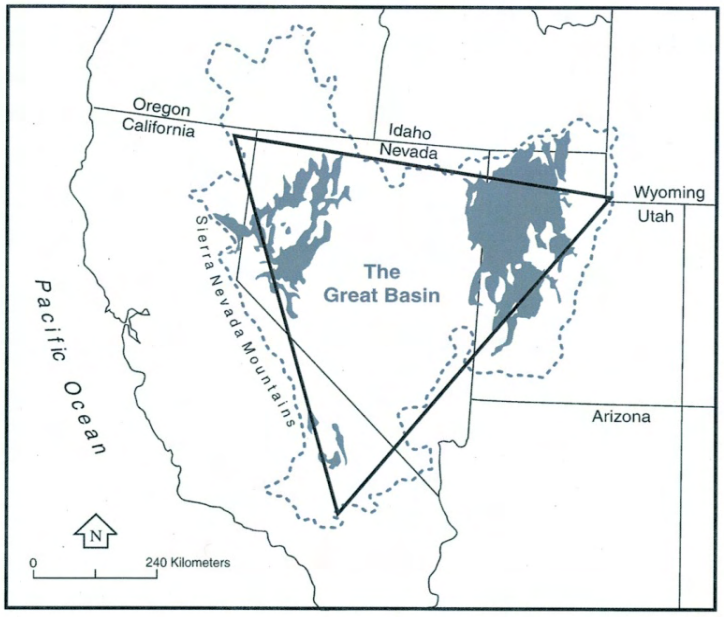

Figure 2. The Great Basin Triangle with Three Pluvial Lakes (from Madsen 1999)

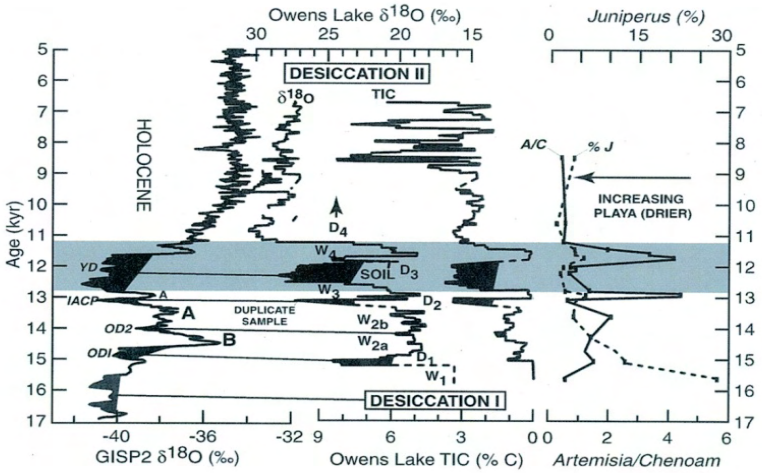

Figure 3. Owens Lake Data Sets: Connecting the Basin to Global Climate (from Benson et al. 1997)

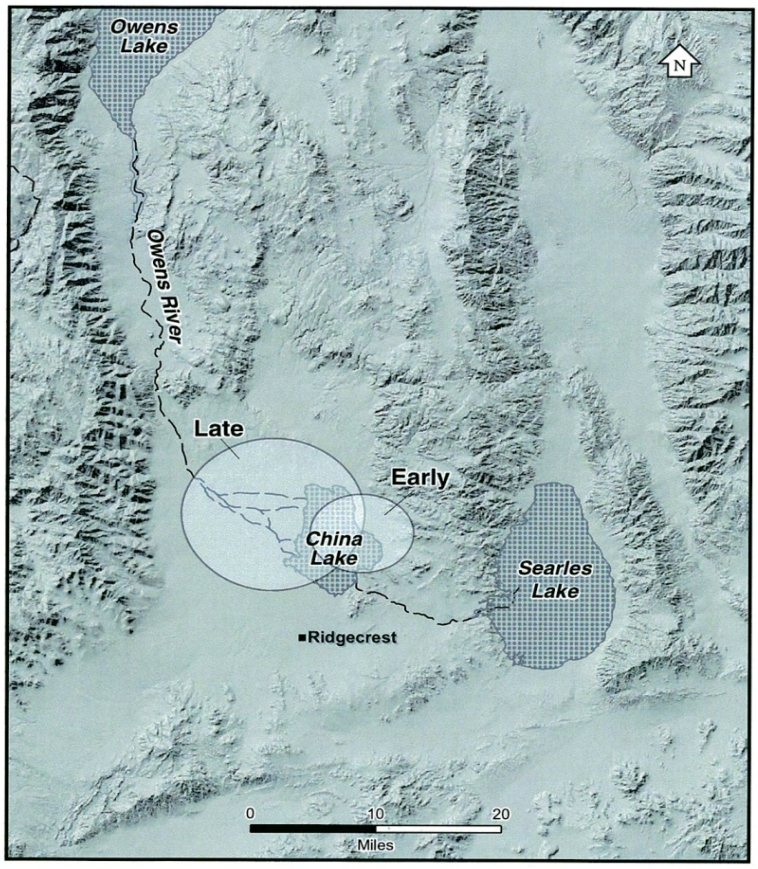

Figure 4. Generalized Site Patterning in the China Lake Basin

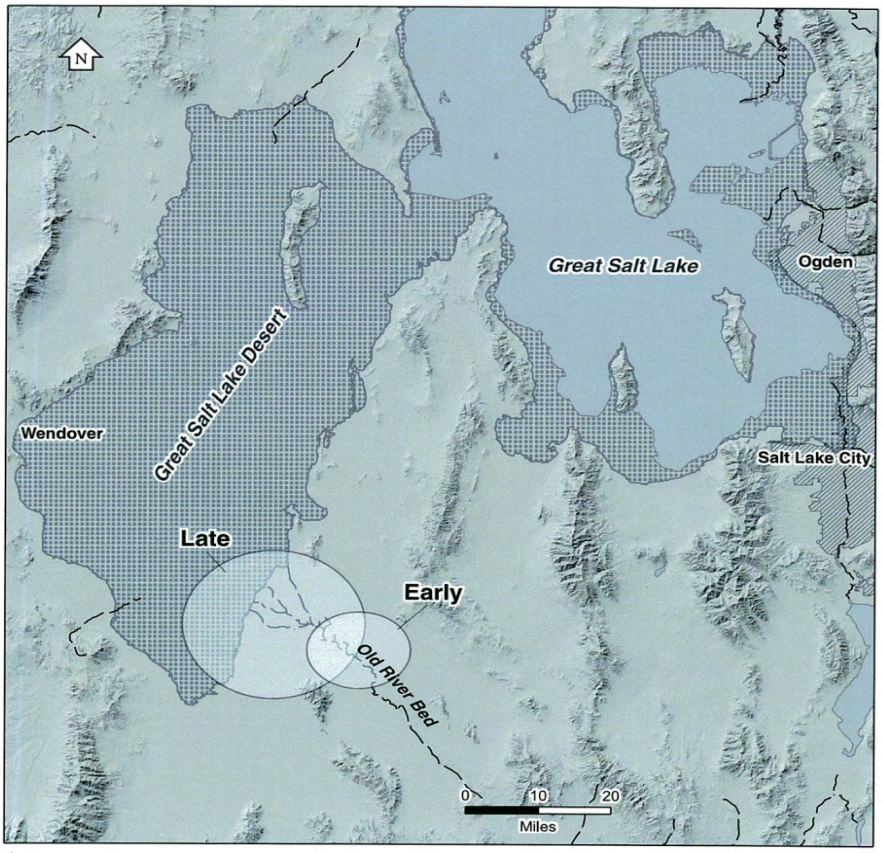

Figure 5. Generalized Site Patterning in the Great Salt Lake Desert, Bonneville Basin

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The Middle Holocene Period and Great Basin Archaeology: Past Ideas, Current Trends, and Future Research

Teresa Wriston

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The middle Holocene, also known as the Altithermal (Antevs 1948), the Long Drought (Antevs 1955), the Hypsothermal (Chiarugi 1936), or the Postpluvial (Currey and James 1982), has a long history of scrutiny by Great Basin geologists and archaeologists. In 1948, after studying European paleoenvironmental records and trends, geologist Ernst Antevs recommended splitting the postglacial, or Neothermal, period into three stages: 1) the Anathermal, ranging from 10,000 to 7,000 yrs BP; 2) the Altithermal, defined as 7,000 to 4,000 yrs BP; and 3) the Medithermal, which began 4,000 yrs BP.

To substantiate his tripartite split of the postglacial, Antevs (1948) used an interdisciplinary approach, drawing information from glacial evidence in the Sierras and western mountain ranges, arroyo down-cutting in the southwest, wind erosion, and pollen profiles. Of particular interest, Antevs used studies of Great Basin pluvial lake shorelines and salinity levels as supporting evidence. He believed that these lakes survived through the relatively mesic Anathermal before drying during the warm and dry Alti thermal.

Of most concern to Great Basin archaeologists, Antevs used archaeological material, or lack thereof, to strengthen his argument. In his 1948 treatise, Antevs proposed that during the worst of the "Long Drought" people had abandoned the Great Basin due to harsh conditions. This statement prompted heated debate amongst Great Basin archaeologists. These researchers disagreed as to whether or not the Great Basin had been abandoned and whether the phases Antevs postulated were valid. Antevs had unknowingly stoked the Great Basin archaeological research engine even while forging a strong conceptual link between environmental and archaeological studies.

In 1955, Antevs further added ratios of grass-chenopod-composite pollen studies, calichification, mammal studies, and dune building to bolster his arguments. In this latter work, Antevs expanded the time range for the Altithermal from 7,500 to 4,000 BP based largely on European temperature studies

by Fries (1951). This change reflected Antevs' intention that these phase designations should be flexible and incorporate new findings.

During the 1960s, as data began to accumulate about pluvial lake history, it became obvious that Antevs had it wrong—the pluvial lakes began to dry up during the Anathermal, not the Altithermal. Bryan and Gruhn (1964) warned of the problems (particularly that it did not match lake level regression) with Antevs' Neothermal sequence and its incorrect use by scientists as universally applicable, dated periods (see also Aschmann 1958; Weide 1976). They instead encouraged local studies and phase designations that recognized varying local responses to large- and small-scale changes. However, some archaeologists (e.g., Baumhoff and Heizer 1965) supported Antevs' model and the idea of large-scale abandonment of the Great Basin, mostly due to a lack of sites from this time period in their study areas (particularly the northern and central Great Basin). Work at Fort Rock and Connelly Caves (Bedwell 1973) in the northwestern Great Basin verified that abandonment there occurred following the eruption of Mt. Mazama ca. 7600 cal yrs BP.

Conversely, excavation in the eastern Great Basin refuted any abandonment. Archaeological evidence from occupations at Danger Cave suggested continuous occupation throughout the Holocene. Hogup Cave was occupied from 8,500 thru 100 BP (Aikens 1970), with no significant occupational hiatus. Sandwich Shelter (Marwitt et al. 1971), Amy's Shelter (Gruhn 1979), Deer Creek Cave (Shutler and Shutler 1963), Newark Cave (Fowler 1968)), South Fork Rockshelter (Heizer et al. 1968; Spencer et al. 1987), Spotten Cave (Mock 1971), and Swallow Shelter (Dalley et al. 1976), also evidenced middle Holocene occupation. Ongoing research in the northwestern Great Basin suggested upland use there during the middle Holocene (Fagan 1974), not abandonment as cave studies had previously suggested (Cressman 1986). These findings led Aikens to declare that "the Altithermal Abandonment model is now dead in Great Basin studies" in 1978 (79).

Despite the archaeological finds, the pollen and mammal studies often associated with the forementioned investigations generally supported that a hot and dry period had occurred during the "Altithermal". As a result, by the early 1980s it was widely accepted that environmental conditions during the

middle Holocene were warm and dry and that biotic communities began to take their current shape during this period (O'Connell and Madsen 1982: 2; Thompson 1990: 219). And although archaeologists working in the eastern Great Basin had declared the Altithermal abandonment theory dead, archaeologists working in the central and southern parts of the Great Basin (e.g., Elston 1982, Lyneis 1982, and Thomas 1982) continued to note the lack of sites or evidence of intensive occupation during much of this period. By the mid-1980s, Antevs' tripartite climatic model had gained wide acceptance by the archaeologists of the Great Basin with some modification of the details and regional deviations (Jennings 1986), but the abandonment theory continues to be a point of contention between archaeologists working in different areas.

This debate, although healthy, results not only from local and regional adaptations people made to changing conditions, but is partly due to the largely unacknowledged climate variation during the middle Holocene.

GLOBAL CLIMATE CHANGE DURING THE MIDDLE HOLOCENE

Data from around the world agree that the onset of the middle Holocene was abrupt and occurred around 8000 cal yrs BP (Stager and Mayewski 1997; Alley et al. 1997; Masson et al. 2000), largely in response to orbital forcing. However, this generally warm and dry period in the northern latitudes, which is most often defined as between 8000 to 4000 cal yrs BP, is more variable than once thought (Bond et al. 1997; Meese et al. 1994); and is punctuated by a more moderate period ca. 5800 to 5200 years ago (Dean et al. 1984; Mayewski et al. 2004; Bond et al. 1997; Denton and Karlen 1973; Magny et al. 2006). After this moderate period and near the end of the middle Holocene, conditions again became warm and dry (Dean et al. 1984), but were less volatile than before. These variations of global-scale climatic conditions had tremendous impacts on cultural development and adaptation. Analysis of middle Holocene archaeology should therefore acknowledge this variability. Towards this end, I have segmented the middle Holocene period into three stages based on climatic variations, the "Initial Middle Holocene" (ca. 8000 to 5800 cal yrs BP), the "Middle Holocene Gap" (ca. 5800 to 5200 cal yrs BP), and the "Terminal

Middle Holocene" (ca. 5200 to 4000 cal yrs BP; Table 1).

Initial Middle Holocene (ca. 8000 to 5800 cal yrs BP)

The transition into the middle Holocene period is reflected in both terrestrial and marine ecosystems. Major changes in atmospheric circulation are also evident (Mayewski et al. 2004). The Laurentide ice sheet rapidly disintegrates (Denton and Karlen 1973), fire frequency increases, monsoonal regions dry, North Atlantic tradewinds strengthen (Alley et al. 1997), sea surface temperatures rise (Steig 1999), and the concentration of greenhouse gases increases (Steig 1999). Some evidence suggests that the Pacific El Nino/Southern Oscillation (ENSO) system shut down during this time (Sandweiss et al 1999), and that major changes in the North Atlantic thermohaline circulation pattern occurred (Bond et al. 1997).

The Initial Middle Holocene was volatile. Extreme ~200 year oscillations are noted in varved lake sediments in the Midwest (Dean et al. 1984). Short-term temperature fluctuations are indicated by changes in oxygen isotope 18 levels from the GISP2 core (Meese et al. 1994), and numerous wet-and-dry intervals are indicated by forest reconstructions in central Taiwan (Liew et al. 2006). In addition, glaciers in the Swiss Alps advance sometime early in the period and then again retreat between 7450 to 6550 cal yr BP (Joerin et al. 2006).

Middle Holocene Gap (ca. 5800 to 5200 cal yrs BP)

Around 5800 cal yrs BP, relatively cool and moist conditions return to the northern hemisphere. Modern woodland communities form in the Great Basin and single-leaf pinyon pine expands into its current range (Thompson 1990). Between ca. 5800 and 5200 cal yrs BP, glaciers advanced (Denton and Karlen 1973), poles cool (O'Brien et al. 1995), ice-rafting events increase (Bond et al. 1997), westerly winds strengthen, and tropics dry (Mayewski et al. 2004, and references therein). Lake Constance' rises during three separate events that correspond to changes in atmospheric ^{14}C levels (Magny et al. 2006).

Peruvian coastal archaeological sites switch from tropical marine taxa to mixed tropical and temperate assemblages at ca. 5800 to 5600 cal yr BP, suggesting that ENSO activated around this time (Sandweiss et al. 1996). In Switzerland, a mid-Holocene climate reversal is noted 5700 to 5200 cal yrs BP as glaciers advance (Joerin et al. 2006). Elk Lake in

Minnesota recovered from the preceding dry period ca. 5400 years ago (Dean et al. 1984). Denton and Karlen (1973) also note a peak in glacial expansion at 5300 cal yrs BP, which suggests that this was the coolest period in the middle Holocene.

Terminal Middle Holocene (ca. 5200 to 4000 cal yrs BP)

After ca. 5200 cal yrs BP, glaciers again began to retreat (Denton and Karlen 1973; Joerin et al. 2006) in response to the return of warm and dry conditions in the northern latitudes (see Dean et al. 1984). However, unlike the Initial Middle Holocene, the less volatile Terminal Middle Holocene gradually improved to reach near modern conditions around 4,000 cal yrs BP. Thus, the transition from the middle Holocene to late Holocene is often difficult to delineate in the various proxy records due to its gradually changing nature and the increasingly important role of localized conditions. As a result, data often disagree as to the timing of the transition into the relatively cool and moist conditions of the late Holocene.

DRIVING FORCES DURING THE MIDDLE HOLOCENE

As proxy data are collected from around the world, it is apparent that atmospheric ^{14}C and ^{10}Be correlates with many global climatic events during the middle Holocene, suggesting that the mechanism responsible for changes in these cosmogenic radionuclides may be responsible for the change in climate (Versteegh 2005). Possible forcing mechanisms include: changes in the earth's magnetic field (long term only), disruption in ocean circulation, varying solar activity, or the cumulative effects of each (Bay et al. 2004; Cane et al. 2006; Liew et al 2006; Mayewski et al. 2004; Stager and Mayewski 1997). There is growing consensus that solar variability and its interaction with large-scale cycles (e.g., weak Dansgaard-Orschger 1470 yr periodicity) is the leading cause of much of the climatic variability noted during the Holocene (Blaauw et al. 2004; Denton and Karlen 1973; Cane et al. 2006; Goosse and Renssen 2004; Magny et al. 2006; Mayewski et al. 2004; Pap and Fox 2004, and references therein; Stager and Mayewski 1997; Versteegh 2005).

While astronomical theory can use the eccentricity, precession, and obliquity of the ecliptic of the earth's orbit to predict solar insulation through time: solar radiation is not as predictable.

Perturbations of solar radiation can occur due to sunspots, solar flares, and volcanic eruptions (Cane et al. 2006), and produce unexpected and complex interactions within the system. Hence, although variations in solar radiation due to changing solar output can be measured using ^{14}C and ^{10}Be, it cannot be predicted.

In the Initial Middle Holocene, disruptions in ocean circulation and/or changes in solar radiance superimposed on astronomical changes are thought to be the major forcing mechanisms that culminated in the volatility of this stage (Stager & Mayewski 1997). However, volcanic activity, which is thought to have increased due to geophysical adjustments from glacial to interglacial conditions at the beginning of the Holocene, is still high until around 6000 years ago (Zielinski et al. 1996). This activity also would have perturbed other proxy climatic indicators and contributed to the overall environmental instability during this time. During the Middle Holocene Gap and Terminal Middle Holocene, solar variability is thought to have played a primary role, but its interaction with astronomical cycles and atmospheric and ocean circulation patterns no doubt enhanced any effect.

Local conditions become increasingly important for paleoecological reconstructions during the Holocene when a wide diversity of available proxies (e.g., pollen, tree-rings, ice-cores, lakes, glaciers) reflect regional complexity that may have been obscured during more dramatic large-scale climate changes, such as from glacial to interglacial periods (O'Brien et al. 1995). This local complexity is demonstrated by the various dates given for the middle to late Holocene transition, which range from 5500 to 3000 BP, depending on the region of study and proxy data investigated. Within the Great Basin, interaction of Pacific, Gulf, and Polar air masses, coupled with varied topography and the timing and extent of large bodies of freshwater (which moderate local climate), further complicate the reconstruction of past environmental conditions and emphasize the importance of local environmental variables through time (Wigand and Rhode 2002).

THE GREAT BASIN DURING THE MIDDLE HOLOCENE

Global proxy data suggests that the climate was sufficiently dynamic in the Holocene to force people to cope with dramatic variability within the ecosystems they relied upon (Mayewski et al. 2004;

Sandweiss et al. 1999). However, the availability of resources varies not only as the result of changing climatic conditions, but also by type, season, topography, and region. In the following, our focus narrows to the Great Basin and the archaeological implications of regional climatic conditions. For these purposes, the Great Basin is partitioned into four areas: the northwestern, central, eastern, and southern regions (Figure 1).

Northwestern Great Basin: Oregon

In the northwestern reaches of the Great Basin, early research concentrated on the explosive eruption of Mt. Mazama ca. 7600 years ago and its effect on nearby peoples. Initially, the area was believed to have been abandoned based on data from Connely Caves, which exhibits continuous occupation except for between ca. 7600 and 5700 cal yrs BP (Aikens 1982; Bedwell 1973). However, later lakeshore and upland investigations proved that people were utilizing other portions of the landscape with varying intensities within this interval (see Aikens and Jenkins 1994; Dugas and Bullock 1994; Fagan 1974; Hanes 1988; Jenkins et al. 2004; Pettigrew and Lebow 1989; Musil 1995, and references therein). For instance, upland sites in the northern Great Basin are more frequent during the Initial Middle Holocene, especially near springs (Fagan 1974). Dirty Shame Rockshelter was occupied from 9500 cal yrs BP to 5850 cal yrs BP (Aikens et al. 1977; Hanes 1988), and similar occupation patterns were noted at Cougar Mountain Cave and at Hanging Rock Shelter (Layton 1972a, 1972b).

According to Grayson (1979), the northwestern Great Basin became severely arid around 8000 years ago. Lakes decline during the Initial Middle Holocene. Dunes were already in existence when Mazama tephra fell, but continue building between 7600 and 5400 cal yr BP (Jenkins et al. 2004), suggesting increased sediment availability due to drought conditions. Paulina Marsh dries after 7800 cal yrs BP (Jenkins and Aikens 1994). Populations of pygmy cottontail (associated with dense stands of sagebrush) decrease after 7000 years ago and Pika became extinct in lowlands of the northern Great Basin (Grayson 1987).

At 5600 cal yrs BP, a wet period is suggested by lake transgression and archaeological evidence (Moessner 2004), and Jenkins et al. (2004) calls the period between 6000 and 5300 cal yrs BP, "the wettest of the middle Holocene". This data supports that the Middle Holocene Gap is evident in the northwestern Great Basin. Its reality is also reflected by

increased archaeological visibility, including lakeside villages where people exploited a broad range of lacustrine and terrestrial fauna and plants, such as waada and bulrush (e.g., the Bergen site [Helzer 2004]). Storage pits become more common and shell beads indicate that these peoples had ties to the coast.

Well into the Terminal Middle Holocene and centered around 4500 cal yr BP, there is a drop in occupation reflected in radiocarbon dates (Mehringer and Cannon 1994), suggesting decreased use during an approximately 300-year interval. However, subsequent occupation returns to previous levels by ca. 4100 cal yrs BP, perhaps due to rising lake levels and increasingly mesic conditions (see Mehringer and Cannon 1994; Wigand 1987).

Truckee River Drainage Basin

Further south, the relatively closed drainage system of Lake Tahoe-Truckee River-Pyramid Lake has provided excellent paleoenvironmental data, varying from submerged tree stumps, tufas, lake cores, and shorelines. A summary of this research is offered that relies heavily on Linström's (1990) work on submerged tree trunks, Benson et al.'s (2002) work on oxygen isotope 18 and magnetic susceptibility records from cores at Pyramid Lake, and Mensing et al.'s (2004) study of pollen and algae microfossils from the same.

In brief, these researchers found that intense aridity characterized the Lake Tahoe-Pyramid Lake system during the middle Holocene, particularly between ca. 7500 and 6300 cal yrs BP. In fact, Lake Tahoe may not have spilled over its sill during this time. Since Lake Tahoe provides a significant amount of the Truckee River flow, it and its sump—Pyramid Lake, would have dwindled. Around 5350 cal yrs BP, Lake Tahoe again topped its sill and released water into the Truckee River. But this was short-lived, as it again dropped to just below its sill ca. 5200 cal yrs BP. Pollen records and oxygen isotope 18 data suggests another severe drought between 5200 and 5000 cal yrs BP, after which more mesic conditions prevail until another dry interval between 4700 and 4350 cal yrs BP. Shortly after this time, mesic conditions returned. Winnemucca Lake, which is fed only by Pyramid Lake overflow, held water by approximately 4320 cal yr BP, as based on pond turtles and fish vertebrae from archaeological deposits in nearby Kramer Cave (Long and Rippeteau 1974).

The above studies of the Pyramid Lake, Truckee River, and Tahoe system have necessarily assumed a constant sill height for the Tahoe Outlet. However, recent information on deformation along three major fault strands in the Lake Tahoe basin suggests that the sill may have varied. For instance, the Stateline Fault has ongoing fault-related slip hypothesized to occur as 3 to 5.5 m step-wise movements on average every 3,000 years (Kent et al. 2005). These preliminary tectonic investigations caution that tectonic forcing mechanisms are still active in the Great Basin and may be superimposed on changes in environment in the proxy data—complicating their interpretation.

Lahontan System

Further east, Davis (1982) recognized a three-part split in the middle Holocene and referred to stages as the Early Mid-Holocene (ca. 7700 to 5800 cal yrs BP), the Middle Mid-Holocene (ca. 5800 to 4800 cal yrs BP), and the Late Mid-Holocene (4800 to 3400 cal yrs BP). These periods were largely based on his study of Mazama tephra's depositional context within the relic Lake Lahontan system, a summary of which follows.

There appears to have been shallow standing water in the Carson-Humboldt Sink, Dixie, and Big Smoky Valleys when Mazama fell 7600 years ago, often on top of existing dunes. Rivers were entrenched into their early Holocene terraces and steep mountain slopes became choked with colluvium as stream discharge decreased (Davis 1982: 65-66). Punctuated mud flow events and alluvial aggradations were fed by intense summer storms with torrential rains that scoured away the sediment loosened by denuded vegetation cover between 7600 and 5800 cal yrs BP (Davis 1982).

In addition, Morrison (1964) estimated that about a cubic mile (2.75 km^3) of sediment was deflated from the Carson Sink during this time. Further south at Walker Lake, a sediment core suggests that it was desiccated at or before 5,030 cal yr BP (Benson et al. 1991). The landscape remained unstable, with continuing depositional episodes until ca. 5,100 cal yrs BP, when a decrease in seasonality led to increased stability and allowed soil development that continued until ca. 4250 cal yrs BP. By the mid-to-late Holocene transition, conditions become more mesic, with shallow lakes in the Carson Sink (the Fallon lakes [Morrison 1964]) and spikes in cattail pollen in samples from Hidden Cave 4,160 cal yr BP (Wigand and Mehringer 1985). Archaeological sites are found in

all major ecological zones of the northwestern Great Basin by then end of the middle Holocene (Pendleton et al. 1982).

The limited data available for Initial Middle Holocene sites in the western Great Basin suggests that populations were low (Elston 1982), and although the people seem to fare better in the northwestern extremes of the Great Basin (e.g., Oregon), site density is lower than before or after. Large sites tend to be located near permanent springs and streams, reflecting the importance of surface water (Layton and Thomas 1979), but all habitats were used. Large game hunting is evidenced in many of the sites dating to this time (c.f. Silent Snake Springs [Layton and Thomas 1979] and Surprise Valley [O'Connell and Hayward 1972]). An archaeological survey of an approximately 200-mile long corridor from Reno to Alturas and Lava Beds National Monument, suggests that sites of this time are rare, but more likely to occur in upland settings of the Modoc Plateau and Pit River Uplands than in lowland basins (McGuire 2002). However, based on excavations at three lowland occupations in Surprise Valley (O'Connell and Hayward 1972), villages there spanned ca. 6700 cal yrs BP to historic times.

By 5800 cal yrs BP, the relief of the Middle Holocene Gap is evident in the increased archaeological visibility as population responds to the abundance offered by the mesic interval. Hidden Cave first sees intensive use during this time (Devil's Gate Phase; Thomas 1985) and milling equipment becomes increasingly abundant (Elston 1982), suggesting widening diet-breadth. Not as many sites are found dating to the Terminal Middle Holocene interval, suggesting alternative strategies to these relatively dry conditions; however, at the mid-to-late Holocene transition, archaeological site density dramatically increases (see Pendleton et al. 1982).

Central Great Basin

Very few records concerning the middle Holocene are available for the central portion of the Great Basin. Heizer (1951) and Baumhoff and Heizer (1965) believed that archaeological evidence from the middle Holocene period is scant due to low prehistoric populations. More recently, the lack of archaeological sites dating to this time is noted in Grayson (1993), Beck (1995), and Thomas (1982).

Ruby Marsh

Central Great Basin paleoenvironmental work is also limited.

One important study is that of Robert Thompson (1992) in the Ruby marsh area, which shows that between 7660 and 5450 cal yr BP, water declined and shadscale expanded at the expense of sagebrush. These changes suggest xeric conditions that are further supported by decreasing sedimentation rates as sediments erode faster than they were deposited. Around 5450 cal yr BP, Ruby marsh rebounds during moister conditions (Thompson 1992).

Humboldt River

Jonathan Davis' work along the Humboldt River for the Rye Patch Reservoir Project (Rusco and Davis 1982) provides a stratigraphic sequence for the area that echoes in his 1982 work discussed earlier. In general, dry conditions beginning before Mazama ash falls ca. 7600 cal yrs BP are suggested by entrenchment of early Holocene terraces and dune building. These processes continue through the period, but in some locations, halted long enough to allow soils to develop around 5000 years ago. The Humboldt entrenched into previous middle Holocene floodplains around 4000 years ago, leaving both early and middle Holocene terraces high above the current water level.

Archaeological investigations associated with the same project includes finds of Humboldt, Elko, and Gatecliff Series projectile points sometimes associated with middle Holocene occupations; however, the earliest radiocarbon date from cultural context is 4000 cal yrs BP (Rusco and Davis 1982: 51). This suggests that the river margin was either not occupied during the middle Holocene, or that it has been obscured or destroyed by river terrace development and erosion, or cut-and-fill sequences.

Gatecliff Shelter

Perhaps the most intensively studied archaeological site in the central Great Basin is Gatecliff Shelter. David Hurst Thomas excavated over 11 meters of stratified fill with abundant artifacts and assayable material from this site (Thomas 1981; Thomas 1983), in addition to surveying nearby Monitor Valley (1988). Based on his work, Thomas (1982) states that the central Great Basin was not occupied until around 5500 cal yrs BP, which is then characterized by low populations and the Triple T concave base point types between ca. 5500 to 4500 cal yrs BP. After 5400 cal yrs BP, pinyon pine was available at Gatecliff shelter, although does not seem to be important until site density increases after 4500 cal yrs BP, a period associated with Gatecliff

points. Site density continued to increase into the late Holocene (Thomas 1982). Gatecliff Shelter data suggests that Gatecliff Series projectile points span 5000 to 3300 cal yrs BP, Elko Series are of late Holocene age, and Humboldt Series points are not reliable temporal indicators.

Leonard Rockshelter

At Leonard Rockshelter, near the boundary for the northwestern and central Great Basin, radiocarbon dates from atlatl foreshafts evidence visitation as early as 7100 cal yrs BP, while an infant burial dated to 5700 cal yrs BP also proves that people were in the area. However, cave occupation did not occur until around 2500 cal yrs BP (Heizer 1951).

Pie Creek Shelter

Near the contact of the northeastern and central Great Basin, work in Tule Valley has documented an important shelter above Pie Creek (McGuire et al. 2004) occupied for the first time during the Middle Holocene Gap. Pie Creek is on the north fork of the Humboldt River and drains an enormous basin. Any surface runoff is bolstered by springs (likely fault-constrained) feeding the creek, which runs year round. Craig Young's work documenting the Pie Creek stratigraphy (McGuire et al. 2004) shows that Mazama ash fell on an undulating eroding soil within the Pie Creek floodplain and in cut-and-fill sequences exposed in arroyos downstream. No cultural material was found associated with Mazama, and occupation of Pie Creek shelter does not occur until 5600 cal yrs BP.

Pie Creek phase strata span 5600 to 4500 cal yrs BP and contain hearth features, flaked and ground stone, and floral and faunal material (McGuire et al. 2004). Points associated with the Pie Creek Phase include Northern Side-notched, a stemmed-like variant, Humboldts, and a leaf-shaped form. There is generally a low ratio of big horn sheep to rabbits, some fish, and minnows. Charred wild rye and goosefoot seeds are abundant and would have been available for collection during late summer-to-fall. A large milling stone assemblage suggests that this was an important activity. During the subsequent South Fork phase, Gatecliff points are most common and there is an increase in large mammal remains; suggesting an increasing reliance on large game. This phase is well constrained by dated hearths to between 4400 cal yrs BP and 3200 cal yrs BP. Of note, most Elko Series points were from later occupations.

Newark Cave

At Newark Cave (Fowler 1968), which is near the boundary of the central and eastern Great Basin, a similar pattern of occupation was noted, with initial occupation around 5800 cal yr BP. Here the earliest occupation is apparently associated with Humboldt Concave Base points; however, examination of the photos begs the question whether some of these would be re-classified as Triple T concave base and Gatecliff points by Thomas. Elko Series points are again limited to the late Holocene assemblage.

During the Initial Middle Holocene, which is arguably the warmest, driest, and least predictable of the Middle Holocene; all lines of evidence suggests that population and site density within the central Great Basin were very low. And although some evidence does exist of an aboriginal presence within the area, no intense occupations are found until the more mesic Middle Holocene Gap. Newark Cave is first occupied at 5800 cal yrs BP and both Gatecliff Shelter and Pie Creek Shelter have occupations beginning around 5600 cal yrs BP. No Terminal Middle Holocene signature/hiatus is evident in these occupations, but differing technological strategies are. For example, the switch to Gatecliff points, the increasing importance of large game in Pie Creek Shelter, and a possible increase in pinyon pine use at Gatecliff Shelter.

Growing evidence suggests that Humboldt and Elko Series points are poor temporal indicators of the Middle Holocene (see Thomas 1983 and Hockett 1995). Gatecliff Series points are more reliable in the central Great Basin than elsewhere, but span into the late Holocene period (McGuire et al. 2004; Thomas 1983). Northern Side-Notched points, which are generally more reliable middle Holocene indicators, are found in surface sites north of the Humboldt River (Layton 1985), and from various contexts in northeastern Nevada (Hockett 1995). Triple T concave base points may be good temporal indicators, but are often mistaken for Humboldt concave base points, limiting their usefulness.

Eastern Great Basin

The majority of the Great Basin, although not necessarily abandoned during the Initial Middle Holocene, evidences limited site density and low populations relative to other periods; however, this does not seem to be the case in the eastern Great Basin where site density, particularly of caves, seems to increase at the early to middle Holocene transition. Many caves were inhabited for the first time around 8300 years ago (e.g.,

Hogup Cave, Camels Back Cave). The transition into the Initial Middle Holocene ca. 8000 cal yrs BP ushered warm and dry conditions that began the desertification here as elsewhere. However, people continued to live in the eastern Great Basin throughout the middle Holocene, perhaps due to the presence of large springs (e.g., Blue Lakes) around the periphery of the Bonneville Basin and development of marsh and saline meadows on newly exposed lake beds (see Harper and Alder 1972). At Danger Cave, Jennings and Norbeck (1955) found that there was no abandonment even though a study of cave sediments (Harper and Alder 1972) suggests that after ca. 8800 cal yrs BP, aridity progressively increased until ca. 4400 cal yrs BP. Research at Hogup Cave (Aikens 1970) produced similar results.

Although no abandonment seemed to occur in the eastern Great Basin, patterns of occupation and foraging strategies changed. Plant foods became important, as signified by increasing numbers of milling gear and the consistent presence of pollen and seeds in human coprolites (Kelso 1970). Beginning around ca. 6200 cal yrs BP, and continuing into the Terminal Middle Holocene period, Madsen and Berry (1975) have shown that substantial upland settlement occurred in the eastern Great Basin and propose that this is due to drowning of halophylitic plants and the marsh resources along the lake periphery that had become targeted resources during the Initial Middle Holocene.

The warm and dry conditions of the Initial Middle Holocene are evident in studies of pollen, macrofossils, animals, lake sequences, and depositional events. Mehringer (1977) suggested that the high ratios of shadscale and other chenopod shrubs relative to sagebrush and conifers found in the Great Salt Lake between ca. 7800 cal yr BP and 6200 cal yrs BP implies that the early part of the middle Holocene was warmer and drier than today (Mehringer 1977, 1985). After this time, and continuing to ca. 4400 cal yrs BP, relative pollen ratios indicate relatively mesic conditions similar to modern times (Wigand and Rhode 2002). Analysis of findings at Snowbird Bog by Madsen and Currey (1979) also find that it was warm and dry between 8800 and 6300 cal yrs BP and warm and relatively moist between 6300 and 6000 cal yrs BP. At Swan Lake, near the northeastern periphery of the Great Basin, low arboreal pollen counts between 8800 cal yrs BP and 3200 cal yrs BP Mehringer (1977) suggests semiarid conditions there as well.

A transgression of the Great Salt Lake between 9000 and 8000 cal yrs BP is proposed by Murchison (1989), but between 7800 cal yrs BP and 6100 cal yrs BP, environmental records are sparse and the Great Salt Lake may have nearly completely dried. A slight rebound around 6700 cal yrs BP (Murchison 1989, Murchison and Mulvey 2000), and another around 5400 cal yrs BP (Murchison 1989) reflect periodic increased effective moisture. Conversely, below the current level of the Great Salt Lake, desiccation polygons testify to droughts and were likely created sometime between 8200 and 5700 cal yrs BP (Currey 1980a; Currey and James 1982). Colluvium was deposited in Sudden Shelter 7600 to 7100 cal yrs BP during intense storm events with tremendous erosive force due to decreased ground cover (Currey 1980b). This pattern is often associated with summer convective storms during summer-dominated precipitation patterns.

During the middle Holocene plant and animal diversity decreased (Grayson 2000; Lyman and O'Brien 2005). Only a handful of preserved packrat middens have been discovered and analyzed, nearly all which are from upland sites. Analyses suggest a characteristically different climate between 8800 and 6300 cal yrs BP (warmer and drier) than between 6300 cal yrs BP and 4400 cal yrs BP (cooler and wetter, particularly around 5200 cal yr BP) (Rhode 2000; Wigand and Rhode 2002). Pinyon Pine arrives in the eastern Great Basin during the Initial Middle Holocene, with pine nut hulls found in archaeological deposits between 8250 cal yrs BP and 7550 cal yrs BP (Rhode and Madsen 1998). Utah juniper and pinyon pine continued to expand their territory between 7800 and 6100 cal yrs BP (Madsen 2000; see also Rhode 2000). And cooler temperatures around 5750 cal yrs BP are indicated by changes in coniferous forest (Currey and James 1982).

Amy's Shelter near Smith Creek Canyon (Gruhn 1979) is occupied beginning around 5200 cal yrs BP. The earliest horizons are associated with Humboldt Concave Base points, but Pinto Series, Elko, Gypsum, and some Stemmed points were also identified in other layers. Conversely, nearby Smith Creek Cave was used during both the early and late Holocene, but not during the middle Holocene. Swallow Shelter is first used beginning around 6150 cal yrs BP, but is not intensively occupied until after 3700 cal yrs BP (Dalley 1976), coinciding with a sharp increase in arboreal pollen.

Camels Back Cave

Recently excavated Camels Back Cave (Schmitt and Madsen 2005) exhibits use throughout most of the middle Holocene. It was first occupied ca. 8300 cal years BP and has a sequence of assayed hearths into the late Holocene. Faunal material shows that bushy tailed woodrat and white-tailed jackrabbit become extinct here around 8000 cal yrs BP, and that the cottontail population declines while hares increase. Decreasing numbers of birds, particularly waterfowl, further testify to the growing aridity. The oldest hearth (8300 cal yrs BP) is associated with jackrabbit bones, a mano, a Northern Side-Notched point, and some debitage. Subsequent hearths created between 8300 and 8100 cal yrs BP are variously associated with calcined jackrabbit bones, charred pepperweed seeds, grinding stones, and a minimal lithic assemblage dominated by basalt detritus.

Beginning 7300 cal yrs BP, and continuing to 6200 cal yrs BP, small game use continues and charred chenopod and pepperweed seeds were found; however, use of basalt becomes rare. Lessening amounts of jackrabbit remains between 6300 and 4500 cal yrs BP is used to argue that the environment is hot and dry, perhaps more arid than any other time in the Holocene. However, this hypothesis is at odds with other climatic information for the area. There is a hiatus in the occupation between ca. 5200 and 4800 cal yrs BP, during the onset of the Terminal Middle Holocene. When occupation resumes, it is quite different, with high ratios of projectile points, increased obsidian use, and small artiodactyls remains and processing debris.

Bonneville Estates Rockshelter

Recent and ongoing excavations at Bonneville Estates rockshelter have proven very fruitful. Use of this rockshelter spans most of the terminal Pleistocene and Holocene and findings will likely provide important information regarding middle Holocene adaptations in the eastern Great Basin. Affiliated testing of Big Brother Rockshelter (Graff et al. 2006) found that Mazama ash fell on boulder rubble and that the initial occupation occurred around 7100 cal yrs BP. Subsequent dates of 5600 and 5500 cal years BP suggest use during the Middle Holocene Gap.

Schmitt and Madsen (2005) ponder why many of the shelters in the Bonneville Basin are first visited during the worsening environmental conditions around the onset of the Initial Middle

Holocene. I would suggest that although the eastern Great Basin appears to be in an environmental decline, it is in relatively good standing when compared to other areas of the Great Basin, particularly the adjacent central Great Basin. The Bonneville Basin, with its abundant springs and saltgrass marshes could have served as a sort of refugia beginning about this time and continuing around 5800 cal yrs BP; after which, populations expand into the uplands and central Great Basin.

Although analysis of projectile points from the culturally-rich caves of the eastern Great Basin is beyond the scope of this article, a general trend is apparent that is illustrated in the points of Camels Back Cave. As expected, Northern Side-Notched, Gatecliff, Elko, and Humboldt Series points are found in middle Holocene deposits; but Gatecliff points are in the upper components while Northern Side-Notched points are in lower components. Elko and Humboldt points are often found throughout, limiting their usefulness for temporal analysis. This suggests that perhaps the Initial Middle Holocene is best represented in the point typology by Northern Side-Notched in the eastern Great Basin while the onset of the Terminal Middle Holocene is often marked by Gatecliff Series points, which then persist into the late Holocene.

Southern Great Basin

At the onset of the middle Holocene in the southern Great Basin, precipitation levels declined and groundwater recharge and discharge were limited. A shift away from winter precipitation (Cole 1982, 1985; Spaulding 1983) and toward convective summer storms (Quade 1986) and monsoonal conditions (Van Devender and Spaulding 1979) is evident, and vegetation types and distribution reached their modern norms (Mehringer 1977; Spaulding 1981, 1990; Wigand and Rhode 2002). Black mats are conspicuously absent during this period (Quade et al. 1998), although they have been dated to as late as 7300 cal yrs BP at Corn Creek Flat (Quade et al. 1998) and 7400 cal yrs BP at Burnt Rock Spring (Seymour and Rager 2005). After ca. 8200 cal yrs BP, spring sediments at Gilcrease Ranch and other nearby springs began to erode (de Narvaez 1995), indicating a declining water table that could no longer provide cohesion of surface sediments. Creosote bush replaced the sagebrush along valley floors, and mesquite bosques grew only where the water table remained very near the surface. Streams and marshlands in the lower elevations decimated, and available water was limited to small springs in the foothills.

The thermal maximum is ca. 7800 cal yrs BP in the southern Great Basin, as indicated by a study of the hydrogen isotopic composition of bristlecone pine trees in the White Mountains (Feng and Epstein 1994). Wind activity increased while biotic activity decreased. The water table declined up to 25 meters below previous levels, allowing subsequent erosion and dune building (Haynes 1967; Quade 1986). Spaulding (1991) also notes a peak in aridity lasting from 7800 to 6000 cal yrs BP, with sediments that date to this period missing from the Las Vegas Valley. Dissection into valley deposits was ongoing (Haynes 1967; Quade 1986), and the location of individual species shifted over elevation and latitudinal gradients in order to adapt to these extremely arid conditions. As xeric species became established in the Mojave Desert, woodland species and other cold-adapted plants shifted northward, or in the case of bristlecone pine, upward (LaMarche 1974; Graybill et al. 1994).

Between ca. 6400 and 5700 cal yrs BP, during the transition into Middle Holocene Gap, the dunes stopped building (Quade 1986) due to water table rebound, decreasing sediment supply. Temperatures declined and effective moisture increased (Spaulding 1995). Little Lake, located between Owens and Searles lakes, filled (Mehringer and Sheppard 1978; Weide 1982); the spring-fed Lower Pahranagat Lake began to form (Peter Wigand, personal communication 2006); and peats built up in Ash Meadows (Mehringer and Warren 1976). More mesic-adapted plants began to accumulate in packrat middens of the McCullough Range (Spaulding 1991), and woodlands extended to lower elevations in the southern Pahranagat Range (Wigand et al. 1995). McDonald et al. (2003) noted soil development on alluvium between 5900 and 4980 cal yr BP, suggesting a stable surface. However, by the onset of the Terminal Middle Holocene, it again became relatively warm and dry, although never to return to the Initial Middle Holocene extreme aridity.

In the southern Great Basin, the only diagnostic artifact thought to date to the Middle Holocene is the Pinto point (Campbell and Campbell 1935), but this is also debated (some believe that the Pinto is actually an Early Holocene type; Schroth 1994). The few sites dating to this time tend to be small surface sites (Warren 1984) with increased numbers of ground stone. An association of Pinto sites with perennial springs and waterways has been noted by Warren (1986) and explained as a middle Holocene settlement shift in response to xeric conditions. Basgall and

Hall (1992) counter this hypothesis and argue that Pinto sites are found in a wide variety of environmental settings. Failure to distinguish definitive middle Holocene sites has led some researchers to speculate that the extremely arid conditions led to abandonment of the southern Great Basin during the early part of the middle Holocene (see Kowta 1969; Seymour 2001; Wallace 1962).

The majority of middle Holocene sites documented in the southern Great Basin are surface sites with no associated radiocarbon dates. Known sites with middle Holocene components include those along Duck Creek (Ezzo and Majewski 1995), near Yucca Mountain (Buck et al. 1998), at Flaherty Rockshelter (26Ck415), at 26Ck3799 near the Eglington Escarpment (dated to between 5500 cal yrs BP and 1930 cal yrs BP [Ahlstrom and Roberts 2001; Blair and Wedding 2001]), and at Tule Springs. Surface collection at the Tule Springs Site (Susia 1964) yielded 278 Pinto Period artifacts (Roberts and Ahlstrom 2002:8). Farther north, portions of the Corn Creek Dune Site also date to late in this period (4900 and 6100 cal yrs BP; Williams and Orlins 1963).

However, at O'Malleys shelter (Fowler et al. 1973) near the southern-and-eastern Great Basin boundary, an early occupation dating between 7900 and 7400 cal yrs BP has Elko, Pinto, Humboldt, Lake Mojave, Northern Side-Notched, and Gypsum points. The pollen profile of O'Malley shelter suggests that more mesic conditions began after ca. 4400 cal yrs BP with non-arboreal pollen types gradually replaced by arboreal types (Fowler et al. 1973).

Whereas pluvial lake systems dominate the environmental record for the northwestern and eastern Great Basin—in the south it is all about the springs. High spring discharge creates black mats and throughout most of the middle Holocene, no new black mats were formed, with the possible exception of a brief interval during the Middle Holocene Gap. The lakes that exist exhibit desiccating conditions and floral and faunal adjustments and reorganization occur. There is little evidence of prehistoric occupation during driest portion of the Initial Middle Holocene period. Around 5900 cal yrs BP, and continuing into the Middle Holocene Gap, site density begins to increase.

OVERVIEW

In summary, the middle Holocene is not universally warm and dry as first

conceptualized by Antevs (1948). Instead there is great variability loosely constrained by a sequence of three globally recognizable periods: the Initial Middle Holocene, the Middle Holocene Gap, and the Terminal Middle Holocene. The Initial Middle Holocene (ca. 8000 to 5800 cal yrs BP) is the driest and most dynamic of the period, with sustained drought punctuated by extreme oscillations. Precipitation seems to be dominated by flashy convective summer storms rather than the slowly released snowpack necessary for spring recharge. Archaeological evidence is very rare to non-existent in the central and southern Great Basin, while in the northwest, landscape use alters as adaptations are made to the relatively warm and dry conditions and Mazama ash fall. In the eastern Great Basin, however, there is increased use, possibly as a refuge from harsher conditions to the west. In each region, the increasing importance of costly plant foods is reflected in the routine presence of milling equipment in assemblages of this age.

During the Middle Holocene Gap (ca. 5800 and 5200 cal yrs BP), the Great Basin becomes relatively cool and wet with a winter-dominated precipitation pattern. The central Great Basin is first intensively occupied during this time. There is a punctuated increase in archaeological visibility throughout the Great Basin and upland use becomes regular in the eastern Great Basin.

Conditions again become warm and dry during the Terminal Middle Holocene (ca. 5200 to 4000 cal yrs BP), but gradually improve to near modern conditions after 4400 cal yrs BP. There is a dramatic increase in the number of archaeological sites in the latter part of this period. In many areas, the transition from the middle-to-late Holocene is obscured by its gradual nature, leading to disagreement over when one period ends and the other begins; however, the explosion of archaeological sites beginning ca. 4000 cal yrs BP supports that this transition took place at that time.

The tempo of the middle Holocene environmental changes was likely controlled by solar variation imposed on astronomical cycles. The regional variation in response to these cycles depended on the history of the system and its inhabitant's ability to adapt to change (e.g., generalized animal species that can adapt versus specialists that go extinct). People adapt easily, but we also travel well, and any extreme drought might lead to at least temporary abandonment of marginal environments,

particularly when population levels are low and territories fluid. Mehringer (1977) suggests that the amount of variation in the middle Holocene was no greater than Great Basin peoples dealt with during a single year. Although true, if you cannot rely on the relief of fall precipitation after a summer drought, winter snowpack to recharge the springs, and a wet spring; not only this year but for the next two thousand—then your coping strategies would necessarily be different. In bad times, humans cope by increasing the diversity of utilized resources, by increasing the intensity of exploitation, or by limiting the population (Elston 1982: 190). On a human-scale, times were bad during the Initial Middle Holocene. However, the skills and traditions that were honed during the middle Holocene, coupled with the changed floral and faunal landscapes, is what set the stage for the cultural boom of the late Holocene.

Northern Side-Notched, Elko, Humboldt, Triple T Concave Base, Gatecliff, and Pinto Series projectile points are all regularly found in middle Holocene sites. Unfortunately, only two of these seem to be good temporal markers – the Northern Side-Notched point in the northern and eastern Great Basin, and the Pinto Series point for the southern Great Basin (although this is also debated). Gatecliff Series points seem to consistently show up in the central and eastern regions beginning in the Terminal Middle Holocene, but they continue well into the late Holocene, limiting their usefulness. Elko and Humboldt points are similarly found throughout the Holocene and cannot be used to delineate sites of this period. Triple T concave base points may be useful indicators in the central Great Basin, but are often classified as Humboldt points.

FUTURE RESEARCH

Many avenues of research are still needed to understand the middle Holocene period in the Great Basin. Helpful studies would include paleoenvironmental investigations that tease out variability within the period rather than lump it into the "long drought". Large central Great Basin projects are needed to test whether or not the central Great Basin was occupied during the Initial Middle Holocene. Obsidian hydration studies may help us serially date surface sites, which most middle Holocene sites are due to the high degree of sediment movement during the period. In addition, the use of Geographic Information Systems (GIS) to build and test both micro and macro-scale models factoring local environmental

variables, large-scale climate trends, and the growing archaeological database, will help us start analyzing landscape use in a more holistic manner; escaping the confines of site-specific interpretations. In order to accomplish this, data across many disciplines is needed and must be comparable. As we begin to tease out variability, our need for precise dates will increase. To this end, I implore all researchers to provide raw radiocarbon data with the standard deviations as well as calibrated versions. In addition, researchers need to be clear as to which of these dates they are reporting, for each discipline and region has its own standard.

Table 1. Holocene Climatic Periods

Period	Time Frame	General Conditions
Initial Middle Holocene	ca. 8000 to 5800 cal yrs BP	Warmest and Driest of the Holocene; Volatile; Summer-Dominated Precipitation
Middle Holocene Gap	ca. 5800 to 5200 cal yrs BP	Relatively Mesic; Cooler Temperatures; Winter-Dominated Precipitation
Terminal Middle Holocene	ca. 5200 to 4000 cal yrs BP	Warm and Dry; Gradual Improvement

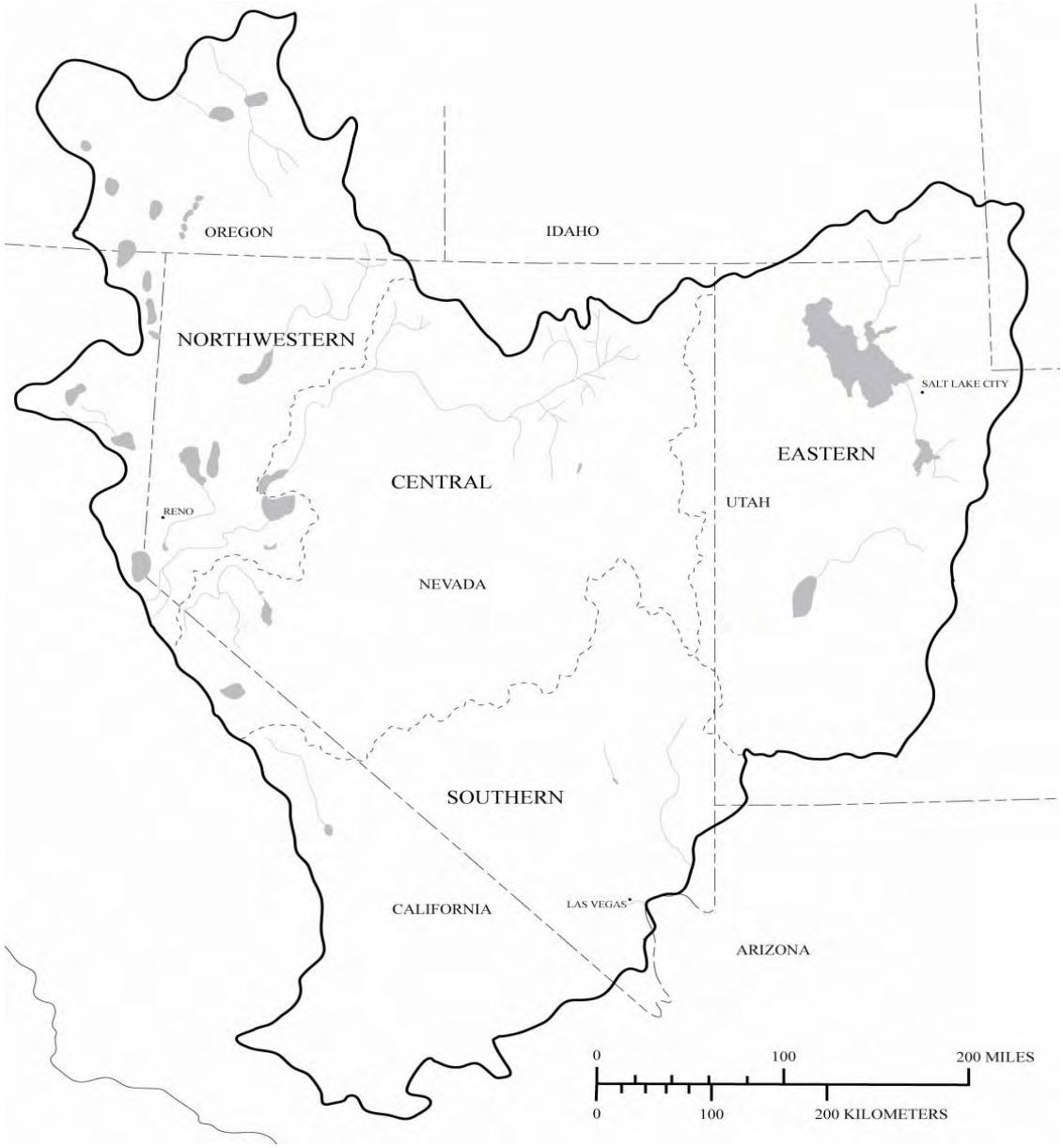

Figure 1. Great Basin partition (based on inclusive hydrographic and physiographic areas).

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