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About the *Journal*

The Journal of Arizona Archaeology is a peer-reviewed journal that focuses on the presentation of emerging ideas, new methods, and current research in Arizona archaeology. It endeavors to be a forum for the scholarly, yet simple communication of research and management related to Arizona's archaeological record. The journal is published twice a year by the Arizona Archaeological Council (AAC). At least one issue per year is devoted to the theme of the AAC annual fall conference. The conference issue (or issues) is overseen by a guest editor. The remaining issues of the journal are intended for open submissions. The frequency of general submission issues is dependent on the number of appropriate manuscripts received throughout the year and the workload of the editorial staff.

The journal is one benefit of membership in the AAC, and members receive a subscription to the Journal with their annual dues. To apply for AAC membership, report a lost/damaged journal, to subscribe to the Journal only, or to learn more about the mission of the Arizona Archaeological Council, please visit the AAC website at: http://arizonaarchaeologicalcouncil.org.

Instructions for Authors

The format of all submitted papers should correspond to the SAA style guide, which can be accessed at this web address: http://www.saa.org/Publications/StyleGuide/styframe.html. All manuscripts must be submitted as a MS Word document. All review (editorial and peer review) will be conducted electronically. Authors should be familiar with the "track changes" and "comments" functions of MS Word. Authors are encouraged to contact the editor with questions regarding the content or formatting of their manuscripts prior to submitting their papers.

Authors should anticipate two to three months for review of their manuscripts. The editor will review each paper prior to peer review to determine if the manuscript meets content and formatting guidelines. If the paper meets these preliminary guidelines, the editor will send the manuscript out for peer review. The editor makes the final decision to accept a manuscript on the basis of his review as well as those of the peer referees. If a manuscript is accepted for publication, authors must submit images in at least 300 dpi. All permissions for photographs and figures are the responsibility of the author and must be obtained prior to publication.

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THEMED ISSUE:

ARCHAEOLOGY OF THE VERDE VALLEY, CENTRAL ARIZONA

PREFACE

Todd W. Bostwick, Guest Editor
Stewart Deats, Guest Editor

This issue of the *Journal of Arizona Archaeology* is a collection of selected papers presented on the archaeology of the Verde Valley at the Arizona Archaeological Council Fall Conference held on October 18 to 20, 2012, at the Cliff Castle Casino Conference Center in Camp Verde and hosted by the Verde Valley Archaeology Center and the Arizona Archaeological Council. The title of the conference was *Verde Valley Patterns, Problems, and Possibilities*. The Verde Valley contains numerous archaeological sites, several of which have been declared National Monuments (Tuzigoot, Montezuma Castle, and Montezuma Well), yet the archaeology of this region has not received the same attention as other areas of the Southwest. The goal of the 2012 conference was to assemble a group of papers summarizing what is currently known about the ancient history of this fascinating region.

The Verde Valley is the middle portion of the Verde River, the second largest perennial river in Arizona, which flows southward for 170 miles from the Chino Valley to the Salt River. This verdant valley was formed by a freshwater lake created when a combination of faulting, basin subsistence, and volcanism blocked the Verde River during the late Miocene and early Pliocene periods. The boundaries of the Verde Valley (also called the Middle Verde) are the Mogollon Rim on the east and northeast, the mouth of Sycamore Canyon to the north, the east-facing slopes of the Black Hills to the west, and the mouth of Fossil Creek to the south. Sedona's beautiful red rock formations are part of the Verde Valley.

Because of its reliable water supply and varied ecology, the Verde Valley has attracted humans since Paleoindians and Archaic hunter-gathers roamed what is now called central Arizona. The first agriculturalists of the region have been identified as the Southern Sinagua, an archaeological culture initially defined by Harold Colton of the Museum of Northern Arizona and dated to approximately AD 600-1425. The Southern Sinagua are related to, but also differ from, the Northern Sinagua of the Flagstaff region to the north of the Verde Valley. From about A.D. 700 to 1125, Hohokam groups appear to have comingled with the Sinagua, primarily along the Verde River where irrigation agriculture was possible. In addition, Yavapai and Apache have lived in the region for centuries, and the Hopi maintain close ties to this culturally diverse landscape. A summary of the archaeological chronology of the Verde Valley is provided in this volume in the Spurr and Deats paper.

A variety of topics pertaining to the archaeology of the Verde Valley are covered by the papers in this volume. These include a discussion of the early pioneers of Verde Valley archaeology (Steven R. James and Peter J. Pilles, Jr.), a summary of Sinagua mortuary patterns (Kimberly Spurr and Stewart Deats), Sinagua pit structure variation through time (Stewart Deats), an analysis of the Mindeleff Cavate site (Susan D. Hall), the Verde Salt Mine (Nancy Jo Chabot and Todd W. Bostwick), a re-interpretation of a catastrophic event in Castle A at Montezuma National Monument (Matthew C. Guebard), differential use of flaked stone at a Sinagua pit house site (Gregory M. Haynes), flaked stone technology at Tuzigoot and Montezuma Castle National Monuments (William D. Bryce and Ashlee M. Bailey), the Tuzigoot phase of the Southern Sinagua (Peter J. Pilles. Jr.), and Sinagua archaeoastronomy (Kenneth J. Zoll). Also included is a paper on Early Formative period specialized pottery production in the Lower Verde region (David E. Doyel).

The members of the editorial panel assisted with peer review and copy editing. Our thanks to David Doyel and an anonymous colleague who provided additional peer review.

The conference was hosted by the Verde Valley Archaeology Center and the Arizona Archaeological Council at the Cliff Castle Casino Conference Center in Verde Valley, and was made possible in part by contributions from the Arizona Natural History Association, Beta Analytic Inc., Desert Archaeology, Inc., EnviroSystems Management, Inc., Logan Simpson Design Inc., Museum of Northern Arizona, National Park Service, Paleowest Archaeology, United States Forest Service, Statistical Research, Inc., and Westland Resources, Inc.

Two generous grants from the Verde Valley Archaeology Center and the Arizona Natural History Association allowed for extended print runs of this issue, making possible a larger distribution through venues in the Verde

Valley.

The mission of the Verde Valley Archaeology Center is to preserve archaeological sites and collections, to curate the collections locally, and to make them available for research and education; to develop partnerships with Native Americans, cultural groups and the communities it serves; and to foster a deeper understanding of prehistory and Native American history in the Verde Valley through the science of archaeology.

The Arizona Natural History Association is a non-profit interpretive organization dedicated to supporting the informed and sensitive use of public lands and resources in the Southwestern United States.

Verde Valley Archaeology Center
and
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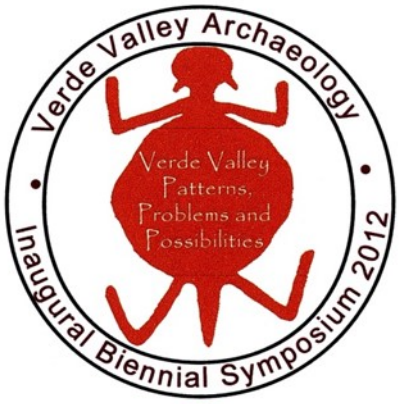

and
Arizona Archaeological Council
2012 Fall Conference
October 18-20, 2012
Cliff Castle Casino Conference Center
Camp Verde, Arizona

The Announcement for the 2012 Verde Valley Conference

LATE NINTEENTH CENTURY ARCHAEOLOGY IN THE VERDE VALLEY, ARIZONA: THE RESEARCH OF PALMER, MEARNS, HOFFMAN, AND OTHER EARLY INVESTIGATORS

Steven R. James
Peter J. Pilles, Jr.

ABSTRACT

Archaeological investigations of the Verde Valley conducted by Cosmos Mindeleff and Jesse Walter Fewkes in the 1890s for the Bureau of American Ethnology are generally cited as the earliest by most researchers. However, even earlier explorations of prehistoric sites in the region were made by Dr. Edward Palmer and Dr. Edgar A. Mearns, two military surgeons stationed at Fort Verde after the Civil War. Both Palmer and Mearns are better known for their biological science contributions, yet they also made the first scientific explorations of Montezuma Well, Montezuma Castle, and other sites in the Verde Valley. In 1890, the results of Mearns' excavations and the first archaeological survey of the valley appeared in print. The works of these two men, as well as Dr. Walter Hoffman and other early investigators, who are not well-known to modern archaeologists, are discussed in this article.

In the past four decades, the early history of anthropological archaeology in the American Southwest have been summarized in considerable detail in articles, books, and edited volumes (e.g., Elliott 1995; Fowler 2000; Hinsley 1981; Hinsley and Wilcox 1995, 1996, 2002; Parezo 1987; Schroeder 1979; Snead 2001; Wilcox and Fowler 2002; Zedeño 1999). However, most of what we provide in this article about early archaeology in the Verde Valley is not covered by these recent publications. The researchers we discuss were primarily naturalists, who also conducted early archaeological investigations in the Verde Valley and surrounding areas of Arizona from the mid-1860s to 1890. Some of these men became quite well-known for their biological investigations and are less known for their archaeological work, especially their research in the Verde Valley. Many of these naturalists knew each other, had been in the field with each other at one time or another, had mutual colleagues in common, belonged to the same scientific organizations, and may have been hired or appointed to their positions by their colleagues, as will become apparent.

With the end of the Great Surveys of the West in the late 1870s, Major John Wesley Powell (1834-1902) became the first Director of the Bureau of Ethnology (changed in 1894 to Bureau of American Ethnology) under the Smithsonian Institution in 1879; he also served concurrently as Director of the U.S. Geological Survey beginning in 1881. Through his influence and political connections, Powell was able to develop the Bureau of Ethnology into a major anthropological research arm of the Smithsonian, which acquired tremendous quantities of archaeological and ethnological specimens from the American Southwest and other regions of the country.

From its very beginning in 1879, the Bureau of Ethnology changed the nature of archaeological research in the Southwest, but it was not until the 1890s that much attention was directed toward the Verde Valley in Arizona. Most Southwestern archaeologists working today in northern and central Arizona know about archaeological investigations conducted in the Verde Valley by Cosmos Mindeleff (1863-1938) and Jesse Walter Fewkes (1850-1930) for the Bureau of American Ethnology (BAE), Smithsonian Institution, during the 1890s (Fewkes 1896a, 1896b, 1898, 1912; Mindeleff 1896). Yet there were earlier explorations of prehistoric pueblo ruins in the region made by self-trained naturalists and other researchers sponsored in part by the Smithsonian prior to the BAE investigations. These include Dr. Edward Palmer and Dr. Edgar A. Mearns, two military surgeons stationed at Fort Verde at different times after the Civil War. Although Palmer and Mearns became known for their biological science contributions, they also conducted

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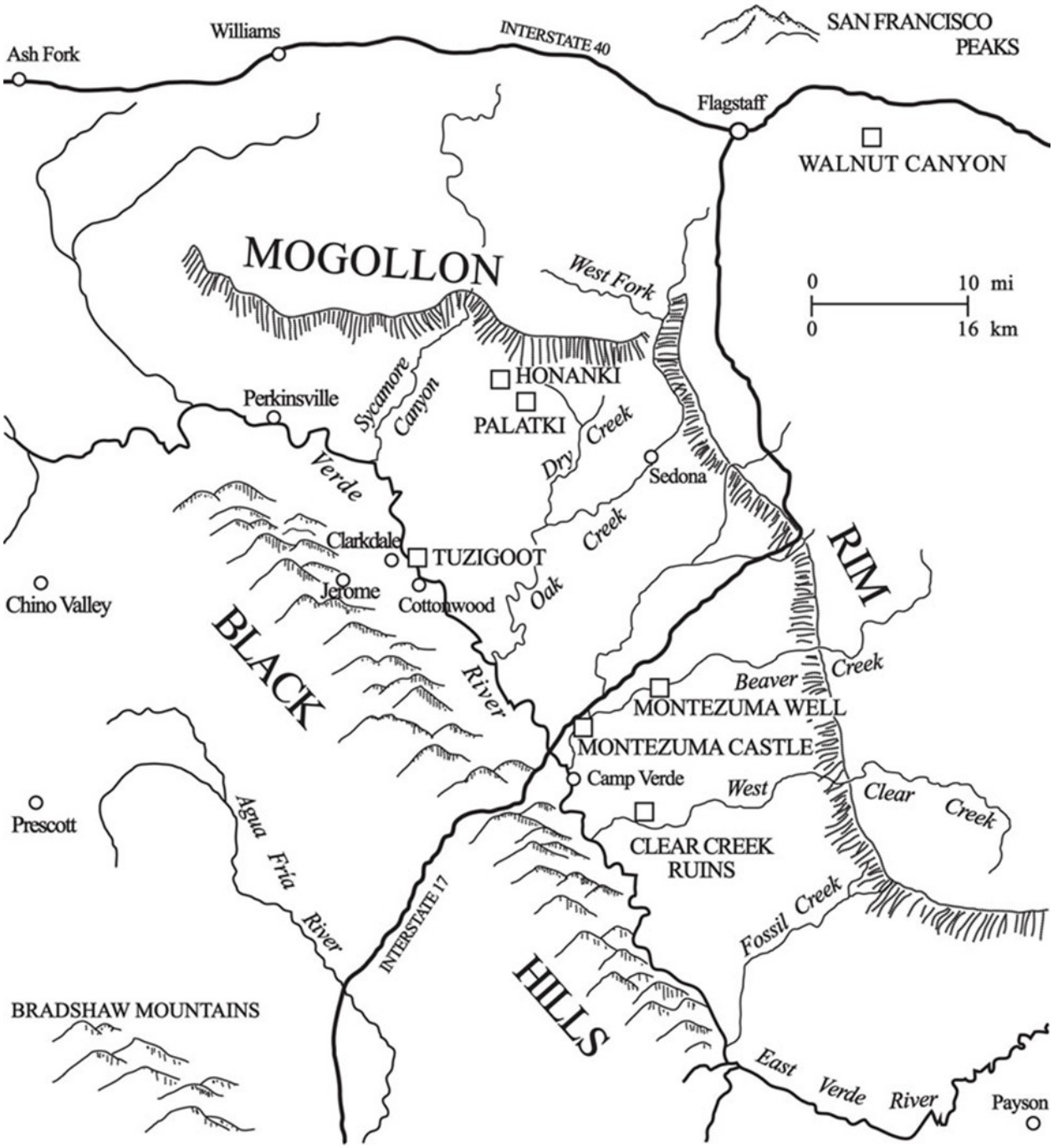

Figure 1. Map of Verde Valley and surrounding region showing major prehistoric sites (Modified from 1981 *Plateau* 53 (1):map inside back cover).

the first scientific investigations at Montezuma Well, Montezuma Castle, and other sites in the Verde Valley (Figure 1). In 1890, Mearns published the results of his excavations and the first major archaeological survey of the valley (Mearns 1890a). In fact, both Mindeleff (1896:186) and Fewkes (1898:530, 535, 544, 546) were influenced by Mearns' publication with regard to the archaeological potential of the Verde Valley.

In this article, we discuss the research of Palmer and Mearns, as well as Dr. Walter James Hoffman who served as a military doctor and naturalist attached to the Wheeler survey in 1871, and other early investigators of ruins along the Verde River, all not well-known to modern archaeologists and historians. We now turn to their contributions and place them within the broader context of what was then an emerging field of anthropology in the American

Southwest and their other scientific research contributions.[1]

DR. EDWARD PALMER: CIVIL WAR SURGEON AND NATURALIST IN ARIZONA TERRITORY

In 1863, gold was discovered near what would become the town of Prescott and the Arizona Territorial Capital. The town was named in honor of William H. Prescott, author of *History of the Conquest of Mexico* (1843), because miners and settlers in the region thought the ancient ruins were built by the Aztec and Toltec as described by Prescott in his book. Similarly, during the 1853-1854 Pacific Railroad Survey along the 35th parallel across northern Arizona, Lieutenant Amiel W. Whipple (1818-1863) attributed the Pueblo Indian ruins he observed along "Pueblo Creek" (present-day Walnut Creek north of Prescott) to the Aztecs. This perspective was reinforced in the report and on survey maps, for Whipple supplied place names, such as Aztec Pass and Aztec Range, where the ruins were located (Conrad 1969; Foreman 1941; Möllhausen 1858, vol. II; Whipple 1856; Whipple et al. 1855; Wilcox et al. 2000).

In order to protect the newly-arrived settlers from Yavapai and Apache raids, the federal government established military bases in northern Arizona Territory at two locations: Fort Whipple (1864), named in honor of Brigadier General A. W. Whipple, who died in May 1863 from wounds sustained at the battle of Chancellorsville, Virginia; and at Camp Lincoln (1865), later renamed Camp Verde and then Fort Verde. Given that Arizona Territory was virtually *tierra incognita* with regard to its flora and fauna, the region was wide open to young naturalists who wanted to discover new species previously unknown to science. The life of a military surgeon offered one way to receive an education and make natural history collections at remote outposts in the West.

Dr. Edward Palmer arrived at Fort Whipple in late July 1865 (Figure 2), where he briefly joined Dr. Elliot Coues (1842-1899), another young surgeon who was becoming well-known as a naturalist. Palmer had traveled by stage from Kansas City, Missouri, across the plains via Fort Dodge, Kansas, and Trinidad, Colorado, over Raton Pass to Albuquerque, and then onto Prescott (McVaugh 1956:25, 207). In our own opinion, Palmer seems to have journeyed to Fort Whipple in anticipation of renewing his contract with the Army as an Acting Assistant Surgeon (cf. McVaugh 1956:24, 28, 207), perhaps to replace Elliott Coues. Professor Spencer Fullerton Baird (1823-1887), who was then Assistant Secretary of the Smithsonian, may have played a part in arranging this transfer (cf. Cutright and Brodhead 1981:81-83), but this needs more research.

Figure 2. Dr. Edward Palmer in Army uniform taken in Kansas City, circa 1864 (© Smithsonian Institution, Department of Botany).

Edward Palmer (1829-1911) was born in England and came to New York in 1849.[2] He later moved to Cleveland, Ohio, where he gained training in natural history collecting and preparation of specimens from Dr. Jared P. Kirtland (1793-1877), a professor at Cleveland Medical College and respected naturalist. In December 1852, Palmer enlisted in the Navy as a hospital steward assisting the ship's surgeon on the steamer USS *Water Witch* during a two-year expedition to Paraguay under Captain Thomas Jefferson Page (1808-1899), explorer and U.S. Navy officer, and later a Confederate Navy Captain. As part of his duties, Palmer collected natural history specimens for the expedition that were brought back to the Smithsonian. He contracted malaria on the voyage and was discharged from the expedition in South America at his own request and paid his way back to Washington, D.C. (McVaugh 1956:9-13; Safford 1911a, 1911b, 1911c). The South American voyage served as the beginning of Palmer's career as a scientific collector for the Smithsonian and other museums, which he combined with his "on the job" medical training, in order to obtain assistant surgeon positions in the army during and after the Civil War.

Upon his return to the United States, Palmer attended lectures at the Cleveland Homeopathic College in 1856 but may not have graduated. In 1857, he opened a practice in Highland, Kansas. Palmer moved to Denver in Colorado Territory in 1859 where he collected plants and other natural history specimens that were sent to the Smithsonian. He left Denver in 1861 and traveled by stagecoach to San Francisco. He was hired by the Geological Survey of California, where he worked for three and a half months as a collector under the direction of Dr. James G. Cooper (1830-1902), a military surgeon, naturalist, and ornithologist. At first, Cooper praised Palmer for collecting marine invertebrates around San Diego and even named a few species after him, but later Cooper disparaged his work. When President Lincoln called for more troops in 1862 to fight the Civil War, Palmer sailed from San Francisco (via Panama and New York) to Washington, D.C., where he enlisted as a volunteer surgeon in the 2nd Colorado Regiment and was soon back in Colorado. Between 1862 and 1864, he traversed the Plains with the military and sent the Smithsonian natural history specimens. He was discharged due to illness, then enlisted as a private with the 2nd Colorado Volunteer Calvary, but spent most of his time as a hospital steward in Kansas City. Between fall 1864 and spring 1865, he served mainly in the Kansas City General Hospital as a contract Army surgeon and made plans to go to Arizona (McVaugh 1956:15-24). His skills in military hospitals, collecting ventures, contacts with Assistant Secretary of the Smithsonian Spencer F. Baird at the Smithsonian, and knowledge of the West provided Palmer with the background he needed to more fully pursue making natural history collections after the Civil War.

At Fort Whipple, both Palmer and Coues made natural history collections together in the area. They may also have collected near Camp Lincoln (later called Fort Verde) on the Verde River (McVaugh 1956:32). At least 600 plant specimens were later sent to the Missouri Botanical Garden in St. Louis (founded in 1859), although a disagreement later arose between them since Coues was credited by botanist Dr. George Engelmann with most of the plant collection (Palmer letter to Engelmann, Nov. 26, 1866; see details in Cutright and Brodhead 1981; McVaugh 1956:25-28). Although Coues did not appear to be interested in prehistoric ruins as part of his natural history collecting activities at Fort Whipple, he was interested in the wounds made by Indian arrows on the soldiers and provided a description of the arrows, arrow points, and bows (Coues 1866). He later sent the arrow points to the Smithsonian (Henry 1872:40).[3]

At the end of October 1865, Coues left Fort Whipple for southern California and then traveled by ship from San Francisco to New York, where he received orders to report to the Smithsonian (Brodhead 1973:56-63; Cutright and Brodhead 1981:83-85). A few days before Coues left, Palmer received his contract as an Acting Assistant Surgeon at $125 per month and was ordered to Camp Lincoln (McVaugh 1956:28, 161). This was the first location of Camp Lincoln (1865) at the junction of Clear Creek and the Verde; the camp was moved upstream in early 1866 to a new location at the confluence of Beaver Creek. Palmer was stationed at both locations of Camp Lincoln for almost a year with the First Arizona Volunteer Infantry (McVaugh 1956:161; Underhill 1984). The post was renamed Fort Lincoln (1866-1868), then called Camp Verde and was moved again in 1871 to its present location on the mesa above the river, and was known as Fort Verde from 1879 to 1891, when it was abandoned (cf. Ayers 2010:37; Brandes 1959:55-56; Granger 1960:360-361).

During his tenure at Camp Lincoln, Palmer made natural history and archaeological collections, probably including the ruins around Montezuma Well and other nearby sites. Following a head injury sustained in a fall from a mule and then contracting malaria, he hastily returned to Fort Whipple for hospitalization in September 1866, but had to leave behind his collections and field journal (McVaugh 1956:31; Underhill 1984:67-68). The only archaeological materials from the Verde Valley ruins that were sent to the Smithsonian by Palmer consisted of two corn cobs:

> When stationed at Camp Lincoln, Arizona, as post surgeon, the writer explored some ancient rock caves near by, which were plastered in the interior, and obtained several corn-cobs, two of which were preserved, and are now in the museum of the Smithsonian Institution…The ruins in which the cobs were found have not been inhabited by the present Indians of the country, who are Apaches, as they believe that evil spirits hover about them, and therefore will not enter them (Palmer 1871:420).

In addition, based on the corn specimens he collected and observed at cave sites along Beaver Creek, Palmer estimated crop yields and, from these, he postulated what the prehistoric population of the Verde Valley may have been (cf. Protas 2002:27, note 27).

If all the archaeological materials collected by Palmer from ruins in the middle Verde Valley had been shipped to the Smithsonian in 1866 as he had intended, these would have been the first specimens

Figure 3. Sketch of Montezuma's Well in the Verde Valley by Edward Palmer in 1866 or 1869 (Underhill 1984; Special Collections, University of Arizona Library).

obtained from the region and may have led to earlier archaeological investigations than those conducted in later decades by Mearns, Mindeleff, and Fewkes. It is not known when the two prehistoric corn specimens were collected from the Verde ruins; perhaps they were collected by Palmer and Coues in the fall of 1865, and shipped by Coues back to the Smithsonian with the other 600 plant specimens. Some of Palmer's unpublished manuscript pages have been housed at the University of Arizona Library since the 1930s. This archival collection contains perhaps the earliest sketch of the ruins at Montezuma's Well. Attributed to Palmer, this sketch may have been drawn in 1866 or more likely during his 1869 visit to Camp Lincoln. It also indicated that the ruins had been named as such by then, for it was labeled with the words "Montezuma's Well" at the bottom of the drawing (Figure 3). Yet the first publication of this sketch was not until nearly 120 years later as depicted in an article about Palmer's account with the Arizona Volunteers stationed at Camp Lincoln (Underhill 1984:60), and it more recently appeared in a book about the history of Montezuma Castle (Protas 2002:Figure 3).

In late 1866, Palmer served at Camp Grant in southeastern Arizona (now known as the location of "Old Camp Grant;" Brandes 1959:50) where he stayed for seven months. Since he still had not recovered from malaria, he was unable to do much collecting. As a result of his illness, he asked for a release from his contract as Acting Assistant Surgeon

and left the post for California in early August 1867 (Mauz 2008; McVaugh 1956:32-34, 160-161). Palmer did, however, obtain some plant, animal, and ethnological collections while at Camp Grant as indicated in the Annual Report of the Smithsonian Institution for 1867:

> Dr. E. Palmer, formerly associated with Dr. Coues in collecting in the vicinity of Prescott, and devoting himself while there especially to the plants and insects, has since spent some time in southern Arizona at Camp Grant, and procured copious collections in all branches of natural history, as well as full series of objects made or used by the Apache Indians, which he has presented to the Institution (Henry 1868:45).

Elsewhere, the report noted that the collection Palmer sent to the Smithsonian that year consisted of "Six boxes collections of natural history, Indian relicts, &c., Arizona" (Baird 1868:75). Some of his ethnological collections were made in Tucson and Yuma in late summer 1867 after he left Camp Grant (McVaugh 1956:34). Palmer also entrusted Coues to publish the list of birds he collected at Camp Grant; these were identified by Spencer Baird at the Smithsonian (Coues 1868).

In 1869, Palmer was again in the Southwest making collections for the Smithsonian, as well as the U.S. Department of Agriculture and the Army Medical Museum. He was now employed as a full-time collector of ethnological, ethnobotanical, and natural history materials rather than as an assistant surgeon in the Army who collected when off duty (McVaugh 1956:41-46). He attempted to make collections to replace his lost 1865-1866 collections from the Verde River area and planned to visit "Astect" [Aztec] ruins at Camp Lincoln. But due to Indian hostilities and lack of a military escort, he was not able to do so. However, archaeological specimens from Montezuma Well and other areas of Arizona were received at the Smithsonian in 1870 from Palmer that were most likely collected in 1869 (McVaugh 1943:771, 1956:45-46), suggesting that he was able to visit the ruins at that time. Further, a few years later, Palmer (1873:755) noted in a brief article on Indian hemp (*Apocynum cannabinum*): "Near Camp Lincoln in Arizona we obtained, from some old Aztec ruins, cloth that had been manufactured by hand from this plant." Since his 1866 collections left behind at the post were never forwarded to the Smithsonian, he must have visited Montezuma Well and other nearby ruins in 1869 to obtain the archaeological specimens he noted later. This may also indicate that the sketch of Montezuma Well was probably drawn at that time and not earlier when he was stationed at Camp Lincoln.[4]

During his 1870 trip to the Southwest, Palmer made a brief excavation of a mound in southern Utah, which he barely mentioned in print: "The past summer the writer opened a mound near St. George, Utah, in which several nicely made and well-burnt earthen pots were found, full of human ashes, charcoals and several pieces of charred corn-cob" (Palmer 1871:420). This may represent the earliest scientific excavation in the Great Basin and perhaps in the American Southwest (Jeter 1990:49-50). Following the 1870 trip, Palmer did not conduct any field work in the West for the next three years. He spent summers in the early 1870s working as an assistant for Spencer Baird at Wood's Hole in Massachusetts preparing marine specimens and was employed part-time at the Smithsonian Institution in Washington during other times of the year (McVaugh 1956:53-55, 344, 350).

Beginning in 1875, among his other botanical and zoological activities in the West, Palmer turned to more intensive archaeological excavations for the Smithsonian, as well as the Peabody Museum at Harvard University. In 1875, he excavated another mound near St. George, Utah, for the Smithsonian in order to obtain artifacts for the 1876 Philadelphia Centennial Exhibition (McVaugh 1956:68; see also Brown 1967:130). A brief account of the excavations was published at the time (Palmer 1876), probably written by Baird or Otis Mason based on Palmer's notes (Mason 1876; see also Fowler and Matley 1978:21), but a detailed analysis and report of the collection was not completed until 100 years later (Fowler and Matley 1978). We feel this was possibly the same mound or another nearby mound along the Santa Clara River as discussed above.

Other archaeological endeavors followed, including a cave and other excavations in southwestern Utah for the Peabody Museum (McVaugh 1956:71; Palmer 1878); caves in Texas and Coahuila, Mexico (McVaugh 1956:81; Palmer 1882); and a Baja burial cave excavated in 1887 for the Smithsonian (Massey and Osborne 1961). Between 1881 and 1884, Palmer conducted excavations in the southeastern United States for the Bureau of Ethnology's Mound Exploration Division (McVaugh 1956:84-88; Smith 1985; Thomas 1894:19). Recently, Palmer's role in these excavations has been examined in detail (Jeter 1990, 1999, 2000, 2010). Finally, Walter Hough (1911) noted in an obituary for Palmer that his St. George work (1875) "was followed by archaeological excavations on the lower Verde River in Arizona." These excava-

tions may have been conducted in 1876 when Palmer collected ethnological specimens along the Gila River (cf. McVaugh 1956:69). Aside from Hough's brief reference, we have not been able to find any other information about his Verde excavations, and further research is needed to verify this work.

During his lifetime, Palmer collected "more than 100,000 specimens of plants and uncounted thousands of archaeological, ethnological, and zoological specimens" that were sent to museums throughout the world (McVaugh 1956:VIII). When he died in 1911, Palmer was credited with discovering between 1,162 to 1,173 new species of flowering plants, of which 200 were named for him (Safford 1911a, 1911b, 1911c).

DR. WALTER JAMES HOFFMAN AND OTHERS: VERDE VALLEY EXPLORATIONS BY THE WHEELER AND HAYDEN SURVEYS

Following the Civil War, the federal government sponsored four extensive geological and geographical explorations and mapping surveys of the western United States from 1867 to 1879. These explorations later became known as the Great Surveys of the American West (Bartlett 1962), but at the time, they were generally referred to by the names of the expedition leaders: the survey by Dr. Ferdinand Vandiveer Hayden (1867-1878); Clarence King (1867-1872); Major John Wesley Powell (1869-1879); and Lieutenant George Montague Wheeler (1869-1879) (see Schmeckebier 1904 for a complete listing of the survey reports).[5]

The Wheeler survey, also known as the Geographical Surveys West of the One Hundredth Meridian, was the most extensive. For the 1871 expedition through Nevada, eastern California, and Arizona, Dr. Walter James Hoffman (1846-1899) was assigned to the Wheeler survey. Although he served in the Army as Acting Assistant Surgeon, Hoffman was appointed to the survey "by the honorable Secretary of War at the *instance* of Professor S. F. Baird, of the Smithsonian Institution, and upon the recommendation of the Surgeon General. He was at once placed in charge of the departments of mineralogy and natural history" (Wheeler 1872:13; emphasis added). Dr. Hoffman was also an ornithologist and artist, and he was accompanied by a zoological collector named Ferdinand Bischoff, both of whom were dispatched by Assistant Secretary of the Smithsonian Spencer Baird to accompany the Wheeler survey and send natural history specimens that they collected back to the Smithsonian. Given the above quote from the *Preliminary Report* for 1871, Lieutenant Wheeler did not seem very pleased to have these two naturalists accompany the expedition (see also Brown 1957:221-222). As with Dr. Elliot Coues, Dr. Edward Palmer, and so many other military doctors interested in natural history during the late nineteenth century, Baird used his influence with the Army in Washington to send his collectors to military outposts and on expeditions throughout the Far West for the Smithsonian.

Based on a reconstruction of the 1871 itinerary for the naturalists on the Wheeler expedition, the entire military party left the mining town of Prescott on November 10, crossed the Verde River (Rio Verde) just north of Camp Verde on the 11th, and traveled up Beaver Creek to the Mogollon Rim the next day (Brown 1957:226, Map 4). Thus, Hoffman would have had little time explore the ruins in the Verde Valley, but in later years, he described both Montezuma Well and what he called a "Cliff Fortress" on Beaver Creek (later known as Montezuma Castle). However, the results of his Verde Valley investigations were *not* published in the Wheeler survey reports, but in Hayden's *Tenth Annual Report* for 1876 under the title "Miscellaneous Ethnographic Observations on Indians Inhabiting Nevada, California, and Arizona" based on the 1871 Wheeler Expedition (Hoffman 1878a). The reason for this has always seemed puzzling, especially since Wheeler and Hayden were rivals vying for Congressional funds each year to keep their surveys in the field. So why publish Hoffman's ethnological and archaeological observations from 1871 in Hayden's report? The answer to this question will become apparent shortly.

As noted above, Hoffman had been imposed on Lieutenant Wheeler by Spencer Baird. The 1871 Wheeler Expedition ended in Tucson in December (Brown 1957:226). By May 1872, Hoffman was working on the geological specimens and preparing a report for Wheeler, presumably at the Smithsonian (Letter from Wheeler to Hoffman dated May 9, 1872; cited in Kelsey 2003:720, fn. 14). Yet he was not among the naturalists on the 1872 Wheeler Expedition, which included Acting Assistant Surgeon Dr. Henry C. Yarrow and Henry W. Henshaw (Brown 1966), both of whom would later become well-known naturalists and also work as anthropologists for the Bureau of Ethnology. But this is not the full story, for some chronological gaps are filled in from Hoffman's obituaries. In August 1872, Hoffman was ordered to the Military Post at Grand River Agency in Dakota Territory, where he served as post surgeon and later accompanied the Seventh Cavalry under General Custer as his surgeon on the Yellowstone Expedition of 1873. In November 1873, Hoffman returned to a medical practice in Reading, Pennsylva-

nia, where he resided for the next four years, until he was appointed to the Hayden survey in fall 1877 and was placed in charge of the ethnological and mineralogical specimens (Anonymous 1900b; Berlin 1907; Chamberlain 1900). By December 1877, two of Hoffman's archaeological and ethnological studies were submitted for publication in Hayden's *Tenth Annual Report* (Hoffman 1878a, 1878b). The two chapters in the report included his descriptions of Montezuma Well and the "Cliff Fortress" from the 1871 Wheeler survey and an analysis of a prehistoric skull recovered by William H. Jackson (photographer for the Hayden survey) in Chaco Canyon,. The Chaco cranium was found in a ravine at a depth of 14 feet near Pueblo del Arroyo, and Hoffman provided sketches of the specimen as part of the study.

These details appear to suggest that Hoffman and Wheeler had a disagreement over his work, and he was transferred in 1872 to the Grand River Agency by the military. Further research is needed to confirm this scenario. However, other scientists on subsequent Wheeler surveys had conflicts with Lieutenant Wheeler and the military style of the expedition with regard to their pursuit of scientific investigations (Bartlett 1962:354-356). Hoffman continued to publish brief natural history and ethnological articles in various scientific journals and the Hayden reports based on his field notes from the 1871 investigations in California, Nevada, and Arizona, (e.g., Hoffman 1875a, 1875b, 1877, 1881a, 1881b), but these studies were not in the Wheeler reports. During the 1871 expedition, Hoffman also made pottery sherd collections in Chino Valley north of Prescott, along Beaver Creek in the Verde Valley (Montezuma Well and Montezuma Castle), and on the Little Colorado River that were sent to the Smithsonian (Hoffman 1878a:476). Yet when the results of the archaeology from Arizona, New Mexico, and California were published by the Wheeler survey (Putnam 1879), there was little mention of Hoffman, except with regard to the Paiute language in Las Vegas Valley, and the pottery collections he made in the Verde Valley were not cited.

With the end of the Great Surveys and the formation of the Bureau of Ethnology under Major Powell in 1879, Hoffman became an assistant ethnologist and made substantial contributions about the lifeways of Native Americans in the West within the emerging field of anthropology. In 1897, Hoffman was appointed by President McKinley to serve as U. S. Consul at Mannheim, Germany, but in fall 1899 he returned home to Reading due to ill health where he died of consumption (probably tuberculosis) at the age of 53. Two days after his death, an obituary was even published in the *New York Tribune* on November 10, 1899, and later in various other publications (Anonymous 1900a, 1900b; Berlin 1907; Chamberlain 1900). Yet in more recent anthropological histories of the Smithsonian Institution and the American Southwest, Hoffman's name is only mentioned in passing (e.g., Fowler 2000; Hinsley 1981), nor is he even listed in a major work on the Great Surveys of the West (Bartlett 1962).

The background about his life in the 1870s following the Wheeler survey help explain how the results of Hoffman's 1871 Verde Valley observations on Montezuma Well and Montezuma Castle were later published in Hayden's *Tenth Annual Report* for 1876. In this publication, Hoffman (1878a:477-478, Plate LXXIX) included a description and drawing of a "Cliff Fortress". This is possibly the first published illustration of Montezuma Castle. Aside from his natural history and archaeological collections, Hoffman made numerous sketches on the 1871 Wheeler Expedition. According to a California newspaper account of the expedition at the end of the 1871 season, Hoffman's "collection of drawings numbers nearly one thousand and among them are undoubtedly some of the finest scenes ever put on paper" (*Sacramento Daily Union*, Jan. 10, 1872). Unfortunately, few of these drawings are known or were ever published. The sketch of the "Cliff Fortress" on Beaver Creek would have been made on November 11, 1871 when the military survey party passed by the cliff dwelling on their way up Beaver Creek. However, for the published version, it appears that William Henry Holmes (1846-1933) may have revised the sketch, as indicated by the initials "WHH" signed at bottom left of the lithograph (Figure 4). The perspective of the cliff dwelling is distorted (see Figure 5) and differs from the more precise illustrations of other ruins by Holmes contained elsewhere in the Hayden report (Holmes 1878). Since Holmes prepared illustrations and maps for the Hayden survey (Fernlund 2000; Nelson 1980:273), the "Cliff Fortress" was most likely drawn by Holmes based on Hoffman's field sketch, and he may not have actually visited the site (cf. Fernlund 2000:54-69).

Although Hoffman may have made the first scientific sketch of Montezuma Castle in the Southwest during the Wheeler survey in 1871, his account and illustration were not published until the end of the decade. In the meantime, the Hayden survey reported and photographed the first cliff dwellings from Mancos Canyon in Mesa Verde, southwestern Colorado, which were discovered in 1874 and described by the expedition photographer William Henry Jackson (1843-1942) along with other ruins in the Four Corners area (Jackson 1876a, 1876b). Jackson and Holmes, who served as an artist,

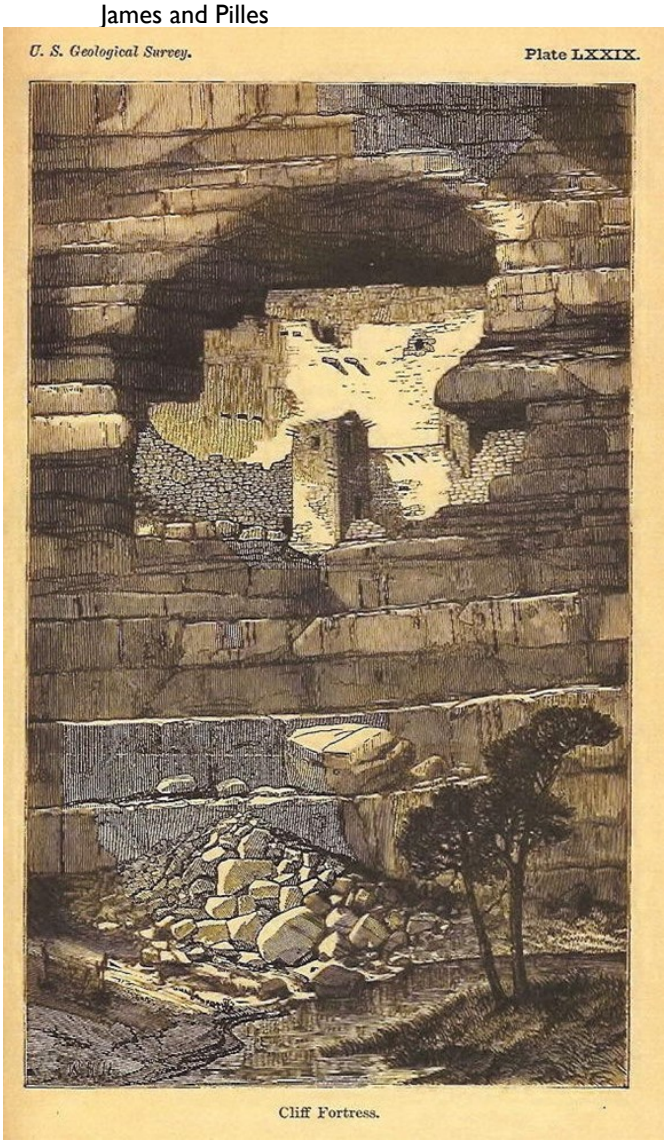

Figure 4. Sketch entitled "Cliff Fortress" in Hoffman (1878a:Plate LXXIX), possibly the first published illustration of Montezuma Castle, which was drawn by William H. Holmes ("WHH" signed at bottom).

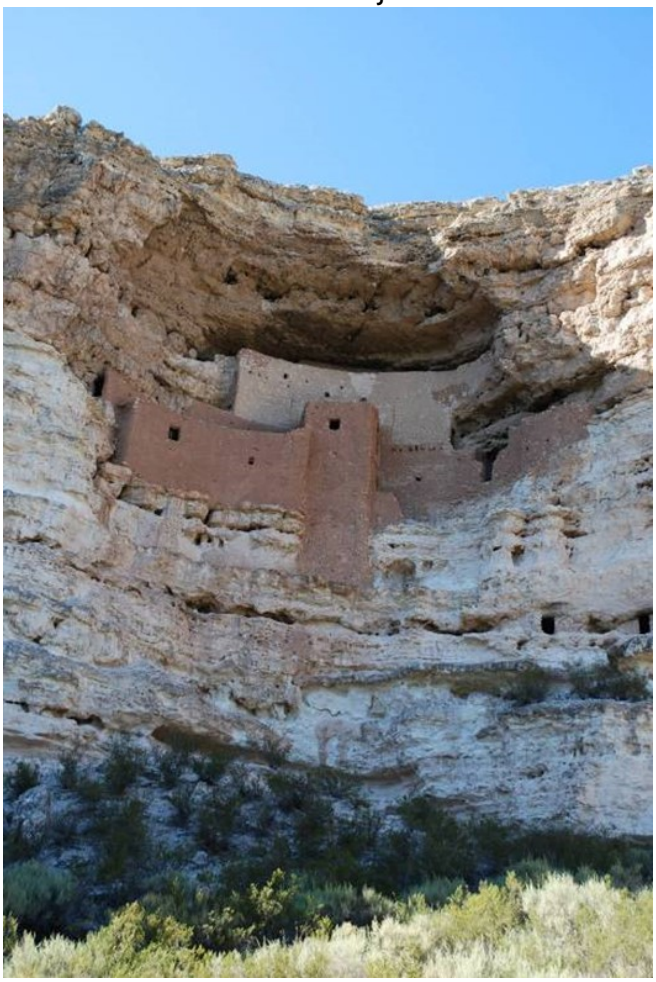

Figure 5. Modern photograph of Montezuma Castle (photo by S. R. James, June 14, 2012).

topographer and geologist on the survey, explored other major ruins in the region, including Chaco Canyon (Holmes 1878; Jackson 1878). Holmes became a highly respected archaeologist for the Bureau of Ethnology and served as the second Director or "Chief" of the bureau in 1902 following the death of Major Powell (see Fernlund 2000 for a biography of Holmes). Similarly, based on his work with the Hayden survey and later photographs, Jackson earned a reputation as a great photographer of the West and produced nearly 80,000 negatives by the time of his death in 1942 at the age of 99 (Szasz 1986).

As part of the 1876 International Centennial Exhibition in Philadelphia for the Smithsonian Institution, models of the Mancos Canyon cliff dwelling and other ruins in the Southwest were produced by Holmes and Jackson and placed on display at the exhibition (Fernlund 2000:59-61; Jackson 1986:243; Nelson 1980:272). Since the "cave town" models as they were called at the time, were quite popular at the 1876 Philadelphia Exhibition, the Hayden survey produced other pueblo models in the next few years, including Pueblo Bonito and Taos Pueblo that were created by Holmes and Jackson. At the time, Jackson also took photographs of the models. The models were later purchased and sold by Henry A. Ward (1834-1906), who founded Ward's Natural Science Establishment in Rochester, New York (Fowler 2000:89).

Since Hoffman was appointed to the Hayden survey in 1877, a year after the Philadelphia Exhibition, he seems to have joined Holmes and Jackson in making scaled plaster models of pueblo ruins. He made the first model of Montezuma Castle (labeled as "Cliff Fortress") at a scale of 1:60. One of the models sold by Ward's indicated that W. J. Hoffman was the artist, for his name was etched on it. A model of Montezuma Well was also produced, which was most likely made by Hoffman, and was the first model of this unique site. By 1880, the Peabody Museum at Harvard had purchased nearly a dozen models of "Pueblos and Cliff Ruins," including "one of 'Montezuma's well' near Camp Verde, Arizona" (Putnam 1880:743). By the turn of the century, many museums, universities, and schools across the country had these pueblo models in their collections (e.g., see MacLean 1901:198).

During the mid-1870s, other illustrations and descriptions of the Verde Valley ruins appeared in a few publications that were influenced by the Wheeler survey. An article written by Lieutenant William C. Manning (1875) was published in *Harper's New Monthly Magazine*, which described Montezuma's Well and what appears to be Montezuma Castle (a large unnamed cliff dwelling), as well as other ruins along the Verde and Beaver Creek. He was with the 23rd Infantry and passed through Fort Verde in the early 1870s (Corbusier 1968:101). Since Manning refers to the 1873 Wheeler survey, his observations may have been made at that time. Some illustrations in the article are based on photographs taken by Timothy H. O'Sullivan (1840-1882), a Civil War photographer who was later employed on the Wheeler survey in 1871 and 1873-1875 (compare Manning 1875:330, 333 with O'Sullivan photos in Horan 1966:295, 300; Kelsey 2003:Figure 13).

Another early account of the Verde Valley ruins was provided in Colonel Richard J. Hinton's *The Hand-Book to Arizona* (1878), which served as a guide book to Arizona Territory. Hinton (1830-1901) provided an illustration of a pueblo ruin in the Verde Valley, as well as a discussion about the ruins (Hinton 1878:418-422). However, the text was quoted from an earlier publication, that of *Arizona As It Is* written by Colonel Hiram C. Hodge (1877:187-194), which did not contain this sketch. What is more disturbing is that the illustration labeled "Rio Verde Ruins" in Hinton (1878:420) is actually based on a photograph by O'Sullivan taken in 1873 during the Wheeler survey of excavations in a room near San Juan Pueblo, northern New Mexico (see Horan 1966:304). Thus, from a historical standpoint, the value of Hinton's book with regard to the early archaeology of the Verde Valley is questionable.

Figure 6. Edgar A. Mearns in Army uniform; photograph taken in November 1891 (Courtesy of the Library of Congress).

DR. EDGAR A. MEARNS: MILITARY SURGEON, NATURALIST, AND ARCHAEOLOGIST IN VERDE VALLEY

Edgar Alexander Mearns (1856-1916) was a U.S. Army surgeon stationed at Fort Verde for four years from 1884 to 1888, but he was also a naturalist and developed an interest in archaeology during his stay (Figure 6). Most of the details about his natural history investigations have been reported by ornithologists (e.g., Fischer 2001:159-162; Hume 1942; Phillips 1940; Richmond 1918, 1919). Biologists have rarely mentioned his archaeological research in the Verde Valley, nor with a few exceptions, have his early archaeological contributions been recognized by Southwestern archaeologists and anthropologists.

Mearns was born in Highland Falls near West Point, New York, on September 11, 1856. At an early

age, he began studying and collecting birds in the region. Soon he had accumulated a large avian collection with at least 1,800 catalogued specimens and was exchanging duplicates with several American and European collectors. One of these, another youthful collector from New York, two years younger than Mearns, became a life-long friend. This was Theodore Roosevelt, who later served as the twenty-sixth President of the United States. Mearns became acquainted with other naturalists, including C. Hart Merriam and Albert K. Fischer, largely through the Nuttall Ornithological Club. By his early twenties, he had published several articles on birds from the Hudson Highlands in New York that were well-received by the profession (Mearns 1878, 1879a, 1879b, 1880, 1881).

After completing his medical degree in 1881, he married Ella Wittich from Circleville, Ohio. She was a skilled naturalist, especially in botany, and helped Mearns catalogue his collections (Richmond 1918:6). In 1882, Mearns passed the entrance exam for admission to the U.S. Army Medical Corps. But he postponed entering the Army for a year while serving as a temporary Curator of Ornithology at the American Museum of Natural History (AMNH) in New York City. He became a founding member of the American Ornithologists' Union in 1883, which held its first meeting at the museum that year. Due to his impressive credentials, he was allowed to select his post and chose Fort Verde, which he felt had the greatest opportunity for new and original research.

However, Dr. Elliott Coues, also a founding member of the American Ornithologists' Union and by then one of the most well-known ornithologists in America, was less supportive of Mearns' decision. Coues had been recently stationed at Fort Whipple in 1880, and he felt his transfer to Arizona, back to where his military career started 16 years earlier, was a form of punishment by his superiors. When in Washington on leave during the fall of 1881, Coues submitted his resignation to President Chester A. Arthur, who at first refused but later accepted it (see details in Cutright and Brodhead 1981:214-232). Some of his bitterness toward the Army was expressed in a letter dated August 21, 1883, where Coues warned Mearns about the problems associated with serving as a military surgeon at Army posts while also making natural history collections for scientific purposes (Coues 1883b).

Mearns and his family left New York and arrived at Fort Verde on March 25, 1884. Within a few days, Mearns was assigned as surgeon to a military expedition that crossed the southern part of the Southwest to Texas, and he made zoological and botanical collections during the journey (Richmond 1918:7). This was just the beginning of many collecting trips, for he was provided military cooperation throughout his tenure at Fort Verde for his natural history endeavors (Mearns 1885), and was even given pack mules to carry thousands of specimens (Dahray 1887). Mearns' interests spanned several fields of scientific inquiry. He was an avid bird collector and reported on his observations in northern Arizona (Mearns 1886). In 1890, he published an inventory of over a hundred birds he recorded during his years at Fort Verde (Mearns 1890b). He also met several Hopi, and with their help, wrote a brief dictionary of Hopi ornithological terms (Mearns 1896).

During his four years at Fort Verde, Mearns traveled over much of Arizona, including Fort Apache, San Carlos, Globe, Tonto Basin, Pine Creek, and Flagstaff, where he climbed to the top of Mt. Humphreys in June, 1887, two years before Dr. C. Hart Merriam's famous biological survey of the San Francisco Peaks (Merriam 1890; Phillips et al. 1989). He also visited Sunset Crater, Walnut Canyon, and other places in the vicinity of Flagstaff.

Mearns took many photographs while stationed at Fort Verde illustrating Army and civilian life in the Verde Valley during the mid-1880s. With regard to archaeology, Mearns' most important work involved documenting major sites in the area. He photographed numerous pueblo ruins in the Verde Valley as part of his investigations, and often provided handwritten details about the ruins on the back of the cabinet card photos. Although some were printed by the studio of Mitchell and Baer in Prescott (see Rowe 1997 for details on these two photographers), we know it is Mearns' handwriting from a comparison of his signature (see Figure 6) and as shown in his obituary in *The Auk* (Richmond 1918:Plate 1; see also Hume 1942:Figure 53). His photographs include Oak Creek Ruin, Cottonwood Ruin, Middle Verde Ruin, Montezuma Well, Montezuma Castle, and the V Bar V Petroglyphs; most are the earliest known photos of these sites (Figures 7, 8, and 9). He spent considerable time at Montezuma Castle, excavating several rooms, documenting architectural details, and making the first detailed floor plans of the rooms.

At Fort Verde, Mearns catalogued the archaeological and natural history specimens that he collected (Figure 10). Before leaving in 1888 he wrote:

> I have packed for shipment to the American Museum of Natural History 1,033 pounds of stone implements… I have examined and discarded twice as many specimens as have been collected; so this is a choice lot, selected from six times the number of specimens (Mearns 1887).

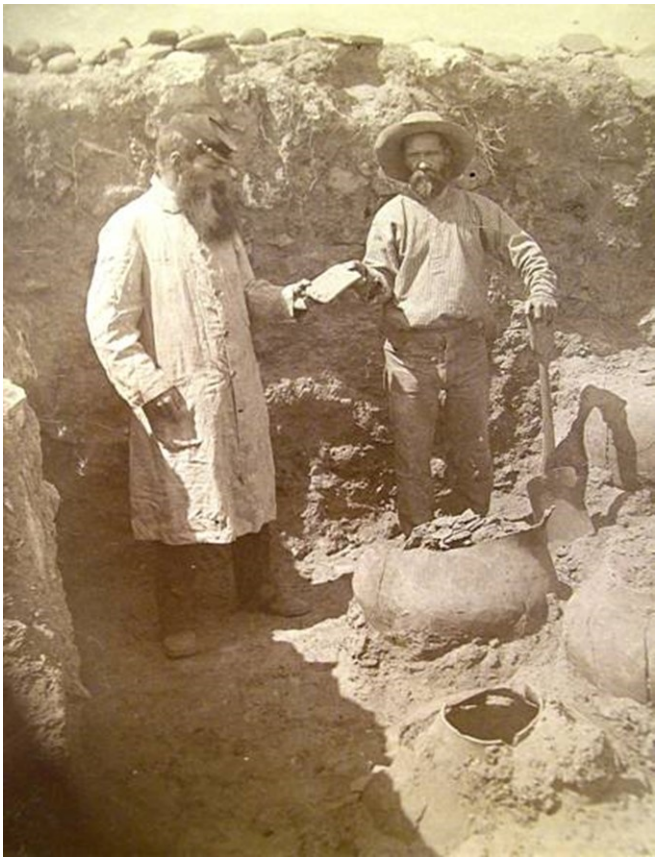

Figure 7. Dr. Edgar Mearns (on left) and Mr. Morse, hired by Mearns at $4.00 per day, at the Middle Verde Ruin, 1887. Note large storage vessels on room floor (Courtesy of the Library of Congress).

The prehistoric artifacts from the Verde Valley were sent to the American Museum of Natural History in New York. They were later placed on display when the East Wing opened in 1896, as announced in the journal *Science*: "There is on exhibition the Mearns collection from cliff dwellings in the Verde valley, Arizona, which is one of the first made in this region" (Anonymous 1896:853). The collection was on display in the Museum afterwards for many years.

After he left Fort Verde, Mearns (1890a) reported the results of his excavations at the large prehistoric pueblos and cliff dwellings in the Verde Valley in an 1890 edition of *Popular Science Monthly*, what was then a major scientific journal. Although it may not be realized by modern archaeologists, this was a landmark article at the time, for it reported the first scientific study of Verde Valley archaeology. This is the earliest account where "Montezuma's Castle" is designated as such in print; the first careful excavations are reported from the site; and perhaps the earliest published photos of Montezuma's Castle. From a zooarchaeological standpoint, Mearns (1890a:762) provided one of the first descriptions of faunal remains from Verde Valley archaeological sites (see also Mearns 1907:*passim*). Similarly, Mearns completed the first archaeological survey of the region, for in just a few years, he and the soldiers from Fort Verde who accompanied him located every large 14th and 15th century pueblo ruin from Flagstaff to Chavez Pass and down to the East Verde River. His "Ruin 49" became known as Tuzigoot. Mearns was the first to recognize prehistoric irrigation ditches at Tuzigoot, as well as elsewhere in the Verde Valley. As noted previously, both Mindeleff (1896:186) and Fewkes (1898:530) credit Mearns' 1890 *Popular Science Monthly* publication as the stimulus that brought them to explore the Verde Valley ruins for the Bureau of Ethnology.

Mearns was transferred to Fort Snelling, Minnesota, in 1888, and never returned to the Verde Valley. However, he maintained his scientific work as part of his military career for the next 21 years. After Fort Verde, Mearns continued to research and write zoological reports while on active duty. From 1891 to 1894, Mearns was assigned as medical officer for the Mexican-United States International Boundary Commission. He was also in charge of conducting a biological transect along the border. About 30,000 natural history specimens were collected and sent to the U.S. National Museum in Washington, D.C. The first part of the Boundary Survey was published in 1907 as the *Mammals of the Mexican Boundary of the United States* (Mearns 1907), but lack of Congressional funds prevented further publication of the survey results (Richmond 1918:9). In this report, Mearns also provided considerable details about the mammalian collections he obtained earlier in the Verde Valley and elsewhere in Arizona from 1884-1888.

On January 1, 1909, Mearns retired from the Army at the rank of Lieutenant Colonel. Then with his consent he was assigned to active duty, with orders to report to President Roosevelt for a hunting and scientific expedition to Africa that was partly sponsored by the Smithsonian Institution. The expedition spent nearly a year in Kenya and Uganda in British East Africa. Of over 4,000 birds collected, Mearns personally collected 3,000 of them, as well as small mammals and plants.

Mearns began a study of the African material after returning to Washington. It was during this period that Childs Frick (1883-1965), a wealthy trustee of the American Museum of Natural History, asked Mearns to join his 1911-1912 expedition to what is now Ethiopia, Somalia, and Kenya in East Africa. The Frick expedition collected 5,000 more African bird specimens. After the expedition, Mearns planned to write up all the African material. However, due to declining health, he was only able to work sporadically on the collections for the next few years, but man-

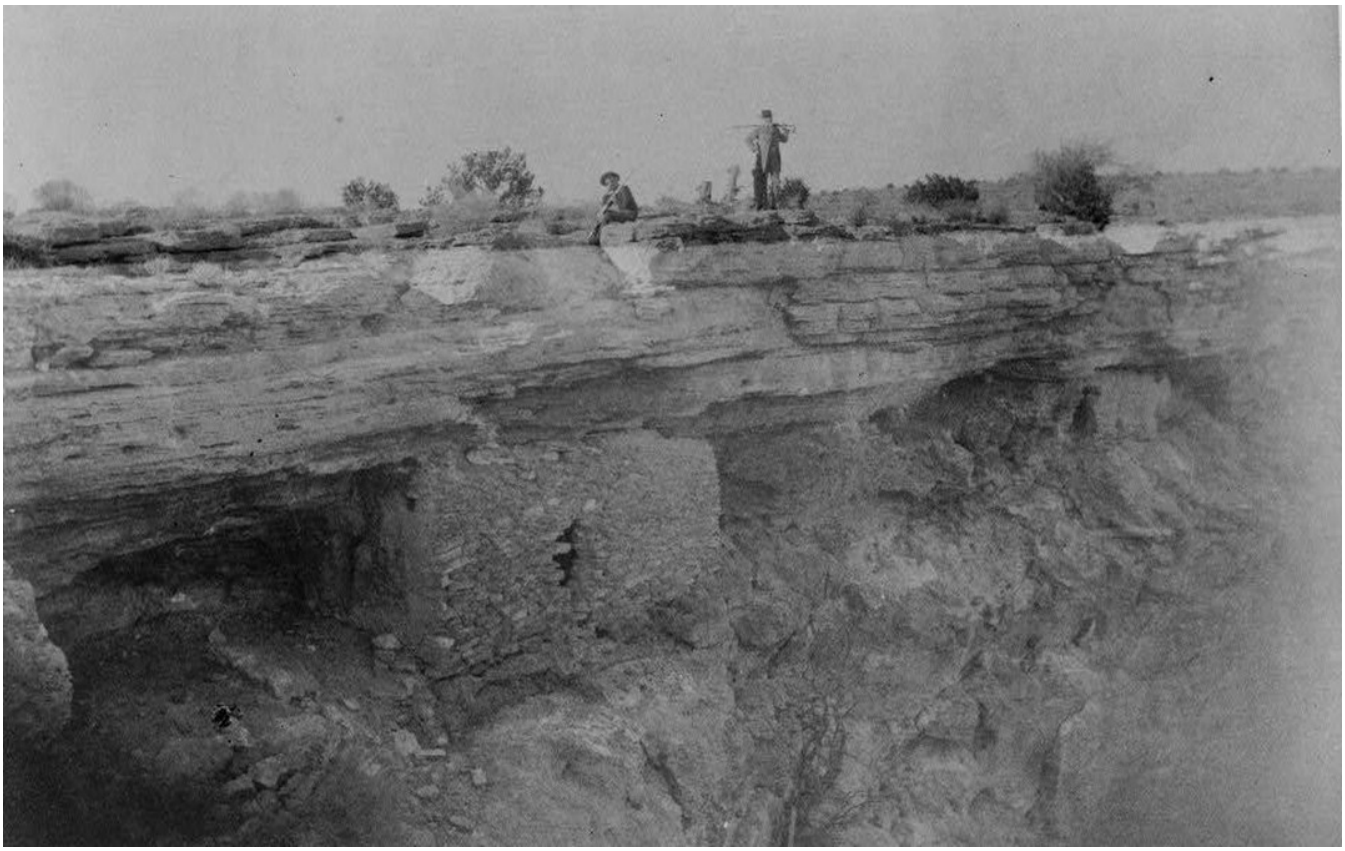

Figure 8. Cliff dwellings on west edge of Montezuma Well, December 26, 1886. Major E. K. Otey standing with rifle on right, unidentified solider seated on left (Courtesy of the Library of Congress).

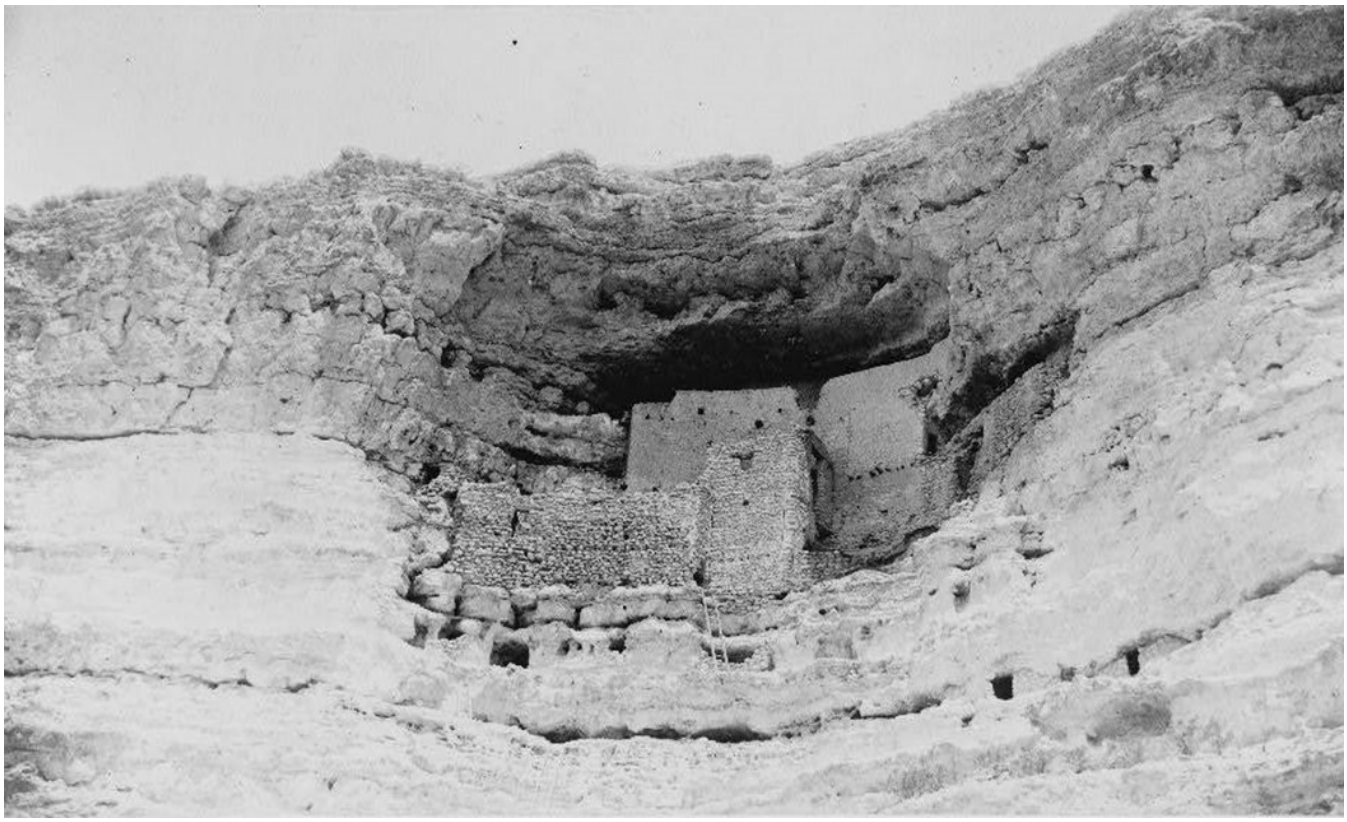

Figure 9. Montezuma Castle photographed by Mearns in 1887 (Courtesy of the Library of Congress).

Figure 10. Dr. Edgar Mearns on a porch at Fort Verde inventorying metates and manos from Verde Valley cliff dwellings and pueblo ruins (Courtesy of the Library of Congress).

aged to publish various articles on the African birds. Mearns died at Walter Reed Army Hospital in Washington on November 1, 1916 at the age of 61. On Plummer's Island in the Potomac River, near where his ashes were laid to rest, a plaque was placed on a boulder that read: "Edgar Alexander Mearns, Naturalist and Surgeon, 1856-1916" (1921 photo by naturalist J. S. Ligon in Hume 1942:Figure 56).

The results of Mearns research are considerable. In terms of archaeological research, he conducted the first survey of the region, as well as the first scientific excavations of Montezuma Castle, the Middle Verde Ruin, and other sites in the Verde Valley. These collections were given to the American Museum of Natural History, the U.S. National Museum, and the Army Medical Museum. He was one of the founders of the American Ornithologists' Union in 1883, and remained an active member all his life. While stationed in the Philippines, he was responsible for forming the Philippine Scientific Association with Major-General Leonard Wood as the first president. At the time of his death, over one-tenth of all bird specimens in the United States National Museum (now the National Museum of Natural History) were collected by him. During his lifetime, he published 125 works, mainly on ornithology, but they also included mammalogy, archaeology, and medicine. Three genera and 50 new species of plants and animals were named after him (Richmond 1918:17). Many of these serve as type specimens, and his publications continue to be cited in the zoological literature. With regard to fauna in the Southwest and West, many of these names are still retained, including antelope jackrabbit (*Lepus alleni* Mearns), Mearns's squirrel (*Tamiasciurus mearnsi* [Townsend]), Botta's pocket gopher (*Thomomys bottae mearnsi* Bailey), white-throated wood rat (*Neotoma albigula mearnsi* Goldman), coyote (*Canis latrans mearnsi* Merriam), Mearns (Montezuma) quail (*Cyrtonyx montezumae mearnsi* Nelson), and San Clemente Island loggerhead shrike (*Lanius ludovicianus mearnsi* Ridgway) (e.g., see Hoffmeister 1986; Monson and Phillips 1981). He truly made important contributions to the biological sciences, and we hope that his early contributions to Southwestern archaeology are now more widely recognized.

SUMMARY AND CONCLUSIONS

Although portions of the American West prior to the Civil War were known through the experiences of mountain men, military explorers, gold seekers, and emigrants on their way California, much of the country between the Sierra Nevada and Rockies was *terra incognita* with regard to its natural history, archaeology, and ethnology. Following the Civil War, the federal government needed to know the scientific and economic potential of this vast region, and sponsored four major geographical and geological expeditions throughout the West, the surveys of Hayden, King, Powell and Wheeler, that are now known as the "Great Surveys."

Most of the natural history specimens including prehistoric and ethnological artifacts collected by the scientists employed on these expeditions were sent to the Smithsonian Institution at the request of Assistant Secretary Spencer Baird. In order to obtain these specimens in the interests of science and for the public good, he recommended the young natural history collectors that he knew to accompany these expeditions. Similarly, Baird used his influence and political connections with the Army to station military doctors at remote outposts on the frontier, men with strong interests in natural history who could make collections for the Smithsonian and describe their findings in scientific publications. The primary focus of our article concerned three such military surgeon-naturalists, that of Palmer, Hoffman, and Mearns, who conducted the first scientific investigations of ruins along the Verde River and sent their collections to the Smithsonian and other natural history institutions. While these three late nineteenth researchers were generally known to other naturalists in their day, they have largely been forgotten by modern archaeologists and archaeological historians of the American Southwest.

With regard to the careers of Dr. Edward Palmer and Dr. Edgar Mearns, both were post-Civil War naturalists who became known for their floral and faunal research, respectively. They were military surgeons stationed at Fort Verde at different times during and after the Indian conflicts in Arizona Territory. Both men were essentially at the beginning of their long professional careers, and the Southwest offered unique opportunities to collect and describe many new species unknown to science.

As for Dr. Walter Hoffman, he was a member of both the Wheeler and Hayden surveys at different times during the 1870s, yet the nature of his relationship with these two surveys was unclear until now. By examining the details of his life at this time period, we have determined that he accompanied the 1871 Wheeler Expedition through Nevada, California, and Arizona, and made the first scientific observations and sketch of the "Cliff Fortress" on Beaver Creek in November 1871, which was later called Montezuma Castle by Mearns in 1890. It was only in fall 1877 that Hoffman became a member of the Hayden survey, and his report was published that included descriptions of Montezuma Well and Montezuma Castle from the earlier Wheeler survey. The illustration of Montezuma Castle based on Hoffman's sketch that was published in the Hayden report appears to have been revised by William H. Holmes, artist and geologist on Hayden's survey. Hoffman also made the first scaled plaster model of Montezuma Castle and probably Montezuma Well around 1877-1878 after he joined the Hayden survey, perhaps with the assistance of Holmes or photographer William H. Jackson since they had developed other models of cliff dwellings and pueblos. In contrast to Palmer and Mearns who continued to focus on natural history, Hoffman devoted the rest of his career to ethnological studies of Native Americans when he joined the Bureau of Ethnology under Major Powell soon after it was founded in 1879, and the four Great Surveys were combined under the U. S. Geological Survey.

Of the three military surgeon-naturalists, only the archaeological investigations of Mearns along the Rio Verde generally became known to other researchers and the public in the East through his 1890 publication in *Popular Science Monthly*, and from the prehistoric artifact collections that were placed on display at the American Museum of Natural History in New York. In contrast, the archaeological research of Palmer and Hoffman in the Verde Valley was scarcely noted in reports at the time or in subsequent decades. Even so, despite the 1890 article by Mearns on the Verde Valley investigations, his research has largely been neglected by later generations of archaeologists, and was superseded by the more detailed Bureau of American Ethnology research reported in the 1890s by Cosmos Mindeleff and Jesse Walter Fewkes.

For Palmer and Mearns, natural history was their passion at an early age and became their profession and way of life, in which they made major contributions to the biological sciences. But they, like Hoffman, also contributed to early archaeological research in the Verde Valley and elsewhere in the Southwest. They also examined these ancient villages before they were impacted by later artifact collectors and looters, so their observations are significant for our understanding of these sites today. Given that the three military surgeon-naturalists made the earliest scientific archaeological investigations in the

Verde Valley and their collections were sent to major museums in the East, their research deserves more consideration and represents an untapped source of historical and archaeological knowledge about the American Southwest during the late nineteenth century.

Notes

1. Since the Verde Valley Archaeology Symposium in 2012, where we initially gave this paper, we have published brief versions for some of the research presented here (James and Pilles 2014, 2015).

2. There is some confusion about Palmer's birth year, and it is generally considered to be around 1831 (see details summarized by his biographer Rogers McVaugh 1956:7-8). One of William Safford's accounts of Palmer's life mistakenly listed his birth year as 1821 (Safford 1911c). Recently, Marvin Jeter (2010) found that Palmer was born on January 12, 1829.

3. Dr. Elliot Coues was sent to Arizona Territory again at the end of his military career in 1880-1881. During his stay at Fort Whipple, he sent a brief communication to the Smithsonian regarding "a cliff-house on Beaver Creek at its junction with the Rio Verde, 40 miles from Fort Whipple, Ariz.," which was noted in the *Annual Report* for 1881 (Coues 1883a:681). This most likely referred to the ruin now known as Montezuma Castle.

4. There are, however, some unresolved questions regarding the 1866 (or 1869) sketch of "Montezuma's Well" attributed to Palmer (Protas 2002:Figure 3; Underhill 1984:60), the two prehistoric corn specimens (Palmer 1871:420), and other artifacts collected by Palmer that reached the Smithsonian in the late 1860s and early 1870s. Some prehistoric artifacts from Montezuma Well were probably obtained by Palmer in 1869 as indicated in the Smithsonian ethnological collections (Nos. 9729 to 9734; McVaugh 1956:46). Later, Palmer (1873) briefly noted that prehistoric cloth made from Indian hemp was from "Aztec ruins" near Camp Lincoln. A recent search (October 6, 2015) of the online catalog database for the Department of Anthropology, National Museum of Natural History at the Smithsonian, lists a few archaeological specimens (corn cob and pottery) collected by Palmer from Camp Lincoln and Fort Whipple that were accessioned by the Smithsonian in 1868 and 1871 (Cat. Nos. A7000, A9975, A9986, and A9987).

In addition, the Palmer archival collection at the Smithsonian was reported over thirty years ago to contain "a collection of maps, drawings, and photographs from the Verde Valley in Arizona—including some of the earliest photographs of Montezuma's Castle" (Fowler and Matley 1978:20). Although Palmer later took photographs during his collecting expeditions to Mexico in the late 1870s (Bye 1979), there was no mention of photographs in the 1865-1866 accounts, and if there were, these were probably lost when his collections were thrown out after he left Camp Lincoln. However, Palmer did recover a "scrap book" when he visited Camp Lincoln again in 1869 (Underhill 1984:68) and perhaps the sketch of Montezuma Well was contained in the scrap book. Further research into the Palmer artifacts and archival documents from the Verde Valley is required to resolve these issues.

5. Newspaper accounts during the 1870s refer to the surveys under the names of the expedition leaders (Hayden, King, Powell, and Wheeler), sometimes referencing the full name of the survey (e.g., Wheeler's Geographical Surveys West of the One Hundredth Meridian) or simply as "Government Surveys" (*Boston Daily Advertiser* 1874; *New York Herald* 1877). Perhaps the earliest use of the term "four great surveys" was by Schmeckebier (1904:7). Bartlett (1962:xiv-xv) seems to have expanded on this term as the title of his book *Great Surveys of the American West*, and are generally referred to as the "Great Surveys" in more recent accounts (e.g., Fowler 2000:79-91; Viola 1987). Goetzmann (1966) is another good source for details on the four surveys of the West, but he does not use the term "Great Surveys" except when citing Barlett's book.

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A SUMMARY OF PREHISTORIC MORTUARY PATTERNS IN THE MIDDLE VERDE VALLEY OF ARIZONA

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ABSTRACT

Patterns of mortuary behavior, including burial location, treatment of the deceased, types of mortuary offerings, and rituals observed during burial and funerary ceremonies, provide important information about human societies. Evidence of mortuary behavior at prehistoric sites in the Verde Valley of Arizona has been variably reported and discussed in the archaeological literature, but no comprehensive summary exists. This paper synthesizes published and unpublished data and explores patterns of mortuary behavior during prehistory in the middle Verde Valley, which may reflect changes in social structure, belief systems, and interaction among cultural groups.

Mortuary behavior, which encompasses burial location, treatment of the deceased, types of mortuary offerings, and rituals observed during burials, is a significant component of human society. Physical expressions of belief systems and ritual behavior are often distinct among cultures, or may be shared between social groups living in close proximity, because they are based on fundamental ideology and practice regarding the transition between life and death. Comparisons of mortuary behavior can provide a fuller understanding of social relationships both within and among culture groups (e.g., Brown 1971; Mitchell and Brunson-Hadley 2001; Rakita et al. 2005). Mortuary traditions of prehistoric people living in the middle Verde Valley of central Arizona have been relatively poorly studied, and no comprehensive synthesis exists. Published reports typically refer to the excavation of more than 400 burials at Tuzigoot and Montezuma Castle, but rarely discuss the isolated and scattered smaller burial samples from sites throughout the valley. It is the goal of this study to bring that information together and provide a summary of patterns that may inform about prehistoric social relationships and belief systems.

One challenge in discussing mortuary patterns in the Verde Valley is the exuberance with which early settlers and visitors undertook casual excavation of sites, often focusing on burials. Nearly all early archaeologists commented on the extensive looting of sites, both large pueblos and small ruins. At Tuzigoot, for example, Caywood and Spicer (1935:94) commented that, based on the amount of human bone on the surface, the number of disturbed graves encountered during their excavations, and accounts of local pot hunters [their term], at least 150 burials had previously been removed from the site. Estimates for Montezuma Castle and Clear Creek Ruin are that at least two dozen burials were removed prior to any systematic studies (Fish and Fish 1977:5; Jackson 1933; Jackson and Van Vankenburgh 1954:21) and at least 60 graves were excavated near Montezuma Well before it was acquired by the National Park Service (Powers and Pearson 2008:71). Aside from the inappropriate and disrespectful treatment of human remains, this rampant destruction of sites hinders an assessment of cultural practices related to death and funerary behavior. The many burials excavated by Caywood and Spicer (1935) at Tuzigoot showed strong patterns in location, orientation, and treatment of adults versus juveniles, perhaps lessening the interpretive loss from looting at that particular site. The same is not true for other locations, particularly small sites and those from earlier time periods, when mortuary traditions may not have been standardized.

The goal of this study is to summarize information about mortuary traditions in the middle Verde Valley during the prehistoric period, prior to A.D. 1500. Given the abundant physical and anecdotal evidence for

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non-systematic burial removal at many sites in the past, our data set clearly does not include all known burials from the middle valley. We did, however, scour the literature for published burial references and completed searches of site files at the Coconino National Forest (CNF) and the Museum of Northern Arizona (MNA), institutions that maintain records for the majority of the professionally excavated sites in the valley. We did not have access to primary records for the National Park Service units in the valley, but results of most excavations at those sites have been published and were included in the study. By collating information on mortuary patterns for as many burials as possible, 638 in this sample, we hope to provide a synthesis that can be used to address questions pertinent to the archaeology of the middle Verde Valley. Table 1 lists sites included in this study, with corresponding project citations[1]. We define the middle Verde Valley as bounded by Sycamore Canyon to the northwest and the East Verde River to the southeast. One site in our sample (AZ N:4:17) lies outside this area, near Perkinsville in the upper valley.

The first systematic, well-documented excavations resulting in substantial information about mortuary traditions were at Tuzigoot in 1933 and 1934 (Caywood and Spicer 1935; Anderson 1992). Other excavations from which we have well documented mortuary populations include Montezuma Castle, the Clear Creek Ruin complex, Oak Creek Valley Pueblo, Calkins Ranch, and AR-03-04-06-08. Most of these are large sites that reflect population aggregation after A.D. 1150, with corresponding substantial domestic architecture and cemetery areas. Smaller numbers of burials have been found at early habitations and within alcoves and cavates, either isolated or associated with pueblos. The last three decades have witnessed an increase in professional excavations in the Verde Valley, carried out in advance of construction for roads, infrastructure, and housing developments, at sites like Grey Fox Ridge, Simonton Ranch, and the Verde Terrace Site. These projects, along with several burials exposed by erosion, have produced additional evidence for characterizing mortuary traditions during the prehistoric period in the Verde Valley.

CHRONOLOGICAL FRAMEWORK FOR THE VERDE VALLEY

Evidence of the earliest inhabitants of the Southwest usually consists of projectile points characteristic of the Paleoindian tradition, including Clovis and Folsom types. No Paleoindian sites have been reported from the Verde Valley, although a few isolated diagnostic points have been found (Krug and Pilles, 2012). Deep sediments along the Verde River contain remains of large extinct mammals such as horse (Pilles 1981) and the presence of permanent water makes the valley a likely venue for early hunters, but such evidence may be deeply buried in alluvium. Evidence for Early Archaic occupation is also lacking in the Verde Valley, with the exception of isolated diagnostic points (Krug and Pilles 2012), suggesting substantial use of the area did not occur until the Middle and Late Archaic periods. Sites from these time periods include large base camps, specialized small activity areas, quarry locations, and short-term habitations; numerous diagnostic projectile points and other lithic artifacts have been documented at sites and as isolated finds in the Verde Valley (Breternitz 1960; Deats 2007; Fish and Fish 1977; Hall and Elson 2002).

The Late Archaic period in the middle Verde Valley is often referred to as the Dry Creek phase, named for a site near Sedona that was geologically dated to 2000 – 1500 B.C. (Shutler 1950). Not all researchers acknowledge this temporal designation, and various ending dates have been proposed for the Dry Creek phase (Breternitz 1960; Hall and Elson 2002). Diagnostic projectile point styles associated with this period (e.g., San Pedro, Cienega types, Datil, and Empire) cease to be produced sometime between A.D. 300 and 500/550, suggesting the latter as a terminal date. Most sites from this phase comprise temporarily-occupied camps that lack formal architecture or extensive midden deposits.

The rise of mixed farming-forager economies with some reliance on maize horticulture and a switch to a more sedentary village life marked the transition to the Formative period. Archaeologists refer to the Formative-period occupants of the Verde Valley as the Southern Sinagua, differentiating them from the Northern Sinagua peoples who lived south and east of the San Francisco Peaks. The suite of traits characterizing the Sinagua, including brown ware pottery manufactured by the paddle-and-anvil method, has been described and assigned to a variety of chronological frameworks that differ from chronologies developed for adjacent regions (Fish and Fish 1977; Pilles 1981; Powers and Pearson 2008). A paucity of locally-produced, temporally diagnostic ceramics has meant that dating Southern Sinagua sites often relied on intrusive tree-ring dated pottery types (Breternitz 1966). Radiocarbon dating has increasingly been used to solidify the chronological sequence in the Verde Valley, particularly for compliance-driven research over the last two decades (Deats 2007, 2011; Hall and Elson 2002). The chronological framework followed in this study is based on that proposed by Breternitz (1960), with modifica-

Table 1. Summary of Burials Reported from the Middle Verde Valley.

Site[1]	Temporal Phase	Inhumations	Cremations	Reference
AZ O:1:33 (ASM)	Dry Creek / Late Archaic	1	0	Weaver 2000
AR-03-04-06-722	Dry Creek / Late Archaic	1	0	Logan and Horton 2000
AR-03-04-06-273 (Devil's Dining Room)	Dry Creek / Late Archaic	1	0	CNF / MNA site files
AZ O:1:88 (ASM) (Crescent Moon Ranch)	Dry Creek / Late Archaic	3	0	Shepard et al. 1998
AR-03-04-06-835 (Pal Site)	Dry Creek / Late Archaic	2	0	Hallock 1985
AZ N:4:110 (ASM) (Grey Fox Ridge)	Dry Creek / Late Archaic to Honanki	14	7	Deats 2011
NA 17235 (Casa de Corte)	Hackberry / Cloverleaf	3	0	Coody 1983; Gutenkauf 1983
AR-03-04-06-250 (Crescent Moon Ranch)	Cloverleaf	1	0	Pilles 1991
AR-03-04-01-190 (Stoneman Lake)	Cloverleaf	2	0	Metcalf 1973
NA 2385 (Calkins Ranch)	Cloverleaf / Camp Verde	4	1	Breternitz 1960; Stebbins et al. 1981
Clarkdale Smelter	Camp Verde	1	0	Peck 1956
AZ N:4:17 (ASM)	Camp Verde	1	0	Fish et al. 1971
AZ N:4:23 (ASM) (Verde Terrace Site)	Camp Verde	0	1	Greenwald 1989
AZ O:5:155 (ASM) (Simonton Ranch)	Camp Verde	1	3	Deats 2007
AZ O:5:156 (ASM) (Simonton Ranch)	Camp Verde	0	4	Deats 2007
AZ O:5:6 (ASM) (Verde Terrace Site)	Camp Verde	0	7	McGuire 1977
AR-03-04-06-04 (Hidden House)	Honanki	1	0	Dixon 1956
NA 22,515 (Oak Creek Valley Pueblo)	Honanki	8	0	Williams 1985; Spurr and Bastin 2010
NA 9471 (Dyck Rockshelter)	Honanki	4	0	Bostwick et al. 2015; Fagan 1967; Lundquist 1963
AR-03-04-06-136 (Boynton Canyon)	Honanki	2	0	CNF / MNA site files
AR-03-04-06-703	Honanki	1	0	Logan and Horton 2000
AR-03-04-01-1065 (Richards Caves)	Honanki	1	0	Pierson 1956; CNF site files
no site number	Honanki	1	0	Wright 1965
NA 10769 (Exhausted Cave)	Camp Verde to Tuzigoot	1	0	Hudgens 1975
AR-03-04-06-58 (Honanki)	Honanki	1	0	CNF / MNA site files
AZ O:5:14 (ASM) (Montezuma Castle) and AZ O:5:95 (ASM) (Castle A)	Tuzigoot	32	0	Jackson and Van Valkenburgh 1954; Tagg 1986; Powers and Pearson 2008
AZ N:4:1 (ASM) (Tuzigoot Pueblo)	Tuzigoot	435	0	Caywood and Spicer 1935; Anderson 1992; Powers and Pearson 2008
AZ O:5:92 (ASM) (Montezuma Well burial area)	Tuzigoot	62	1?	Powers and Pearson 2008
NA 1269 (Sugarloaf Pueblo)	Tuzigoot	2	0	MNA site files

Table 1 (Continued). Summary of Burials Reported from the Middle Verde Valley.

Site[1]	Temporal Phase	Inhumations	Cremations	Reference
AR-03-04-01-05 (Clear Creek Ruin)	Tuzigoot	8	0	Coody 1982; Morris 1928; CNF / MNA site files
AR-03-04-06-87 (Page Springs Ruin)	Tuzigoot	2	0	CNF site files
AR-03-04-06-08	Tuzigoot	4	0	Fish and Fish 1977; Skinner 1965
AR-03-04-06-354 (Crescent Moon Ranch)	Tuzigoot	1	0	CNF / MNA site files
NA 2931 (Verde Salt Mine)	Tuzigoot	3	0	Morris 1928; Chabot and Bostwick, this issue
AR-03-04-01-600	Tuzigoot	1	0	CNF / MNA site files
AR-03-04-01-255	Tuzigoot	1	0	CNF / MNA site files
AR-03-04-01-100 (Hackberry Site)	Tuzigoot	1	0	CNF / MNA site files
AR-03-04-06-930[2]	Hackberry to Honanki	1	0	Logan 1996
no site number[2]	Hackberry to Tuzigoot	1	0	Wade and Kent 1968
no site number[2] (near Hatalacva)	Hackberry to Honanki	2	0	Deats et al. 1995
AZ O:5:23 (NAU)[2]	Hackberry to Honanki	1	0	McEnany 1991; Spurr 2010
AR-03-04-01-600[2]	Hackberry to Tuzigoot	1	0	CNF / MNA site files

[1] Site numbering is inconsistent in the literature and site files; when possible, the Coconino National Forest or Arizona State Museum site number has been used. Names in parentheses are from project reports or site files and usually refer to the site, but sometimes to the project or location.
[2] Not included in Tables 2 – 6 because the temporal assignment is uncertain.

tions informed by more recent research (Fish and Fish 1977; Hall and Elson 2002; McGuire 1977; Pilles 1981). Phase names and summary attributes are presented in Figure 1.

The first temporal period associated with the Southern Sinagua is the Hackberry phase, dating approximately A.D. 500 to 800. Initial production of local Verde Brown ceramics occurred at this time, and the presence of trade wares such as Lino Gray, Lino Black-on-gray, Gila Butte Red-on-buff, and Snaketown Red-on-gray provides a solid temporal signature. More permanent architecture appeared in the form of small, slab-lined pit structures (Breternitz 1960) and larger pit structures associated with midden deposits (Deats 2007).

By A.D. 800, there are numerous archaeological indications of Hohokam influence in the middle Verde Valley, prompting transition to the Cloverleaf phase (A.D. 800 – 900). Verde Brown remained the dominant plain ware ceramic type, with intrusive Kana'a Black-on-white and Santa Cruz Red-on-buff as the main diagnostic decorated types. Established villages, some quite large, began to appear during this phase (Fish and Fish 1977; Pilles and Stein 1981). House-in-a-pit structures similar to those of the Hohokam Santa Cruz and Sacaton phases were concurrent with Sinagua-style pit houses. The largest settlements had mounds and possible communal structures and both canal irrigation and dry-farming techniques were used (Breternitz 1960; Pilles 1978; Pilles and Stein 1981).

Increasing population during the Camp Verde phase (A.D. 900 – 1150) has been attributed to Hohokam migration into the Verde Valley, but Pilles (1996) asserted that most changes during this period reflect indigenous transformation, rather than large-scale immigration. During the Camp Verde phase, Verde Brown remained the most common plain ware, with the addition of Tuzigoot Brown (also termed Tuzigoot Plain) and its smudged variety after about A.D. 1100. Common nonlocal ceramics included Sacaton Red-on-buff, along with Black Mesa and Sosi black-on-white types. Pit house villages became common and increased in size. Agricultural features such as terraces and check dams also became increasingly prevalent. There is evidence for formal community organization and village structure, including sites containing three or more pit houses clustered around a larger site comprising eight or more structures. These larger central sites are often associated with a community pit house, a mound, or a ballcourt (Pilles 1996). A variety of pit house styles, and surface masonry fieldhouses, are found at upland sites during the Camp Verde phase.

The most widespread occupation of the Verde Valley occurred during the Honanki phase (A.D. 1150 to 1300), a time when the Sinagua experienced their greatest cultural florescence (Pilles 1996). Verde

Temporal Periods		Calendar Years	Phases	Some Distinctive Archaeological and Cultural Characteristics
MODERN		Last 50 years		
HISTORIC		1580—	Historic	Non-indigenous artifacts, technology, and domesticated animals
PROTOHISTORIC			Yavapai and Apache	Subsistence and economy based on hunting and gathering; seasonal mobile migration; habitation in caves, shelters, and open sites in brush structures; agave roasting pits; Buck Taylor arrow points
		1450—	Abandonment?	Little archaeological evidence from this period.
FORMATIVE		1400—	Tuzigoot	Aggregation into large masonry pueblos; some community rooms/kivas, plazas, and defensive site traits; hilltop "forts" continue; intrusive ceramics mainly from Winslow and Chavez Pass areas
		1300—	Honanki	Masonry surface rooms common; a few larger pueblo sites, but most are smaller pueblo and pit house hamlets; hilltop "forts"; Tuzigoot Brown, Red, and Red-on-Buff
		1200—		
		1100—	Camp Verde	Formal community organization and village structure; ballcourts; masonry surface structures at upland sites; Snaketown Triangular Straight Base and Kahorsho Serrated points; Hodges Contracting Stem arrow points until ca. A.D. 1000
		1000—		
		900—	Cloverleaf	Hohokam influence evidenced in artifacts and architecture; irrigation agriculture; Hodges Contracting Stem and Kahorsho Serrated points
		800—	Hackberry	Transition to a more sedentary village life in small groups of pit houses; partial reliance on floodwater agriculture; ceramic pottery production (Verde Brown); bow and arrow replaces atlatl; Hodges Contracting Stem arrow points after A.D. 600
		700—		
		600—		
		500—		
ARCHAIC	LATE	400—	Dry Creek / Late Archaic	Mostly highly mobile hunting-gathering lifeway with some sedentary village life in small groups of pit houses; agriculture introduced to the Southwest; San Pedro, Gypsum (2000–800 B.C.), Cienega-style points introduced 800 B.C.
		300—		
		200—		
		100—		
		A.D.		
		B.C.		
	MIDDLE	2000—	Middle Archaic	Mostly highly mobile hunting-gathering lifeway with some large base camps, small specialized activity areas, and quarry sites; atlatl and dart points such as Pinto, Bajada, and Chiricahua
		3000—		
		4000—		
	EARLY	5000—	Early Archaic	Subsistence based on gathering wild plants and hunting modern animal species; high mobility, but possibly more localized than Paleoindians, presumed low population density; atlatl and dart points; no pottery; no significant remains found in the middle Verde Valley
		6000—		
		7000—		
PALEOINDIAN		8000—	Paleoindian	Subsistence based heavily on hunting megafauna, gathering plants; high mobility; presumed low population density; sophisticated projectile points (Clovis, Folsom, etc.); no significant remains found in the middle Verde Valley

Figure 1. Chronological framework for the middle Verde Valley area.

Brown continued as the dominant ceramic type, along with Tuzigoot Brown, Red, and Red-on-buff. Nonlocal trade wares included Flagstaff, Walnut, and Tusayan black-on-white, and Citadel or Tusayan Polychrome. Small sites containing one to four masonry rooms and/or pit structures were abundant, probably used as seasonal field houses. Pueblos with 20 or more rooms made up only 2 percent of Honanki phase sites, but large community rooms continued to be built (Pilles 1996). Sites in lowland settings were generally adjacent to waterways, but upland sites tended to be cliff dwellings along Verde River tributaries and in areas farther from permanent water sources. Although canal irrigation continued, the presence of Hohokam-like traits, including ceramics, seems otherwise to have been minimal.

The Tuzigoot phase (A.D. 1300 – 1425/1450) was characterized by aggregation into large masonry pueblos, which "are usually multistoried and average about 35 rooms, while others are single-storied and about six rooms each" (Pilles 1981:14). Several pueblos occupied during the Honanki phase were expanded during the Tuzigoot phase. Most pueblos were in the lowlands close to the river and streams or on hilltops. Irrigation canals continued to be used and large agricultural systems have been documented from this phase (Midvale 1920-1971, in Archaeological Consulting Services 2000). Large pueblos exhibited regular spacing across the landscape and included formal architecture that controlled social space, suggesting well-developed political and social structure. Local ceramics included Verde Brown and Tuzigoot Brown and Red. Intrusive ceramics, primarily Jeddito Yellow Ware, indicate trade with people in the Hopi, Winslow, and Chavez Pass areas (Pilles and Stein 1981). By A.D. 1425 to 1450, the population of the Verde Valley decreased sharply.

Following the Southern Sinagua occupation, the Verde Valley was home to the Yavapai and saw frequent visits from Apache groups. The mortuary traditions of these peoples are distinct from prehistoric funerary patterns, and deserve consideration in a separate venue.

CURRENT STUDY

As noted above, this paper aims to present descriptive information about mortuary traditions in the middle Verde Valley during the period before A.D. 1500. Due to space limitations, we do not explore the extensive literature on mortuary studies or include significant cross-cultural comparisons. Instead, we summarize the data that are currently available to support these types of future research.

Our exploration of prehistoric mortuary patterns in the Verde Valley region focuses on temporal trends, which may reflect changes in local social systems as well as regional relationships (cf. Mitchell and Brunson-Hadley 2001). No mortuary features are known from the Paleoindian or the Early and Middle Archaic periods, but several recent projects contribute to our knowledge of burials during the Dry Creek phase, or Late Archaic.

Dry Creek / Late Archaic Burials

Table 2 lists the nine burials reported from this interval, most dating between A.D. 200 and 500. Only one juvenile burial has been identified from the Dry Creek / Late Archaic interval. Whether this reflects differential mortuary treatment for adults and children, with juveniles buried in locations away from habitations and camps, or whether it results from the small sample size remains unknown at this point. Three adult burials were discovered when they were exposed by erosion in areas lacking substantial surface artifacts, indicating that interment did not always occur near habitations. It seems likely that early burials will continue to be encountered in similar isolated contexts, as well as at known sites.

All Dry Creek / Late Archaic burials have been found at open sites in the valley rather than in cave or alcove locations. Those from undisturbed contexts were consistently found in a tightly flexed position, placed on the back or side. One burial was laid face down. Orientation of the burials was variable, with a slight preference for the head placed toward the northwest. Mabry (2005:227) notes similar patterns in burial position and orientation during the Early Agricultural period in southern Arizona, possibly indicating widespread cultural connections. None of the middle Verde Valley burials from this period contained mortuary offerings, although it is likely that perishable items were interred with the individuals and did not survive the centuries in open settings.

All burials dating to the Dry Creek / Late Archaic interval have been encountered in extramural locations, rather than within structures. Sites of this period tend not to have deep midden deposits like later Sinagua habitations, and the burials were not associated with defined refuse areas. One burial at Grey Fox Ridge intruded the fill of an earlier structure. A common attribute of the Dry Creek / Late Archaic burials was the presence of large rocks placed over the graves. At AZ O:1:88, one of the cover rocks weighed 42 pounds and others were 5 to 6 pounds each (Shepard et al. 1998:62). Whether the rocks were used to mark graves or to protect them from disturbance, their presence seems to be a hallmark of this period. Large rocks or recycled metates also

Table 2. Dry Creek / Late Archaic inhumations from the middle Verde Valley.

Site	Age / Sex	Location	Position	Orientation	Comment
AZ O:1:33 (ASM)	Adult / I	Extramural pit	Flexed	Unknown	Disturbed; poor condition
AR-03-04-06-722	60-70 yr / M	Extramural pit	Flexed on right side	Head to NW	Two large river cobbles above pit; partial clay lining of pit
AR-03-04-06-273 (Devil's Dining Room)	50-60 yr / F	Extramural pit	Flexed	Head to E	Exposed on surface in road cut
AZ N:4:110 (ASM) (Grey Fox Ridge)	45-55 yr / M	Extramural pit	Flexed, prone, arms under torso	Head to SE	Intruded pit house fill; no overlying rocks present
AZ O:1:88 (ASM) (Crescent Moon Ranch)	16-20 yr / I	Extramural pit	Flexed on back	Head to NW	Covered by large rocks
(same)	35-50 yr / I	Extramural pit	Flexed on back	Head to N	Covered by overturned metate & large rocks
(same)	ca. 5 yr / I	Extramural pit	Unknown	Unknown	Disturbed; covered by large rock
AR-03-04-06-835 (Pal Site)	Adult / I	Extramural pit	Flexed on left side	Head to NW	Possibly covered with large rocks
(same)	Adult / I	Extramural pit	Flexed on left side	Head to NW	Possibly covered with large rocks

have been noted above burials dating to the Early Agricultural period in southern Arizona (cf. Huckell 1995:40-41; Mabry 2005:227).

Hackberry through Camp Verde Phase Burials

Known burials from the Hackberry through Camp Verde phases (A.D. 500 – 1150) are combined in Table 3 to increase the sample size and because several site occupations extend across phase boundaries, making separation difficult. The 21 burials in this group show many similarities but exhibit marked differences from burials from the earlier Dry Creek / Late Archaic period. After about A.D. 500, individuals began to be placed in extended supine positions, a pattern that continued through the Honanki and Tuzigoot phases. Several burials were also in semi-flexed positions, with the legs bent, but only one at Grey Fox Ridge was fully flexed as in the earlier period. Slightly more than half the burials from these phases were oriented with the head toward the east or southeast. Other individuals were placed with their heads toward all other cardinal directions.

Burials continued to be interred primarily in extramural spaces, including midden areas that became common as habitation sites were occupied for longer periods of time. Individuals were also placed into fill of abandoned pit houses or masonry rooms, perhaps marking the beginning of familial claims to land and habitation areas. Two burials at Grey Fox Ridge were found on pit house floors, and in one case the structure was burned after the burial was placed. Two burials, an adult from Grey Fox Ridge and an infant from Calkins Ranch, were found in pits below house floors, a pattern that became much more common for juveniles during later periods.

One burial at AR-03-04-06-250, dated to the Cloverleaf phase, was covered by large cobbles and a metate fragment. One individual at AZ N:4:17 was covered by large sandstone slabs, and local ranchers reported that at least three similarly covered burials had eroded and been excavated from the site in the past. All of these burials were within extramural pits. This behavior perhaps reflects a continuation of Dry Creek / Late Archaic practices, although both of these sites are dated after A.D. 800. It is also possible that covering burials with rock was a matter of practicality when there was a high chance for disturbance, for example if a site was abandoned soon after the burial took place.

The burial sample from the period between A.D. 800 and 1150 comprises both adults and children, although the frequency of juvenile burials is quite low and likely does not represent the actual rate of childhood mortality. Again, the demographic pattern may be skewed by interment of children in non-site locations or poor preservation of less robust skeletal elements, or it may simply reflect the small number of burials representing more than three centuries. The few juvenile burials are distributed across the same extramural and intramural contexts as adults, so if the small sample is representative, there is no evidence of differential burial locations by age group.

Mortuary offerings during the Hackberry through Camp Verde phases were variable in quantity and variety. Several burials contained only one complete or partial vessel. The largest number of vessels from a single burial was six with a middle-aged female, comprising four bowls, a canteen and a pitcher. Locally-produced Alameda Brown Ware ceramics dominated the mortuary assemblages, but trade wares from both north and south of the Verde Valley were also provided. Domestic items such as ground and flaked stone tools occurred with some burials. A pattern emerged at this time of interment with personal ornaments such as stone and shell beads or pendants and bone hair pins. The amount of shell placed with burials is of note because it clearly indicates that Verde Valley residents participated in established trade networks extending to the south and southwest. One adult female found near the Clarkdale Smelter was adorned with 16 *Glycymeris* sp. bracelets on one arm, and several burials at Grey Fox Ridge contained bracelets, ornaments, or unworked shell pieces.

Cremation as a Mortuary Tradition in the Verde Valley

A significant trend in the Verde Valley between about A.D. 800 and 1150 is the co-occurrence of inhumation and cremation as mortuary traditions. Table 4 presents summary information for the 23 cremations that have been reported in the valley and shows that three sites contained both cremations and inhumations. The majority of the cremations so far documented were adults, although few could be identified as male or female. At least two juvenile individuals are represented in cremations from AZ O:5:156 and the Verde Terrace Site. The presence of both cremated and inhumed adults at Calkins Ranch and Grey Fox Ranch indicates some protocol existed for determining appropriate mortuary treatment based on physical traits or social position of the deceased. In the Hohokam culture area, demographic patterns of cremated and inhumed adults have been used to suggest social differentiation based on age, sex, or status (Craig 2001; Haury 1976; McGuire 1992).

Most cremations documented in the Verde Valley are secondary features. Only one primary cremation and one crematorium have been reported from the Verde Terrace Site, where six secondary crema-

Table 3. Southern Sinagua inhumations from the middle Verde Valley, Hackberry to Camp Verde.

Site	Phase	Age / Sex	Location	Position	Orientation	Comment
AZ N:4:110 (ASM) (Grey Fox Ridge)	Dry Creek / Late Archaic to Hackberry	25-40 yr / I	Extramural pit	Extended supine	Head to N	Lower body removed during later pit house construction
	Hackberry to Camp Verde	30-40 yr / I	Reused roasting pit	Legs extended, torso bent to right; supine	Head to NW	
NA 17235 (Casa de Corte)	Hackberry / Cloverleaf	35-45 yr / M	Extramural pit?	Extended supine	Head to E	
	Hackberry / Cloverleaf	Adult / M?	Extramural pit?	Extended supine	Head to W	
	Hackberry / Cloverleaf	5-9 yr / I	Extramural pit?	Semi-flexed on left side	Head to E	
AR-03-04-06-250 (Crescent Moon Ranch)	Cloverleaf	24-39 yr / M	Extramural pit	Extended supine	Head to E	Covered by basin metate & 6 large basalt cobbles
AR-03-04-01-190 (Stoneman Lake)	Cloverleaf	Adult / I	Pit house fill	Unknown	Unknown	Disturbed and disarticulated; may post-date site occupation
	Cloverleaf	Adult / I	Pit house fill	Unknown	Unknown	Disturbed and disarticulated; may post-date site occupation
NA 2385 (Calkins Ranch)	Cloverleaf / Camp Verde	40+ yr / M	Room fill	Extended supine	Head to ESE	Disturbed by trench
	Cloverleaf	10-16 mo / I	Pit below floor	Extended supine	Head to ESE	
	Cloverleaf / Camp Verde	40+ yr / I	Extramural pit	Extended supine	Head to E	Disturbed
	Camp Verde	5-8 yr / I	Midden	Extended?	Head to E?	Disturbed
AZ N:4:110 (ASM) (Grey Fox Ridge)	Cloverleaf / Camp Verde	35-50 yr / F	Extramural pit	Extended supine	Head to E	Azurite pigment present but bone not stained
	Cloverleaf / Camp Verde	25-35 yr / M	On pit house floor	Extended supine	Head to SSE	Structure burned after burial was placed
	Camp Verde or Honanki	12-15 yr / I	Pit house fill	Extended supine	Head to E	
	Camp Verde	40+ yr / M	On pit house floor	Semi-flexed, legs to right, supine	Head to N	
	Camp Verde	40+ yr / M	Pit below floor	Flexed on right side	Head to SE	Seven cobbles within burial pit
	Camp Verde / Honanki	≥ 18 yr / I	Pit house fill	Unknown	Unknown	Probable secondary inhumation
AZ N:4:17 (ASM)	Camp Verde	30-45 yr / F	Extramural pit	Extended supine	Head to SW	Covered by large slabs
Clarkdale Smelter	Camp Verde	Adult / F	Extramural pit	Extended supine	Head to SW	Exposed by blading
AZ O:5:155 (ASM) (Simonton Ranch)	Camp Verde	Adult / I	Extramural, on surface under mound	Extended supine	Head to E	Poorly preserved

tions were found in individual pits surrounding the crematorium area. Secondary cremations were most commonly placed directly into an extramural pit. About one-third of secondary cremations were interred within a ceramic vessel, and frequently accompanied by one or more partial or complete vessels that were rarely burned. The frequency of cremated remains being within vessels versus loose in pits cannot be considered reliable because the relationship between cremated bone and accompanying vessels was unclear at several sites due to disturbance. At the Verde Terrace Site, a significant number of mortuary vessels were incomplete or had been broken prior to burial, suggesting they did not hold cremated remains.

The general types of mortuary objects were similar whether the burial was a cremation or inhumation. Cremations were variably accompanied by ceramic vessels, projectile points, ground stone tools, shell ornaments and mineral specimens, as well as instances where no mortuary objects were present. A single vessel was the most common offering, but the crematorium and six secondary cremations at the Verde Terrace Site were associated with at least 23 vessels. As with inhumations, ceramic types were dominated by locally-produced plain wares such as Verde Brown, but black-on-white and red-on-buff types were also offered, often within a single burial. Most funerary objects with cremations were not burned.

Most Southern Sinagua cremations comprise very small amounts of human bone (see Table 4), far less than would be anticipated for a complete cremated body[2]. This pattern could result from mechanical crushing of cremated bone, incomplete collection of burned bone for burial after cremation, or partitioning of the cremated remains of a single individual for burial in more than one location. All of these behaviors have been documented among historic Southwestern tribes and researchers have suggested them for prehistoric groups as well (e.g., Haury 1976:171; McGuire 1992:81-89; Regan and Turner 1997:180-181; Swartz et al. 1995:211). Partitioning after cremation was demonstrated at the Verde Terrace site by refitting portions of the same vessel from more than one secondary cremation pit.

Cremation as a mortuary tradition evidently occurred in the Verde Valley only during the Cloverleaf and Camp Verde phases, as no cremations have been identified from Honanki and Tuzigoot phase sites. One “possible cremation” was noted during excavation of burials at Montezuma Well by the former landowner (Powers and Pearson 2008:71), but given the lack of details about excavation, and the fact that no other cremations have been reported from post-A.D. 1150 contexts, the identification of this feature is considered doubtful. The coincidence of cremations with the period of greatest Hohokam influence in the region, possibly including an influx of migrants (Breternitz 1960; Fish and Fish 1977:14), may signal the final disposition of Hohokam individuals or local individuals who adopted Hohokam religious practices. The presence of both cremations and inhumations at three sites presents the possibility of coresident migrant and local populations, a model that is also supported by architectural variation at the sites. The small number of cremations so far identified at Verde Valley sites prevents a robust interpretation of the physical or societal requirements that dictated appropriate mortuary treatment between the ninth and middle twelfth centuries. This problem is further exacerbated by the fact that few sites have been completely excavated, so the actual distribution of cremations and inhumations remains unknown. As is often the case, intriguing questions of social interaction and ritual practices must await additional excavation.

Honanki and Tuzigoot Phase Burials

The sample of burials known from the Verde Valley during the Honanki and Tuzigoot phases (A.D. 1150 – 1425/1450) is much larger than from earlier periods, partly due to more intensive archaeological investigation of large, late pueblos and cliff dwellings. By the middle of the twelfth century, mortuary traditions became formalized and regular, but generally continued patterns from the previous phases. Southern Sinagua burials after about A.D. 1150 clearly reflected social standards observed by nearly all residents of the valley.

The largest documented burial population from the Verde Valley is from Tuzigoot, where Caywood and Spicer (1935) recovered the skeletal remains of 429 individuals from 411 graves. Five additional burials were found at Tuzigoot in the 1940s during stabilization efforts and one during excavation for a drainage system (Hartman 1976; Powers and Pearson 2008:74). Excavations at Montezuma Castle revealed 31 burials, limited work at Oak Creek Valley Pueblo exposed eight burials, and at least 25 burials are known from other sites such as the Clear Creek Ruins complex, Grey Fox Ridge, and smaller habitations and cavate sites. In addition to published reports that allow detailed tabulation of mortuary characteristics, a number of references exist to early excavations that lacked any documentation. A short article in the Camp Verde Independent (1978), for example, noted that crews building an irrigation ditch in 1928 obtained stone from masonry walls at Middle Verde Ruin (AR-03-04-06-26 to 28) to fill the ditch grade. In

Table 4. Southern Sinagua cremations from the middle Verde Valley.

Site	Phase	Age / Sex	Type	Within Vessel?	Bone Wt.	Location	Comment
AZ N:4:110 (ASM) (Grey Fox Ridge)	Late Hackberry / Cloverleaf	40+ yr / I	Secondary	No	1150.4 g	Pit house fill, just above floor	
	late Hackberry to Camp Verde	Adult / I	Secondary	No	240.9 g	Extramural pit	
	Cloverleaf	Adult / I	Secondary	Yes?	365.8 g	Extramural pit	
	Camp Verde	Adult / I	Secondary	Yes	317.2 g	Extramural pit	
	Camp Verde	Adult / I	Secondary	No	161.0 g	Extramural pit	
	Hackberry to Honanki	Adult / I	Secondary	No	17.7 g	Extramural pit	
	Hackberry to Honanki	Adult / I	Secondary	No	197.1 g	Extramural pit	
AZ N:4:23 (ASM) (Verde Terrace Site)	Camp Verde	Adult / F	Secondary	Yes	391.5 g	Pit house floor, near entryway	
AZ O:5:155 (ASM) (Simonton Ranch)	Camp Verde	Adult / I	Primary	No; sherds present	524.4 g	Above fill of structure	
		Indeterminate	Secondary	Yes	5.3 g	Extramural pit	
		Indeterminate	Secondary	Yes	6.3 g	Extramural	
AZ O:5:156 (ASM) (Simonton Ranch)	Camp Verde	Adult / I	Secondary	Yes	20.8 g	Extramural pit	
		Adult / I	Secondary	No; sherds present	183.7 g	Extramural pit	
		<12 yr / I	Secondary	No	1.8 g	Extramural pit	
		Adult / I	Secondary	No; sherds present	92.6 g	Extramural pit	
AZ O:5:6 (ASM) (Verde Terrace Site)	Camp Verde	Adult / I	Crematorium	No; vessels present	79.0 g	Extramural	Associated with secondary cremations in extramural area
		Adult / I	Secondary	No?; vessels present	1.5 g	Extramural	Associated with crematorium
		Adult / I	Secondary	No?; vessels present	18.7 g	Extramural	Associated with crematorium
		Adult / I	Secondary	No?; vessels present	28.0 g	Extramural	Associated with crematorium
		Adult / I	Secondary	No?; vessels present	10.3 g	Extramural	Associated with crematorium
		Adult / I	Secondary	No?; vessels present	4.7 g	Extramural	Associated with crematorium
		2-3 yr / I	Secondary	Yes	10.8 g	Extramural	Associated with crematorium
NA 2385 (Calkins Ranch)	Camp Verde	Adult / I	Secondary	Yes?	Not listed	Extramural	Possible second cremation indicated by ash deposit

the process of disassembling rooms, the crews found at least 12 burials "varying from a large man down to the size of an infant." Jackson (1933) also mentions burials excavated by local residents for which no reliable information is available. Table 5 presents information for 20 burials dated to the Honanki phase and Table 6 shows more than 550 burials from Tuzigoot phase sites. The large number of burials from Tuzigoot are summarized here but a detailed study was presented by Anderson (1992) and the interested reader is referred to that document for data on demographic groups, mortuary feature construction techniques, and funerary accompaniments that is beyond the scope of this paper.

The most common location for adult interments after A.D. 1150 was in midden deposits or in clusters of extramural pits or cists outside room blocks. The majority of burials (250) from Tuzigoot came from the midden deposits on the slopes to the east and west of the pueblo. Of these, 157 (63 percent) were adults and 93 were children less than 15 years old. Although burials were found throughout the middens on both sides of the ridge, most were situated on the upper slopes close to the pueblo. A similar pattern was noted at Clear Creek Ruin, where burials from the midden were nearly equally divided between adults and juveniles. All adult burials from Montezuma Castle were found in "cist graves" along the base on the cliff, and one child was also interred there. These cist graves were typically oval chambers excavated into the clay stratum at the base on the limestone cliff, with a limestone ledge forming the cist roof and the outer wall lined with upright slabs (Jackson and Van Valkenburgh 1954:22, Figure 6). Excavations at Montezuna Castle focused on architectural features rather than on the floodplain below, so the association of burials with midden deposits is unclear. Adult burials at Montezuma Well were placed in the flat area downslope from the pueblo, which was situated on bedrock (Schroeder 1975:86). Adult burials from AR-03-04-06-08 and Grey Fox Ridge were found in extramural pits or within the fill of abandoned rooms.

At Tuzigoot, Montezuma Castle, and other late pueblos, young children and infants were typically buried in pits beneath room floors. Of the 171 burials found within rooms at Tuzigoot (in 161 graves), only three were adults. This means that 98 percent of burials in rooms were children, whereas 37 percent of burials in the midden were children. Viewed another way, adults were extremely rarely buried in rooms (less than 2 percent), whereas children were most often buried in rooms, but about one-third of children were interred in the midden areas. At ruins associated with Montezuma Well, children were buried directly adjacent to the exterior wall of the pueblo, which lies on bedrock and did not have subfloor pits (Schroeder 1975:86). Infant remains from Clear Creek Ruin came from the midden as well as within masonry rooms and cavate rooms below the pueblo. At Oak Creek Valley Pueblo, six of seven infants were interred within subfloor pits. Four infants from the Dyck Rockshelter were found in pits within rooms.

Use of rooms for interments varied among sites. All three subfloor burials from Montezuma Castle came from Room 3, whereas only eight (of 86) excavated rooms at Tuzigoot did not contain burials. Five of seven juvenile burials at Oak Creek Valley Pueblo were within one room. The reason for this variation is unclear, and the lack of complete excavation at most sites prevents a more detailed discussion of these patterns. At Tuzigoot, rooms typically contained one to three burials, although up to 14 interments were found. Due to the presence of bedrock beneath most of the pueblo, interior pits were generally only 15 to 18 inches (38 to 46 cm) deep, with floors sometimes elevated to provide deeper cover. Burials in rooms were most commonly placed along or slightly under the east wall or in the southeast corner, which resulted in most interior burials being oriented north-south; a slight majority were placed with the head to the south. Oak Creek Valley Pueblo showed no standard orientation among the burials, and the other sites lack orientation information for most individuals.

In terms of cardinal orientation, all but nine of the midden burials at Tuzigoot were oriented north-south, but this probably reflects the site topography with burials placed parallel to the slope below the pueblo. According the Caywood and Spicer (1935), about half were oriented with the head to the north, the other half with the head to the south. Adults were somewhat more likely to be oriented toward the north, juveniles more frequently toward the south. Burials from other sites show more variation in cardinal orientation, with no dominant direction but a general preference for placing the head toward the east or west. One problem with discussing burial orientation is that many in the Honanki and Tuzigoot phase sample come from undocumented excavations so while the location of the interment may be known, few details are available regarding position or orientation.

No matter where the burial occurred or whether the individual was adult or juvenile, nearly all Honanki and Tuzigoot phase burials were placed in an extended supine position with arms along the sides. At Tuzigoot, Caywood and Spicer (1935) mentioned that a few burials were placed with the ankles crossed and one with an arm bent across the pelvis. Rare ex-

Table 5. Southern Sinagua inhumations from the middle Verde Valley, Honanki phase.

Site	Phase	Age / Sex	Location	Position	Orientation	Comment
NA 22,515 (Oak Creek Valley Pueblo)	Honanki	8-12 mo / I	Below wall	Unknown	Unknown	Poorly preserved
	Honanki	10-16 mo / I	Below floor	Extended supine	Head to NW	In pit with Burial 3
	Honanki	8-12 mo / I	Below floor	Extended supine	Head to NW	In pit with Burial 2
	Honanki	1.5-2.5 yr / I	Below floor	Extended supine	Head to S	
	Honanki	8-10 mo / I	Below floor	Unknown	Unknown	Poorly preserved
	Honanki	3-8 mo / I	Below floor	Semi-flexed on right side	Head to N	
	Honanki	20-40 yr / F	Extramural pit	Extended supine	Head to N	
	Honanki	Neonate / I	Unknown	Unknown	Unknown	Identified in lab
NA 9471 (Dyck Rockshelter)	Honanki	Infant / F	Rockshelter room	Extended	Head to NW	Mummy wrapped in cotton textiles, wearing cotton apron
	Honanki	Infant / I	Rockshelter room	Extended	Head to W	Mummy wrapped in cotton textile
	Honanki	Infant / I	Rockshelter room	Extended	Head to S	Bones crushed and flattened, wrapped in cotton textile, matting covered face
	Honanki	"Child" / I	Rockshelter room	Extended	Head to N	Partially disarticulated and feet missing, with abundant mortuary objects
No site number	Honanki	2-4 mo / I	In cavate room	Extended	Unknown	Wrapped in cotton textile, laid on beargrass mat
AR-03-04-06-703	Honanki	ca. 5 yr / I	Midden pit	Extended supine	Head to NE	Disturbed by roots/rodents
AR-03-04-01-1065 (Richards Caves)	Honanki	30-40 yr / I	In cavate room	Unknown	Unknown	Fragmentary remains identified after excavation
AR-03-04-06-04 (Hidden House)	Honanki	ca. 40 yr / M	In alcove room	Extended supine	Head to SW	Wrapped in painted cotton blanket tied with yucca cords, covered with cotton blanket
AR-03-04-06-58 (Honanki)	Honanki	3-9 mo / I	Unknown	Unknown	Unknown	Mummy wrapped in cotton blanket
AR-03-04-06-136 (Boynton Canyon)	Honanki	4-6 yr / I	Unknown	Unknown	Unknown	
	Honanki	Infant / I	Unknown	Unknown	Unknown	Removed and reburied by CNF personnel
AZ N:4:110 (ASM) (Grey Fox Ridge)	Honanki	25-35 yr / M	Extramural pit	Reclined kneeing, legs to left	Head to SE	
	Honanki	35-45 yr / M	Extramural pit	Semi-flexed spuine	Head to W	
NA 10769 (Exhausted Cave)	Camp Verde to Tuzigoot	25-25 yr / I	In cavate room	Unknown	Unknown	Disturbed and disarticulated; associated with Clear Creek Ruin

Table 6. Southern Sinagua inhumations from the middle Verde Valley, Tuzigoot phase[1].

Site	Phase	Age / Sex	Location	Position	Orientation	Comment
AR-03-04-06-354 (Crescent Moon Ranch)	Tuzigoot	350-40 yr / F	Extramural pit	Extended supine	Head to WNW	Blue-green staining on face
AR-03-04-06-08	Tuzigoot	40+ yr / F	Extramural pit?	Unknown	Unknown	Partially eroded
	Tuzigoot	45+ yr / F	Extramural pit?	Unknown	Unknown	Partially eroded
	Tuzigoot	30-40 yr / F	Intrusive into room	Extended supine	Head to SW	
	Tuzigoot	18-22 yr / F	Intrusive into room	Extended supine	Head to W	
NA 1269 (Sugarloaf Pueblo)	Tuzigoot	5-8 yr / I	Within room	Unknown	Unknown	May have been multiple burial
		3-6 mo. / I	Within room	Unknown	Unknown	May have been multiple burial
AR-03-04-06-87 (Page Springs Ruin)	Tuzigoot	Adult / F?	Slab-lined cist	Extended supine	Unknown	Double burial on slope below ruin
	Tuzigoot	Adult / F?	Slab-lined cist	Extended supine	Unknown	Double burial on slope below ruin
NA 2931 (Verde Salt Mine)	Tuzigoot?	Adult / M	Within mine shaft	Unknown	Unknown	
		Adult / M?	Within mine shaft	Unknown	Unknown	
AR-03-04-01-05 (Clear Creek Ruin)	Tuzigoot	20-25 yr / I	Midden N of main ruin	Unknown	Unknown	Collected from surface
	Tuzigoot	40-50 yr / F	Midden N of main ruin	Unknown	Unknown	Collected from surface
	Tuzigoot	1-2 yr / I	Midden N of main ruin	Unknown	Unknown	Collected from surface
	Tuzigoot	3-5 yr / I	Midden N of main ruin	Unknown	Unknown	Collected from surface
	Tuzigoot	Infant / I	In cavate room	Extended supine	Head to E	Wrapped in cotton textiles, covered with twilled matting
	Tuzigoot	3-5 yr / I	Below room floor	Extended supine	Unknown	Wrapped in cotton textiles, covered with bark and grass
	Tuzigoot	4-6 yr / I	Unknown	Unknown	Unknown	
	Tuzigoot	4-6 yr / I	Unknown	Unknown	Unknown	Wrapped in cotton textiles and reed mat
AR-03-04-01-600	Tuzigoot	35-50 yr / M	Within alcove	Unknown	Unknown	
AR-03-04-01-255	Tuzigoot	Adult / I	Unknown	Unknown	Unknown	Collected from surface
		20-30 yr / M	Unknown	Unknown	Unknown	Collected from surface
		18-25 yr / I	Unknown	Unknown	Unknown	Collected from surface
AR-03-04-01-100 (Hackberry Site)	Tuzigoot	Adult / I	Unknown	Unknown	Unknown	Collected from surface
Montezuma Castle	Tuzigoot	Infant / I	Under Room 3 floor	Extended	Head to W	Wrapped in twilled matting; in pit with Burial 2, above slabs
	Tuzigoot	Infant / I	Under Room 3 floor	Extended	Head to E	Wrapped in twilled matting; in pit with Burial 1, below slabs
	Tuzigoot	Infant / I	Under Room 3 floor	Extended	Not listed	Wrapped in twilled matting

Table 6 (Continued). Southern Sinagua Inhumations from the Middle Verde Valley, Tuzigoot Phase[1].

Site	Phase	Age / Sex	Location	Position	Orientation	Comment
Montezuma Castle (continued)	Tuzigoot	1 infant, 2 adult M, 1 adult F	Cave NE of Room 3	Unknown	Unknown	Disturbed in prehistory
	Tuzigoot	1 infant, 1 child, 1 adult M, 1 adult F	Cist Grave 1 under ledge	Unknown	Unknown	Disturbed and disarticulated
	Tuzigoot	Elderly adult M	Cist Grave 1	Extended supine	Head to E	On floor of cist
	Tuzigoot	3-4 yr / I	Cist Grave 2	Extended	Head to W	
	Tuzigoot	Elderly adult / I	Cist Grave 2	n/a	n/a	Secondary burial?
	Tuzigoot	30-40 yr / F	Cist Grave 3	Extended supine	Head to W	
	Tuzigoot	Elderly adult / I	Cist Grave 3a	Unknown	Unknown	Disturbed and disarticulated
	Tuzigoot	3 adult M, 1 adult I	Cist Grave 4/5	Unknown	Unknown	Disturbed and disarticulated
	Tuzigoot	Elderly adult / F	Cist Grave 4	Extended supine	Head to E	
	Tuzigoot	Elderly adult M, Elderly adult F	Cist Grave 5a	Unknown	Unknown	Disturbed and disarticulated
	Tuzigoot	30-40 yr / M 30-40 yr / F Adult / I	Cist Grave 7	Unknown	Unknown	Disturbed and disarticulated
	Tuzigoot	Elderly adult / M	Cist Grave 7	Extended supine	Head to W	On floor of cist
	Tuzigoot	Elderly adult / M	Cist Grave 7	Extended supine	Head to W	On floor of cist
	Tuzigoot	Adult / F	Pit house fill	Extended supine	Head to W	
	Tuzigoot	Adult / M	Floor of Room 3a	Extended supine	Head to S	Within burned roof material
	Tuzigoot	Infant / I	Within room	Unknown	Unknown	Excavated by tourist
	Tuzigoot	Infant / I	Within room	Unknown	Unknown	Excavated by tourist
AZ N:4:1 (Tuzigoot)[2]	Tuzigoot	50+ yr (n=19) 21-50 yr (n=118)	98% in middens; 2% below room floor	Extended supine	Various	
	Tuzigoot	15-21 yr (n=11)		Extended supine	Various	
	Tuzigoot	6-11 yr (n=87)		Extended supine	Various	
	Tuzigoot	<6 yr (n=170)		Extended supine	Various	
	Tuzigoot	unknown age (n=24)	Various	Extended supine	Various	
AZ O:5:92 (Montezuma Well)[3]	Tuzigoot	Adult / F and M	Outside rooms	Extended supine	Various	Approximately 30 adults
		Juvenile / I	Within rooms	Extended supine	Various	Approximately 30 juveniles

[1] Many burials from Tuzigoot phase sites are poorly documented

[2] See Caywood and Spicer (1935)and Anderson (1992) for more detail

[3] Minimal information is available; see Powers and Pearson (2008:71-72)

ceptions to this positioning occurred for two adults at Grey Fox Ridge and one infant at Oak Creek Valley Pueblo, all placed in semi-flexed or reclining positions. Body position and orientation could not be determined for the majority of the cist burials at Montezuma Castle because these features were used repeatedly, with the earlier burials moved aside or scattered during later interments. Similar long-term use of burial features as crypts, probably by family or clan groups, has not been documented at other Southern Sinagua sites but is reported elsewhere in the Southwest (see Loendorf 1998). Double or multiple burials also occurred at Oak Creek Valley Pueblo and Sugarloaf Pueblo, but are not documented at earlier sites, suggesting a change in kinship or community structure after A.D. 1150.

Construction technique of graves, in particular the amount of effort required, is often cited as correlating with status of the deceased individual (e.g., Carr 1995; Saxe 1970; Tainter 1978). Richness of mortuary assemblages, in particular the presence of exotic or "high-cost" objects, may reflect the status of the deceased but seems more often to vary among social categories such as age and sex (Binford 1971; Carr 1995:169; Mitchell and Brunson-Hadley 2001). In terms of both grave construction and offerings, mortuary behavior at late Verde Valley sites varied widely. Caywood and Spicer (1935) carefully documented grave construction at Tuzigoot, where coverings included slabs (n=93, 22 percent) or wooden poles (n=27, 6 percent), but about two-thirds of the burial pits were simply filled with sediment. Burials covered with closely-spaced cottonwood or sycamore poles were found only in the midden, mainly on the east slope. These graves were almost exclusively for adults, and "were more common for males than females" (Anderson 1992:23). Slab-covered burials were found in the midden (n=36) and within rooms (n=57), and four graves showed evidence that the slabs had been stabilized with mortar. Most slabs were local limestone, but two burials, both containing numerous offerings, were covered with red sandstone slabs that must have been carried at least 6 miles (9.6 km) from the nearest source. These graves, containing one adult and one child, constitute evidence of high energy input and probable high-status individuals. Slab-lined graves were also constructed for juveniles at Montezuma Well (Powers and Pearson 2008:72). Details are not provided by Jackson and Van Valkenburgh (1954) for construction of graves within the rooms at Montezuma Castle, suggesting they did not involve elaborate wood or stone coverings. The cist graves below Montezuma Castle were excavated under shallow limestone ledges, with upright slabs set to delineate the front wall, and additional rocks were used in some cases to seal the upper section. Thirteen burials at Tuzigoot were found in niches excavated below bedrock ledges and subsequently covered by midden deposits, and similar graves were reported from Montezuma Well (Powers and Pearson 2008:72). Burials at AR-03-04-06-08, Grey Fox Ridge, and Oak Creek Valley Pueblo lacked evidence of stone or wood covers, perhaps indicating less elaborate burial practices at smaller sites.

Preparation of the deceased for burial involved specific rituals that often corresponded to the age, sex, and social position or roles held by the individual. At Tuzigoot, eight adults exhibited evidence of facial painting with red or green pigment, the entire area below the eyes being stained[3]. Another 12 burials at Tuzigoot contained powdered mineral residue, sometimes within vessels. Two burials found near Hatalacva, one adult female and one child, and one adult from AR-03-04-06-354 exhibited blue and green facial paint. One child buried at Tuzigoot with an abundance of shell and stone beads had been covered from the torso to the knees with red hematite powder and then wrapped in a fine twilled mat. The chest of the adult male from Hidden House had been covered with yellow pigment. Adult burials at Montezuma Well displayed green staining at the head and arms, and black stains near the elbows (Powers and Pearson 2008:71). Such distinct body treatment must have held specific meaning to those conducting the burial rites, and the use of various paint colors undoubtedly reflected relationships between the worlds of the living and the dead (e.g., Lamphere 1983; Mabry 2005; Parsons 1939).

Southern Sinagua burials recovered from protected locations, such as Hidden House, Montezuma Castle, and smaller cavates, were found wrapped in cotton blankets, some of which showed paint residue. These individuals were also wrapped in or covered with coarser twilled mats made of yucca, beargrass, or other natural fibers. Both adults and children were prepared for burial in this manner, wrapped in two to five layers of textiles. One infant burial from an open room at Clear Creek Ruin was wrapped in well-preserved textiles and matting, protected by the thick layer of bark and other organic debris laid above it. Cotton textiles enshrouded three infants from the Dyck Rockshelter and one was partially covered by coarse matting. Finely-woven cotton fabric was found covering the face or head of a mummified individual from the Verde Salt mine (Chabot and Bostwick, this issue), and textile impressions or small fragments of cloth or matting have been noted in burials at open sites such as Grey Fox Ridge and near Hatalacva.

Pottery was by far the most widespread mortuary offering during the Honanki and Tuzigoot phases, although not all burials contained vessels and few were accompanied by more than four. The maximum number of vessels reported for a single burial is 33, found with an adult at Montezuma Well (Powers and Pearson 2008:71). At Tuzigoot, 115 (28 percent) of the burials contained pottery and the majority of these were in the middens; only 8 percent of juvenile burials in rooms contained vessels. The most common mortuary vessels were undecorated bowls but vessel forms included small ollas, pitchers, and ladles. About half of the burials at Montezuma Castle and Oak Creek Valley Pueblo were endowed with ceramics. Pottery was most often placed near the head, next often near the pelvis, next at the chest or near the right elbow. A "considerable number" of the bowls found in burials at Tuzigoot contained organic residue, probably the remains of food left for the deceased (Caywoood and Spicer 1935:101). A painted mug or small bowl with an infant in the Dyck Rockshelter had azurite staining on the interior (Bostwick et al. 2015). A few instances of gourds, probably used to hold water or food, have been reported from sheltered sites, including two infant burials from the Dyck Rockshelter. Whole and partial baskets occur with burials from sheltered sites, including Hidden House and the Dyck Rockshelter, and basket fragments have been reported from open sites, but in much lower frequencies than pottery. None of the burials at smaller habitation sites such as Grey Fox Ridge and Oak Creek Valley Pueblo were interred with large numbers of mortuary offerings, but most contained at least one or two vessels and often a few ornaments. One individual at Grey Fox Ridge was buried with four manos that exhibited yellow and black pigment staining.

The majority of non-ceramic mortuary objects were personal ornaments, most often made of stone or shell. These were found in positions indicating ear bobs, necklaces, bracelets on the upper and lower arms or ankles, and around the knees, possibly sewn onto garments. Ornaments were manufactured from both local and exotic materials. Argillite beads were common, probably made from stone procured in the upper Verde Valley (Bartlett 1939; Elson and Gunderson 1992). Turquoise ornaments may be from local or distant sources, but none have been sourced. The abundance of shell ornaments at Honanki and Tuzigoot phase sites continued the pattern noted in earlier periods and indicates exchange networks with groups to the south and southwest. One adult male at Tuzigoot was interred with a cache of unworked obsidian and exotic chert.

DISCUSSION OF VERDE VALLEY MORTUARY PATTERNS

This paper is not a comprehensive study of Verde Valley mortuary traditions, but offers a solid foundation for future work. Our goal was to gather information for as many burials as possible in an attempt to define patterns in mortuary traditions through time. The variable nature of the information available from both published reports and institutional site files limits our ability to compare all characteristics at all sites or for all burials, but a number of patterns are evident.

Burials during the Dry Creek / Late Archaic interval (2000 B.C. to A.D. 500/550) were placed in tightly flexed positions within extramural pits, often oriented with the head to the northwest, and usually covered by large boulders or recycled ground stone. No mortuary offerings have been found, but perishable objects were probably placed during burial. The Hackberry to Camp Verde phases (A.D. 500 to 1150) brought extended supine positioning, with a general trend of orienting the head to the east or southeast. Interment commonly occurred in extramural pits or fill of abandoned pit houses. Ceramic vessels became standard mortuary offerings, along with personal ornaments made of stone and shell. The occurrence of cremations during the period between A.D. 800 and 1150 reflects influence, and possibly migration, from the Hohokam region. The presence of both cremations and inhumations at some sites suggests coresidence of local people and migrants, or local adoption of Hohokam ritual practices including mortuary behavior. Burial traditions became standardized during the Honanki and Tuzigoot phases (A.D. 1150 to 1450), with adults interred almost exclusively in extramural and midden areas and juveniles more frequently buried in sub-floor pits within pueblos and cliff dwellings. Extended body position continued to dominate, but head orientation was variable. Preparation for burial involved wrapping the deceased in multiple layers of textiles and sometime painting the face or other body areas with colored pigments. Ceramic vessels dominated mortuary assemblages, but utilitarian tools, personal adornments made of stone and shell, minerals and pigments, and food items were also placed with burials. The diversity in type and number of mortuary offerings during the Honanki and Tuzigoot phases reflects the rich material culture of the Verde Valley residents. Anderson (1992) explored patterns in the association of specific artifact types with demographic groups at Tuzigoot, but a useful line of future inquiry would be to define "tool kits" of either an economic or ritual nature, as

have been identified in the Hohokam area to the south (Rice 2016).

Keith Anderson (1992) surmised that the distribution of mortuary offerings at Tuzigoot indicated a system of achieved status among the Southern Sinagua, because the number and variety of objects was significantly higher among adult burials, particularly for adult males. He noted that "the maximum number of artifacts with a male burial was over 20; six was the most found with a female[4]" and that "individuals older than 6 were significantly more likely to have jewelry" (Anderson 1992:25). He singled out the graves of one woman and one infant with unusual mortuary offerings as possible examples of "hereditary elite" but generally rejected the idea that Southern Sinagua followed strict social ranking.

Unfortunately, it is not currently possible to construct such models for other Southern Sinagua sites from any time period due to the small number of well-documented burials. A more detailed assessment of correlations between demographic groups and mortuary offerings to explore social structure at Honanki and Tuzigoot phase sites may be possible, but is beyond the scope of this paper. We hope that our compilation and summary of known burials from the middle Verde Valley will assist other researchers in future studies, and will lead to a broader understanding of intra- and interregional relationship among culture groups in the prehistoric period.

Notes

1. Burials from Coconino National Forest (CNF) land in the Verde Valley were recently documented prior to repatriation under the Native American Graves Protection and Repatriation Act of 1990, resulting in adjustments to demographic information from site files or published reports; those changes are reflected in Table 1.

2. Binford (1972:385) states that the cremated remains of an adult should weigh at least 1,750 grams.

3. Anderson (1992:27) notes that this information is reported by Caywood and Spicer (1935) but not included in their excavation notes.

4. Due to the nature of the Tuzigoot data, number of objects refers to object types, for example, a bracelet made of many shells was counted as one item.

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THE VERDE SALT MINE REVISITED: SINAGUA SALT MINING AND RITUAL BURIALS

Nancy Jo Chabot
Todd W. Bostwick

ABSTRACT. *In the mid-1920s, Earl Morris of the American Museum of Natural History, and Byron Cummings, Director of the Arizona State Museum, independently visited the commercial mining of a salt deposit near Camp Verde, Arizona, after receiving reports that prehistoric artifacts and human remains had been found. Both Morris and Cummings obtained a variety of artifacts from prehistoric tunnels exposed by the commercial operations, which were then put into the collections of their respective museums. Cummings also obtained at least three different mummified human remains from the mine. Morris published a brief report in 1928 on his 1926 visit, although Cummings failed to write a report on his two visits in 1926 and 1927. This paper presents the results of a detailed study of their investigations and summarizes the reanalysis of more than 130 artifacts obtained from the salt mine currently housed at those two museums, as well as 20 located at the Museum of Northern Arizona. Comparisons are made with artifacts from another prehistoric salt mine in southern Nevada that Mark Harington of the Museum of the American Indian excavated in the 1920s. In addition, the paper discusses radiocarbon (AMS) dates obtained on five wooden pick handles and one cedar bark torch from the Verde Salt Mine. The dates firmly place the artifacts in the Tuzigoot phase of the local Southern Sinagua Culture. Finally, the ritual acquisition of salt in the American Southwest is examined in order to provide an alternative interpretation for the presence of human burials within the salt mine.*

Salt is an essential component of the human body and has to be constantly replenished because it is lost through normal bodily functions, such as sweating and urination. Hunter-gatherers typically obtain their salt through the animal flesh they consume, while agriculturalists must supplement their diet with additional salt minerals (Kurlansky 2002). To the Mayans, salt was "white gold" and it was traded throughout Mesoamerica (Andrews 1983; McKillop 2002). Salt also widely traded by the Mississippian Culture of the Eastern United States (Brown 1981; Muller 1987) and was used and traded by various historic Indian groups throughout Western North America (Kroeber 1941). In the American Southwest, salt was considered sacred and procurement often involved ritual acts and prescribed behaviors (Benedict 1935; Boas 1928; Duff et al. 2008; Hill 1940; Kraemer 1976; Parsons 1939; Russell 1908; Stevenson 1915; Talayesva 1942; Titiev 1937; Tyler 1964; Underhill 1946).

The following discusses an important prehistoric salt mine in the Verde Valley.[1] The origins of this salt deposit are described, followed by a history of mining operations and the discovery and collection of prehistoric artifacts and human remains from the mine in the 1920s. An evaluation of those human remains is presented, as well as the results of a reanalysis of the artifacts curated in three different repositories. To better understand the importance of salt to the prehistoric cultures of the Southwest, a summary is presented of the ethnographic literature pertaining to the ritual procurement of salt by historic Pueblo and O'odham groups. Finally, the Verde Salt Mine artifacts and human remains are reinterpreted based on their reanalysis and the ritual contexts of salt procurement and use in the Southwest.

VERDE VALLEY SALT DEPOSITS

The Verde Valley was once the location of a freshwater lake created when the ancestral Verde River was blocked through a combination of faulting, basin subsidence, and volcanism in the late Miocene and early Pliocene periods (Nations et al. 1981; Ranney 1989). Streams from the Mogollon Rim delivered water and sediment derived from the bedrock geology of the Rim to the lake basin; this fluvial action resulted in the deposition of alternating layers of limestone, mudstone, and dissolved minerals. The fluctuating climate caused the lake to expand and shrink through the next six million years, with episodes of aridity con-

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Figure 1. View of the eroded Verde Salt Mine cliff, looking southwest.

centrating dissolved minerals in the southernmost parts of the lake basin near present-day Camp Verde. The supersaturation of the confined lake water ultimately initiated the dissolution of the minerals into layers of halite, gypsum, and other mineral species in this area (Ranney 2010). Acid waters from volcanic activity, combined with sodium- and calcium-bearing shales and limestones, created soluble salts as evaporates during dry periods.

In the southern end of the Verde Basin, southwest of present-day Camp Verde, a thick layer of salt deposits formed and was then exposed during the early Pleistocene (Figure 1). These deposits contain a variety of salts, including common table salts (sodium chlorite, NaCl) as well as other salt minerals less desirable for human consumption – thenardite (sodium sulfate, Na_2SO_4) and glauberite ($Na_2Ca[SO_4]_2$) (Jenkins 1923; Thompson 1983). They also include other evaporate minerals such as aragonite ($CaCo_3$), calcite pseudomorphs, and gypsum ($Ca_2So_42H_2O$). The sodium chlorite occurs as hard crystals of halite less than 2 inches thick, some of which have a beautiful blue color that radiates from the center of the crystal. Perhaps the halite's color and luster were attractive to prehistoric miners (Figure 2). Halite crystals are located below and within a thick layer of thenardite (also called natronite), which forms coarse crystalline masses. The white-colored mineral that covers the hills and cliff face of the Verde Salt Mine area is called mirabilite ($Na_2SO_4{\cdot}10H_2O$), an efflorescent powdered coating which is created when sulphates are exposed to the air.

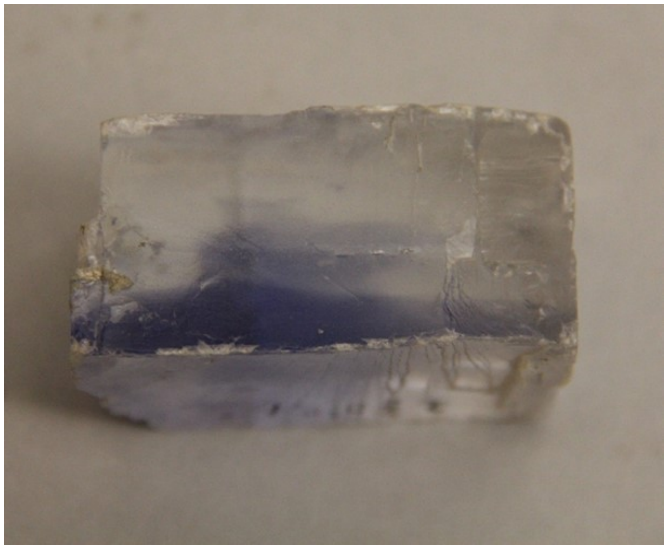

Figure 2. Halite salt crystal with blue color recovered from the Verde Salt Mine (ASM 23561).

HISTORIC MINING OF VERDE SALT DEPOSITS

Early explorers and military officers of the early 18th century noticed and recorded the Verde Valley salt deposits. Willard Rice showed Lt. George M. Wheeler the deposits when Wheeler passed through the Verde Valley during his survey of Arizona, Nevada, and California in the 1870s. The *Weekly Arizona Miner* newspaper published an article titled "Mountain of Salt" on February 17, 1872. This article noted that the post trader at Camp Verde (later Fort Verde) had sent salt specimens to the San Francisco area for testing because of their potential value for the treatment of base silver ores. Little action took place, however, until the early 1920s. On October 13, 1923 the *Verde Copper News* reported that equipment had been brought in to run a sodium sulphate plant operated by Milton Staples. The processed materials were then shipped 29 km (18 mi) away to Clemenceau, where they were loaded onto railroad freight cars and shipped to manufacturing plants. The refined products were used in the production of glass and paper, were placed in cattle food, and were even useful for medicinal purposes (*Verde Copper News* 1927).

In May 1926, the *Verde Copper News* reported that a Western Chemicals' steam shovel, which was cleaving salt deposits from a cliff face, discovered a well-preserved human body within the salt deposits. In August of the same year, Warren S. Smith contacted E. O. Hovey of the American Museum of Natural History (AMNH) in New York to inquire if the museum was interested in examining the body and a collection of archaeological materials associated with it. Clark Wissler of the AMNH instructed archaeologist Earl Morris, who was at that time working in the Canyon de Chelly region of Arizona for the Ogden Mills Exploration Project, to inspect the discovery. Morris, well known for his excavations of Aztec Ruin in New Mexico, visited the Verde Mine on September 13, 1926, and spent a few days examining the discoveries and taking notes. He sent Dr. Wissler a short report a week later. He then returned to Aztec Ruin, where he shipped to the AMNH two boxes with approximately 50 artifacts collected by Western Chemicals employees and donated by Superintendent George W. Campbell. Two years later, Morris (1928) published a detailed, 17-page report on his visit to the Verde Mine; the account included 10 photographs of the mine and its archaeological materials.

Byron Cummings, Director of the Arizona State Museum (ASM) and Chair of the Department of Archaeology at the University of Arizona, was also informed of the discovery at the Verde Mine. Cummings detested the idea of artifacts leaving the state of Arizona, and wanted to ensure that ASM received its share of any artifacts still present at the Verde Mine (Bostwick 2006). During the Thanksgiving break in November, Cummings and several of his students visited the mine and collected a few artifacts, a set of mummified human remains, and two additional mummified feet. According to Emil Haury, Cummings did not take notes during his visit. Thus, there is no known information about the geological or cultural context of the collected artifacts, nor is there a specimen log (Chabot 1992:24).

Mining operations at the Verde Salt Mine picked up in 1927, with 35 men employed.[2] The salt was sold to firms as far away as Norway and Sweden (*Verde Copper News*, May 3, 1927). In November 1927, Cummings sent some unknown person or persons to acquire additional materials for ASM from the mine, but he himself did not participate in this field visit.

Cummings never wrote a report on the results of his two trips. He did make a brief mention of the mine and some of its artifacts in his book, *First Inhabitants of Arizona and the Southwest* (Cummings 1953:79-80). Fortunately, Cummings wrote catalog cards for all the artifacts obtained from the mine, and ASM still curates 91 objects identified on Cumming's catalog cards. These items were either collected (N=29) at the mine, purchased by ASM from D. E. Cathay and Charles Robinson (N=27), or donated by Calcium Products Company (N=32).

MORRIS' 1928 REPORT

Earl Morris' 1928 report provides the only accurate account of the geologic and cultural context of the prehistoric mining operations at the Verde Mine. Morris did not actually remove any artifacts from the mine himself, since it was too dangerous. E. W. Richards scaled the cliff face to remove the archaeological materials that were exposed and E. C. Robinson assisted with the "description of conditions in the parts of the hill that have been dug away" (Morris 1928:79). Morris reported that dynamite and a steam shovel had taken down the slope of a hill to create a cliff face that was 200 ft (61 m) wide and 100 ft (30.5 m) in height (Figure 3). He identified four stratigraphic layers in the cliff face cross-section, one (III) of which was the main cultural layer (Table 1). Morris (1928:83) felt that the topography of the area was essentially the same as when the prehistoric mining operations took place. Morris also identified five archaeological features that contained cultural materials (Table 2). Three of these were separate prehistor-

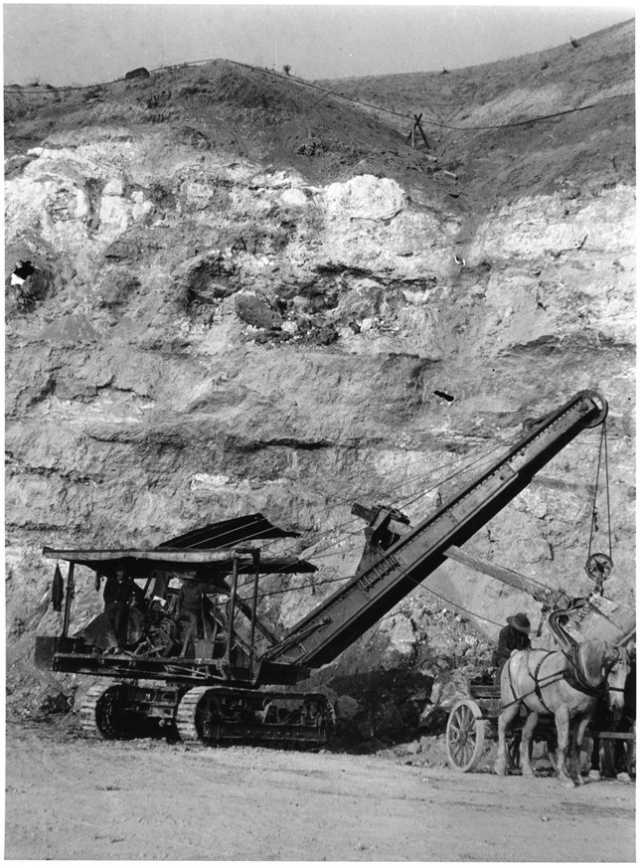

Figure 3. 1926 photograph of the Verde Salt Mine (Photo Courtesy of Arizona State Museum, #460). Ann Axtell Morris (1978: Figure 24) later published a similar photo as an example of how not to do field archaeology.

ic tunnels and one was an "ancient bore" located below a tunnel.

The salt-preserved set of human remains that had been blasted out by the mining company from Tunnel Feature A, months before Morris' visit, was apparently a crouching adult in a crouching position flattened by breccia. Morris (1928:82-84) described the five features exposed in the mining cliff cross section (Figure 4). He commented on how rapidly the prehistoric tunnels filled in naturally through re-deposition of salt precipitants. This re-deposition process consolidated the archaeological materials into a mass of compact breccia.

There was no evidence for timbering used in the prehistoric tunnels, nor were any pillars left in place to secure the roof. According to Morris (1928:81), once a stratum was identified that contained lots of salt, the prehistoric miners "followed it inwards, beating to pieces the breast [vertical face], casting the predominance of waste behind, and garnering the precious bits of salt." The waste was transported to the mouth of the tunnel and thrown into a cavity from previous salt extractions. Morris (1928:83) estimated that "at least a few thousand cubic yards of rock" had been worked over by the prehistoric miners, but that mining was probably done only occasionally, "as demand might dictate."

Table 1. Morris' (1928) description of stratigraphic layers in the cliff face cross-section.

Level No.	Description
I.	Cliff top, drift and water worn igneous boulders
II.	Greenish-yellow fine-grain clay, iron inclusions
III.	Hard, 10-ft thick brown band of mass of "crushed ice and dirty rock salt that one packs into an ice cream freezer;" copiously impregnated with ash and vegetable matter; blue-grey color halite; north end pick hafts, torch stubs, sticks, and fiber protruded
IV.	Sodium sulphate and clay with various salt inclusions

Morris also provided a detailed description of the artifacts donated to AMNH. These include 16 J-shaped pick hafts 9.5 to 13.5 inches in length and several grooved-stone picks for hafting (Morris 1928:Figures 5 and 7), hand-held stone picks (Morris 1928:Figure 6), 5 plaited yucca fiber sandals (Morris 1928: Figure 3), new and used cedar bark torches (Morris 1928:Figure 2), rolls of twigs used for pot rings or burden-basket pads, fiber lashings, a smooth and tapered wooden club, yucca leaves, prepared yucca fiber, and yucca matting. He did not see, but was told that mining employees also had recovered deer horns, a long queue of black human hair, and a blade-shaped knife. No ceramics were reported by Morris, nor collected by Cummings, making the cultural affiliation and age of the prehistoric miners unclear. Morris (1928:90) suggested the miners used gourd containers for water, although there were none in either the AMNH or ASM Verde Mine collections. He believed the mine "was always necessarily a damp, dark, and unlovely place in which no one would spend more time than necessary" (Morris 1928:90).

WALTER TAYLOR'S SALT ANALYSIS

More than 25 years after Morris' publication, three salt specimens from the Verde Salt Mine were analyzed by Walter W. Taylor (1954). Taylor was interested in the chemical composition of five salt samples collected from natural deposits known or assumed to have been used by Native Americans; he then compared these samples with three archaeological salt specimens. In addition to the Verde Mine samples, the other natural salt deposits were Zuni Salt Lake in New Mexico and Colorado River Bright Angel shale deposits in the upper Grand Canyon. The archaeological specimens originated from Medicine

Table 2. Morris' (1928:82-84) description of cultural features exposed in the cliff face cross-section.

Feature Name	Description
Feature A Tunnel (Stratum III)	A soft, brown band 3.5-5.5 ft thick across the entire 200-ft width of the exposure; breccia composed of waste and rubbish cemented together by secondarily precipitated salts with no beginning or end; mummified human remains found at north end of tunnel
Feature B Tunnel (Stratum IV)	Terminus 8 to12 ft below northern end of Feature A
Feature C Tunnel	5-ft wide; connects Tunnel Features A and B
Feature D Ancient Bore	3 ft below Tunnel Feature B, with picks and ash
Feature E	25 ft below Feature D; hand pick in a mass of consolidated waste

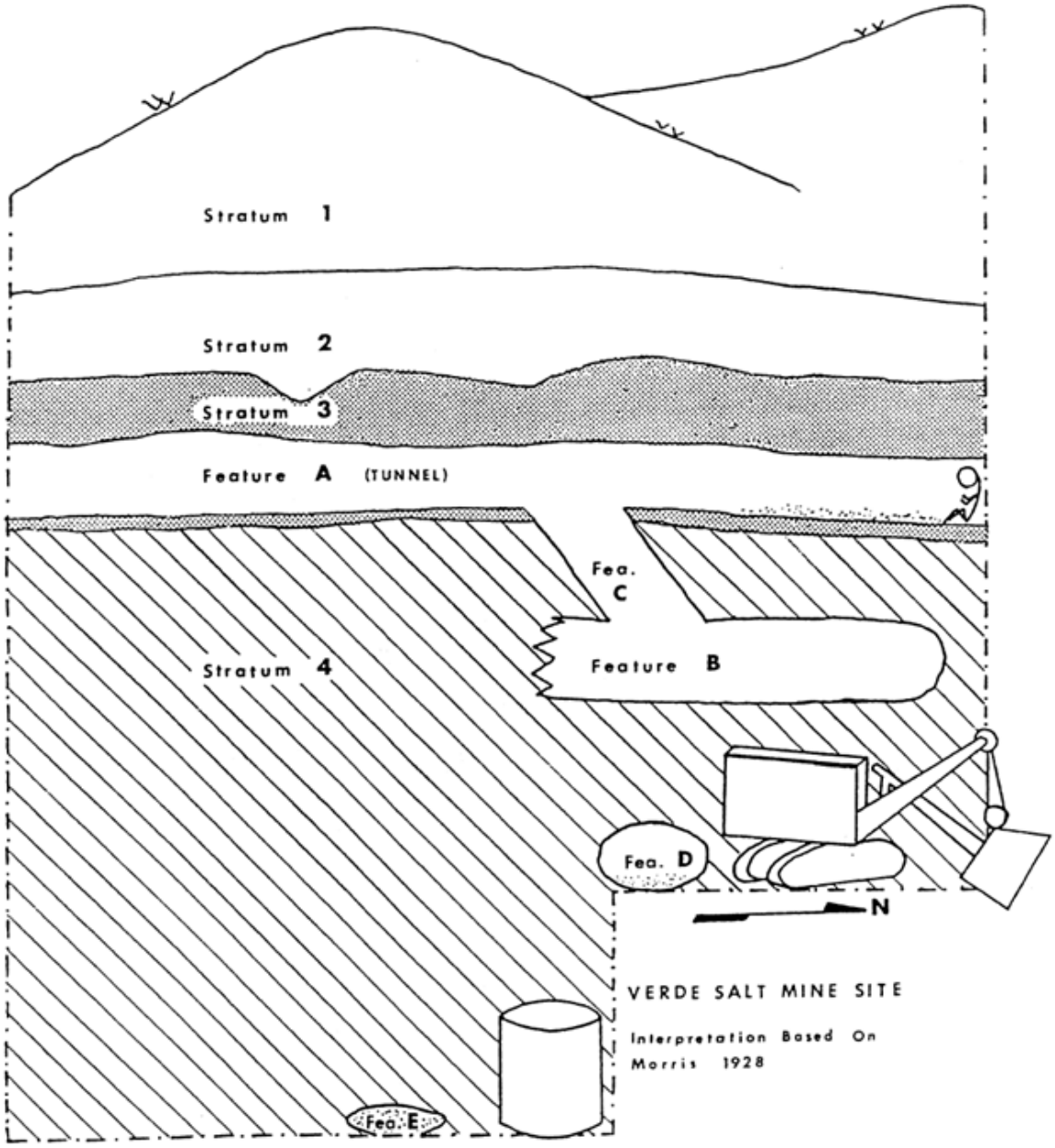

Figure 4. Profile illustration of Verde Salt Mine based on Morris' (1928) photographs and descriptions (from Chabot 1992:Figure7).

Cave near Flagstaff in northern Arizona, Mohawk Canyon on the Hualapai Reservation, and from Fewkes Cave in Mesa Verde National Park (Taylor 1954:Table 1).

Zuni, Hopi, western Keres and other groups have gathered salts from the Zuni Salt Lake deposits for centuries (Parsons 1939; Duff et al. 2008). Taylor's chemical assays of this salt revealed that it was remarkably good quality for human consumption. His work demonstrated that Zuni Salt Lake salts were relatively free of impurities and had the highest sodium chloride (88.7 percent) content of all of the salts he analyzed. It also contained lesser quantities of potassium sulfate (5.6 percent), potassium chloride (4.3 percent), and magnesium chloride (1.2 percent) than any of the other samples.

Taylor's sample of the Grand Canyon salt, which the Hopi collected, was a very poor quality table salt, with a high proportion of impurities and a low quantity of sodium chloride (25.2 percent). It included enough magnesium sulfate (4.9 percent) and sodium sulfate (3 percent) to impart strong purgative qualities to it. However, we suspect Taylor's (1954) single sample was not representative of the quality of salt that is available in the upper Grand Canyon. Five years later, Eiseman (1959:30) collected 50 lbs (22.7 kg) of salt from the Hopi salt mine in the Grand Canyon and his analysis revealed a sodium chloride content of 64.2 percent, although sodium sulfate (18 percent) and magnesium sulfate (3.1 percent) also were present. The Hopi were aware of the different qualities of salt at different locations within the Grand Canyon (Titiev 1937:253).

Lloyd Pierson of the National Park Service collected three salt samples from the Verde Mine for analysis; he apparently chose three different types of samples to represent the different types of salt present at this location. One sample was halite, containing 80 percent sodium chloride and 18.3 percent potassium chloride. The composition of this sample suggested that it was a good table salt, perhaps with a slightly bitter taste, and that it was possibly diuretic (Taylor 1954:4).The second sample was mostly sodium sulfate, or thenardite (80.2 percent). When combined with magnesium sulfate (2.5 percent) and potassium sulfate (10.3 percent), the sodium sulfate in this sample would create bitter tasting salt and a strong laxative. This type of salt was later used as a salt for livestock. The third salt sample from the Verde Mine is a pseudomorph. It occurs when a halite crystal is dissolved and the resulting cavity is filled with impurities, such a calcium sulfate or anhydrite (20.1 percent) (also called plaster of paris), and only small quantities of sodium sulfate remain (3 percent). Taylor (1954:5) noted that this type of salt was not readily consumable.

Taylor's (1954:5) analysis revealed that the three archaeological specimens collected from Medicine Cave, Mohawk Canyon, and Fewkes Cave were good table salt, with no bitter tasting or purgative substances. In fact, these samples were higher quality than the natural sources that were analyzed by Taylor and he wondered if the native peoples purified their salts through precipitation, although he could find not ethnographic data that they knew how to remove impurities from natural salt deposits. Nonetheless, his analysis indicates that the prehistoric salt miners and/or users were aware of the different types of salts and their various characteristics. Taylor (1954:6) also speculated that the archaeological sample from Mesa Verde, with 90 percent sodium chloride, may have come from the Verde Mine, although there were differences in the quantities of potassium and sodium chlorides. The Mesa Verde sample was a cone of salt gathered while damp and patted into shape as indicated by finger-prints on its surface and the impressions of a stone slab on its bottom. Associated with the salt cone was a corrugated jar dating from the Pueblo II or early Pueblo III. Watson (1955:59-61), who sent Taylor the Mesa Verde salt sample, thought it came from Zuni Salt Lake.

Euler (1954) followed Taylor's report with an analysis of a natural salt deposit from the lower Virgin River in southern Nevada, a salt mine pointed out to him by his Hualapai informants and investigated by Harrington (1925, 1926a, 1926b). This salt was especially pure and contained 98.5 percent sodium chloride; it appears to be the source of the archaeological sample (94.6 percent sodium chloride) Taylor (1954) analyzed from the Hualapai Cave excavated by Euler in 1953.

HUMAN REMAINS FROM THE VERDE SALT MINE

In the late 1980s, the senior author (Chabot) re-examined the Verde Salt Mine to determine if previous research on this unusual site was still valid and to provide more detailed and updated information. One of her tasks was to better understand the nature of the mummified human remains retrieved from the mine. However, none of the human remains from the 1926 and 1927 Verde Mine collections are still present at ASM because they were "disposed of" on February 10, 1949, due to their deteriorating condition.[3] Most of what is known about these mummified human remains is based on inaccurate newspaper accounts and four catalog cards at the ASM.

ASM Catalog card 16225, written in November 1927, states that a gift from the Calcium Products Company consisted of "mummified human hand and fore-arm." ASM catalog card 16234, dated November

1927, lists another gift from the Calcium Products Company as "human hair, from a body struck by the steam shovel." ASM catalog card 1637 is dated November 1926 and lists "mummy, broken by steam shovel. Two extra feet were recovered from the deposit. Hair destroyed." Finally, ASM catalog card 16242, dated November 1927, states that the University of Arizona Expedition collected a "[b]ody, partially preserved, with fragments of a second body." This card also notes that "[h]air from this body left with human remains in Vault 9/25/53 WK," which suggests that the hair was not disposed of at the same time as the other human remains.

Altogether, the catalog cards indicate that the ASM obtained from the Verde Salt Mine two mummified human bodies, the unspecified fragments of a third body, a hand, a forearm, two feet, and hair. In September 1932, G. M. Butler, Dean of the College of Mines and Engineering at the University of Arizona, wrote a letter to H. I. Smith, Chief of the USGS Mining Division, confirming that three mummified human bodies from the Verde Mine were present in the ASM collection.

Various interpretations have been proposed for the presence of the mummified human remains in the Verde Salt Mine. The *Verde Copper News* (May 7, 1926) thought the mummified human remains found in 1926 was several hundred thousand years old. The paper further hypothesized that the remains were of a man who fell out of his boat or canoe and drowned, only to have his body covered in salt. *The Verde Copper News* followed that story with another one on May 11, 1926, which noted that the human remains found in 1926 had no head (presumably as a result of damage inflicted by mining operations), was over 5 ft 6 inches tall (1.68 m), and had a fracture of the right leg "which appears to have happened before burial was made." Both Morris (1928:82) and Cummings (1953:80) suggested the person who became mummified had died from a cave-in while mining salt. A story in the *Arizona Daily Star* on May 5, 1927, was titled "First Disaster in State Mine 1000 years old; so says Dean Cummings after Archaeological Discovery near Prescott."

Based on our re-analyses of the artifacts and on published descriptions of their geological and cultural contexts, we propose a possible alternative interpretation – intentional ritual burials of Sinagua salt miners. This interpretation is supported by the ethnographic literature on the ritual significance of salt to native peoples of the Southwest. The following summarizes this literature. We then present the results of our reanalysis of the Verde Salt Mine artifacts, showing that some of the artifacts were not used for mining, but are most likely associated with the ritual burial of the individuals found in the prehistoric mine.

SALT IS SACRED IN THE AMERICAN SOUTHWEST

The Verde Salt Mine is one of several major salt acquisition locations in the American Southwest. Two of these are prehistoric mines (Verde Mine and Nevada Mine) and others are associated with bodies of water (Salt Canyon in the Grand Canyon, Zuni Salt Lake, and the Gulf of California). Freshwater salt deposits are also present in the Estancia Valley of central New Mexico and were important to Pueblo, Plains, and Jumanos Indians (Kraemer 1976).

Numerous ethnographic accounts indicate that salt gathering was difficult, dangerous, and required rituals and prescribed behavior by those involved. Because salt locations were considered sacred areas guarded by deities, corn and prayer sticks were left as offerings during each of the salt gathering journeys, and prayers sticks have been found in both the Verde Mine and the Nevada Mine. Many of the Southwestern groups believed that Salt Woman or Salt Mother protected their salt sources, including the Zuni, Laguna, Acoma, Zia, Santa Clara, San Juan, San Ildefonso, Taos, and Navajo (Hill 1940:17; Tyler 1964).

The O'odham salt journey across an arid desert to the Gulf of California was considered a rite of passage for young men (Russell 1908; Underhill 1946). Four to eight days of preparation were required, and after the salt was gathered, the young men were sent on a vision quest before they could return home. Salt pilgrims wore a breechcloth and sandals and carried four different kinds of prayer sticks and cornmeal for offerings to the ocean (Underhill 1946:214). Upon returning, the young men had to undergo purification rituals which could take up to 16 days. Salt was spoken to in songs as though it was corn and lumps of salt were breathed in to obtain its power. Archaeological data indicates that the Hohokam made this same journey to obtain salt, marine shells, and obsidian (Mitchell and Foster 2011).

Hopi men also underwent a rite of passage by travelling into the Grand Canyon at its confluence with the Little Colorado River to gather salt and a special clay from a location considered close to their mythical underworld (Beaglehole 1937). Spider Woman owned the salt and she instructed the War Twins to make a trail for the Hopi to the salt source (Talayesva 1942:236). The location of this salt trail has been recently verified (Ferguson et al. 2004). Before making the trip, men had to abstain from sexual

activities for four days. Many shrines were located along the route, where prayer sticks or feathers were deposited during the journey, both there and back. Salt was gathered from a mine in the Tapeats Sandstone, from salt stalagmites and stalactites in overhangs, and from sand deposits (Billingsley et al. 1997:17; Titiev 1937:253).[4] When they returned home, the Hopi men underwent rituals and participated in a feast.

Zuni Salt Lake is a shallow, spring-fed body of water in northwestern New Mexico. Extending far back in time, it has been considered sacred and is visited by the Zuni, Acoma, Laguna, Hopi, Apache, and others. The journey there was also considered a rite of passage for young men and required silence and the depositing of prayers sticks. Trips were made to the Zuni Salt Lake to pay homage to Salt Woman, to collect salt, for initiations into religious societies, and to bring rain (Duff et al. 2008:7; Stevenson 1915). This salt lake is located inside a dramatic-looking cinder cone and the edge of the lake is the home of the Zuni War Twins. In the past, salt gatherers were thought of as a war party, although the lake itself was considered a war-free zone, and permission to make the journey had to be obtained from village authorities (Tyler 1964:188, 191). At Zuni Pueblo, a corn ear was impregnated with salt from the lake and kept in the granary to insure the granary was always full (Parsons 1939:89).

The ethnographic literature on historic salt procurement clearly shows that salt was a sacred item that required prayer and ceremonial acts of reverence. Prayer sticks were especially important ritual items deposited during the procurement of the salt. We believe that our reanalysis of the ASM collection has identified prayer sticks from the Verde Salt Mine.

ARTIFACTS CURATED AT THE AMERICAN MUSEUM OF NATURAL HISTORY, ARIZONA STATE MUSEUM, AND MUSEUM OF NORTHERN ARIZONA

More than 150 artifacts from the Verde Salt Mine were collected by Morris and Cummings in the 1920s. A small number of Verde Salt Mine artifacts also were donated in the 1930s to the Museum of Northern Arizona (MNA), and in 1945 E. B. Sayles obtained several shell bracelets from the salt mine for ASM. Altogether, 120 ASM catalog cards exist for Verde Mine materials, with 39 of the items discarded or lost and the remaining still in storage. The remaining items are in excellent condition and were re-examined in the late 1980s by Chabot and in 2012 by Bostwick. Chabot also re-examined a smaller quantity of Verde Mine artifacts in the AMNH, and in 2013 Bostwick analyzed 20 artifacts in the MNA collections. The following is a discussion of those artifacts based on a reanalysis of both the artifacts and their catalog cards.

Figure 5. Three-quarter groove stone pick from Verde Salt Mine (MNA 374-1812).

Stone Picks

Two types of stone picks were identified: (1) those with three-quarter grooves designed for a fitted wooden haft and (2) hand held picks. A combined 13 three-quarter groove picks are in the AMNH (N=8), ASM (N=4) and MNA (N=1) collections (Another 15 are listed on ASM catalog cards, but are missing; in addition, five broken pick points are listed on ASM catalog cards, but are missing). The Verde Mine three-quarter grooved picks are well-made and mostly bullet-shaped with pointed ends. Their ungrooved side is where the J-shaped haft would have been tied down (Figure 5). They were pecked to shape and then abraded to smoothness. None of the AMNH and ASM picks have visible cortex, although the MNA pick is approximately 30 percent cortex. All appear to have been manufactured from local basalt, gabbro or greenstone. Most of these picks are broken, typically with the tips broken off, and all show use wear including breaks, abrasions, polish, and salt residues. The MNA pick is complete and is 19.4 cm in length, 7.5 cm in width, and 8.3 cm thick; its tip is pointed and its poll round.

Morris (1928:89) included in his report a photo of a three-quarter groove pick still hafted that was in the private collection of George Campbell. Three-quarter groove axes have been found in Sinagua sites, and at Mogollon and Hohokam sites (Reed 1951), but three-quarter groove picks are not common anywhere in the Southwest. Two three-quarter groove axes are listed on ASM catalog cards from the Verde Mine but are missing, so it could not be confirmed that they were axes and not stone picks.

Curiously, Cummings (1953:80) published a photograph of four hafted picks that he stated were from the Verde Salt Mine. However, neither the grooved stone picks nor the wooden hafts are similar to those in the AMNH or ASM Verde Salt Mine collections. In fact, the four hafted picks in Cummings photograph are identical to the hafted picks that Harrington found (1926b, 1927; Sedar 2012:57) in the two prehistoric salt mines he excavated along the lower Virgin River in southern Nevada, 240 km northwest of the Verde Salt Mine. Cumming's book was written when he was in his late 80s and he may have been confused about where the four hafted picks originated. Cummings sometimes exchanged artifacts from Arizona for those from other regions (Bostwick 2006), and the four hafted picks in his 1953 photograph may have been obtained from the Nevada Salt Mines.

The Nevada pick hafts are composed of two willow staves, each wrapped from opposite sides around the notches of the stone picks (Harrington 1927:127). In addition, the Nevada Salt Mine picks are only partially grooved and have undergone far less pecking to shape them compared to the Verde Mine picks. The Nevada picks look more like a stone tool identified as a grooved maul from the Verde Mine (two other Verde Mine mauls were identified on ASM catalog cards, but are missing). Harrington (1927) believed that Pueblo Indians dug the Nevada salt mines based on pottery types recovered from the mine. Shutler (1962:60) proposed that the southern Nevada salt deposits were mined by Basketmaker III and Pueblo groups, which has been supported by recent radiocarbon dates obtained from various items including cordage on two "mauls" dating between AD 482 and 875 (Gilreath 2012:37, Table 17).

The other type of Verde Salt Mine stone pick is a hand-held variety that is larger and heavier compared to the three-quarter grooved picks. None of the 13 hand-held picks have grooves, although five of them had been smoothed similar to the three-quarter groove picks. Several of them have been flaked to create a sharp edge. One of the hand-held picks in the ASM collection is a broken three-quarter groove pick that was flaked to create a hand-held pick. The five hand-held picks that had been smoothed ranged from 20.8 to 31.3 cm in length, compared to 19.8 to 23.3 cm for the two complete three-quarter grooved picks. The non-smoothed, flaked edge picks were smaller: 11.6 to 14.1 cm in length.

Wooden Hafts

A total of 49 J-shaped wooden hafts are in the AMNH (N=16), ASM (N=18), and MNA (N=15) collections, the largest quantity from any site in the American Southwest. All are of single stave construction and were bent to shape the hook, probably soon after they were freshly cut (Figure 6). They appear to have been selected for a certain diameter and length, since none of the handles were whittled down. Most of the hafts were stripped of their bark, although four of the MNA hafts still contained bark on the handle portion of the haft. Haft lengths for those from the AMNH and ASM collections ranged from 26 to 48 cm, with a mean of 37 cm, and widths from 4 to 21 cm, with a mean of 12.7 cm. Eight complete wooden hafts in the MNA collections have handles 26 to 39.5 cm in length, with the majority of them 30.6 to 33.2 cm; widths ranged from 2 to 2.5 cm in diameter. Some of the hafts were modified at the tip of their hook, typically wedge-shaped, and several were etched or grooved around the circumference of the tip to serve as guides for the cord that bound the haft around the stone pick. Most of the handles had been rounded at their bases. The inside part of the haft wrapped around the stone pick was carved flat, reducing its thickness by about one-half of its original diameter. Wood types include catclaw (*Acacia greggii*), mesquite (*Prosopis velutina*), and oak (*Quercus sp.*), all of which were available along the Verde River within 3 miles (4.8 km) of the mine. According to the ASM catalog cards, two of the pick hafts were found with Burial 1; all others were apparently discarded or left behind by the prehistoric miners. Many of them were heavily used, with breaks at stress points.

Figure 6. Wooden haft for three-quarter groove pick from Verde Salt Mine (ASM 16189).

Wooden Sticks

Five other wooden artifacts were identified by Morris and ASM as digging sticks or clubs. However, three of these artifacts appear to be prayer sticks. They are all formed from a single stave of local wood stripped of bark and then tapered, their ends rounded, and the stick polished. One of these sticks was whittled into three tiers. None of them had any use

wear, although two of them had splits near their narrow tips. They range from 65.5 to 34.2 cm in length. Two of these wooden artifacts were found with Burial 1 and could have been burial offerings. A large collection (N=40) of prayer sticks from Chetro Ketl in Chaco Canyon had round ends and were polished; splits at their narrow ends were used as plume holders (Vivian et al. 1978:111). The mid-section diameters of the Chetro Ketl prayer sticks were similar to two of the Verde Mine sticks – 1.3 to 1.6 cm. In addition, a 46.9 cm long stick found in Medicine Cave near Flagstaff was whittled into three tiers (Bartlett 1934), similar to one of the Verde Mine sticks.

Weaving Tools

Two sticks from the Verde Mine were whittled to form wide and thin objects. Both are broken at one end, but complete at the other end. One of these artifacts is a sword-like object that has a tapered and thinned curve on its complete end and is very polished and smooth. It is 31.2 cm in length and 5.5 cm in width with thin edges. This artifact was cataloged (ASM 16188) as a digging stick, but it is more likely a weaving batten used to compress rows of weaving on a loom, which were being used in the Verde Valley by at least AD 1000 (Kent 1983). Three wooden battens were recovered from Montezuma Castle, including one from a burial (Jackson and Van Valkenburgh 1954:32).

The possible weaving tool is a narrow and smooth stick pointed on its complete end. It has an oval cross-section and is 13.5 cm in length and 1.1 cm in width. This tool was cataloged as an awl, but it could be a weaving tool used to carry or push the last wefts through the warps, or to compact the last few wefts. Kent (1983:123) describes a similar Hopi weaving tool used on an upright loom and called it a "slender pointed stick." Alternatively, if the Verde Mine artifact is a wooden awl, it would have been used for basket making.

Torches, Brooms, and Bundles

Mining salt in a dark tunnel would require some illumination and at least 14 torches were recovered from the Verde Salt Mine. These objects are bundles of shredded juniper (*Juniperus Californica*) bark wrapped tightly and tied with yucca or juniper bark to create a handle at one end (Figure 7). The yucca fiber ties were hitched and knotted or just wrapped and knotted. Many of the torches are charred at one end, and some have been trimmed at their burnt ends to make them serviceable again. Handle widths range from 2 to 5.6 cm, and overall torch lengths were 17.8 to 47 cm. They appear to fall into three different sizes – small, medium, and long. The longer

Figure 7. Juniper bark torch from Verde Salt Mine (ASM 16241).

torches (mean 43.5 cm) were not charred and therefore had not yet been used. Juniper bark was selected for torches because it burns well and is aromatic. Three torches were associated with Burial 1; two that are still in the ASM collection are both slightly salt encrusted.

Two brooms were also found at the Verde Mine. They are similar to torches, consisting of juniper bark tied at one end with yucca fiber, but do not have handles as do the torches. The brush bark fibers are fine and tightly compacted. One broom is very small, 9.8 cm in length, and is charred at one end. The other brush is quite long (37 cm) and is not charred, but is salt encrusted. One of the brushes was found with Burial 1.

Five fiber bundles of juniper bark also were recovered from the Verde Mine which are not torches or brushes. They do not have any use wear, nor are they salt encrusted.

In addition, five twig bundles are recorded from the Verde Mine. These are groups of twigs of uniform length and diameter, bound together with yucca fiber (Figure 8). They include U-shaped, J-shaped, and straight bundles. Clean cut ends of the twigs suggest they were cut to size, and all twigs in each bundle were selected for uniform diameter. Bundle width ranged from 3.1 to 7.1 cm, with diameters of the twigs 33 to 71 mm. None had obvious use wear. Morris (1928:86) suggested the twig bundles served as broken pot rings or burden basket pads. Four of the twig bundles were associated with Burial 1.

Sandals

Thirteen woven fiber sandals are in the AMNH (N=5), ASM (N=7), and MNA (N=1) collections, 11 complete and 2 fragments (another sandal is listed on an ASM catalog card, but is missing). All but one of

Figure 8. Bundle of twigs from Verde Salt Mine which may have served as a pad for a burden basket (ASM 16285).

the sandals are made from yucca or agave leaves or leaf fibers and are simple plait construction – over one under one. Each sandal has a thick rounded toe, a thinner mid-section, and a square heal folded over to double its thickness (Figure 9). Many of the sandals have a leaf strip that crisscrossed the foot and surrounded several toes in order to secure the sandal to its wearer's foot. Some of the sandals are loosely woven, while others are tightly woven and thus more rigid. One sandal was made of wicker construction from flattened leaf wefts woven over and under two rigid warps. All of the sandals appear to have been made for adults, with lengths ranging from 21 to 27 cm, and all show fraying or flattening use-wear on the toes and/or bottoms. Nearly half of the sandals are salt encrusted on their bottoms, indicating they worn inside the salt mine (Figure 9).

Loom-Woven Textiles

Several loom-woven textile specimens were cataloged in the ASM collection, with some individual

Figure 9. Woven Sandal from Verde Salt Mine. Above: Top of woven sandal; Below: bottom side showing salt encrustation in toe area and fraying in heal area (ASM 16182).

catalog numbers containing multiple pieces of textiles. Chabot (1992:97-99) has attempted to sort out the confusion with the catalog numbers for these textiles. All of the Verde Mine textiles are identified as cotton. The Sinagua apparently did not use animal fibers in their textiles, unlike the Salado, even though Sinagua and Salado textiles are very similar (Teague 1998:184). Five of the Verde Mine textiles are plain woven canvas-like cloth with no decoration and are similar to those found at Montezuma Castle (Kent 1954:9). The other two textiles are more finely woven and are intricately decorated. One of the plain woven specimens is a rectangular (63.5 x 13 cm) breechcloth that was doubled over and stitched at one end; a second specimen may be the back portion of another breechcloth. Another textile consists of 11 fragments that indicate this plain weave cloth was as large as 124 x 73 cm and thus was a blanket. According to Kent (1983:225), cotton blankets were used for everyday wear as shoulder robes, as sleeping covers, or as burial shrouds.

One of the plain-woven textiles from the Verde Mine has a red and tan plaid design, a relatively rare prehistoric fabric that post-dates AD 1200 (Kent 1983). Cummings (1953:124) stated that this textile

Figure 10. Basketry plaque with repairs from Verde Salt Mine (ASM 16202).

was wrapped around the head of a man buried in the salt mine (Burial 1). Another textile is a white open gauze work created on a loom, and one of the specimens has a series of positive and negative stepped repeating triangles created by the weft-warp technique. Teague (1998:120-121) argues that the Sinagua probably used a backstrap loom, which was introduced from Mexico. The second motif on this textile is a series of lines formed by the gauze work technique. According to an ASM catalog card (ASM A-33760), the decorative textiles were "found over the face of a man buried in one of the prehistoric tunnels in the salt mine." Similar gauze work was found wrapped around a burial from Ventana Cave (Tanner 1976:82).

Coiled Basketry Plaques

The Verde Mine collection at ASM includes two coiled basketry specimens. Both are flat, however, and probably were not baskets, but plaques. Both were made with two-rod, one bundle coil foundations with interlocking stitches. In cross-section, the coil looks like a triangle. The material used for the rods appear to be willow (*Chilopsis* or *Salix*), which grow along the Verde River. One of the basketry specimens (ASM 16202) is 12.6 in diameter and has a star or zig-zag pattern made from heavy stitches that were mistaken by the cataloger as "aboriginal patching" (Figure 10). The other basketry plaque (ASM 26279) is 7.8 cm in diameter. Hopi coiled plaques or flat trays were used for a "sacred meal tray" at ceremonial events (James 1909:13). Both basketry plaques from the Verde Mine have salt encrusted bottoms, indicating they were used inside the mine.

Woven Mats

The Verde Mine collection at ASM also includes four large fragments of flat mats with coarse weave. Three of these fragments are made by plaiting long leaves or strips of yucca or juniper bark with a twill technique. One of these mat fragments has two selvage edges (Figure 11). The thickness of these three fragments ranges from 3.2 to 4.5 cm. Two similar mats found at Montezuma Castle were wrapped around infants buried under a floor (Jackson and Van Valkenburgh 1954:21). However, during salt expeditions to the Gulf of California the O'odham placed lumps of marine salt onto woven mats in order to dry the wet salt in the sun (Underhill 1946:232).

The fourth mat fragment, collected by Morris, was made using a wicker technique of wrapping yucca leaves around 21 long twigs, with two rows of twining. This mat is twice as thick (9.6 cm) as the plaited mats, and it may have been used not as a mat but as part of a cradle, similar to a specimen found at Antelope House in northeastern Arizona (Adavasio 1977:137).

Cane Cigarette

A single cane cigarette was recovered with Burial 1 at the Verde Mine. This 3.6 cm long and 1.2 cm diameter cane fragment contains a septum that has had a hole punched into it. One of the ends is well charred; the other end is slightly beveled or rounded.

Fire Drill and Fire Drill-Hearth

Three wooden fire drill-hearths and one wooden drill were cataloged in the ASM Verde Mine collection. This fire-making kit created friction by twirling the drill into holes in the hearth that produced a hot dust which ignited tinder. Two fire drill-hearths remain in the ASM collection and both are undecorated, broken, and well-used as indicated by blackened holes. The narrow stick fire drill is 41.9 cm long, 1 cm in diameter, and is smooth and rounded. All three fire drill-hearths and the drill were associated with Burial 1, with one fire drill-hearth "found at the breast of mummy (Burial 1)."

Hair Rope

The ASM Verde Mine collection contains two well preserved lengths of rope or cord made of human

Figure 11. Woven Matting from the Verde Salt Mine (ASM 16881).

hair. Both ropes are jet-black in color and each piece is approximately 75 cm in length and 1.2 cm thick. Both pieces of cord were formed by a multi-ply (11+) Z-twist. A small amount of salt encrustation is present on both of them. Human hair has been found at archaeological sites in the Southwest as cordage, non loom woven fabrics and sacks, and netting (Kent 1983). Cordage made from human hair is generally highly durable. McBrinn and Smith (2006:271) experimental studies have shown that human hair, as well as yucca, is easiest to spin z-wise compared to s-wise.

Shell Bracelets

Neither Morris nor Cummings collected any shell artifacts from the Verde Salt Mine. However, during the examination of Verde Mine artifacts at ASM, Bostwick discovered that in December 1945, E. B. Sayles obtained 14 *Glycymeris* shell bracelet fragments from the mine. It is unknown if he collected these bracelets himself or if they were a donation. All 14 of the bracelets are salt encrusted, indicating that they indeed are associated with the salt deposits. Two of the shell bracelets are complete and measure approximately 7 cm in diameter, and the other shell fragments are similar in size. All of the bracelets appear to be designed for adults.

Yucca Leaves

Two catalog numbers in the AMNH Verde Mine collection are identified as four to six yucca leaves. Two of the leaves are fully decorticated except for their pointy tips, which could have served as a sewing material. The other specimen is a clump of two to four decorticated and macerated leaves. Morris (1928:84) suggested this clump was a string or cord. However, it also could have been a chewing wad. Yucca is highly nutritious and contains a chemical that acts as a strong laxative (Osborne 1965:46; Zauderer 1975:67).

Corn and Charcoal

Two ASM catalog cards identify additional organic materials associated with one of the burials. These

include a small corn cob, several corn kernels, and some charcoal.

DATING THE VERDE SALT MINE

Various speculations were made concerning the age of the prehistoric Verde Salt Mine. Cummings initially estimated that it dated to the 10th century (*Arizona Daily Star* 1927), and later assigned it to the "Great Pueblo Period" (Cummings 1953:80). Morris (1928:90) did not find any pottery associated with the Verde Salt Mine, which he noted could imply that the "mining was done before pottery came into use in the Verde country," although he discounted this interpretation. Rather, Morris (1928:90) argued that the "interior of the mine was always necessarily a damp, dark, unlovely place in which no one would spend more time than necessary," and consequently, "there would be little incentive to carry in unnecessary objects such as the majority of pottery vessels would have been." He proposed that gourds were used by the miners for water containers, yet none of those were found either.

Morris (1928) examined several nearby sites to help determine the general age and cultural affiliation of the Verde Salt Mine. Morris (1928: 93-96) found artifacts very similar to those from the Verde Mine inside human-dug cavates above Clear Creek on the other side of the Verde River. These included a J-shaped wooden haft for a pick, a twilled mat, and a woven yucca sandal. He also found a flexed infant burial with its head placed under a pad of woven cloth and covered with two wrappings, an inner fine-textured cloth and a coarser outer cloth; one of the cloths associated with the child burial was embroidered (Morris 1928: Figure 11). Leaning against the wall were nine round sticks with their ends cut and measuring 14 to 18 inches long and 1.5 to 2.5 inches in diameter (prayer sticks?). Ceramics from nearby ruins were red and black plainwares and a crude redware which he thought was similar to redwares found at Roosevelt Lake. Morris (1928:97) suggested that the Verde Mine and Clear Creek sites dated later rather than earlier in time.

In an attempt to provide a more accurate chronological assessment, in 1988 Chabot (1992:46-51) selected six artifacts from the Verde Mine in the ASM collection for radiocarbon dating by the University of Arizona. These artifacts consist of five pick handles and a bark torch. Charles Miksicek, a paleobotanist, determined that all six artifacts were crafted from young wood. The resulting Accelerator Mass Spectrometry (AMS) calibrated dates ranged from A.D. 1215 to 1480 at 1 sigma, and A.D. 1160 to 1640 at 2 sigma (Table 3).

Table 3. AMS dates for six artifacts from the Verde Salt Mine (Chabot 1992:Table 1).

Artifact No. and Type	Lab No.	C-14 age	Calibrated Age Range
16154 Pick haft	AA3086	463+/-85	1408-1480 1-sigma 1302-1640 2-sigma
16156 Pick haft	AA-3087	552+/-45	1325-1422 1-sigma 1280-1440 2-sigma
16157 Pick haft	AA-3088	514+/-55	1332-1435 1-sigma 1305-1450 2-sigma
16238-1 Pick haft	AA-3089	780+/-50	1215-1278 1-sigma 1160-1280 2-sigma
16239- Pick haft	AA-3090	470+/-45	1414-1444 1-sigma 1331-1488 2-sigma
16240 Bark torch	AA-3091	556+/-45	1324-1420 1-sigma 1285-1435 2-sigma

These dates post-date the period of Hohokam influence in the Verde Valley and indicate that the Verde Mine artifacts date to the Tuzigoot phase of the Southern Sinagua (Pilles 1981) and are contemporary with the occupation of the nearby Montezuma Castle (Jackson and Van Valkenburg 1954). Thus, Morris (1928) was correct when he suggested the mine dated later rather than earlier. Furthermore, the only known ceramic from the Verde Mine, a large jar sherd obtained in 1927 by Cummings, has been identified as Verde Brown, a Sinagua plainware.

Numerous chunks of salt, some with deep blue-colored streaks similar to salt from the Verde Salt Mine, were recovered from a Sinagua cliff dwelling in the Dyck Rockshelter; this site is located just north of Montezuma Castle and has been dated to A.D. 1100-1300 (Bostwick et al. 2015). Haury (1934:59-60) found salt wrapped in a cotton cloth bag that was placed on an altar of a ceremonial room in the Canyon Creek cliff dwelling located in the Sierra Ancha, southeast of the Verde Valley. He suggested the salt may have come from the Verde Salt Mine. Cutting dates for the Canyon Creek cliff dwelling ranged from A.D. 1326 to 1348 (Haury 1934:58). If the salt from these two cliff dwellings was indeed from the Verde

Salt Mine, their dating is consistent with the dates obtained from artifacts recovered from the salt mine.

SUMMARY AND CONCLUSIONS

The Verde Salt Mine is a unique and very significant archaeological site which contains a high quality salt suitable for human consumption. Unfortunately, its discovery was made during historic mining operations and the archaeological materials were salvaged by mining employees. Further exacerbating the problem, one of the two archaeologists involved, Byron Cummings, failed to prepare field notes or write a report on his two investigations in 1926 and 1927. Fortunately, Earl Morris did make careful observations during his brief 1926 visit and he published a detailed report two years later. Because more than 160 artifacts still exist in storage at the AMNH, ASM and MNA, re-analysis by the present authors has provided a wealth of new information concerning the Verde Salt Mine. A large Verde Brownware sherd suggests the presence of the Southern Sinagua, and the chronometric dates establish that the miners were collecting salt during the Tuzigoot phase (A.D. 1150-1350). Terraces between the salt mine and the Verde River to the east contain Sinagua habitations.

Hopi, Yavapai, and Apache also are reported to have collected salt from the Verde Salt deposits after the Sinagua left the region. The Hopi call the site, *Sakwaönga* (Blue Salt Mine), and are known to have collected salt from it for many centuries (Kralj KenCairn and Randall 2009:36-37). Byrkit (1988) plotted a well-known Hopi trail which originated at the Hopi villages of Walpi and Awatobi, traversed south through Chavez Pass, and then turned west on its way to Jerome and Prescott. This trail, called the Palatkwapi Trail, passed through Verde Valley, where Hopi travelers visited the Verde salt deposits on their way to obtain azurite and malachite from Jerome (Byrkit 1988:3). KenCairn and Randall (2009:37) state that the Verde Salt Mine is located on the Hopi north-south migration route known as *Payunawit*, a passage or emergence route that follows *Hotsikvayu*, the Verde River. A boulder recorded by Fewkes (1898:545) about 0.40 km (0.25 miles) south of the Verde Salt Mine contains petroglyphs which KenCairn and Randall (2009:37) identified as Hopi clan migration symbols.

Many of the artifacts recovered from the Verde Salt Mine were part of the prehistoric miner's tool kits – hafted and hand held picks, torches, fire-making implements, sturdy sandals, woven mats, and burden basket pads. At least 28 three-quarter groove stone picks and 49 wooden hafts were found; nearly all of the stone picks were broken from heavy use. Hafted picks, hand held picks, brush torches, and "stout" work sandals also were found in large numbers at the Nevada salt mine (Harrington 1926b, 1945, Sedar 2012:57-58).[5] Harrington (1945:11) commented that the Nevada salt mine must have "possessed some special power or virtue" since plenty of salt was available near the mine that did not require crawling through a narrow passageway on one's hands and knees for some distance in order to enter the chamber which was mined for salt.

The presence of several mummified bodies in the Verde Mine led Morris and Cummings to believe they were miners killed in cave-ins. Many Arizona miners lost their lives in mining accidents in the 1920s; it was not an unreasonable interpretation for the prehistoric miners at the Verde Salt Mine. However, neither Morris nor Cummings saw the burials *in situ*, and we believe there is a possible alternative explanation for the human burials in this salt mine.

Among the artifacts recovered from the Verde Salt Mine are a number of materials that do not appear to have been part of a miner's tool kit. These include the weaving batten and pointed stick, several carefully made prayer sticks, two basketry plaques that may have held offerings, fine human hair cordage, a used ceremonial cane cigarette, and finely-made and decorated cloth. Cummings (1953:80) stated that one of the buried individuals "was wrapped in cotton blankets and the head was covered with a piece of quite fine cotton cloth woven in open-work design." Inhumations found in Verde Valley cavates and cliff dwellings are often wrapped in textiles (Dixon 1956; Fagin 1967; Kent 1983:261; Wade and Kent 1968; Spurr and Deats, this volume). Morris's (1928) own investigations at the nearby Clear Creek ruins discovered an intentionally buried human accompanied with some of the same materials as the Verde Mine mummified human remains. The flexed position of one of the mummies in the Verde Salt Mine, as shown in Figure 4, is consistent with an intentional burial.

The ethnographic literature clearly shows that salt was considered a sacred resource, was highly sought after, involved arduous journeys requiring prayer stick offerings, and was treated with great rev-

erence. The Verde Salt Mine with its beautiful blue-colored halite crystals was probably considered a powerful place, a sacred location protected by deities such as Salt Woman of the Pueblo people. Burying a person inside the salt mine may have been an act of reverence for that person; perhaps they were salt miners who died of natural causes and were then buried inside the salt mine.

In conclusion, our study of the Verde Salt Mine artifacts has demonstrated that archaeological collections housed in museums, referred to as *legacy data*, hold great value for current research. The Verde Salt Mine artifacts were collected more than 80 years ago, yet continue to yield important information about the ancient people of the Verde Valley.

Notes

1. This paper is based on Nancy Jo Chabot's 1992 MA Thesis with additional data, historical information, references, and photographs by Todd W. Bostwick.

2. Commercial operations at the Verde Salt Mine continued after visits by Morris and Cummings, and in the early 1930s room and pillar techniques were used with timbering by the Arizona Chemical Company. Approximately 150 men worked at the mine in 3 shifts and 15 tunnels were excavated as deep as 600 ft (182.9 m), making it the largest producer in the United States. When a more pure German sodium sulfate became available on the market in 1933, the Verde Mine operations ceased. Attempts to revive the mine in the 1960s were unsuccessful, and the Prescott National Forest currently owns and manages the 80-acre Verde Mine property.

3. There are no human remains from the Verde Salt Mine at the American Museum of Natural History, nor at the Museum of Northern Arizona. There is reference to the possibility that human remains from the Verde Salt Mine were to be studied at the Smithsonian Institution, but that museum has no record of ever having any involvement with the site.

4. Little has been reported about the Hopi salt mine (*Öönga*) in the Grand Canyon since it is difficult to find and has been off-limits to non-Hopi visitors since 1989. Walter Taylor (1954) was not able to locate this mine when he collected his salt sample from the Grand Canyon in 1953. However, a 1973 photograph of the mine shows an opening in a thick deposit of salt that was about 1m in height and at least 2 m in width (Billingsley et al. 1997:Figure 5). Salt deposits that do not require excavations are available near the Hopi salt mine. The Havasupai also obtained salt from the Grand Canyon.

5. Harrington (1926b:228) found 290 single-point picks, 73 double-point picks, 20 axes, and 35 hammerstones within the Nevada Mine. Although halite crystals were present in this mine, much of the prehistoric mining activity involved pecking circular grooves into the salt deposits inside a deep chamber and prying off disks of salt about 30 cm in diameter. No human remains were found in this salt mine.

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AN ANALYSIS OF PREHISTORIC PIT STRUCTURE ARCHITECTURE IN THE MIDDLE VERDE VALLEY

Stewart Deats

ABSTRACT

Over 30 sites with pit structures dating between A.D. 120 and 1425 have been excavated in the Middle Verde Valley, the stretch of Verde River Valley between Sycamore Canyon to the northwest and the East Verde River to the southeast. However, an in-depth comparative analysis of these pit structures has not been conducted. The current study compiled much of the available information on pit structures in this region. Data on 100 pit structures compiled from 20 different studies were analyzed for synchronic and diachronic patterns using attributes such as floor area, shape, depth, construction methods, subfeature configuration, site elevation, and function. The analysis found that the size of pit structures in this region changed significantly over time, and that there was a small group of much larger structures that might have been communal spaces. There was no apparent correlation between site elevation and structure size, depth, or shape, and most pit structures were dug to a fairly consistent depth until around A.D. 1150. In contrast, there is a highly significant difference in the proportions of various structure shapes based on whether they were in riverine or highland environments. Environmental controls and culturally-based stylistic differences are presented as possible explanations for this phenomenon, but further research must be conducted to reach a definitive conclusion. Furthermore, these represent preliminary results that may change as larger sample populations are assembled.

For more than a century the Middle Verde Valley, the stretch of Verde River Valley between Sycamore Canyon to the northwest and the East Verde River to the southeast, has drawn the attention of archaeologists. During that time at least 30 sites with pit structures have been excavated, and 113 of the structures have been investigated to some degree. Archaeologists have long recognized differences in the size and architectural characteristics of pit structures in the Southwest. This variability has been used to help construct culture histories and define material culture traits for particular geographic regions. This paper attempts a comparative analysis of pit structures in the Middle Verde Valley by looking for synchronic and diachronic patterns using a variety of architectural attributes and location data. In particular, this study examines if pit structure size changed significantly over time, and if there are any correlations between site elevation or environmental setting and structure size, depth, or shape. In addition, Middle Verde Valley pit structure characteristics are briefly compared with those of pit structures in neighboring cultural regions.

METHOD

Data on 100 pit structures at 26 Middle Verde sites dating to the Late Archaic (2000 B.C. to A.D. 500) and Formative (A.D. 500–1450) periods were gleaned from 20 project reports (Table 1). The resulting compiled dataset represents 87 percent of known reported sites with pit structures and 88 percent of the investigated structures in the Middle Verde River region. For this study a pit structure was defined as any subterranean or semi-subterranean roofed structure large enough for a person to enter other than storage pits and granaries. Another requirement was that the structure had been constructed below the ground a substantial amount, and thus surface structures, cavates, and cliff dwellings were excluded. In all but one case the structures were unattached single-room features, and therefore rooms within room blocks were not included. The one exception was a subterra-

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Table 1. Middle Verde Valley Prehistoric Pit Structure Data Source Summary.

Reference	Site Number			Pit Structures
	Arizona State Museum	Museum of Northern Arizona	United States Forest Service	
Breternitz (1960)	AZ O:5:46	NA4616C		4
Breternitz (1960)		NA2385		7
Breternitz (1960)		NA3528		1
Caywood and Spicer (1935:6)*				2
Deats (2007)	AZ O:5:155			13
Deats (2007)	AZ O:5:156			6
Deats (2011)	AZ N:4:110			17
Edwards et al. (2005)	AZ O:1:141			3
Gilpin et al. (2010)	AZ O:5:188			3
Graff (1990)	AZ O:5:20			1
Graff (1990)	AZ O:5:21			1
Greenwald (1989)	AZ N:4:23			3
Hallock (1989)		NA13384	AR-03-04-06-134	7
James and Black (1974)		NA11076		1
Logan and Horton (1996)			AR-03-04-06-294	1
Logan and Horton (2000)			AR-03-04-06-703	1
Logan et al. (1992)			AR-03-04-06-648	1
Martine and Pilles (2005)	AZ O:5:133	NA26435	AR-03-04-01-1004	1
McGuire (1977)	AZ O:5:12			2
McGuire (1977)	AZ O:5:6			9
Munson (1979)	AZ N:4:18	NA15600		1
Pilles (1991)			AR-03-04-06-250	2
Stebbins et al. (1981)		NA15761		1
Stebbins et al. (1981)		NA2385		7
Vanderpot (2011)	AZ O:1:10		AR-03-04-06-838	3
Weaver (2000)	AZ O:1:12			1
Weaver (2000)	AZ O:1:34		AR-03-04-06-535	1

*No site designation provided.

nean two-room structure in which two sequentially built rooms shared a single solid wall.

Twenty-three data variables were recorded for each pit structure; half of which were architectural attributes. The other variables pertained to structure age, dating method, abandonment method, site elevation, geographic location, site identification (number and name), feature designation, and data source citation. Recorded architectural data included structure depth, length, width, floor area, shape, orientation, roof support method, hearth presence and placement, wall and floor treatment, and the presence of certain types of subfeatures. The presence and morphology of entries, alcoves, and ventilators were also recorded.

Because the compiled pit structure data were pulled from 20 different project reports, the availability and quality of information varied for each recorded attribute. This information was affected by differences in the amount of excavation, investigation methodologies, and the degree of detail documented and reported. Consequently, although the compiled dataset contains information on 100 pit structures, few of the individual cases contains a complete set of variable data. Degree of completeness for individual architectural attribute variables and dating information variables ranges between 95 percent and 66 percent, with most having 80 percent or more of the variable attribute fields containing data (Table 2).

ANALYSIS

After compiling the data, the date range of each structure was examined, and the structure was assigned to one of six temporal categories: A.D. 1–800, A.D. 800–1000, A.D. 1000–1150, A.D. 1150–1300, A.D. 1300–1450, and indeterminate. Ninety-four structures could be assigned to distinct time range groups based on where most of their age range overlapped with a specific temporal category. Six structures could only be identified more broadly as dating to the Formative period. These temporal groups were then used to explore the characteristics of con-

Table 2. Summary of recorded data variables and number of available samples per category.

Data Variable / Structure Attribute	Number of Samples	Description
Citation	100	Bibliographic reference for information source
Site Number	98	
Geographic location (environmental zone)	100	Riverine or Highlands
Site elevation	100	Elevation of the site in feet above mean sea level
Structure designation	100	Name or number of structure assigned by researchers
Structure age – start date	93	The earliest date of a structure's date range
Structure age – end date	95	The latest date of a structure's date range
Dating method	95	Method utilized to determine the structure's age
Structure length	96	Length of a structure to the nearest centimeter
Structure width	89	Width of a structure to the nearest centimeter
Floor area	89	Floor area of a structure in square meters
Structure depth	93	Depth of a structure to the nearest centimeter
Structure shape	87	Overall shape of a structure in plan
Structure orientation	81	Direction of entry/alcove/ventilator or short axis
Main roof support method	66	Roof support system based on posthole arrangements
Fire pit location	68	Location of hearth(s) within a structure or noted absence
Entry/alcove/ventilator shape	69	Shape of the entry/alcove/ventilator or noted absence
Wall treatment	84	Wall construction method/material(s)
Floor treatment	86	Floor construction method/material(s)
Subfeatures	74	Presence or absence of particular subfeatures (raised floors/platforms/ benches)
Deflector	73	Presence or absence of a deflector
Abandonment	81	Method of abandonment (e.g. cleaned out and left to the elements, cleaned and burned, catastrophic burn, etc.)

temporaneous structures, as well as to compare structures across time.

Floor Area

Researchers studying prehistoric pit structures in other areas of the Southwest have noted various trends related to pit structure size. Wirt Wills (2001:483) notes that "…the preceramic-to-ceramic transition in the Southwest, which varies between A.D. 1 and 500 in most subregions, marks a major increase in pit house size…" In their 1977 review of Verde Valley archaeology Fish and Fish (1977) noted a similar trend, observing that post-A.D. 800 pit houses were substantially larger than earlier houses. However, more than 35 years have passed since their observation and more data are now available. Consequently, a reexamination of diachronic change in pit structure floor area was worthwhile.

Histograms of floor areas for each temporal group show that nearly all the pit structures in the Middle Verde Valley are between 4 square meters and 36 square meters. However, there are five notable examples of considerably larger pit structures during the first three time periods (Figure 1). All but one of these is a statistical outlier, and to make valid comparisons these much larger structures were not included when calculating the average floor area for each temporal group. Based on the somewhat bimodal nature of the histograms, a cutoff was made at 41 square meters and the means of the floor areas were determined. These larger structures will be addressed later, but the current discussion focuses on the smaller pit structures that comprise the vast majority of the sample population.

As can be seen in Figure 2, there is a 6.22 square meter increase in the average pit structure size between A.D. 1–800 and A.D. 800–1000. However, the average structure sizes in the next two periods are each about 4 square meters less (at around 18 square meters), and average floor area decreases further to its smallest size of around 10 square meters during the last time period. An analysis of variance (ANOVA) statistical comparison was performed with the mean floor area of each temporal group to determine how likely it is that five sample groups with these means and standard deviations could come from a single parent population. Such an analysis utilizes a comparison between the variance observed among the groups and the variance within groups. The result is that there is only a 7.8 percent

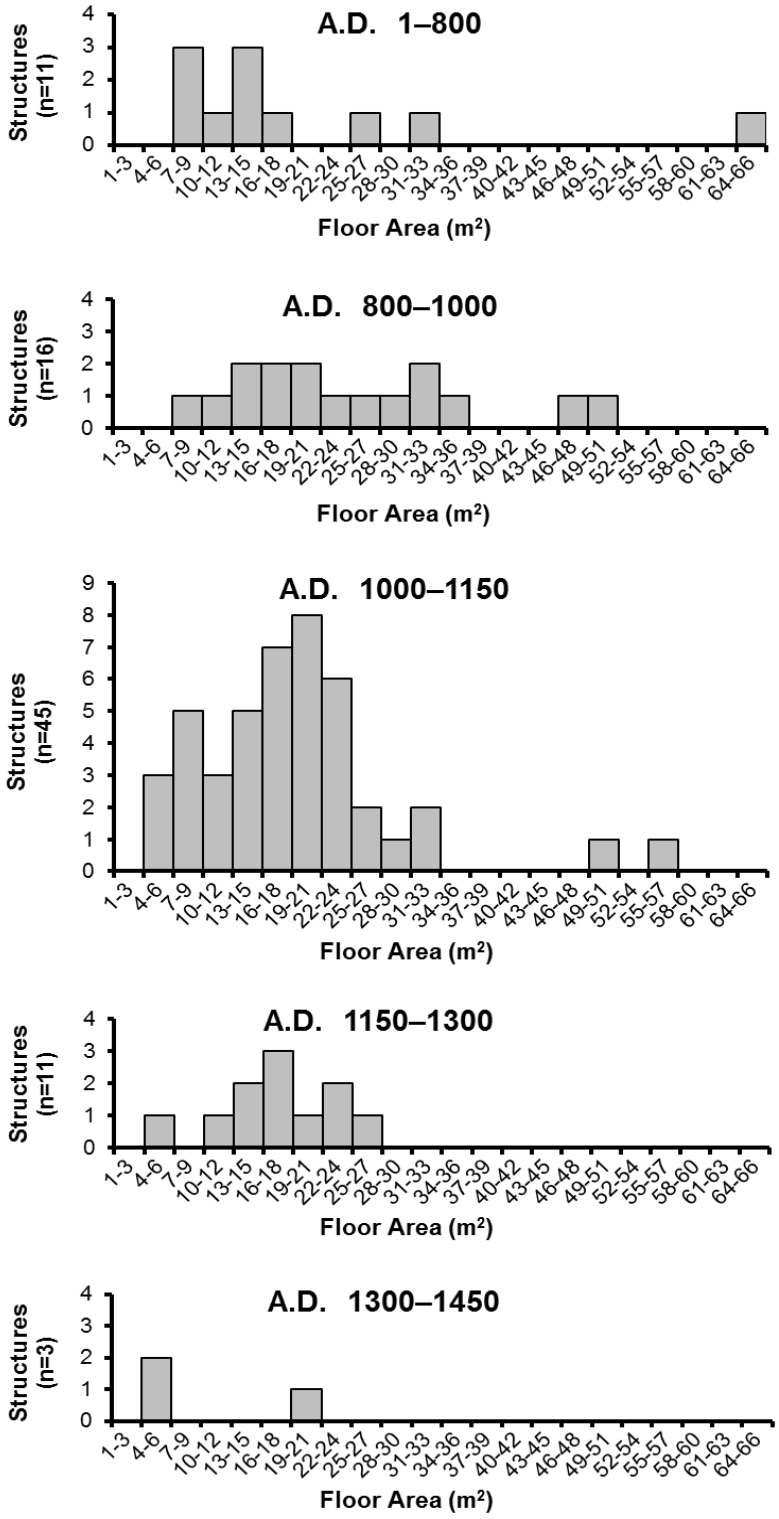

Figure 1. Histograms of floor area by temporal group.

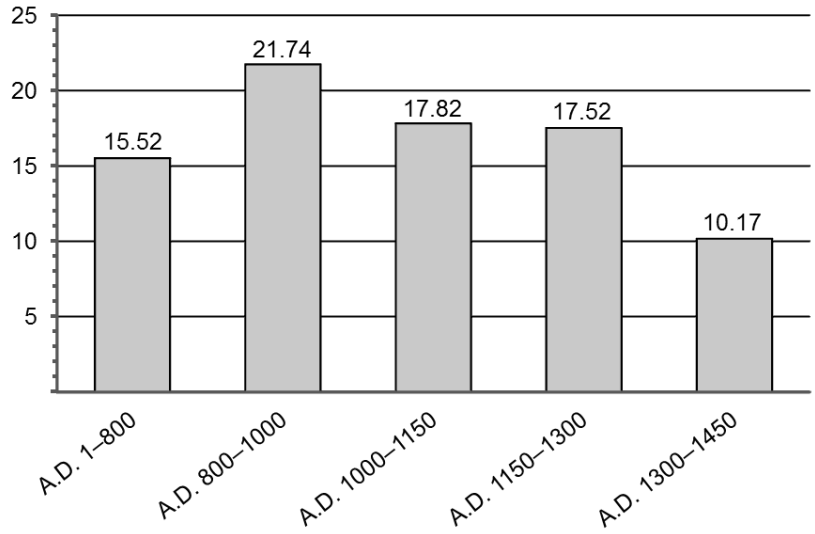

Figure 2. Pit structure mean floor area by temporal period.

probability (about a 1 in 13 chance) that the difference observed between the floor areas of each temporal group is simply a consequence of the vagaries of sampling (S^2_B = 108.76, S^2_W = 49.74, F = 2.19, p = 0.078032, .1 > p > .05). In other words, it is fairly unlikely that these differences can be attributed to chance, and that we can be reasonably confident (as there is a 92.2 percent probability) that pit structures from different periods really do have different mean floor areas.

The underlying bases of this statistical tool are that sampling the distributions of the mean from a parent population (whether having a normal distribution or not) should approach a normal distribution, and the standard deviation of the means (i.e., the standard error) will decrease as sample size increases (termed the normal distribution sampling theorem and the Central Limit Theorem). With a large enough sample size the mean of the sample should be a good approximation for the mean of the parent population. A sample size of 30 or more is considered sufficient to provide a very good approximation. Unfortunately, only one of the temporal periods (A.D. 1000–1150) has a data sample meeting this criterion. Consequently, the differences observed between groups, particularly those with especially small sample sizes, should be considered preliminary.

Furthermore, statistical significance tests are often approached as hypothesis testing that utilize an arbitrary significance level (usually 5 percent and sometimes 1 percent) for rejecting a "null hypothesis" that a difference is just random sampling variation. However, the significance testing approach taken in this paper is an effort to determine and evaluate the probability that results are due to sampling vagaries or whether they really characterize the populations involved.

The increase in structure size after A.D. 800 confirms Fish and Fish's (1977) earlier observation that post-A.D. 800 pit houses were substantially larger than earlier houses. It also mirrors the nearly pan-Southwest trend that Wills (2001) has noted. However, the post-A.D. 800 increase in pit structure floor area in the Middle Verde Valley did not approach the doubling (or more) in size observed in other Southwest subregions (Wills 2001:483).

So what could be driving the more modest changes in pit structure size? Fish and Fish (1977:13) suggested that it might be the result of additional space-consuming activities inside the buildings, or that the structures sheltered more people. Similarly, Wills (2001) proposed that the increase in size may reflect increasing workloads for women and the emergence of households as relatively autonomous units of production linked, in part, to ceramic production. However, Wills (2001) argued against agricultural surplus and increased reliance on domesticated crops as being a significant factor in the pit structure size increase. The size increase also could be the result of greater use of pit houses for storage or ritual purposes due to social changes, or changes in activities relegated to public versus private space (Herr and Young 2012:9).

Local ceramics such as Verde Brown were being produced in the Verde Valley prior to A.D. 800, possibly as much as three centuries earlier (Wood 1987; see also Schroeder 1960). Consequently, the organization of production, particularly of ceramics, might not entirely account for the increase in structure size after A.D. 800. However, the timing of the size increase coincides with the well-known rise in Hohokam cultural influence in the Middle Verde Valley (Colton 1946; Fish and Fish 1977; Fish, Pilles, and Fish 1980; Pilles 1981; Powers and Pearson 2008; Schroeder 1960).

Another widespread change in pit structure size is a decrease in floor area in subregions where early ceramic period pit houses were quite large. In most areas this move to smaller domestic pit structures corresponded with increasing use of surface architecture, a change often referred to as the pit house-to-pueblo transition (Wills 2001:483). This appears to be a plausible explanation for the 7.35 square meter drop in mean floor area between the last two temporal periods. However, the last temporal period currently only contains three structures, and the observed reduced floor area might simply be a function of small sample size rather than reflecting an actual pit structure size change.

Although masonry surface rooms were common between A.D. 1150 and 1300 (a time span known as the Honanki phase), and there were a few larger pueblo sites, most sites in the Middle Verde Valley during this time were smaller pueblo and pit house hamlets. It was not until the following Tuzigoot phase from A.D. 1300 to circa 1450 that there was widespread aggregation into large masonry pueblos (Fish and Fish 1977; Pilles 1996; Powers and Pearson 2008). Consequently, the seemingly sizable reduction in floor area after A.D. 1300 corresponds to a period when surface pueblo architecture became the primary form of architecture in the Middle Verde Valley, particularly for habitation and storage.

Functionality

As has been pointed out by other researchers, there is considerable synchronic and diachronic variability in the size, configuration, and construction of structures that archaeologists call “pit houses” (Breternitz 1960; Gregory and Huckell 1998; Huckell 1995; Mabry 1998:240; Seymour 1994; Wills 2001:480). However, not all pit structures were residences. While some pit structures were primarily used for habitation, it is likely that there were other functional types. Some probably were used exclusively for storage, others in which food processing and storage were combined, and there might have been communal or “public” structures as well.

The consideration of function is useful when examining the five large pit structures excluded from the previous calculations of mean floor area. The floor area histograms showed that these structures did not cluster with the others and were outliers. Ignoring temporal association for a moment, a look at these five structures shows that they are considerably larger than the others. The smallest of these large structures was 47.80 square meters, while the largest “small” structure was 35.83 square meeters; a difference just shy of 12 square meters. Both structures date to the same time period and were at the same site (NA2385), yet the larger structure was one-third larger than the next biggest one. Furthermore, the mean floor area of the five oversize structures was 54.71 square meters and the median floor area was 51.10 square meters. In contrast, the average floor area of all the other structures (n=84) was 17.92 square meters, with a median floor area of 18.03 square meters.

Size alone, however, does not determine functionality. In order to see if there are any other differences between the five large structures and the other pit structures, a variety of other characteristics were examined. These traits included structure shape; presence, type, and location of subfeatures; and inferred activities based on recovered artifacts and samples from the structure floors, floor fill (deposits directly above the floor to a distance of 10 cm), and storage features. However, other than size there were no characteristics shared by all five of the larger structures that definitively set them apart from the other structures. Nevertheless there were some interesting differences. Only two of the structures in the dataset had what could be described as “screen deflectors,” and both were larger structures (House 3 at AZ O:5:46[ASM]/NA4616C and Feature 7 at AZ O:5:155[ASM]). The screen deflectors were 2.00–2.23 -m-long by 26–30-cm-wide floor trenches symmetrically located between the main roof support posts of each structure and in line with the hearth and entry way (Figure 3; also see Breternitz 1960:Figure 6). These trenches might have anchored interior walls (made of wood posts and other perishable materials) that functioned as privacy screens or wind deflectors. Only one other pit structure in the dataset had a deflector of any type, and this was described as a small, partially upright stone slab; something not analogous to the two screen deflectors.

Similarly, three of the five large structures had wall post footing grooves around the floor perimeter. Due to excavation technique, it was unclear if a fourth large structure had a similar groove or not. In other words, of the four larger structures where the presence or absence of a groove could be deter-

Figure 3. Feature 7 at AZ O:5:155(ASM); a large pit structure with "screen deflector," view to the southwest.

mined, three (75 percent) had floor grooves. Two of the smaller structures also had floor grooves. This represents less than three percent of the smaller structures where the presence or absence of a groove could be determined.

Three of the large structures had fairly definitive evidence of raised floors, platforms, or benches in the form of notched-stone joist supports, post hole patterns, and burned wooden structural elements (see Motsinger 1994; Seymour 1994). The post hole pattern in a fourth large structure was less definitive, but was also suggestive of a raised floor. However, this characteristic was not unique to the larger pit structures; 10 of the smaller structures also had evidence of raised floors or platforms. The larger structures did not have many subfloor storage pits. However, this paucity in subfloor storage pits could be a consequence of having raised floors or floor platforms, the presence of which would inherently restrict access to some floor areas. Among the five large structures there were only three subfloor pits, none of which were especially large. Nonetheless, even though many of the smaller pit structures had substantial subfloor storage space, many others were devoid of storage pits.

Many of the other architectural attributes of the large structures were not unique. These structures were rectangular and rounded rectangles, which were common shapes for the smaller structures. All of the larger structures had hearths—all of them off-center toward the entrance with three in line with the entrance. However, many of the smaller pit structures had identical hearths. Similarly, three of the large structures had ridge line roof support post patterns, one had a four post support system, and one was indeterminate. None of these were unusual among the smaller structures either.

Artifacts recovered from the large structures included ceramic vessels, manos, metates, rubbing stones, bone awls, slate palettes, and projectile points from two or more structures. At least one structure had a pottery anvil and another yielded several ceramic spindle whorls and a stone ball. Consequently, it is clear that a variety of activities were probably being conducted in these larger structures. However, none of these tasks appear to have been restricted to just the larger structures.

Overall, it remains unclear if the larger structures served some specialized function or were simply large domestic structures. However, it is clear that they were significantly larger than other pit structures, and some had architectural characteristics that were either unique or were very uncommon among the smaller structures. This pattern suggests that they were more than simply big pit houses. The range of activities indicated by the variety of artifacts in these structures argues against them being restricted spaces utilized for special occasions. Rather, it seems more likely that the larger structures may have served as communal gathering spots where more ordinary tasks were undertaken. It may be that these larger structures simply provided a sheltered

Table 3. Pit Structure Age and Elevation Summary.

Elevation	A.D.						Total
	1–800	800–1000	1000–1150	1150–1300	1300–1450	Unknown Formative	
4000–4499 ft	1		11				12
3500–3999 ft	2	1	5	5	1		14
3000–3499 ft	8	15	35	6	2	6	72
2500–2999 ft			2				2
Total	**11**	**16**	**53**	**11**	**3**	**6**	**100**

space for people to gather to conduct their everyday activities that was bigger than the typical pit house and that was outside the individual household.

OTHER POSSIBLE PATTERNS INVESTIGATED

The questions of whether elevation or geographic location had an effect on pit structure size, depth, or shape were also studied. Similar investigations have been conducted in other areas of the Southwest. Erica Cameron (1999) conducted a study of Northern Sinagua and Cohonina pit houses near Flagstaff, Arizona. In particular, she analyzed data regarding those pit houses that were located within the ash fall zone created by the prehistoric eruption of Sunset Crater and were occupied between A.D. 1050 and 1150. Among her findings was that the average size of these contemporaneous pit structures generally increased with greater elevation. In contrast, average structure depth seemed to decrease with higher elevations. Furthermore, both trends held up when the elevations were divided into biotic communities (Cameron 1999:69). The exact opposite pattern has been noted for pit houses in the Mogollon area (Wills 2001:481).

Floor Area and Elevation

Examining the Middle Verde Valley pit structure data did not reveal any definite trends regarding mean floor area and elevation. During some time periods the average floor area decreased with elevation, whereas in other periods it increased. It is very possible that trends do exist, but they were obscured by the relatively small sample sizes for some age and elevation combinations (Table 3). In contrast, an examination of mean and median structure depth showed fairly consistent depths around 41–46 cm for pre-A.D. 1150 pit structures (n=74) regardless of site elevation. However, post-A.D. 1150 pit structures (n=13) were significantly deeper, with an average depth of 86 cm and a median depth of 74 cm. This increase in depth with the later structures is probably related to the fact that 69 percent (n=9) of these structures were masonry lined, either in whole or in part, and all were rectangular or square. Essentially they were subterranean masonry rooms analogous to the numerous surface masonry rooms constructed after A.D. 1150.

Structure Shape and Elevation

An examination of site elevation and structure shape revealed that different elevations did not significantly affect the proportions of structure shapes. Of the 87 pit structures where plan shape had been determined, two-thirds (n=58) of the structures were rectangular to square, 13.8 percent (n=12) were circular to ovoid, slightly less (12.6 percent, n=11) were rounded rectangles, and 6.9 percent (n=6) were irregular shapes. Examining site elevation revealed that 72 of the 100 pit structures that have been excavated in the Middle Verde Valley lie between 3,000 and 3,499 feet above sea level (Table 3).

Structure Shape and Environmental Zone

Seventy-nine of the 100 pit structures in the dataset are classified as having been in riverine environments or directly adjacent to riparian areas. The other 21 structures were in highland areas about a quarter mile or more from permanent streams, rivers, and springs. However, this disparity could very well be a function of site sampling bias and degree of site excavation, rather than representing a dichotomy in geographic pit structure distribution. Nearly twice as many sites in riverine environments (n=17) are repre-

Table 4. Pit Structure Shape and Environmental Zone Summary.

Environmental Zone	Structure Shape				Total
	Rectangle*	Rounded Rectangle	Circular / Ovoid	Irregular	
Riverine	51	8	5	5	69
	(73.91%)	(11.59%)	(7.25%)	(7.25%)	(100%)
Highland	7	3	7	1	18
	(38.89%)	(16.67%)	(38.89%)	(5.56%)	(100%)
Total	**58**	**11**	**12**	**6**	**87**
	(66.67%)	**(12.64%)**	**(13.79%)**	**(6.90%)**	**(100%)**

*Includes rectangles with rounded corners

sented in the compiled dataset in comparison to highland environment sites (n=9).

This could also explain why the ratio of pit structures in the two environmental zones appears to have varied over time. In the A.D. 1–800 period the ratio of riverine to highland pit structures was 2.7:1, and in the A.D. 1000–1150 period the ratio was similar at 2.3:1. However, all the structures dating to the period in-between (i.e., A.D. 800–1000) were in the riverine environmental zone, as were all the structures dating to A.D. 1150–1300. In contrast, the A.D. 1300–1450 period structures had a riverine to highland ratio of 0.5:1. However, the small sample size for this period (n = 3) easily could have distorted the result. Comparing the proportions of architectural categorical variables rather than the counts of pit structures between the two environmental zone sample populations alleviates many of the concerns arising from using data from a disproportionate number of riverine sites.

When structure shapes (which could be determined for only 87 of the 100 pit structures) were compared with their environmental setting, the relative proportions of the different shapes was not consistent (Table 4). A chi-square test was performed to determine how likely it would be that samples as different as these could be selected if the two environmental zones did not really differ in regard to pit structure shape proportions. The result showed that the difference between the riverine and highland zones with respect to the proportions of various pit structure shapes had a very high significance level (χ^2 = 11.5824, .01 > p > .001). Cramer's V was also calculated to measure the strength of these results, and it showed a moderate association (V = .36). More simply put, the proportions of pit structure shapes differed from one environmental setting to the other, and statistically the relationship between environmental zone and structure shape has very high significance. The confidence level that the two environmental zones actually differ, and that these numbers are not just the result of sampling vagaries, is just over 99 percent. Almost three-fourths of the pit structures in riverine environments were rectangular in plan, whereas in highland environments rectangular and circular/ovoid structures were equally common; each shape comprised just under 39 percent of all the highland pit structures.

In contrast, a comparison of pit structure mean depth and size by environmental zone revealed that the structures were not significantly different. Overall, riverine pit structures were slightly deeper (< 10 cm) and smaller (< 1 square meter) than highland structures, but these differences were relatively minor. Cameron (1999:71) noted similar trends that were both more pronounced and statistically significant for pit houses in the Sunset Crater ash fall zone in northern Arizona. Differences there were at least partially attributed to being a function of thermal efficiency associated with the disparity in climate and location factors between environmental zones (Cameron 1999:93). Researchers in other areas of the Southwest have made similar environmental arguments (Rocek 1998; Stuart and Farwell 1983 as cited by Wills 2001; also see Roth and Stokes 2007). As elsewhere, the significant differences in pit structure shape proportions for riverine and highland zones in the Middle Verde Valley might be a function of strong environmental control. This would be particularly relevant if the riverine and highland pit structures were occupied during different times of the year because of residential mobility tied to seasonal rounds. Not only would different climatic conditions influence shelter requirements, but the differing sub-

sistence activities associated with each environmental zone (e.g., agriculture versus foraging) also might have played a role.

Alternatively, the significant differences in pit structure shape proportions for riverine and highland areas in the Middle Verde Valley might be an indicator of different ethnic groups occupying the two environmental zones. Numerous researchers have noted Hohokam influence in the Middle Verde Valley from A.D. 800–1150, particularly in pit house villages in the lowlands / riverine environmental zone (Powers and Pearson 2008). It has also been argued that "house-in-a-pit" structures similar to those of the Hohokam Santa Cruz and Sacaton phases were concurrent with Northern Sinagua-style pit houses, and houses of both styles existed side by side in the same villages (Breternitz 1960; Fish and Fish 1977; Pilles and Stein 1981; Schroeder 1960). Unfortunately the two pit house types are usually ill-defined.

Comparisons of Regional Pit Structure Architecture

An examination of literature providing detailed descriptions of Hohokam pit houses (Haury 1976; Rice 2003; Sayles 1937) demonstrates that Hohokam Santa Cruz and Sacaton phase pit houses frequently exhibited a suite of traits in houses built in shallow, rectangular to sub-rectangular pits. The most common roof support method consisted of main posts (usually two, but often more) aligned along the central long axis (i.e., the roof ridge line). The main support posts were usually accompanied by a series of secondary wall posts located around the structure perimeter. Many of these houses had encircling floor grooves and nearly all had short linear or bulbous entries. Some also had short (< 15 cm) raised rims encircling the floors just inside the floor grooves or floor perimeter.

Roughly contemporaneous Northern Sinagua pit houses were deep structures that usually utilized the pit wall as the lower portion of the house wall (i.e., a "true" pit house). More than 80 percent of these pit houses were either rectangular or rectangular with rounded corners (fewer than three percent were rounded rectangles). The most common (32 percent) roof support method was main posts aligned along the long central axis usually accompanied by a series of secondary wall posts around the structure perimeter. The second most frequently used (24 percent) roof support method was a four to six main post system forming a quadrilateral arrangement with post holes in the interior of the structure. Very few Northern Sinagua pit houses had encircling floor grooves, and most commonly (24 percent) they lacked any type of entry, alcove, or ventilator. About 16 percent of the pit houses had bulbous entry or alcoves and 5 percent had short linear entries. Nearly half (48 percent) of the Northern Sinagua pit houses had masonry walls, with other treatments including smaller percentages of clay-lined (19 percent), timber-lined (11 percent), and earthen (6 percent) walls (Cameron 1999:74–84).

Middle Verde Valley pit structures do share many of the same architectural traits as both Hohokam and Northern Sinagua pit houses. However, the most common combinations of these variables are not identical to the most frequent in either of those culture areas. As can be seen in Table 4, a fairly small percentage of structures in either Middle Verde Valley environmental setting were rounded rectangles. As with both the Hohokam and Northern Sinagua, ridge line support posts (usually with secondary wall posts) was the most frequent roof support system. One-third of riverine zone structures and half of the highland zone pit structures utilized main support posts aligned along the long axis. More often than not the main support posts were accompanied by an encircling series of secondary wall posts. Having no post holes, or post holes with no discernible pattern was also fairly common. Most frequently (41 percent) pit structures lacked any discernible entry, alcove, or ventilator. The next most frequent occurrence (33 percent) was pit structures with short linear entries. This pattern was fairly consistent regardless of environmental setting, although short linear entries occurred slightly more frequently with highland pit structures. Bulbous entries were not common, although the frequency varied somewhat with just under 4 percent of riverine structures having them in comparison to 19 percent of the highland pit structures. Also, as previously discussed, fewer than 6 percent of the pit structures had floor grooves. A variety of wall treatments occurred in Middle Verde Valley pit structures, but most often structure walls were simply untreated bare earth. In general, bare earthen walls were the most common over time until around A.D. 1150 when masonry walls became more prevalent.

Based on this cursory comparison of architectural trait suites, it is far from clear that many Middle Verde Valley pit structures closely resemble contemporaneous Hohokam or Northern Sinagua style pit houses. Other architectural traits of a "typical" Middle Verde Valley pit structure include characteristics of the floor, depth, and hearth location. Unplastered, use-compacted earth was the most common floor type over time, although the frequency of plastered floors increased after A.D. 1150. As previously mentioned, most pit structures would likely be 41–86 cm deep, with most being at the shallower end of this

range. Lastly, about 78 percent of the time a pit structure would have at least one hearth. These were usually located off center and closer to the entrance (or the middle of a long wall) and in line with the central short axis, but sometimes they were off a little to one side.

Ultimately, however, attempting to define a characteristic Middle Verde Valley pit structure type that might be subject to definable changes over time may well be somewhat of an unproductive endeavor. Other researchers have attempted to define "typical" pit houses for certain regions or prehistoric cultures but often without success for a variety of reasons. Some of these issues include the great diversity of pit structure styles, possible functional variation, as well as difficulties with chronometric control and establishing definitive cultural affiliation (see, e.g., Colton 1946; Rice 2003; Roth and Stokes 2007). Nevertheless, many other studies focusing on other aspects of regional pit structure architecture have provided considerable insight into pit structure function, variability, and ethnic and stylistic indicators.

SUMMARY AND CONCLUSIONS

Much of the compiled data used for this study came from other investigators' work conducted at different times over the last century for widely varying research purposes. Compiling and utilizing this type of data has its difficulties. Excavation and documentation techniques have changed and become more rigorous over time, information is recorded differently, and what information was deemed important and prioritized for collection and analysis varied from investigator to investigator. Nevertheless, using other researchers' data is crucial for attempting a regional analysis such as this.

This pilot study has shown that Middle Verde Valley pit structure size changed significantly over time, and that there is a small group of much larger structures that might have been communal spaces. Furthermore, there does not appear to be a correlation between site elevation and structure size, depth, or shape. However, most pit structures were dug to a fairly consistent depth until around A.D. 1150 when they began to become deeper.

In contrast, there is a highly significant difference in the proportions of various structures' shapes based on whether they were in a riverine or highland environment. These differences could be a function of varying thermal efficiency needs dictated by a disparity in climate and location factors between the two environmental zones. Such environmental influence would be even more of a factor if the riverine and highland pit structures were seasonally occupied during different times of the year. If this were the situation, then differing subsistence activities associated with each environmental zone (e.g., agriculture versus foraging) also might have influenced architectural needs. Alternatively, the significant differences in pit structure shape proportions for riverine and highland areas might be an indicator of different ethnic groups occupying the two environmental zones.

However, to properly address this issue more robust statistical analyses need to be conducted than were performed for the current study. Unarguably much additional work needs to be done in order to more fully understand the variability among Middle Verde Valley pit structures. In particular, future research would benefit from compiling and incorporating associated data regarding permanence of occupation and seasonality. Addressing the issue of cultural affiliation should incorporate artifact data and other non-architectural information, in addition to a statistical analysis of possible culturally associated pit structure traits as outlined above. Such a study would entail compilation and syntheses of pit structure data for each culture to which the Middle Verde Valley structures were to be compared.

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DWELLINGS AT THE MINDELEFF CAVATE SITE, VERDE VALLEY, ARIZONA

Susan D. Hall

ABSTRACT

Cavates are artificial cave-like rooms carved into soft rock formations. Geologic conditions must be just right to allow construction of this unusual dwelling type. In the American Southwest cavates are found in volcanic tuff in northern New Mexico and in tertiary sedimentary deposits of the Verde Valley in central Arizona. One large group of cavates at the Mindeleff Cavate Site near Camp Verde was the subject of this author's thesis investigations in 1992. Data were collected for 343 cavate rooms in 89 interconnected groups to search for patterns suggesting room function and dwelling diversity. An assessment of preservation was made, comparing current conditions with Mindeleff's descriptions of five specific cavate groups. Erosion and recreational collecting had left practically no portable artifacts and few elements of masonry, but the cavate architecture was well preserved, with many dwellings having intact walls, ceilings, doorways, and architectural features. The study provided baseline data for further cavate research and for comparison with pueblo dwellings.

Cavate dwellings are clusters of cave-like rooms carved into the faces of soft rock formations (Figure 1). The term cavate was coined in the late nineteenth century by John Wesley Powell (1886), to distinguish them from cliff dwellings built inside natural caves. Cavates are found in many parts of the world, but in the American Southwest most are located in the Verde Valley of Arizona (Fewkes 1898, Hall 1895, Mearns 1980) and on the Pajarito Plateau of northern New Mexico (Beam 1909, Bierbower 1905, Hyland 1986, Toll 1989). The largest group of cavates in the Verde Valley is the Mindeleff Cavate site, designated NA 1511 by the Museum of Northern Arizona and AR-03-04-01-266 by the National Forest Service. The site is located just east of the Verde River in the Coconino National Forest, approximately 11 km south of Camp Verde, and directly across the river from a picnic area and small boat landing at Beasley Flat.

Cosmos Mindeleff's comprehensive description of the site was published by the Bureau of American Ethnology (BAE) in 1896. He also produced an excellent overall plan map showing a remarkable concentration of cavates (Mindeleff 1896:Plate XXV). While at Northern Arizona University, I collected data from 343 rooms in the 89 accessible cavate dwellings (Hall 1992) for an analysis of the diversity of room functions and room features in household units. This endeavor was substantially aided by referring to Mindeleff's plan for orientation; it proved easy to locate and identify the dwellings on his plan. Since then, I have been able to update and make a few corrections to his plan (Figure 2). The Mindeleff Site occupies the confluence of two small but deeply cut drainages that enter the Verde River near the central portion of the site. The two arroyos divide the sandstone cliffs into three sections (see Figure 2), the recessed central section and the river-side northern and southern arms. Most of the cavate groups are constructed at about the same elevation, accessible from paths and ledges running along cliff faces, however, there are two tiers of cavates at short segments of each site section. The rock formation that made the site possible consists of soft sandstone layers sandwiched between harder sedimentary deposits, allowing for extensive tunneling into the soft layers and a stable living surface on the harder layers.

For my research, I assigned a number to each group of rooms, starting at the northern end of the site, and numbering the groups in the lower tier of each section before the groups above. The five dwellings that Mindeleff (1896) designated as Groups A through E were also given numbers in my system to maintain the sequence. The groups are referenced in Figure 2 using both his and my systems. This summary

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Figure 1. Mindeleff Cavate Site from across the Verde River.

of my investigations includes detailed descriptions and sketches of cavate dwellings.

DWELLING AND ROOM CHARACTERISTICS

One goal of my cavate evaluation was to identify different room functions and determine the types and numbers of rooms that made up the dwelling units that would have accommodated households. A household can be viewed as a group of individuals who regularly cooperate in the production and sharing of food and resources (Goody 1972:3). Although the terms dwelling and household are often used interchangeably, they may be different in terms of social behavior, since it is possible for household members to live in separate dwelling units (under different roofs), or for multiple households to share a dwelling. Whatever the relationships are among members of a household, it is the primary unit for the expression of age and sex roles, kinship, socialization, and economic cooperation (Netting et al. 1984:xxii). Cultural anthropologists and ethnographers use rules of kinship, marriage, and inheritance to define households, but what is visible in the archaeological record is the access that enables the sharing of space, resources, and activities, and the physical barriers that divide one dwelling unit from another (Dean 1969; Lowell 1988; Burchett 1990).

Determining the extent of each cavate dwelling at the Mindeleff Site was easy, because most were entered through well-made doorways (Figure 3). Most of the doorways open directly into a fairly large subrectangular or oval-shaped room with heavily smoke blackened walls and ceiling. A few doorways open into small round rooms resembling vestibules, the largest being 1.6 m (63 in.) in diameter. Erosion of the cliff face and rockfalls may have destroyed some vestibules, but many dwellings probably never had one. I began my study by taking measurements (Table 1) and making sketches of room plans and elevations within each dwelling. This revealed patterns that provided a basis for inferring different room types within each dwelling.

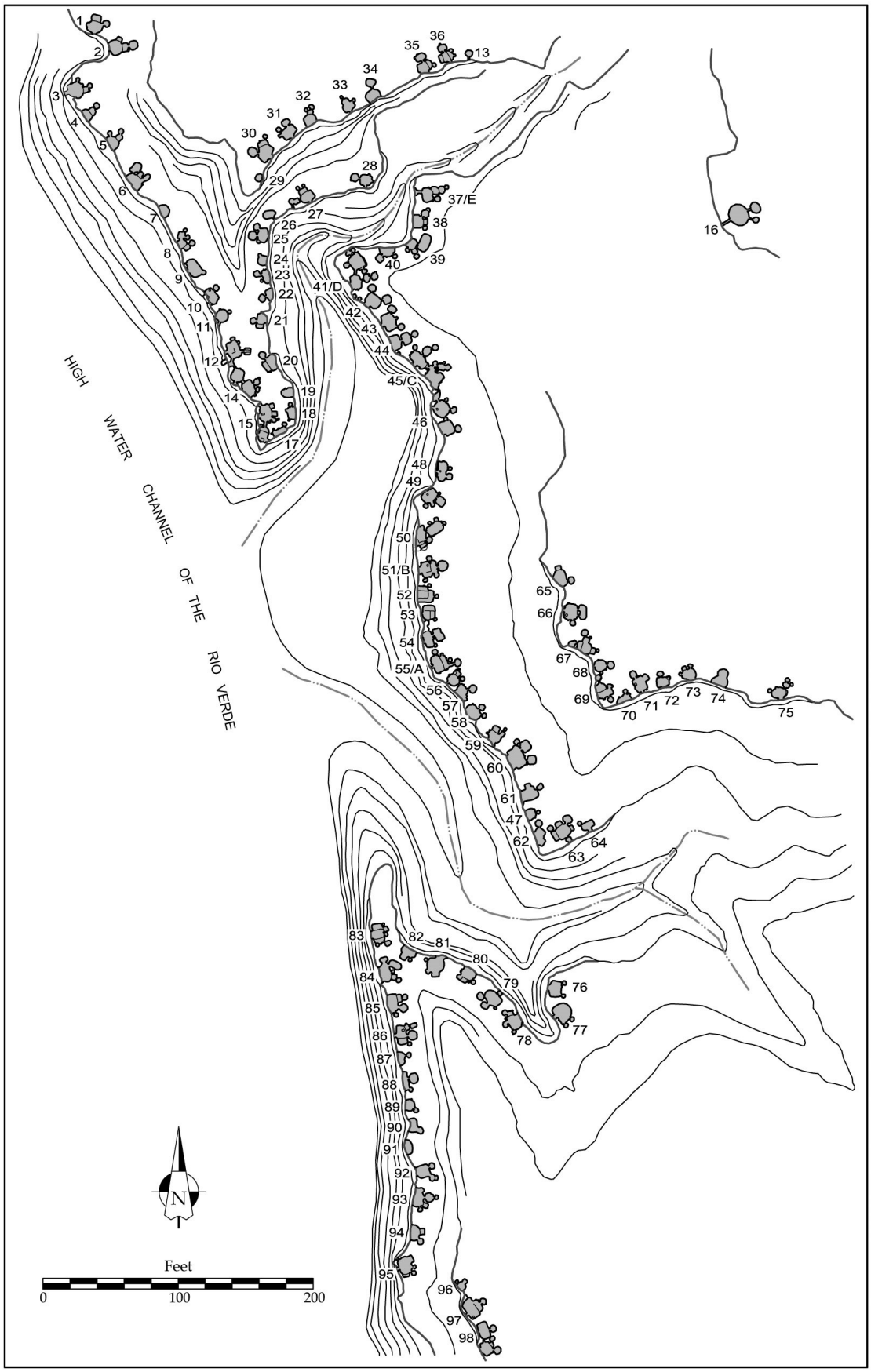

Figure 2. Site Plan based on Mindeleff (1896:Plate XXV), with groups numbers added by Hall.

Table 1. Dwelling and Room Areas in Square Meters Separated by Room Function.

Dwelling No.	Main Room	Alcove	Habitation (Main+ Alcove)	Storage (< 7 sq. m)	Other	Total Area
1	17	5.1	22.1	4.5	0	48.7
2	15.8	5.6	21.4	2.8	7.1	52.7
3	17.3	2.9	20.2	1.8	0	42.2
4	9	4.5	13.5	2.5	0	29.5
5	13	3.6	16.6	1.8	0	35
6	21	2.4	23.4	5.4	9.3	61.5
8	6.5	3.4	9.9	10.7	0	30.5
9	17.6	0	17.6	1.1	0	36.3
10	17	0	17	2.8	0	36.8
11	13.1	0	13.1	1	0	27.2
12	20	0	20	3.6	0	43.6
14N	15.1	0	15.1	0	0	30.2
14S	17.5	0	17.5	6.3	0	41.3
15N	18	1.8	19.8	3.2	0	42.8
15S	11.5	0	11.5	0.8	0	23.8
18	11	0	11	1.8	0	23.8
19	10.8	0	10.8	0	0	21.6
20	17.6	5.4	23	4.9	0	50.9
21	9.5	5.4	14.9	3.1	0	32.9
22	9.5	0	9.5	4	0	23
25	14.9	1.3	16.2	4.9	7.1	44.4
27	14.9	4.6	19.5	9	0	48
28	12.6	0	12.6	0	7.1	32.3
29	4.8	0	4.8	0	0	9.6
30	21.2	6.3	27.5	1.6	8	64.6
31	17.1	0	17.1	7.3	0	41.5
32	10.6	2.6	13.2	2.7	0	29.1
33	8.3	4.6	12.9	1.2	0	27
35	14.2	0	14.2	1.5	7.9	37.8
36	11.9	0	11.9	1.9	6.4	32.1
37	14.6	4.4	19	7.2	0	45.2
38	12.6	2.7	15.3	1.8	6.2	38.6
39	7.6	3.1	10.7	3.6	18.9	43.9
40	12	0	12	7.4	0	31.4
41N	23.3	0	23.3	9.2	0	55.8
41S	14.7	0	14.7	8.1	0	37.5
42	19.9	0	19.9	5.3	8.1	53.2
43	22.7	0	22.7	11.2	0	56.6
44	17.2	0	17.2	3.1	10.8	48.3
45N	18.7	1.9	20.6	6.7	7.1	55
45S	25	3.3	28.3	8.3	0	64.9
46N	22.5	0	22.5	5.8	0	50.8
46S	19.8	0	19.8	3.2	0	42.8
47	10.5	0	10.5	1.3	0	22.3
48	17.5	0	17.5	4.7	0	39.7

Table 1 (Continued). Dwelling and Room Areas in Square Meters Separated by Room Function.

Dwelling No.	Main Room	Alcove	Habitation (Main+ Alcove)	Storage (< 7 sq. m)	Other	Total Area
49	19	2.3	21.3	2.8	8.4	53.8
50N	17.3	2.2	19.5	1.9	0	40.9
50S	16.5	1.8	18.3	7.3	0	43.9
51	13.5	6.9	20.4	6.4	8	55.2
52	16.3	0	16.3	3.3	0	35.9
53	15.4	5.8	21.2	2.4	0	44.8
54	13.5	0	13.5	0.8	9.6	37.4
55	14.9	7.1	22	7.7	0	51.7
56	16.3	3.7	20	7	0	47.0
58	7.8	3.7	11.5	3.7	0	26.7
59	14	0	14	4.8	0	32.8
60	25.2	0	25.2	9.9	12.3	72.6
61	17.3	4.2	21.5	3.3	0	46.3
62	7.8	4.4	12.2	3.8	0	28.2
63	20.9	10.3	31.2	2.5	8	72.9
64	9.8	0	9.8	1.8	0	21.4
65	16.5	3.2	19.7	3.9	0	43.3
66	22.5	0	22.5	3.4	11.9	60.3
67	14.7	7	21.7	8.3	0	51.7
68	12.3	0	12.3	5.1	0	29.7
69	16.5	3.6	20.1	6.4	0	46.6
71	9.7	9	18.7	7.5	0	44.9
72	11.2	0	11.2	2.5	0	24.9
73	12.7	0	12.7	3.9	0	29.3
75	14.8	0	14.8	6.9	0	36.5
76	20	0	20	3	0	43.0
77	30.4	0	30.4	2.7	0	63.5
78	12.2	2.3	14.5	4.4	0	33.4
79	22.4	0	22.4	4.5	0	49.3
80	15	2.3	17.3	4.1	0	38.7
81	22.5	4.7	27.2	1.3	0	55.7
82	14	3.6	17.6	1.8	0	37.0
83	20.2	2.6	22.8	4.3	0	49.9
84	18	2.1	20.1	6.7	9.7	56.6
85	13.8	3.7	17.5	4	6.6	45.6
86	18.9	2.6	21.5	4.8	7.1	54.9
89	7.6	0	7.6	1.8	0	17.0
92	15.8	0	15.8	7.2	0	38.8
93	22	2.5	24.5	1.8	6.4	57.2
94	12.2	3.2	15.4	3.1	0	33.9
95	18	5.9	23.9	2.9	0	50.7
97	12	7	19	3.1	0	41.1
98N	16.1	0	16.1	5.3	0	37.5
98S	11.9	1.8	13.7	5.6	0	33.0

Figure 3. Cavate doorways in the cliff face, left at Group 45/C, right at Group 55/A.

The main "living room" in each dwelling had a hearth, raised benches, wall niches, floor cists, and a variety of other architectural amenities sculpted into the soft rock. Some of the largest *main rooms* (labels for room categories are italicized) have clay ridges on the floors, which were possibly used to define activity areas within the room. The *main rooms* range in size from 4.8 to 30.4 sq m and have a mean ceiling height of 1.8 m (71 in.). The smallest *main room*, assigned number 29, is located at the extreme western end of the upper tier of the northern arm (see Figure 2). With good views down the Verde and across to the broad terraces west of the river, this atypical room may not have been a habitation; its attributes more closely resemble those of a field house (see Pilles 1978). It is the only example of a cavate fieldhouse at the site.

I refer to another specialized room as a raised "*alcove*." *Alcoves* are most often located opposite from the entrance to the *main room*. They are completely open to a *main room* on one side, and are generally rectangular in plan. The *alcove* walls lean slightly inward, curving into a ceiling that is an extension of the *main room* ceiling or somewhat lower. A few *alcove* room floors are level with the *main room*, but most are raised 20 to 60 cm above it, suggesting a convenient height for sitting. *Alcove* size varied from 1.3 to 9.1 sq m. The open access and the presence of similar wall niches suggest that the *alcove* was an extension of the *main room*; part of the total habitation area. It may have provided a comfortable place to work or sleep, especially in the winter if the main floor was drafty. In roughly half of the dwellings with raised *alcoves*, they provide access to one or two small rooms with low ceilings.

Aside from *main rooms* and *alcoves*, the other rooms in each dwelling are generally small and round in plan without wall or floor features. The round rooms tend to be accessible from the *main room* through doorways or low tunnels and they make up almost 60 percent of the rooms at the site (see Table 1). These were all initially assumed to be used for storage. In comparing the area devoted to habitation (main and *alcove* rooms) with that of the round rooms (Figure 4) modes in the sizes of the round rooms were evident. Most of the round rooms are less than 7 sq m in area, with ceiling heights below 1.2 m; these were almost certainly used for storage, and are termed *storage rooms*. Rooms in the mode from 7 to 10 sq m had more variable ceiling heights, were occasionally more subrectangular than round, and almost always occurred in addition to smaller *storage rooms*. These could have accommodated other uses, but few had wall or floor features to suggest what those uses might have been. These were assigned to a category termed "*other.*" A bar chart (Figure 5) illustrates the variability within the dwellings of the percentages of space allocated to habitation area (combined area of *main rooms* and *alcoves*), *storage rooms*, and rooms that probably had other uses.

There are four rooms in the *other* category that are larger than 10 sq m in area. The largest is in Group 39 and resembles a *main room* in area and ceiling height, but it has no direct access to the cliff face. In Group 44, the large *other room* connects a

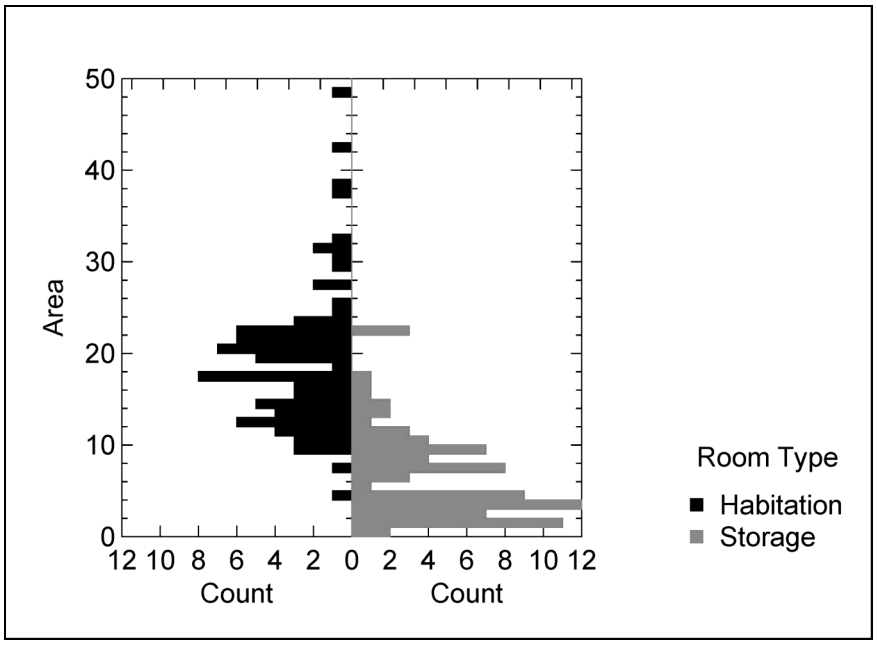

Figure 4. Histogram of room types by floor area, demonstrating modes in room size.

relatively small *main room* and a *storage room*. In Group 60, the large *other room* appears no different than the small *other rooms* except in size. The large *other room* in Group 66 was created by removing the rock between two round, storage-sized rooms. The resulting subrectangular room retains two doorways from the *main room*. These large rooms in the other category were probably used for more than storage. However, they have too little in common to infer a specific function.

Occasionally a small room acts as a passage to rooms farther back from the cliff face. The deepest dwelling was one Mindeleff described as Group E (Figure 6a) with remnants of a vestibule and a narrow passage giving access to four more rooms, carved deeply into the cliff. Because they are located farther from cliff faces, the *storage rooms* are often more intact than *main rooms* and have a higher proportion of intact doorways. A few exhibit a specialized doorway with a partially recessed jamb (Figure 7), possibly to receive a slab closure that could be sealed with mortar to keep out rodents or to protect valuable objects while the inhabitants were away.

Most of the dwellings consisted of two to five rooms. However, there were seven interconnected groups that had between 6 and 10 rooms, each of which had two large *main rooms* connected to smaller rooms. These may have functioned as "duplexes," with each *main room* being the nucleus for its own 3 to 5 room dwelling. Two of the cavate groups described by Mindeleff (Groups 45/C and 41/D) were this duplex dwelling type (see Figures 6b and 6c). More than one-third of the site's cavate dwellings are almost completely intact. Many of the smallest and most heavily eroded dwellings are in the northern arm of the site, while dwellings in the central section tend to be more complete. Dwellings in the southern arm are generally more intact, except for an area where rockfalls have damaged several dwellings overlooking the Verde. This may suggest that the northern arm was occupied first, with new cavates carved into the other cliff faces as some dwellings deteriorated, or as population increased. By 1992, no artifacts remained within the accessible cavate rooms to support a finer intra-site chronology. Mindeleff (1896:221) postulated an overall population of 150 to 200 for the site. Based on a household size of 4 to 5 people, if even one-third of the dwellings were occupied at the same time, this site could have housed a population of 140.

ARCHITECTURAL FEATURES IN *MAIN ROOMS*

Most of architectural features at the site occurred in *main rooms*. These included doorways, niches, recesses, and small holes that suggested the locations of less permanent features like pegs, shelves, and loom anchors. Some of the most complex assemblages of these features were found in the five dwellings that Mindeleff described in 1896. The *main rooms* provided enough data to begin piecing together a picture of domestic life. My investigation of wall features began during data collection in these five groups. A familiarity with the range of architectural features was derived by sketching floor plans

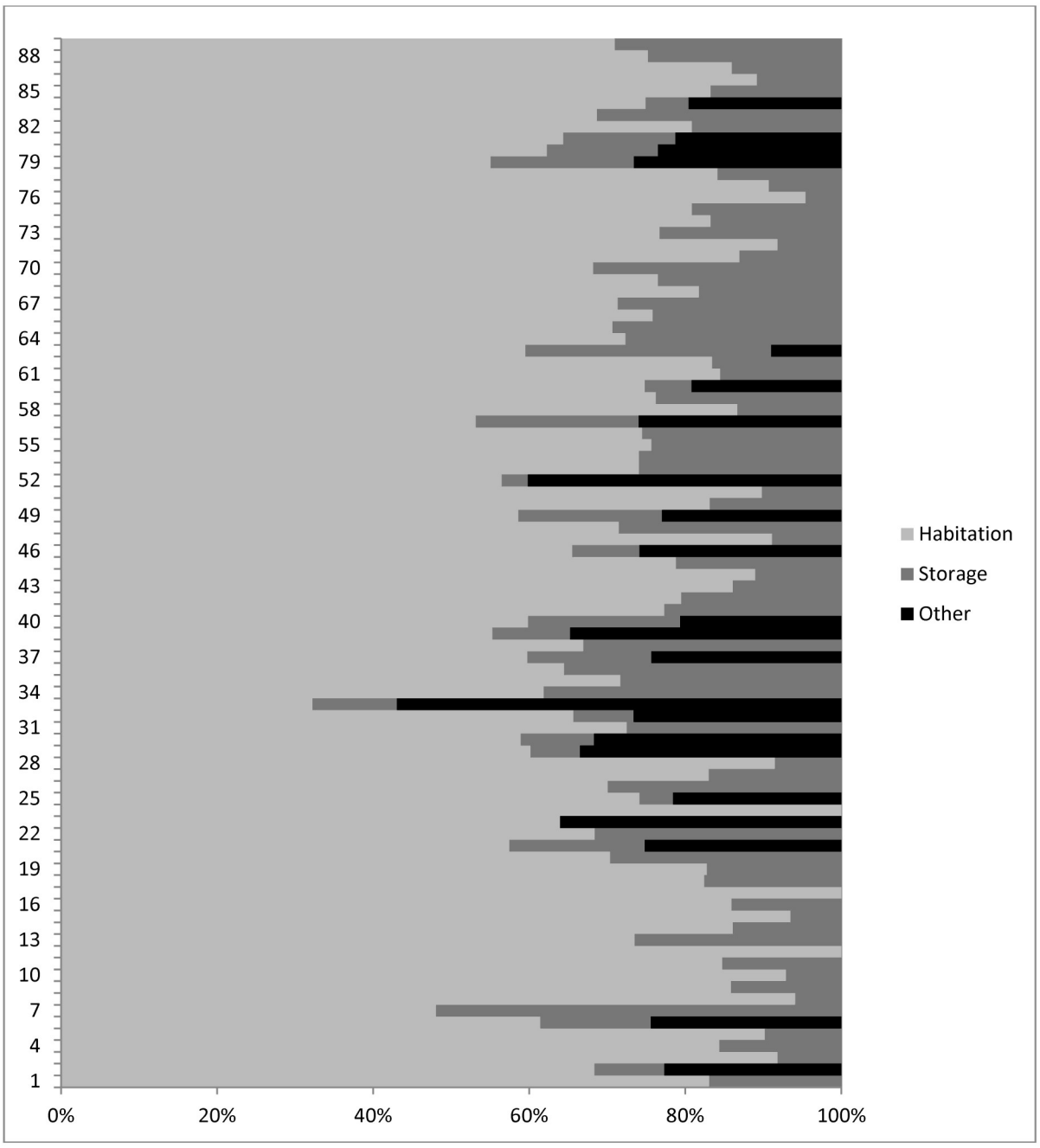

Figure 5. Percentages of room types by function within dwellings.

and wall elevations, and measuring distances between features to produce scaled drawings.

Architectural wall features include all of the constructed elements that contribute to how a space is used by its inhabitants, and how activities are spatially organized. The relatively intact condition of cavate room walls suggested it might be possible to define activity areas within them. My analysis of wall features began with defining the kinds of variation that occur in different feature types and looking for regular combinations of features that might suggest functional characteristics. The feature classes are discussed in more detail in the following sections.

Doorways

The most notable wall feature is the doorway, which varied in size and shape, but also in the type of sill. Most cavate doorways are relatively flat at the top, but the sides bow out, resulting in a more oval appearance. The sill was often no more than an extension of the room floor, but other forms were observed. Built-in masonry sills were evident in 10

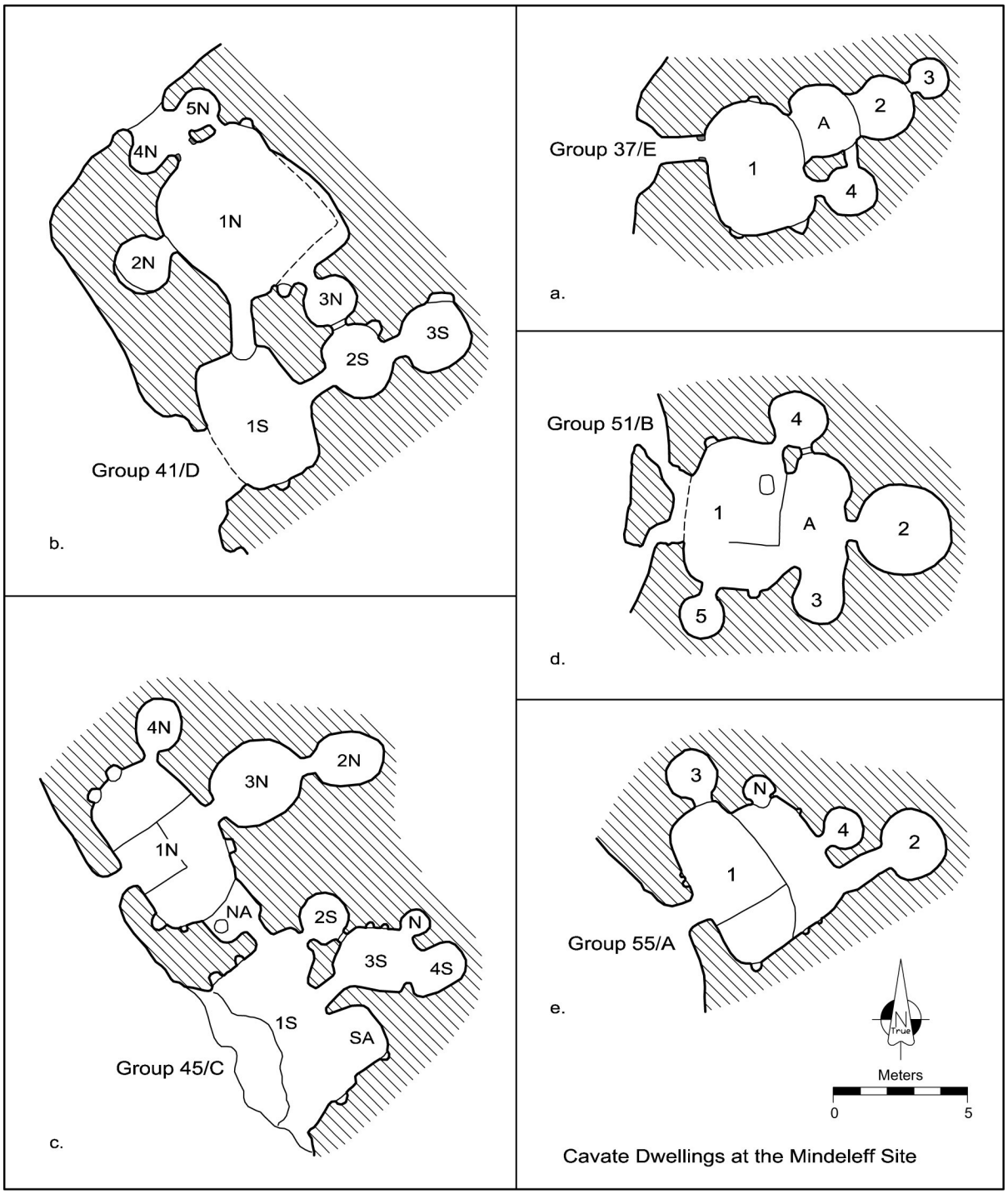

Figure 6. Cavate Groups a-e, originally described by Mindeleff (1896), measured and drawn to scale by Hall (1992).

doorways throughout the site. In nine other cases, the doorway was located well above floor level, leaving a sill of natural stone measuring 10 to 45 cm high. Similar high door sills were noted ethnographically at Zuni (Mindeleff 1989:194) and archaeologically at Mug House (Rohn 1987). Rohn suggested the purpose of the raised sill was to keep the door opening small while facilitating movement, since it was easy to step through the small raised doorways at Mug House. At the Mindeleff Cavate Site, raised doorways typically are associated with small round rooms (1-3 sq m) that have relatively low ceiling heights (1.0-1.5 m) that were probably used for storage. The higher door height that accompanies the raised sill does make access easier, but many similar rooms have low doorways that one must crawl through. Perhaps the raised sill is related to the materials that were stored in these rooms.

Figure 7. Doorway with recessed jamb and remnants of a masonry sill.

The last sill form refers to those in which the floor of the room to be entered was situated above or below the *main room*. Here the sill usually corresponded with the higher floor level, resulting in a step up or down into the secondary room. In a few cases the change in floor level followed a change in the hardness of the surrounding rock, but in most cases no reason was readily apparent for the change in room level.

Niches

Niches occurred in a wide variety of sizes and shapes (Figure 8). One type was raised above the floor, tended to be small, and differed greatly in shape and proportions. This type appeared to have been shaped to accommodate various types of objects. Many of these were less than 20 cm in any dimension and ranged in volumetric shape from cubes to spheres to pear-shaped recesses. Regardless of whether the specific shape was significant to how these niches were used, they would be very limited in the type and number of objects they could hold.

Niches at floor level were of three distinct types. The first type had a shaped doorway and resembled a tiny room measuring less than 80 cm in diameter, and rarely more than 70 cm high. The second type occurred infrequently but was so carefully shaped it suggested some special use. This type had very rectangular or trapezoidal sides, was relatively low, and was deeper than it was wide. The third type was vertically oriented, but resembled a half circle in plan with a diameter of 40 to 65 cm. This type had a curved top, was usually taller than wide, and had a flat bottom or a bottom that was rounded below the opening at the wall and recessed slightly below the *main room* floor (see Figure 8). This last type might have been useful for keeping a large water jar upright and more out of the way.

Wall Holes

Although the most apparent wall features were doorways and niches, the most numerous were holes of various sizes. These often occurred in pairs or sets, having horizontal or vertical relationships. Their size, spacing, relationship to doors and niches, and their height above the floor all helped suggest their function. In one typical situation, a pair of holes occurred above and to the sides of a doorway; pegs inserted into these holes could have supported a blanket or mat to cover the door opening. A similar feature was seen above niches, but in these cases the holes occurred in sets of three or four, as well as in pairs. It is possible that pegs in these holes would have supported a series of slender poles that served as a shelf, a feature that was described by Victor Mindeleff (1989:209) at Zuni. Mindeleff (1989:110) also described a common practice at Zuni and Hopi, of suspending a long pole from roof beams for hanging blankets and garments. Relatively large holes occurred at opposite sides of *main rooms* in several dwellings. These rooms all had one hole near the entryway and a hole on the opposite wall to one side of a raised *alcove*. In two of the groups, a pole inserted into the holes would have run above the edge of a raised side area or a floor ridge; a blanket hung from the pole would effectively partition off part of the *main room*. However, this partition would not have completely closed off the space. The holes occurred at heights of 1.3 to 1.7 m above the floor, leaving a space of 50 cm to 70 cm above the proposed pole.

At Group 55/A, holes occurred in side walls just in front of the large raised *alcove*. A similar condition occurred at Group 51/B which had a large *alcove*, but the *alcove* floor was raised very little above the *main room* floor. Instead the *alcove* ceiling was lower and the paired holes occurred in the *main room* wall above the ceiling height of the *alcove*. A pole and blanket, supported on pegs inserted into these holes, would have partitioned the *alcove* from the *main room*.

As is usually the case with architecture, the variations possible in space allocation and use can be numerous and complex (Kent 1990). The features in cavate dwellings show evidence of many different ways to organize space and the activities within discrete spaces, without adhering to a limited set of spatial patterns or standards.

UPDATE ON MINDELEFF'S CAVATE GROUPS

Mindeleff (1896) chose five groups of cavates to describe in detail in his BAE report. These included some of the largest and best preserved dwellings at the site. Based on my recording of cavate attributes, I

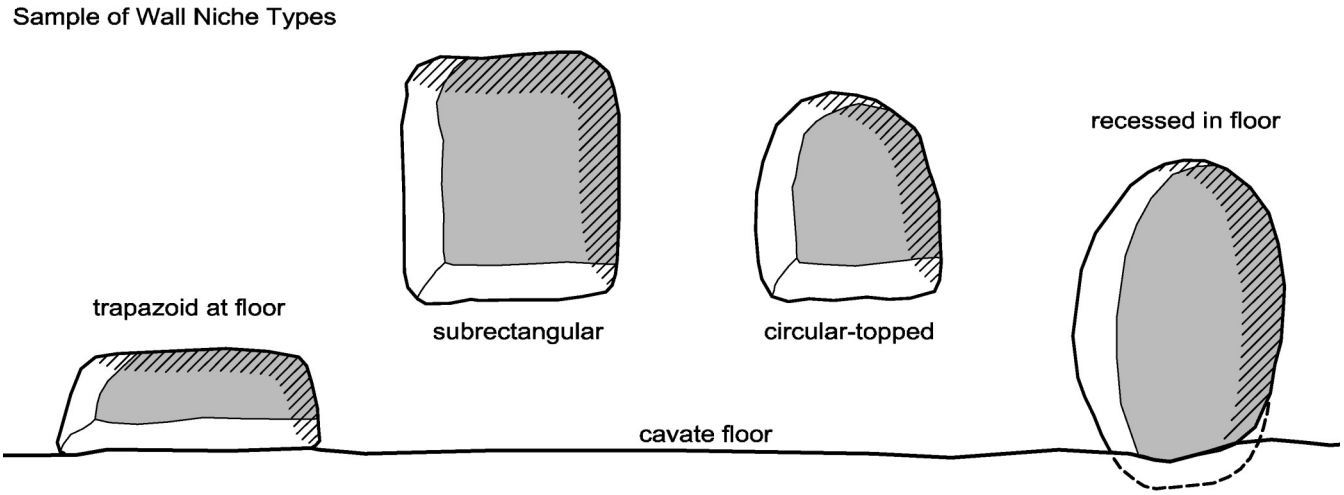

Figure 8. A sample of niche types found at the Mindeleff Cavate Site.

reevaluated Mindeleff's original descriptions and compared his insights with my own observations of their condition in 1992. This comparison allowed me to identify the extent and severity of deterioration and level of preservation within a sample of dwellings.

Cavate Group 55/A

This dwelling is located in the central section of the site, and in the lower tier of cavates. The group has a large raised *alcove* (see Figure 6e) that is more integrated with the *main room* than is typical. The *main room* exhibited many wall features, and in particular the *alcove* contains more features than usual. There is a large below-floor niche along the north wall of the *alcove*, a very small pear-shaped wall niche with a horizontal set of three widely spaced holes in the east wall, and another small wall niche and a floor niche at the south wall of the *alcove*. This concentration of features continues uninterrupted along the south wall of the *main room*, with a horizontal pair and one individual hole, and a small below -floor niche. This array of features is spatially separated by the entryway to Room 2, but not by the change in floor level at the edge of the raised *alcove*. Another cluster of features occurs across the *main room* at the west wall, beside the entry. Here, two closely spaced wall niches are present, with a set of holes above. Based on the way clusters of wall features are distributed around the room, there appear to be three distinct activity areas.

The entry was intact, and little additional deterioration was evident, except for some disturbance to the *main room* floor. Mindeleff described two clay floor ridges that defined three roughly equal spaces in the room. The floor ridge south of the entry remains, and the area between it and the south wall is raised 10 cm above the central area. Today, there is no sign of a floor ridge north of the entry. Mindeleff specifically stated that no firepit was found in Group A, but today a circular pit is visible in the *main room* in line with the entry and closer to it than to the opposite side of the room. Another discrepancy is Mindeleff's description of the small room (my Room 3) north of the *main room*. He mentions a 2-foot-long passage for access to the room; in fact this doorway is not unusually deep. Also, Mindeleff did not mention that the door sill and Room 3 itself are raised 17 cm above the *main room* floor.

Cavate Group 51/B

Group B is located near the center of the site, in the lower tier of cavates. The *main room* contained few wall features. A small floor niche is located at the northwest corner, and the other features occur near the opening between the *main room* and the *alcove*. The overall dwelling layout (see Figure 6d) shows an unusual relationship between the *alcove* and the *main room*. *Alcoves* are typically much smaller and more regularly shaped. The *alcove* in this group more closely resembles the raised areas that often occur within *main rooms*, except that these rarely have low ceilings. It is possible the *alcove* in this group functioned as a more integral part of the *main room*.

The entry is more deteriorated than Mindeleff's plan shows; fallen rock partially blocks the entrance today. The only other noticeable change is at the small opening between the large raised *alcove* (my Room A) and the small room (my Room 4) north of the *main room*. This opening was filled in with cobble masonry and sealed with plaster in Mindeleff's description, but was open by 1992. There is also a floor pit in the northeast corner of the *main room* that Mindeleff did not describe. However, he did not indi-

cate that the floors of this group were cleared, and the pit may have been covered at that time.

Cavate Group 45/C

Group C is located just north of the center of the site. Mindeleff describes this as two groups joined together (see Figure 6c). The south *main room* had been severely damaged by rockfall, and so it was only possible to analyze wall features in the north *main room*. This room was somewhat longer and narrower in proportion than most *main rooms*, and the remaining visible floor ridges suggest that the room was divided roughly into thirds. The northern part of the room contains two similar below-floor niches and a small wall niche. There is a hole above the floor ridge near the entry, but no opposing hole that might suggest a pole and hanging ever partitioned this area. The southern third of the room contains a relatively large vertical-walled niche, a very small floor niche, and another below-floor niche. The niches flank the opening of the raised *alcove*, which contains a storage cist and also provides access to the south cluster of rooms.

It appears that the north and south ends of the *main room* were separate activity areas that contained storage features to accommodate quite different objects or materials. The south end has a greater variety of storage facilities, in terms of shape, size, and orientation. The niches at the north end of the room are more uniform and seem particularly well suited for storage of large jars or ollas. The curved, recessed bottom of each niche extends out into the room floor, so a jar placed there would be well supported. The jar would be recessed so as to be somewhat protected and out of the way without hampering access to its contents.

Mindeleff (1896:234) stated that the south room cluster had already suffered deterioration and that the *main room* was filled with rubble from a "recent" rockfall that eliminated the west wall of the room and a large part of its ceiling. The condition was much the same in 1992. A secondary opening between two of the back rooms (my Rooms 2S and 3S) had been filled with masonry and sealed with plaster so as to be "hardly perceptible" (Mindeleff 1896:234). A few pieces of masonry remain in the opening today, but in general, masonry has not stood up to the impacts of time.

The northern cluster of Group 45/C is in much better condition. The entry is intact and the clay floor ridges, which Mindeleff did not mention, have survived. The floor areas to the north, east, and south of the floor ridges are slightly higher, leaving a low area immediately inside the entry.

Mindeleff (1896:234) referred to a "cove" that connects the north and south clusters, but he did not count this space as a separate room, as I had done in my analysis. He noted an in-floor pit in this raised *alcove* and remarked that its location precluded its identification as a hearth. The pit is a 40- by 50-cm oval in plan, and 32 cm deep. The opening at floor level is somewhat smaller than the interior dimensions. This profile and depth are more indicative of a storage feature. Mindeleff suggested the pit could have been used to store water.

Cavate Group 41/D

This group occupies a projecting angle of the cliff where the north arroyo bends east. It is another compound dwelling with north and south room clusters (see Figure 6b). The *main rooms* could have been the center of a large integrated household, but they could also have housed two related, but relatively independent households. My first goal was to determine whether wall features in the two *main rooms* had repetitious patterning to indicate a duplication of activity areas, thus supporting the latter hypothesis. This was not the case; the *main rooms* have surprisingly little in common. Although this does not necessarily signify that the two *main rooms* were used for different activities by one large household, it underscores the extent to which architectural features can vary while accommodating the same general activities

The north *main room* of Group 41/D is large, almost square, and once contained a pattern of floor ridges that separated the room into at least three areas. Entry was through a doorway in the north wall. The lower portion of this doorway had masonry jambs, a feature that remains scarcely visible at a few other dwelling entries. The rooms designated 4N and 5N probably functioned as an enlarged vestibule that was accessible from the path below by a ladder. Three niches are distributed around this room, including a horizontal wall niche and a small floor niche near the entry. The third niche is sunk into the floor within a recessed area near the door to Room 3N. It appears that storage facilities were loosely clustered in two remote activity areas in the north *main room*.

The south *main room* of Group 41/D is smaller and subrectangular in plan. The entry is centered on the long exterior wall, part of which no longer remains. Most of the wall features are clustered in the south part of the room. Only one horizontal wall niche and a small floor niche remain, but there are three horizontal pairs and three sets of holes between the door to Room 2S and the current entry opening. One set of four holes are closely spaced at 25 cm above the horizontal wall niche. The size and

depth of this niche, and the height of the holes above it, make this a likely place for a pole-supported shelf.

Mindeleff concentrated on the north cluster, where he cleared the floor of sediment and bat guano. This was the only group where he mentioned portable artifacts, including fragments of basketry and fabric, sandals, grinding stones, sherds of a large bowl and olla, and what resembled a piki oven made of broken metates.

Mindeleff (1896:227) described the floor features in detail, but the floor plaster and clay ridges that he described have been destroyed. He also described a firepit, another narrow pit, and two round depressions in the floor; none of these remain today. Mindeleff's (1896:Plate XXXII) sketch of the north *main room* shows the doorway partially filled by low stone jambs resembling a rough version of a T-shaped doorway, only the sill and a few small mortared stones remained as of 1992. This cavate dwelling has suffered a great deal of damage by vandals or pothunters.

The only natural deterioration has been the partial collapse of the external wall of the south *main room*. At the area just outside of the south *main room* there remain some plaster and stonework, suggesting a finished floor once existed there. Perhaps this served as an outdoor porch or vestibule, but it is possible that another room once fronted the south cluster. Two small rooms remain just south of the current entry that are not directly connected to any dwelling unit today, but might have been entered from this earlier room.

Cavate Group 37/E

This group is located at the extreme north end of the central section of the site, extends approximately 10 m into the cliff, and is the only intact group that is four rooms deep (see Figure 6a). It is entered through a deep passage which Mindeleff (1896:Plate L) showed having low stone jambs at the exterior end, similar to those in the north *main room* of Group 41/D. Only a few stones and bits of mortar remain near the sill today. This *main room* is somewhat rectangular in shape but the corners are very rounded. This and the location of the entry, which is not centered on the long wall, make the room appear to be more circular in plan.

Two wall niches and two floor niches, all of different shapes and sizes, are distributed around the room. Holes seem to be scattered everywhere, but they sort out into four horizontal pairs in the north wall, a set of four holes and a high wall niche in the west wall, and a cluster of holes between the raised *alcove* and the door to Room 5. On the whole, the wall features in this room do not appear to cluster in a way that would help define specialized activity areas. Except for the masonry at the entry, the group has remained intact. Its location makes it easy to overlook by visitors, which has increased its appeal to roosting bats.

CONCLUSION

The Mindeleff Cavate Site in central Arizona's Verde Valley is of particular interest because of its unusual construction method, its large number of dwellings, and the complexity of their interconnected rooms. Most cavates along the Verde River are small, single rooms, which resemble seasonal field houses more than year round dwellings, and there are typically only a few cavate rooms at any site. Even relatively large sites like Clear Creek Ruin (Morris 1928) and the Montezuma Castle complex (Mearns 1890, Wells 1988) have fewer than 50 recorded cavate rooms. With its two arroyos providing an abundance of vertical cliff face in a compact area, the location of the Mindeleff Cavate Site may be the only place in the Verde Valley where this large cavate village was possible.

Each of the large cavate sites in the Verde Valley has a spatial relationship with a pueblo structure on a bench or mesa top above, or at the base of a cavate cliff. Mindeleff (1896), Fewkes (1898, 1910), and contemporary investigators (Pilles and Madsen 1979) have inferred that both structural types were occupied simultaneously. This raises questions about why some inhabitants chose to live in cavates, while others built pueblos nearby. Perhaps there were social or cultural affiliation differences involved, but these questions cannot be answered without excavation of both pueblo and cavate rooms, and an analysis of the recovered artifacts. Unfortunately, wherever cavates are accessible they attract curious visitors and have been a favorite source for collectors for a long time (see Attwell 1934 regarding Clear Creek Ruins). Mindeleff made few references to artifacts and I was unable to find out how much he collected during his 1891-92 investigations, or where his collection was eventually housed. Tracking down cavate artifacts and pursing their analysis could be a useful endeavor.

Another area of investigation that might be pursued is a comparison of the Mindeleff Cavate Site with others in the Verde Valley. Few other cavate sites have received any attention, and no attempt has been made to describe or quantify how cavate sites differ. Regional studies are necessary before Verde Valley cavates can productively be compared to cavates in other regions, like New Mexico's Pajarito Plateau.

My analysis of architectural features in cavate *main rooms* proved more productive in raising ques-

tions than in providing answers. As is often the case with architecture, cavate dwellings showed that there are many different ways to organize space and the activities within spaces, without adhering to strict spatial patterns. Spatial patterning in cavate dwellings was most evident at a fairly general level. Room sizes, shapes, and relative positions within dwellings were regular enough to infer some functional types and to suggest that rooms were spatially sub-divided into activity areas, but the locations of architectural features like niches and wall peg holes were not sufficiently patterned to permit correlating specific combinations of features with specific activities. My graphic analysis of room arrangements and wall features continued a largely intuitive tradition of seeking patterns and abstract organizing principles through a process of visual examination, directed by theories regarding the social use of space.

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TWO TO FOUR INCHES OF LIME DIRT: PUBLIC ARCHAEOLOGY AND THE DEVELOPMENT OF OLD AND NEW INTERPRETATIONS AT THE CASTLE A SITE, MONTEZUMA CASTLE NATIONAL MONUMENT

Matthew C. Guebard

ABSTRACT

This paper addresses recent archaeological work at the Castle A site (AZ O:5:95 [ASM]), located within the Montezuma Castle National Monument boundary. Initially excavated and stabilized in 1933 and 1934 by National Park Service archaeologists Earl Jackson and Sallie Pierce, the project is a historically significant event in the development of Verde Valley archaeology. Based on Jackson and Pierce's interpretation of stratigraphic evidence, they believed a catastrophic fire destroyed the site long after abandonment, an interpretation that has persisted for over 80 years. A recent reanalysis of field data coupled with archaeomagnetic dating questions this interpretation. Instead, new evidence points to a large fire resulting in the destruction and abandonment of the site at the end of the 14th century.

This paper discusses the reanalysis of archaeological data and briefly examines the development of a historic interpretation explaining the abandonment of the Castle A site (AZ O:5:95 [ASM]). Originally excavated in 1933-1934, explanations of events at Castle A were based entirely on the discovery of two to four inches (5.08 to 10.16 cm) of sediment on room floors (Jackson and Van Valkenburgh 1954). Specifically, this interpretation held that the Castle A site burned in a large fire long after its abandonment. This paper presents a revised interpretation of excavation data, osteology and ceramic analysis, as well as new archaeomagnetic dates to argue the Castle A site burned while occupied in a violent event occurring at the end of the 14th century.

CASTLE A, CULTURE HISTORY, AND THE VERDE VALLEY

The Castle A archaeological site is located in the Verde Valley of central Arizona along Beaver Creek, a tributary of the Verde River. The site is part of Montezuma Castle National Monument established in 1906 to protect and preserve the Montezuma Castle cliff dwelling. Montezuma Castle and Castle A are part of a larger group of sites which include culturally modified caves (cavates), cliff dwellings, alcoves, pit structures and freestanding masonry architecture within the national monument boundary (Powers and Pearson 2008; Wells and Anderson 1988). Castle A is one of hundreds of sites throughout the Verde Valley representing the Southern Sinagua archaeological culture originally defined by Harold S. Colton (1946).

Castle A consists of cavates, natural alcoves and open air masonry architecture. Existing viga sockets and wall alignments suggest Castle A was at least five stories tall and consisted of as many as 45 rooms (Jackson and Van Valkenburgh 1954:9; Wells and Anderson 1988:28). The site contains walls composed of unshaped limestone and mud mortar. Large rectangular rooms, some with floor ridges and jacal dividers, were constructed on natural limestone ledges overlooking Beaver Creek. Beam sockets carved into the soft limestone bedrock attest to an ingenious and complex blueprint wherein much of the dwelling was tied to the surrounding cliff face (Figure 1).

Since Colton defined the Southern Sinagua culture, our understanding of prehistoric life in the Verde Valley has grown. Today, studies discuss the establishment and abandonment of villages like Castle A (Hartman 1976; Pilles 1996; Pilles and Wilcox 2001; Powers and Pearson 2008; Whittlesey 2002; Wilcox and Holmlund 2006). In the early 1930s however, very little archaeological work had been conducted in the Verde Valley. Descriptive inventories by Mindeleff (1896), Fewkes (1896, 1898a, 1912) and Gladwin and Gladwin (1930) organized sites into characteristic

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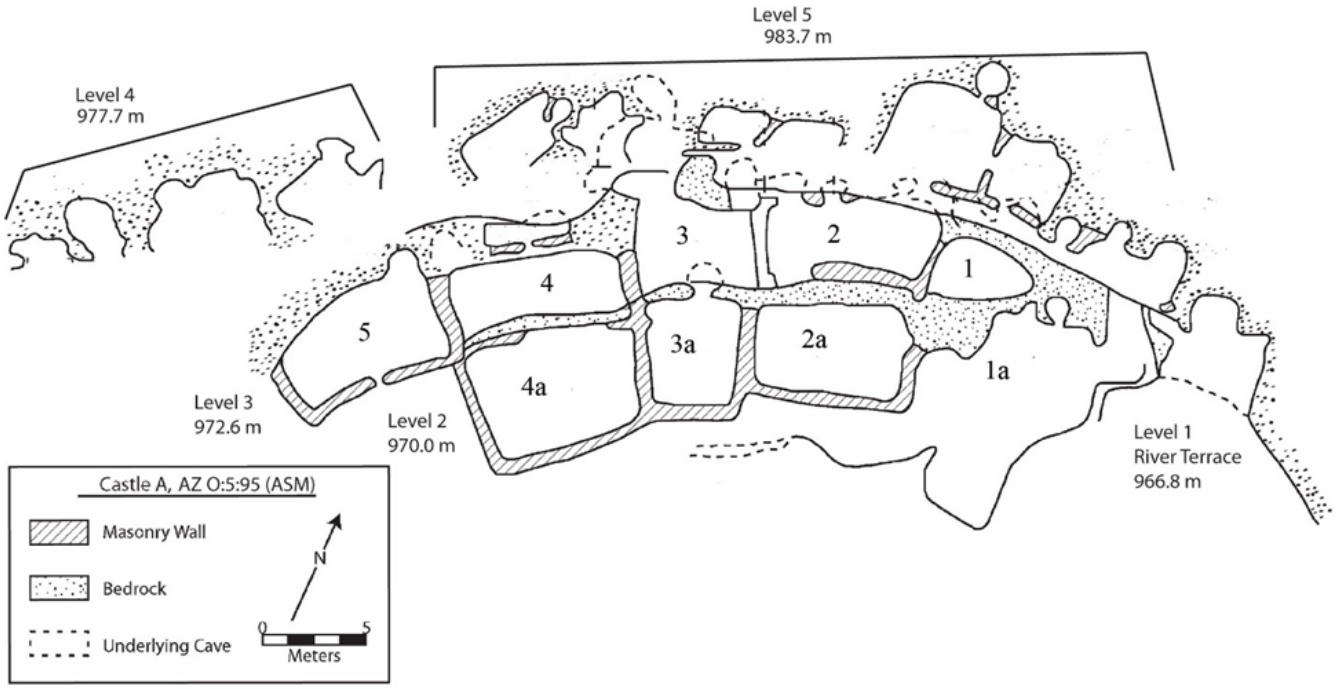

Figure 1. Plan map of Castle A showing room numbers (Reproduced from Wells and Anderson 1988: Figure 2.5).

types. Other studies investigated sites and associated features in more detail (Fewkes 1898b; Manning 1875; Mearns 1890; Morris 1928). Descriptive studies were typical of the early 20th century and are commonly referred to as culture history, where material culture is used to inductively arrive at large scale archaeological patterns (Lyman et al. 1997; Willey and Phillips 1958). By the 1930s, culture history included the culture area concept. This paradigm organized archaeological patterns into discrete geographic areas representing specific cultures and was widely adopted throughout the American Southwest (Lyman et al. 1997:18).

The 1933-34 excavation of Castle A is one of the earliest systematic archaeological projects undertaken in the Verde Valley. The detailed information and archaeological interpretations in the report are exceptional for the time. However, conclusions were reached without the well-developed chronology eventually proposed by Harold Colton. During the Castle A project, Earl Jackson and Sallie Pierce[1] focused primarily on the categorization of architecture and artifacts. New theoretical paradigms and analytical techniques create opportunities to reassess existing information and develop new interpretations of the site. This is particularly important at Montezuma Castle National Monument, where over 400,000 visitors come to learn about archaeology and Native American history each year.

CIVIL WORKS ADMINISTRATION (CWA):1933-1934

Between December 1933 and April 1934, Jackson, Pierce and 10 CWA workers excavated nine rooms and several test trenches around Castle A (Jackson and Van Valkenburgh 1954). Additionally, the crew stabilized standing wall sections, reconstructed a room on Level 2, and made improvements to the surrounding landscape (Figure 2). They discovered a total of 28 human burials and many well-preserved artifacts (Jackson and Van Valkenburgh 1954; Kent 1954). The primary objective of the CWA excavation at Castle A was to recover artifacts for display in the Montezuma Castle National Monument museum and create a comparative artifact collection representing Verde Valley prehistory.

The excavation recovered evidence of a catastrophic fire that caused Castle A to detach from the surrounding cliff face and collapse onto itself. Jackson and Pierce cite evidence of fire in the form of burned roof material in seven of nine (78 percent) rooms excavated. Burned roofing and underlying sediment provide the main evidence for an interpretation of the site. Jackson and Pierce concluded that,

> Castle A fell from the cliff as the result of a great fire which razed the structure from top to bottom. It was

Figure 2. Overview photograph of Castle A during excavation, ca.1934 (Courtesy of National Park Service).

> at first believed that this fire was the cause for the abandonment of the building; research here has shown this not to be the case. The weight of evidence, as seen in the silt accumulations underneath the charred ceilings, shows the ruin to have been abandoned, perhaps for a considerable time, before the firing occurred [Jackson and Van Valkenburgh 1954:49-50].

Jackson and Pierce explain a post abandonment fire with stratigraphic evidence. At least two to four inches (5.08 to 10.16 cm) of sediment found on top of occupational floor surfaces, but below burned roofing in three rooms is cited as evidence of a long period between the abandonment of the site and the burning of the pueblo. Underlying sediments within rooms are variously described as "lime dirt," "sand," and "soil" but also as "stratified," "mixed," "washed," and "rain-or flood-washed" (Jackson 1933b; Jackson and Van Valkenburgh 1954:12-18). Brief descriptions of each deposit exist within the report and field notes, although there are no associated stratigraphic maps, detailed soil descriptions or photographs. Descriptive labels used for each deposit suggest several possible explanations for formation processes within each room. In contrast to Jackson and Pierce's original interpretation, information in field notes and the 1954 report suggest rooms at Castle A have different occupational and depositional histories (Table 1).

Ethnographic and archaeological evidence suggest that individual pueblo rooms are often subject to dynamic processes encompassing use, repair, abandonment and reuse during their occupation (Cameron 1999). To investigate rooms at Castle A, descriptions in existing field notes and the 1954 report were reassessed. Whole ceramic vessels or unbroken (usable) objects such as ground stone and bone tools described as being found "on the floor" were considered as floor assemblages. Artifacts found in "fill" and consisting of pot sherds or other tool fragments were considered as secondary refuse deposits. Artifacts described without a clear association to the floor surface or to a fill deposit were considered inconclusive. A total of nine rooms were reassessed (Table 1). Second story spaces described above Rooms 4 and 3a were not considered because of a lack of existing information. Although this approach is simplistic and does not fully address the complexities likely encountered by excavators in each room, it did provide the best way for assessing the limited information available.

A reassessment of artifacts found within rooms suggests a number of different depositional processes. For instance, stratigraphy in at least one room may indicate room abandonment, neglect, reoccupation and abandonment. Jackson and Pierce report

Table 1. Information on Room Deposits noted in Jackson and Van Valkenburgh (1954).

Room	Sediment Noted on Floor Surfaces	Burned Roofing	Floor Assemblages	Trash Deposits
2*	None noted.	"charred stump of a large post upright" (11).	None noted.	None noted.
3	None noted.	"burned ceiling rested directly on floor" (11).	Ceramics, ground stone, bone/stone/wood tools.	Inconclusive.
4	"Stratified sand and lime dirt" (12).	None noted.	None noted.	None noted.
5	"Stratified sand and lime soil, mixed...to a depth of 3 inches" (13-14).	"slightest traces of a burned ceiling" (14).	Ceramics, ground stone.	None noted.
1a	"Two to 4 inches of sand and lime dirt" (15).	None noted.	None noted.	"fill above the floor" containing broken ground stone and ceramics (14).
2a	"Two to 4 inches of water-washed sand and lime dirt" (16).	"scattered and charred ceiling fragments lay about a foot above the floor" (16).	Ceramics, ground stone.	None noted.
3a	None noted.	"charred ceiling...directly on the floor…second story ceiling, also charred…15 inches above" (17).	Ceramics, ground stone, bone/antler tools, basketry, human remains.	None noted.
4a	"stratified sand and lime dirt…rain-or flood-washed" (18).	"burned ceiling material…was 2 ½ feet above the floor" (18).	None noted.	Inconclusive.

*George Boundey conducted excavations within Rooms 1 and 2 in 1927. Jackson and Pierce note disturbances caused by this work in their report. Descriptions of Room 1 contained no useful information for reanalysis.

that Room 1a had two surfaces; a bedrock floor overlaid with two to four inches of compacted "sand and lime dirt." Above that, a layer of "fill" containing pottery sherds and trash (Jackson and Van Valkenburgh 1954:15-16). Stratigraphic layering in Room 1a suggests that the room was abandoned, subjected to the accumulation of sediment, briefly reoccupied and used as a trash dump. In this way, the accumulation of two to four inches of lime dirt is indicative of the disuse of the room, not the abandonment of the entire site.

Furthermore, Jackson and Pierce report artifacts found directly on the floor surfaces of Rooms 5, 3, 3a and 2a. For instance, in Room 3a, Jackson and Pierce describe the following,

> Four feet south of the firebox a crack in the ledge had provided a sizeable hole, in which were found most of the pieces of a large plain olla. In the northeast corner was found a large olla, shattered but complete. By the side of this olla was a large metate, one end propped up on a stone, in position as it had evidently been used…in addition to those already described, were: one round basin metate; one antler, badly rotted; three manos; two bone awls; parts of several stone hoes. From the second story came one grooved stone pick and one grooved axe. Near the west wall on the bottom floor was found a large section of charred and rotted basketry [Jackson and Van Valkenburgh 1954:17-18].

A similar suite of domestic artifacts including three stone axes, five metates (one with a mano resting inside), 12 manos, one intact ceramic bowl, two bone awls, one bone dagger, a spindle whorl and a bone needle were also found on the floor of Room 3. Room 5 contained three metates, four manos and two large ceramic ollas, one resting over a stone lined hearth. Room 2a contained many ground stone artifacts including two metates and eight manos as well as a ceramic bowl.

All four rooms contain *de facto* refuse, or objects abandoned in their original use location (Lightfoot

1993; Schiffer 1985). Interestingly, Rooms 5 and 2a also contained layers of sand and lime soil directly on floor surfaces (Jackson and Van Valkenburgh 1954:13 -14, 16). In Room 5, Jackson and Pierce report that most burned roofing on the floor had been removed by "action of water" (Jackson and Van Valkenburgh 1954:14). This suggests a post-depositional process wherein the burned roofing was carried away by erosive flooding. This same process likely resulted in the deposition or mixing of sediments within the room. Without additional information, a more in depth interpretation of sediment deposition in this room is inconclusive. Room 5 does, however, further illustrate the dynamic nature of stratigraphic deposits described by Jackson and Pierce.

Similarly, sediment in Room 2a is described as water-washed, but may also indicate a period of time after the abandonment of the room and before the fire. The appearance of *de facto* refuse and no sediment in Rooms 3 and 3a, however, may indicate a hasty abandonment. This is consistent with what might be expected during a catastrophic fire wherein inhabitants do not have time to collect their belongings (Diehl 1998:619).

At the very least, Jackson and Pierce's descriptions of stratigraphy and floor assemblages within individual rooms at Castle A raises questions regarding their original post abandonment fire hypothesis. The two to four inches of lime dirt found on top of floor surfaces and below burned roofing in three rooms does not support abandonment of the entire site, as Jackson and Pierce concluded. Instead, the appearance of *de facto* refuse suggests the site, or at least two rooms within it, were occupied or in use at the time of the fire. To further investigate this new hypothesis I will discuss other lines of evidence including osteology, ceramics and archaeomagnetic dates in the following section.

ARCHAEOMAGNETIC DATING AND THE DEVELOPMENT OF NEW INTERPRETATIONS

Archaeomagnetic dating began as an early form of chronometric geochemical analysis (Tarling 1975). In the last 40 years, this technique has developed into a reliable method of dating archaeological materials (Eighmy 1990; Tarling 1975). Archaeomagnetic dating relies on earth's magnetic field to determine date ranges for specific thermal events containing undisturbed archaeological features with ferromagnetic (iron) particles. When heated to the Curie Point (580-680° C), iron enters a state of flux and on cooling aligns with the prevailing direction of magnetic north (Cox 2011:2; Tarling 1975:186). The remnant magnetism of a sample is compared with a known record of changes in the earth's magnetic field, known as a virtual geomagnetic pole (VGP). Similarities in the magnetic orientation of the sample and the VGP provide date ranges associated with the last thermal event.[2]

Successful archaeomagnetic dating requires four specific elements. First, samples must contain ferromagnetic particles. Second, sample material must be sufficiently heated for particles to reach flux and realign upon cooling. Third, samples must remain undisturbed after heating or exist on a stable substrate. If samples move from the location where thermoremnance occurred, dates will be compromised. Fourth, field specimens must be carefully extracted and recorded (Cox 2011:2; Hodsdon 2006:2).

Two sets of 10 samples each were collected from Room 2 in 2011 and 2013. Each set of 10 samples was used for a single chronometric determination. Sample locations at Castle A met all four criteria for successful dating. Mortar used at the site was acquired from local soil containing naturally occurring hematite. Iron content for soil used in mortar is 4 parts per million (.0004 percent) by measure (IAS Laboratories 2012). Jackson and Pierce reported the discovery of a burned support beam within the room (Jackson and Van Valkenburgh 1954:11). Similarly, scorched and fractured bedrock as well as oxidized mortar indicates a sufficiently high temperature needed to reach thermoremnance. The sampled mortar was located on an immovable bedrock ledge and was securely attached. Finally, Thomas Windes, an archaeologist known for chronometric studies at Chaco Canyon, assisted with the collection of samples. Detailed field forms, photography and digital video recorded the location, orientation and appearance of each sample. Windes submitted samples to the Archaeomagnetic Dating Laboratory at the New Mexico Office of Archaeological Studies (OAS).

Archaeomagnetic Results

All samples were analyzed using the OAS laboratory methodology and were compared against the Wolfman and Eighmy/Lengyel SWCV 2000 (SWCV) VGP curves (Cox 2011, 2014). The 2011 archaeomagnetic set (ADL 1353) produced three alternate date ranges on the Wolfman Curve; A.D. 945-1020, A.D. 1330-1365 and A.D. 1375-1415. Comparisons with the SWCV curve produced four date ranges including A.D. 935-1010, A.D. 1295-1350, A.D. 1370-1475 and A.D. 1630-1700. The 2013 set (ADL 1367), of which two samples were removed from consideration, produced one date range obtained from comparison with the Wolfman curve; A.D. 1370-1395. Comparison with the SWCV curve produced a date range of

Table 2. Results of Achaeomagnetic Sampling in Room 2, Castle A (from Cox 2011: Table 1, 2014: Table 1).

Set	Site	Feature	Inc. (°)	Dec. (°)	VGP Lat. (°)	VGP Long. (°)	$\alpha 95$ (°)	δp	δm	N	De-mag level (Oe)	Wolfman Curve	SWCV2000
1353	AZ O:5:95 (ASM)	Room 2, North Wall	58.45	358.577	85.313	234.532	1.674	1.838	2.481	10 of 10	100	A.D.945-1020 A.D. 1330-1365 A.D. 1375-1415	A.D. 935-1010 A.D. 1295-1350 A.D. 1370-1475 A.D. 1630-1700
1367	AZ O:5:95 (ASM)	Room 2, North Wall	62.512	354.81	79.92	226.283	0.634	0.774	0.991	8 of 8	150	A.D. 1370-1395	A.D. 1335-1375

A.D. 1335-1375. It is important to note that ADL 1367 produced an extremely small *α95* value of 0.634°. This value indicates high precision and a strong thermoremnance relevant to providing an accurate date range associated with the fire event at Castle A. Table 2 reports the results of archaeomagnetic sampling at Castle A.

The Wolfman curve is generally considered to be more robust than the SWCV from A.D. 1000-1450 (Cox 2011:3). Based on decorated ceramics found at Castle A, occupation of the site was estimated at approximately A.D. 1125-1400 (Wells and Anderson 1988:28). For this reason, comparisons with the Wolfman curve are considered more appropriate for analysis at Castle A. Because both samples are from Room 2, date ranges are reasonably assumed to represent the fire event noted by Jackson and Pierce. Dates compared from both sample sets suggest the fire at Castle A occurred in the interval from A.D. 1375-1395, the period of overlap for archaeomagnetic determinations on the Wolfman curve. Results of ceramic reanalysis presented below support this date range.

Ceramic Analysis

Jackson and Pierce report decorated ceramics representing the Honanki and Tuzigoot phases (A.D. 1125-1400) at Castle A. In January 2012, the author conducted a reanalysis of all ceramics recovered from Castle A. The intent of this reanalysis was to provide a basis for understanding and confirming archaeomagnetic dates acquired in 2011. All ceramics collected during the CWA excavation are stored at the Western Archeological and Conservation Center (WACC) in Tucson.

Diagnostic ceramics analyzed in 2012 consist of Little Colorado White Ware, Tsegi Orange Ware, Tusayan White Ware, Winslow Orange Ware, Roosevelt Red Ware, Jeddito Yellow Ware, and White Mountain Red Ware. All of these were also noted by Jackson and Pierce during analysis of the Castle A assemblage. The ceramics found and collected in 1933-34 are wares expected of a typical Honanki and Tuzigoot phase archaeological site.

For the purposes of this paper, only Tuzigoot phase (A.D. 1300-1400) ceramics will be discussed. A total of 205 Tuzigoot phase sherds were analyzed in 2012, compared with 124 reported in 1954 (Table 3). Higher counts noted in 2012 include sherds originally removed from the site by National Park Service worker George Boundey in 1927.[3] Additionally, type designations such as Awatovi Black-on-yellow and Los Muertos Polychrome were not available to analysts in 1934. The artifact counts and type designations recorded in 2012 are therefore different than those reported in 1954.

The archaeological provenience of artifacts determines the human activities and behaviors they date (Christenson 1994). For instance, cross-dated ceramics lying directly on the floor of a room may provide a date range for the room's last use. Although many plain ware sherds and vessels were noted within excavated rooms, only two well-dated vessels, both Jeddito Yellow Ware bowls were reported on the floors of Room 2a and 3.[4] Decorated sherds described as Jeddito Black-on-yellow and Gila Polychrome were also noted on the floor of Room 3a

Table 3. Castle A Ceramic Types Analyzed in 1954 and 2012.

Type	Percentage (count) 1954	Percentage (count) 2012
Awatovi Black-on-yellow	N/A*	7.8% (16)
Bidahochi Black-on-white	0.8% (1)	0.5% (1)
Bidahochi Polychrome	0.8% (1)	0.5% (1)
Fourmile Polychrome	0.8% (1)	0.5% (1)
Homolovi (Winslow) Polychrome	11.3% (14)	16.6% (34)
Gila Polychrome	N/A*	2.9% (6)
Jeddito Black-on-orange	N/A*	0.5% (1)
Jeddito Black-on-yellow	75.0% (93)	61.0% (125)
Los Muertos Polychrome	N/A*	1.5% (3)
Tonto Polychrome	11.3% (14)	1.9% (4)
Tuwiuca Black-on-orange	N/A*	6.3% (13)
TOTAL	**100% (124)**	**100% (205)**

*Types not reported in Jackson and Van Valkenburgh (1954).

Table 4. Referenced Dates for Ceramics Found at Castle A.

Type	Ware	Date	Reference
Awatovi Black-on-yellow	Jeddito Yellow Ware	A.D. 1300-1375	Bernardini 2013
Bidahochi Black-on-white	Tusayan White Ware	A.D. 1325-1400	Wilson 2013
Bidahochi Polychrome	Jeddito Yellow Ware	A.D. 1315-1400	Bernardini 2013
Fourmile Polychrome	White Mountain Red Ware	A.D. 1300-1390	Neuzil 2008
Homolovi Polychrome	Winslow Orange Ware	A.D. 1275-1375	Hays-Gilpin 2013
Gila Polychrome	Roosevelt Red Ware	A.D. 1300-1450	Lyons and Clark 2012
Jeddito Black-on-orange	Jeddito Orange Ware	A.D. 1250-1350	Adams et al. 1993
Jeddito Black-on-yellow	Jeddito Yellow Ware	A.D. 1350-1700	Bernardini 2013
Los Muertos Polychrome	Roosevelt Red Ware	A.D. 1390-1450	Lyons and Clark 2012
Tonto Polychrome	Roosevelt Red Ware	A.D. 1340-1450	Lyons and Clark 2012
Tuwiuca Black-on-orange	Winslow Orange Ware	A.D. 1260-1350	Laurila 2005

(Jackson 1933b). Based on these descriptions, at least three rooms were occupied during the Tuzigoot phase, the period in which Jeddito Yellow Wares and Gila Polychrome overlap (Table 4). Unfortunately, Jackson and Pierce do not report proveniences for most ceramic material found at the site. Available information suggests that a majority of ceramics were found in mixed contexts including secondary refuse deposits and room spaces.

The lack of provenience information makes dating any event at the site difficult. To account for this problem, all late Tuzigoot phase ceramics were considered. The wide range of ceramic dates creates a baseline against which to assess archaeomagnetic date ranges. Late dated ceramics recovered from the site fit well within the ranges provided by archaeomagnetic sampling and analysis.

Jackson and Pierce present compelling evidence that Castle A burned in a large catastrophic fire and this paper argues the fire resulted in the site's abandonment. Late dated Tuzigoot phase ceramics and archaeomagnetic dates are reasonably determined to represent the abandonment of the site sometime in the interval from A.D. 1375-1395. Osteological evidence including the presence of an unburied body and injuries associated with violent trauma suggest the fire at Castle A was an intentionally violent event.

Evidence for Violence at Castle A

The discovery of unburied bodies or skeletal remains with evidence of trauma, especially in association with large catastrophic fires, may indicate past violent behavior (LeBlanc 1999:85). Jackson and Pierce discovered an articulated human skeleton lying under burned roof debris in Room 3a. According to Jackson and Pierce, "No burial artifacts were found, and no indication that a grave had been dug for the body. Whether this body was buried on the floor after the ceiling fell, or was lying on the floor at the time of the fire, or was buried under the clay floor of the second story cannot be determined" (Jackson and Van Valkenburgh 1954:18). A review of existing field notes and excavation photographs clearly indicate the body was lying directly on the floor at the time of the fire. In fact, field notes describe the body as "flat on floor" (Jackson 1933b). Along with possible de facto refuse found on the floor of Room 3a, this evidence suggests the room was occupied immediately before the fire. Furthermore, human remains with evidence of physical trauma and burning suggest violence was associated with the fire.

Jackson and Pierce note human remains representing two individuals with evidence of violence in Cist Graves 4 and 5, a single burial shaft containing the remains of four individuals located immediately west of the site. According to Jackson and Pierce,

> One peculiar feature about the skull fragments was that each of two male skulls showed, on the posterior portion of the right parietal bone, several straight, ragged cuts, such as could have been caused by a blunt stone axe. One had been broken entirely through. Acts of violence were evidently not unknown at Castle A [Jackson and Van Valkenburgh 1954:25].

Evidence for violence and burning on skeletal remains representing three individuals found at Castle A were reanalyzed by the Arizona State Museum, two of which were described by Jackson and Pierce above. All three individuals, each male, were found within Cist Graves 4 and 5. Cut marks and fractures are located across the cranial vault and there is evidence of burning on the interior portion of each fracture consistent with the singeing of live bone. (James Watson, personal communication 2012). Ethnographic data suggests that cranial vault fractures are com-

mon indicators of violence in the American Southwest and result from close combat fighting with clubs or other blunt objects (Nado 2013).

It is important to note that the only human remains with evidence of violent trauma found at Castle A are located in the same burial context. Similarities in the type of trauma and burning found on each skull suggest individuals in Cist Graves 4 and 5 were killed in a distinct and simultaneous event associated with the fire at Castle A. Archaeological evidence therefore strongly suggests the Castle A site was destroyed in a large fire with associated violence. Many archaeologists argue social change and violence appear together in areas throughout the Southwest, including the Verde Valley (Haas and Creamer 1997; LeBlanc 1999; LeBlanc and Rice 2001; Wilcox et al. 2001; Wilcox and Holmlund 2006). Violence at Castle A may therefore fit with evidence for social stress found throughout the Verde Valley in the 13th and 14th centuries.

Evidence for Violence in the Verde Valley

Cross-cultural studies conclude that the causes of prehistoric violence are variable (Ember and Ember 1992; Thorpe 2003). Interpreting the motivation for violence is difficult, although larger regional patterns noted in the archaeological record may suggest that communities were aware of social conflict or afraid of violence. During the 14th century, population aggregation accompanied by large scale abandonment has led archaeologists to speculate about political organization and social interaction within the Verde Valley. During the Tuzigoot phase, populations coalesced into larger and concentrated settlements along the Verde River and its tributaries (Pilles 1996; Powers and Pearson 2008). Hill top forts with line of site and aggregated pueblos with defensive features such as roof entries, loop holes and perimeter walls are commonly cited as evidence of fear of violence (Pilles 1981; Wilcox et al. 2001; Wilcox and Holmlund 2006). Perhaps the events at Castle A were related to increasing social stress throughout the Verde Valley. Future research is needed to investigate this premise in more detail.

Past Archaeological Interpretations of Violence

Evidence of fire and violence are noted in earlier archaeological reports throughout the American Southwest, though these reports were often short and largely undeveloped by contemporary standards (Haas and Creamer 1997:235; LeBlanc and Rice 2001:9; Wilcox and Haas 1994:213). These reports look outside the pueblo world for attackers, usually settling on groups such as Athabaskan and Yuman speakers (Jackson and Van Valkenburgh 1954:50; LeBlanc 1999:25; Wilcox and Haas 1994:214). In his 1933 Master's thesis Earl Jackson speculates that overpopulation and social stress resulted in the construction of defensive architecture throughout the region. He rejects the popular notion that non-Puebloan groups drove out occupants and briefly discusses the role that intra-cultural conflict may have played within the Valley (Jackson 1933a:101). Jackson's interpretation of Verde Valley prehistory is incorporated into the Castle A report.

Jackson and Pierce conclude that Castle A burned in a fire occurring long after the site's abandonment. This paper presents an interpretation of evidence that is very different than Jackson and Pierce's penultimate conclusion. New techniques such as archaeomagnetic dating supplement existing information and provide new avenues for understanding the site. Despite this, it is important to briefly consider factors influencing their interpretation. In their conclusion, Jackson and Pierce cite stratigraphic evidence as proof of a post-abandonment fire at Castle A. Their report also acknowledges evidence for a large fire, evidence for violent trauma on human remains, social stress and fear of violence in the area as well as *defacto* refuse within several rooms. Why then, did they only use stratigraphy as a basis for interpreting the site?

Jackson and Pierce refer to the prehistoric inhabitants of Castle A as the "peaceful ones" (Jackson and Van Valkenburgh 1954:50). This follows the popular 1930s notion that all Pueblo society was egalitarian and peaceful (Benedict 1930, 1934). This also suggests that their interpretation of site abandonment may have been affected by the widely held belief that violence and warfare among ancestral pueblo people was unlikely.

Additionally, in the 1930s very little was known about the prehistory of the Verde Valley. The inductive approach of professional archaeology advocated for the construction of geographic culture areas over site-specific research questions. Jackson and Pierce were focused on descriptions of artifacts and architecture applicable to larger regional classifications of prehistory. They consider several possible explanations for the abandonment of Castle A including violence, drought, and disease, but do not settle on any. As they write, "No single satisfactory reason for the abandonment, in the fifteenth century, of the Castles and of other Verde Valley sites can be offered at the present" (Jackson and Van Valkenburgh 1954:50). The value of Castle A, it seems, was in its ability to provide explanations for the abandonment of the Verde Valley as a whole. With a general lack of support for archaeological interpretations of violence

and no evidence of violence or fire at other sites, Jackson and Pierce may have chosen to focus solely on stratigraphy as a means of explaining the abandonment of Castle A.

SUMMARY AND CONCLUSIONS

Jackson and Pierce's work at Castle A is an important milestone in the development of archaeology in the Verde Valley. Although their interpretation has been questioned, the excavation is historically important. Site information reported by Jackson and Pierce helped to develop the Southern Sinagua archaeological culture area, a unit that continues to be used by archaeologists today. In the 80 years following the excavation, new scientific techniques and theoretical paradigms supplement existing information and create new opportunities for reinterpreting the site to visitors. Despite this, additional work is needed to refine the preliminary interpretations presented in this paper.

Future Research Needs

Native American oral history often provides an accurate reconstruction of past events and insights into larger social processes (Ferguson and Colwell-Chanthaphonh 2007; Teague 1993). The National Park Service is currently working with culturally associated tribes to develop appropriate ways of collecting and presenting oral histories about the Castle A and Montezuma Castle sites. Recently collected histories from Hopi, Yavapai and Apache representatives supplement the conclusions presented here by recounting a violent attack and the destruction of the site by fire. More work is needed to develop an interpretation of prehistoric events that incorporates archaeological data and traditional knowledge in a defensible and culturally appropriate way.

The preliminary results presented here also raise several new questions about the site's relationship with the Montezuma Castle cliff dwelling. De facto refuse within two rooms at Castle A suggests the site was at least partially occupied at the time of the fire. An ongoing architectural study at the Montezuma Castle cliff dwelling is investigating the construction sequence and history of occupation at the site. This study may provide important information regarding the social impacts of the Castle A fire. For instance, was Montezuma Castle also abandoned after the fire, or did the remaining inhabitants from Castle A move into the cliff dwelling. It is exciting to consider how additional work incorporating a combination of archaeological methods and traditional knowledge will provide possible answers to these questions.

Notes

1. Van Valkenburgh is the married surname of Sarah (Sallie) Pierce. Ms. Pierce was unmarried during the Castle A excavation, but subsequently wed before the publication of the report in 1954. Her married name therefore appears on the final publication.

2. Archaeomagnetic analysis dates the last thermal event producing temperatures at or above the Curie Point for hematite (580-680º C). Subsequent temperatures below the Curie Point will not result in datable thermal events.

3. George Boundey was an avocational archaeologist and National Park Service employee hired to excavate the Castle A site in 1927. He collected artifacts from many of the rooms within the site, including Rooms 1 and 2.

4. A Jeddito Black-on-yellow bowl from Room 3 is listed in the WACC collections as MOCA-82, Accession 02. A "Brown-on-yellow" bowl is reported for Room 2a in Jackson and Van Valkenburgh (1954:16), although no matching provenience is listed for this bowl in the current WACC collections.

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THE TUZIGOOT PHASE OF THE SOUTHERN SINAGUA

Peter J. Pilles, Jr.

ABSTRACT

Prehistoric human occupation in the Verde Valley culminates with the Tuzigoot phase of the Southern Sinagua between A.D. 1300 and 1400. The Tuzigoot phase is significant for its aggregation of the population into about 61 large pueblos of 20 to over 200 rooms. Archaeological survey data indicate these pueblos are regularly spaced at about 3 km intervals along perennial streams as well as across the Valley itself. Another spacing interval, of about 30 km occurs between the very largest sites and may have linked them to other large pueblos across central Arizona. Social and religious integration within and between the pueblos is inferred from a variety of specialized rooms, large architectural features, and different site plans. Plaza-oriented sites may be a function of their proximity to a cultural frontier with the Salado. A dynamic trade system is indicated by different ceramic types; however, these distributions indicate a striking lack of interaction between the Sinagua and their closest neighbors, the Salado. Besides the natural mineral resources of the Valley, exchange of cotton, textiles, and agricultural foods may have been important trade commodities. Previous arguments for abandonment of the Valley after 1400 have suggested overpopulation, climate change, soil exhaustion, and conflict as causal forces. However, estimates of potential food production and population size suggest these are not likely explanations.

The earliest definition of the Sinagua tradition (Colton 1939) placed them within the broader framework of the Mogollon Culture. The early portion of Sinagua prehistory does show much greater similarities to the Mogollon than to the Anasazi or Hohokam, as evidenced by basic cultural traditions of plain ware pottery, occasionally smudged and polished; early use of red slip; large pit houses with ramp entryways; square to rectangular benched kivas; primary villages with community rooms; dual technology of coil and scrape as well as paddle-and-anvil ceramic production; early use of flexed inhumation burial practices, mostly changing to extended inhumations after AD 1000; vertical occipital deformation; and specialized dry-farming agricultural technologies to the clay-based soils of the Mogollon Rim. In the later part of their history, after AD 1000 and particularly after AD 1300, they have often been included as part of the Western Pueblo Tradition (Reed 1948). It is the latest part of the Sinagua in the Verde Valley, the Tuzigoot Phase of AD 1300-1400, which is the subject of this paper.

Although archaeological investigations have been conducted within the Verde Valley for almost 150 years, data with which to reconstruct the course of prehistoric developments within this area are still frustratingly lacking. Present evidence suggests initial sedentary populations by AD 500/600, developing from Archaic Period antecedents, with populations specializing in the exploitation of both the upland portion of the valley, along the bench of the Mogollon Rim, and in the lowland regions along the courses of the Verde River and its major tributaries. The specific localities within the Valley occupied by the major population concentrations shift through time and seem to be related to major climatic fluctuations, although the theme of populations specializing in maximizing the resource potential of different environmental zones is one that characterizes the valley throughout its history. This theme, that the population of the Verde Valley consisted of geographic localities that had social identity and cohesiveness through time, will be developed further in this paper. First, however, problems with dating the Tuzigoot phase and the traditional interpretation will be addressed. New data resulting from archaeological surveys over the years since the traditional interpretation was proposed are presented

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as a basis for its evaluation and to offer new perspectives on the Tuzigoot phase.

DATING THE TUZIGOOT PHASE

We have very little evidence to provide concrete dates for the Tuzigoot phase, let alone the entire Southern Sinagua sequence, except in a very general manner. Our lack of substantial dates for this period is partly due to a lack of excavation in Tuzigoot phase sites. Only four Tuzigoot phase sites and small portions of two others have ever been professionally excavated: Tuzigoot, the site from which most dates have come (Caywood and Spicer 1935); Montezuma Castle A, which was basically a salvage excavation of the burned and tumbled remnants that were left after 75 years of pot hunting (Jackson and Van Valkenburgh 1954); five of the 48 rooms at Perkins Pueblo (Alger 1968); six rooms at Oak Creek Valley Pueblo, a 10-15 room pueblo that is dominantly Honanki phase but with some ceramics indicating an early Tuzigoot phase occupation (Williams 1985); a scatter of sherds washed downslope from the Clear Creek Ruins (Stebbins et al. 1981); and one small cavate at the Clear Creek Ruins (Hudgens 1975).

Besides a dearth of excavation, our lack of solid dates is due, ironically, to the mild climate of the Verde that makes it so desirable for human occupation. Because of this, trees in the Verde are complacent, and do not show the ups and downs of climatic variation as they do in higher elevations. Consequently, less than a third of all tree-ring samples from Tuzigoot phase sites collected have been datable.

As a rough estimate, out of approximately 100 tree-ring samples that have been collected from 18 Tuzigoot phase sites, only 34 samples from four sites provided dates. Of these, only 17 samples dated to the 14th century and 11 of these are from a single site, Tuzigoot. With one exception, all other dates are pre-1300. Boulder Canyon Ruin has one date (1302vv) (Robinson 1981) and the latest dates came from Tuzigoot (1386r and 1386vv) (Bannister et al. 1966:12-14), Perkinsville (1387r) (Dean 2000), and the West Clear Creek Cliff Dwelling (1323v) (Robinson 1979). All of these dates would still support an occupational ending date by AD 1400.

The major basis for dating Tuzigoot phase sites is ceramics, yet even this information is grossly inadequate. In consulting the site records for approximately 184 Tuzigoot phase sites identified by this study, less than half have some sort of identifications of the ceramics present on the site: only six accounts give sherd counts from the excavations noted above; 14 only note the types present; 31 are grab samples; and only 11 are from controlled surface collections. Almost all Tuzigoot phase assignments for sites are based on the occurrence of Tuwiuca Black-on-orange, Homol'ovi Polychrome, Awatovi Black-on-yellow, and Jeddito Black-on-yellow (the ubiquitous hallmark of the Pueblo IV period). Yet how confidently can we distinguish 14th to 15th century Hopi Yellow Ware from that produced in later times, particularly considering the small size of most Jeddito Yellow Ware sherds that remain on the surface of sites? Nonetheless, sherds that have been identified, vessels from excavations, and pot hunted collections are dominated by the previously mentioned Winslow Orange Ware and Jeddito Yellow Ware types.

At one point I proposed that more time was needed to account for the diminishing population of the valley and suggested the Tuzigoot phase might extend beyond AD 1425 (Pilles 1981:16). Several reports have cited this 1425 date for the end of the Tuzigoot Phase (e.g., Gilpin et al. 2010:8; Greenwald 1989:24; Hall and Elson 2002:10; Logan and Horton 1996:11; Powers and Pearson 2008:30; Weaver 2000:7). However, ceramics and tree-ring dates do not yet support a terminal date for the Southern Sinagua later than AD 1400. One sherd of Sikyatki Polychrome was recently confirmed at a site in the Verde uplands. But with the exception of unconfirmed reports of a single sherd apiece of post-AD 1400 types such as Sikyatki Polychrome (AD 1375-present) and perhaps Santa Ana or Zia pottery (AD 1700-1750) from the Clear Creek Ruin, the virtual absence of Sikyatki Polychrome anywhere in the Verde Valley suggests that the end of the Sinagua sequence is somewhat even earlier than AD 1400.

Early and Late Tuzigoot Phase

In recent surveys conducted in the Verde Valley, as controlled sampling or complete analysis of ceramics on sites has become more common, I have observed that a distinction can be made between the early and late stages of Tuzigoot phase sites on the basis of ceramic assemblages. "Early Tuzigoot phase" is characterized by a dominance of Winslow Orange Wares, Verde Brown, and Verde Red, while "Late Tuzigoot phase" is dominated by Jeddito Yellow Wares, Tuzigoot Plain, and Tuzigoot Red. Hudgen's (1975) excavation at Exhausted Cave, a cavate in the Clear Creek Ruin complex, seems to provide some stratigraphic support for this as well. A similar temporal division based on the proportions of Winslow Orange Ware and Jeddito Yellow Ware has also been noted by the Homol'ovi Research Program (Adams 2001:123-125). This temporal distinction is providing more information about potential changes in settlements, population aggregation, and potential allianc-

es in the Verde and adjacent areas (See below and cf. Wilcox 2005, Wilcox and Holmlund 2007:21).

TRADITIONAL INTERPRETATION OF THE TUZIGOOT PHASE

Since the 1940's it was asserted that the Flagstaff area was mostly abandoned between AD 1130 and 1250 as people moved below the Rim and were responsible for the numerous masonry pueblos and cliff dwellings in the Verde Valley that characterize the Honanki phase (Colton 1946:304, 311; Schroeder 1975:20).

By AD 1300, supposedly in response to the Great Drought of AD 1276-1299, it has been thought that the existing population in the Valley, along with their migrant relatives from the north, made major population shifts and concentrated into a number of large pueblos located along the Verde River as well as its perennial tributary streams. These were estimated to average 40 rooms each, with the largest being about 100 rooms in size (Caywood and Spicer 1935:12-13).

This aggregation was thought to result in overpopulation and taxing of the floodplain agricultural production. Water rights and practices, established during earlier times, became disrupted. This caused strife and a choice of hill-top locations for defense. To make up for the supposed loss of agricultural resources, hunting and gathering were suggested to have increased.

All was lost by AD 1400, when the system collapsed – a time proposed by some when the Yavapai entered the Verde Valley, hastening the demise of the Sinagua from the archaeological record (e.g. Caywood and Spicer 1935:106; Fewkes 1913:185; Gladwin and Gladwin 1930:201; Schroeder 1954:18; Schroeder and Hastings 1958:10).

REVIEW OF CURRENT DATA

Examination of the data collected since the 1940s, when the traditional concepts were first conceived, however, suggests a somewhat different picture. Rather than attributing an apparent A.D. 1130 to 1250 population increase in the Verde Valley to an influx of Northern Sinagua abandoning the Flagstaff area, survey data indicate that both areas saw their greatest geographic extent and largest number of sites during this time. From an initial estimate of 19 large Tuzigoot phase pueblos, (Caywood and Spicer 1935:13), that number has grown over the years to 40 (Fish and Fish 1977:18; Pilles 1981:14), and 50 pueblos (Tagg 1986:32). Today, approximately 60 large pueblos, ranging from 20 to 250+ rooms, have now been identified, although all of these were previously identified by Mearns in the 1880's (James and Pilles, this issue). Importantly, they are not restricted to riparian settings, as previously thought, but occur in upland situations as well (Figure 1, Table 1). Survey work by the Arizona Archaeological Society, Verde Valley Chapter, has identified a settlement and land use pattern around these late upland pueblos with a full complement of Tuzigoot phase site types, including agricultural fields, field houses, five-to-six room pueblos, 18 to 20 room pueblos and seven 20+ room pueblos such as Boulder Canyon, Hackberry Basin, and Salome (Graceffa 2010).

In addition, rather than widespread relocation of the population, it appears that most of the aggregation into the large pueblos was of a more localized nature. Examination of pre-Tuzigoot phase site distributions in the Perkinsville, Montezuma Well, Sacred Mountain Basin, Clear Creek, Fossil Creek, and Hackberry Basin areas – each the center of one or more large Tuzigoot phase pueblos – reveals the presence of AD 900 pit house sites as well as 10 to 19 room Honanki phase pueblos within a few km radius of the Tuzigoot phase pueblos. This suggests the populations of the Tuzigoot phase pueblos may have existed as distinct social communities prior to their coalescence into small pueblos, some of which became the core of large Tuzigoot phase pueblos as other Honanki phase pueblos in their vicinity were abandoned. During this time, some of the pueblos of 10 to 19 rooms (N=18) could represent seasonally occupied villages akin to the historical relationship of Nutria, Pescado, and Ojo Caliente to Zuni, or Moenkopi to Oraibi; farmsteads of 3 to 9 rooms (N=16); and field houses of 1 to 2 rooms (N=31).

Specialized activity sites to support the large pueblos have also been identified. Field houses are most common in the uplands, on the bench of the Mogollon Rim and its flanks, and are often associated with dry farming field sites of linear borders, gridded borders, and rock-cleared areas. Direct association of all 1 to 2 room sites in the uplands with the Tuzigoot phase is difficult, since decorated ceramics that can be used for temporal placement of the sites are rare. Hence, many more sites of this sort that have been recorded but lack decorated ceramics may also date to the Tuzigoot phase. Future work in seriating the various, mostly undescribed, plain ware varieties may help assign these sites to temporal periods more precisely than is possible at present (e.g., Christenson 1999, Watkins and Kelly 2014). These 10 to 19 room pueblos of the Honanki-early Tuzigoot phase tend to have large rooms of 22 to 28 sq. m., whereas most rooms in the later pueblos are smaller, about 11.1 to 18 sq. m. in size. In many of the large pueblos, it is not uncommon to see larger rooms, presumably the

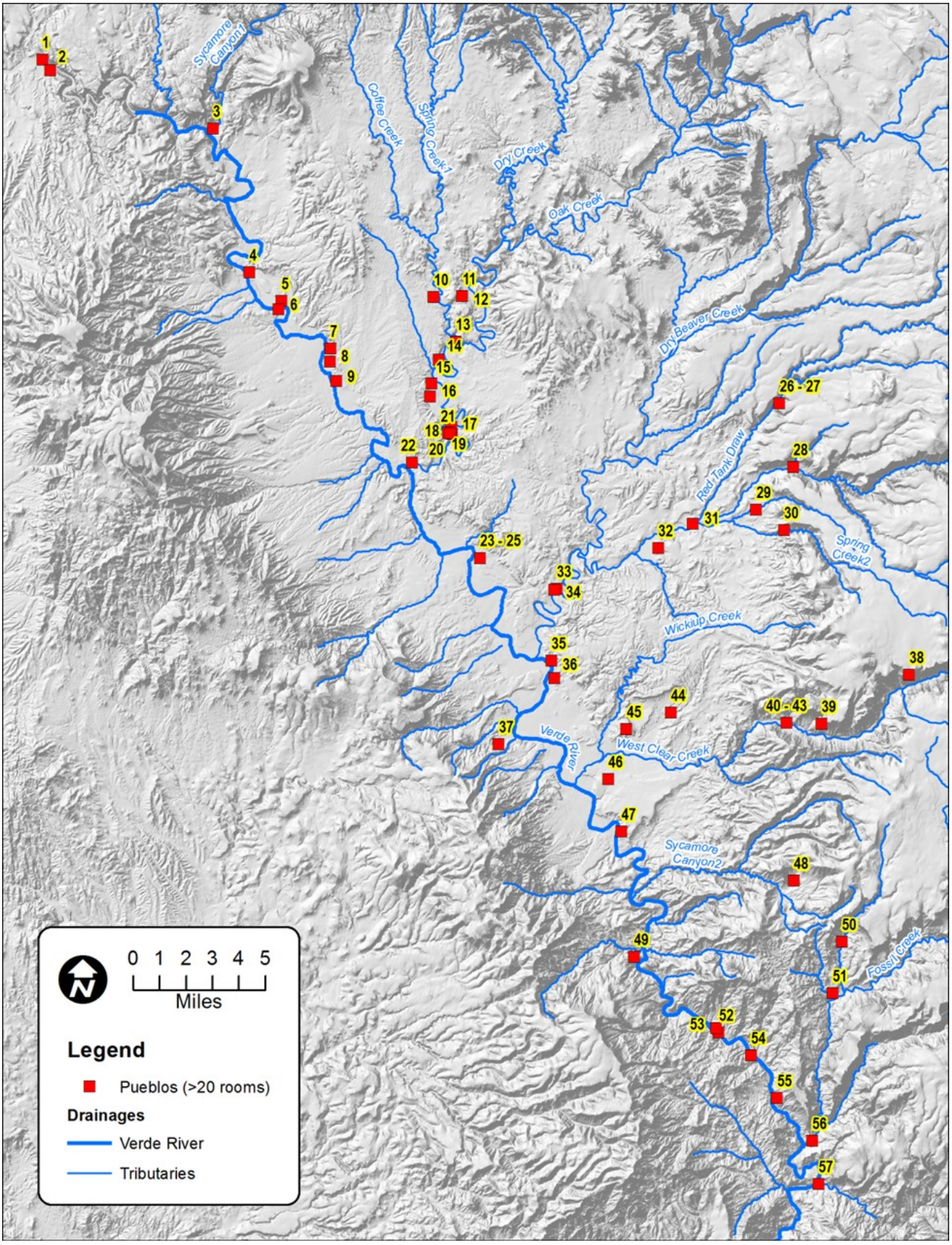

Figure 1. The Tuzigoot phase world, AD 1300-1400, showing pueblos with 20+ rooms in size. See Table 1 for key to site numbers.

Table 1. Key to site numbers in Figure 1.

Map No.	Name	USFS Site No.	Other Site Numbers/Names	No. Rooms	No. Pueblos
1	Perkins Pueblo		NA2940,NA9469, AZ.N:4:14(ASM), AZ N:4:2(ASU)	50	1
2	Perkinsville Cave		NA2439, AZ.N:4:15(ASM), AZ N:4:1(ASU)	17-20	1
3	Packard Ranch Pueblo	AR-03-04-06-05	NA3501, AZ.N:4:4(ASM), King's Ruin A	30-45	1
4	Hatalacva		NA1263, NA5225, AZ.N:4:27(ASM), Verde:5:42(GP)	105	2
5	Tuzigoot Extension		NA1261, NA2733, AZ.N:4:1(ASM),*Tsor'ovi,*	94	4
6	Tuzigoot Extension		AZ.N:4:26(ASM)	20	1
7	Stone House Flat		NA1259, Verde:5:7(GP)	13	1
8	Stone House Flat		NA1260, Verde:5:8(GP)	12	1
9	Bridgeport	AR-03-04-06-74	NA979, NA1258, AZ.O:5:21(ASM), Verde:5:3(GP), Verde:5:41(GP), All Nations Ruin, Haydorne Hill, *Honovi*	170-240	2
10	Spring Creek	AR-03-04-06-1151	NA26,019	45	2
11-12	Page Springs	AR-03-04-06-87, 392, 393	NA4645B, NA5223B	57	3
13	Oak Creek Valley	AR-03-04-06-341	AZ.O:5:7(NAU)		1
14	Sheepshead	AR-03-04-06-160	NA7327, NA9467	20-30	1
15	Cornville	AR-03-04-06-43	NA1268, AZ.O:5:1(ASM)	60-70	2
16	Little Cornville	AR-03-04-06-83	NA19,100	9	1
17	Sugarloaf Group	AR-03-04-06-75	NA1265, AZ.O:5:19(ASM),Verde:5:11(GP)	9	1
18	Sugarloaf Group	AR-03-04-06-76	NA1266	2	1
19	Sugarloaf Group	AR-03-04-06-77	Iron Rock Ruin, NA1267, AZ.O:5:18(ASM), Verde:5:10 (GP)	5	1
20	Sugarloaf Group	AR-03-04-06-78	NA1269, AZ.O:5:20(ASM), Verde:5:12(GP)	55-65	1
21	Sugarloaf Group	AR-03-04-06-79	NA1270	1-3	1
22	Oak Creek Ruin	AR-03-04-06-41	NA1500, AZ.O:5:13(ASM), Verde:5:34 & 35(GP)	25-40, 13 cav.	1
23-25	Middle Verde	AR-03-04-01-26 to 28	Talbot Ranch Ruin,NA3526, NA8959, Verde:5:38(GP)	120-165, 7 cav.	2
26-27	Rarick Canyon	AR-03-04-01-302	Riordan Canyon Ruin, NA3993A, NA6296	60-70	4
28	Casner Canyon	AR-03-04-01-85	NA3617, AZ.O:6:13(NAU)	40	1
29	Sacred Mountain	AR-03-04-01-80	Ida Ruin, White Hill, NA3808, NA4626, Museum of New Mexico 8-542	38	4
30	Walker Creek	AR-03-04-01-69	NA5550.	20	1
31	Montezuma Well	AR-03-04-01-304	NA1273A	24-30	1
	Montezuma Well	AR-03-04-01-305	NA1274	10-20	1
32	Jackson Ranch	AR-03-04-01-43	NA1275, NA1276, NA10,025, AZ.O:5:10(ASM), Thoeny Site, Goodwin-Sayles 4, 8/797 Museum of New Mexico	30	3
33	Montezuma Castle	AR-03-04-01- 34	NA1278, AZ.O:15:14(ASM), *Wupatpela, Hotsiquayvi, Hotsikvayki, Sakaytaka*	25	1
34	Montezuma Castle A	AR-03-04-01-640	NA6383, *Gaan begowa*	57	1
35	Calloway Ruin No. 2	AR-03-04-01-58	NA3519(NA4093), Verde:5:14(GP)	80-160	5
36	CV Hill	AR-03-04-01-59	NA3520, NA4094, Verde:5:16(GP)	30-50	1
37	Salt Mine Pueblo	AR-03-09-05-26	NA6662	20	1
38	W. Clear Cr. Cliff Dwelling	AR-03-04-01-342	NA6668	21	1
39	AR-03-04-01-14	AR-03-04-01-14	NA12,533	23	1
40-43	Bull Pen Ranch	AR-03-04-01-246	NA2448, Verde:5:29 & 30 (GP)	32	4
44	John Heath Ruin	AR-03-04-01-68	NA18,495 Verde:5:25(GP)	100	1
45	Clear Creek Ruin	AR-03-04-01-05	NA2806, AZ.O:5:5 and 25(ASM), Verde:5:20 and 21(GP)	62-100, 58 cav.	4
46	Wingfield Mesa	AR-03-04-01-67	Verde Ruins, NA4624 (NA3521, NA2494, NA3664), Verde:5:18(GP)	37	1
47	Mindeleff's Cavate Lodge Group	AR-03-04-01-266	Beasley Flat, Osborne Flat Ruin,	29, 256 cav.	1

cav. = cavates

Table 1 (continued). Key to site numbers in Figure 1.

Map No.	Name	USFS Site No.	Other Site Numbers/Names	No. Rooms	No. Pueblos
48	Doren Castle	AR-03-04-01-100	NA3604	61	1
49	Brown Springs	AR-03-09-05-201	NA5348A	50	4
50	Boulder Canyon	AR-03-04-01-255	NA19,287	44	1
51	Salome	AR-03-04-01-254	NA19,286; Verde:10:12; Sally May	30	5
52	AR-03-04-01-498		NA18,961	30	1
53	AR-03-04-01-499		NA18,960	42	1
54	Verde Hot Springs	AR-03-12-01-52	NA7187, AZ.O:10:14(ASM)		1
55	AR-03-04-01-25	AR-03-04-01-25		25	1
56	Fossil Creek Ruin	AR-03-04-01-521	NA3515, Verde:10:6 (GP)	26	1
57	East Verde Ruin	AR-03-12-04-45	NA3514, Verde:10:7 (GP)	38	1

cav. = cavates

earlier portions of the pueblo, to be divided in half at some point after their initial construction (e.g., Mindeleff 1896: Plate XVII). For the large pueblos, ranging from 20 to 200 rooms, there are few clear size breaks, but they can be divided into five size classes: 20 to 29 rooms (N=24), 30-39 (N=14), 40 to 79 rooms (N=14), 80 to 100 rooms (N=3), and over 100 rooms (N=6).

The majority of these sites have a massed room block plan, such as Clear Creek Ruin and the East Verde and Fossil Creek Ruins (Mindeleff 1896: Figure 280 and 281) similar to earlier Sinagua pueblos in both the Verde and Flagstaff regions. However, other layouts are evident: 1) plaza-oriented, such as Wingfield Mesa Ruin (Mindeleff 1896:Figure 286), Sugarloaf, and Cornville Ruin; 2) courtyard-oriented, such as Sacred Mountain and the John Heath Ruin; and 3) clustered, such as Blocks IV and VI at Tuzigoot (Caywood & Spicer 1935:16), with open areas between room blocks that may have served as plazas (Pilles 1996:66-67). It is significant that plaza and courtyard oriented sites tend to occur in the lower part of the valley, near Fossil Creek and the East Verde. Such sites are more commonly found further downstream to the south (see North et al. 2003) where they are typically associated with Gila Polychromes.

Cliff dwellings are also present, and while some, such as Montezuma Castle, occur in the lowland/valley proper, most are located in the rugged canyon country that cuts into the upland zone, such as the West Clear Creek cliff dwelling. In addition, there are numerous smaller cliff dwellings that cannot be dated due to a lack of decorated ceramics. These occur all up and down the lowland stream courses such as Beaver Creek, but are also numerous in the upland canyons, such as along Fossil, upper Beaver, and West Clear Creeks. Although it cannot yet be demonstrated, it is strongly suspected that many of these small sites might also date to the Tuzigoot phase, since Tuzigoot phase field houses can be identified on the bench of Mogollon Rim above them. Some sites occur on top of prominent hills, such as Sacred Mountain, Sugarloaf, and the Bridgeport Ruin.

CEREMONIAL AND COMMUNITY STRUCTURES

The absence of ceremonial structures has often been cited as a characteristic of the Sinagua (Smith 1952:151-165; Schroeder and Hastings 1958:10-11; *cf.* Colton 1946:273). However, it is now generally accepted that they did built such structures (Downum 1992:22; Kamp and Whittaker 1999:30-35; Kelly and Skinner 1966; McGregor 1955; 1967:302, 380, 419-420; Pilles 1987:7). By AD 1150, Sinagua kivas are rectangular in shape with a raised bench across the narrow end of the room, usually the north side. Although none have yet been excavated in the Verde Valley, they can be recognized in the cliff dwellings of Honanki and Palatki (Figure 2).

Caywood and Spicer (1935:36-37) identified one room at Tuzigoot as a possible “ceremonial room,” primarily because a “raised platform” had been constructed along the south side of the room. However, they indicate it was only 21 cm thick and 13 to 21 cm deep and would seem to be a perimeter bench, rather than a platform. The raised benches in Sinagua kivas are typically much higher, usually about 1 m. The Tuzigoot “platform” is more akin to the slightly raised platforms or benches found in cavate rooms, such as at Montezuma Castle, Clear Creek Ruins, Oak Creek Ruin, and Mindeleff’s Cavate Lodge group. No artifacts or specialized features were identified, only an informal burned area, rather than a defined hearth. The original configuration of the room had been changed by later remodeling, with two wall stubs dividing what had been one room into three.

Figure 2. Kiva at Honanki. Notice raised bench at north end of room.

Overall, however, this room does not match what have been considered to be "kivas" in the Verde Valley and Flagstaff areas.

Sinagua "Great Kivas," or, more appropriately, "community rooms," are also found on some sites. Schroeder (1975:18) noted the presence of these unusually large structures during his Verde Valley survey in the 1940s, but did not suggest a communal function for them. In Tuzigoot phase pueblos, about 20 community rooms are known in the Middle Verde Valley with the best examples evident at Montezuma Well, the Jackson Ranch Ruin (Figure 3), Sacred Mountain, and Page Springs Ruin. They range in size from 28 to 352 sq. m and average about 108 sq. m. Three size classes seem to be present: 28 to 79 sq. m (N=11), 80 to 157 sq. m (N=6), and 195 to 352 sq. m (N=3). They occur in diverse locations within a site: as rooms inside a massed pueblo; on the edges of a pueblo; or as separate structures and appear to have been later additions to the pueblo.

Other possible communal constructions include two "race tracks" and a "dance plaza." Race tracks are linear areas that have been cleared of rocks and are as much as 1 km in length. Two have been identified in the Middle Verde, in the Hackberry Basin area, but they are more commonly found in areas outside the main valley, such as at Polles Mesa and Perry Mesa (Russell 2012). Only one "dance plaza" is known, and that is at the Clear Creek Ruin (Figure 4). It is a 30 by 40 m sub-triangular area isolated from the main pueblo and is outlined by large boulders and a raised berm of earth. A ceremonial function is inferred from its spatial separation from the main occupation areas of the site and association with several natural blow holes and a unique and unusual serpentine shaped geoglyph.

SPACING AND SETTLEMENT DISTRIBUTIONS

The distribution of Tuzigoot Phase towns consists of five linear groups that follow the Verde River and its four major tributaries – Oak Creek, Beaver Creek, West Clear Creek, and Fossil Creek. While proximity to optimal areas of alluvial farmland seems to be one factor in site selections, social reasons also seem to be involved, since sites occur at regularly spaced intervals of 2.7 to 3.2 km (1.7 to 2 mi), and other alluvial bottomlands that offer attractive locations for settlement were passed by. There is also a secondary spacing throughout the Valley where sites cluster within 0.4 km (0.25 mi) of each other, such as at Tuzigoot Extension, Walker Creek, Verde Hot Springs, Middle Verde, and Page Springs.

Figure 3. Community rooms at Jackson Ranch Ruin.

Figure 4. Clear Creek Ruin "Dance Plaza" at tip of mesa; Main pueblo is on the hill in upper left of photo. Cavates are scattered along the outcrop layers below the main pueblo.

The chain of sites located along the primary tributaries suggests the presence of communities that connect the pinyon-juniper upland resource zone of the canyons and flanks of the Mogollon Rim with the riparian zone in the lowlands. Sites in the uplands have an abundance of mescal knives and higher frequencies of flaked stone than the lowland sites. Although this may be the result of later intensive use of this area by the Apache and/or Yavapai, I suggest that in prehistoric times there was specialized resource exploitation and redistribution between the upland and lowland sites within each of the drainage chains. The upland sites likely specialized in hunting and gathering the wild plant resources of the uplands, such as agave, prickly pear, and pinyon, as well as dry farming. The lowland sites are in areas where irrigation of corn, beans, squash, and cotton would be more productive, for example.

Within each of these settlement chains, one site has characteristics that suggest it may be a central place for its drainage community. They are typically plaza or courtyard oriented pueblos located atop prominent hills, such as Sugarloaf and Sacred Mountain. Walls divide the sites into inner and outer courtyards with a community room inside the inner courtyard. In the case of Sacred Mountain, a ballcourt, apparently contemporaneous with the Honanki phase component of the pueblo (Schroeder 1949), is also located at the base of the hill. This identical layout is also seen in the Flagstaff area during the AD 1150-1250 period at sites such as Ridge Ruin and Juniper Terrace and continues in a slightly modified form at Nuvakwewtaqa (Chavez Pass). Fish et al. (1980) have noticed such sites have a higher frequency of trade pottery and luxury items such as shell and mineral ornaments and are situated along potential trade routes based on ethnographic and historical accounts. Because of these special, unique characteristics, it is clear that these sites were not typical habitation sites of the day, but likely had very important roles in the organization of Southern Sinagua society.

Besides these community groups, the spacing between the largest sites in the Verde Valley, each with 150 or more rooms, suggest another level of social integration consisting of several combinations of drainage communities. The largest sites in the Middle Verde Valley, Polles Mesa (180-200 rooms), Mindeleff's Cavate Lodge Group (29 rooms and ca. 250 cavates) and the Bridgeport Ruin (150 to 200 rooms), are spaced about 28.8 to 32 km (18 to 20 mi) apart, dividing the valley into three more-or-less evenly-sized units. Distribution of site types and trade ware ceramics suggest these three units have distinct identities, since Salado-like characteristics, such as plaza-oriented sites, race tracks, and Gila Polychrome are concentrated in the southern end of the Middle Verde, primarily near Fossil Creek, and the East Verde River.

TRADE

Intrusive ceramics at this time show an orientation of the Verde Valley to northern groups. Pottery and obsidian from the San Francisco Mountain volcanic field near Flagstaff and Williams is evenly distributed throughout the valley, as might be expected for a Sinagua population. Hopi pottery consistently dominates the trade ware assemblages at all sites. Jeddito Yellow Ware comprises 36 percent of the decorated pottery at Montezuma Castle A and 35 percent at Tuzigoot with Winslow Orange Ware accounting for five percent at both sites (Jackson and Van Valkenburgh 1954:41; Caywood and Spicer 1935:48). A similar dominance is reflected in survey collections from other Tuzigoot phase sites as well.

The ubiquity of Hopi ceramics stands in stark contrast to the rarity of Gila and Tonto Polychromes, which are commonly found elsewhere in 14th century sites in central and southern Arizona. From excavations and surveys, they have only been reported from ten sites in the Verde Valley. They total a mere 30 sherds (of which 14 are from Montezuma Castle alone) and one bowl from the Bridgeport Ruin. The sites and approximate number of sherds found are: Bridgeport (N=1 bowl), Tuzigoot (N=6), Page Springs Ruin (N=3), Montezuma Castle A (N=14, representing three bowls), Verde Hot Springs (N=3), Salome (N=1), Boulder Canyon Ruin (N=1), Fossil Creek Ruin N=1), and the East Verde Ruin (present) (Coconino National Forest Site Files; Wilcox and Holmlund 2007:Table 11, Appendix B; Jackson and Van Valkenburgh 1935:43-44; Caywood and Spicer 1935:48; North *et al.* 2003:41). Similarly, White Mountain Red Ware constitutes less than one-percent of the decorated pottery from Montezuma Castle (Jackson and Van Valkenburgh 1954:44) and Tuzigoot (Caywood and Spicer 1935:48)

The near absence of ceramics from their Salado neighbors "just over the hill" in the next valley east of the Verde Valley suggests significant cultural friction during what is otherwise a period of dynamic exchange for both groups. Given the importance of cotton textiles for trade in both prehistoric and historic times (Adams 1991:183; Kent 1983:28, 261-262; Ford 1983), the suitability of both areas for growing cotton, and the similarity of weaving techniques used by both the Sinagua and Salado (Kent 1983:259-260, Teague 1998:184), perhaps the two areas were competitors in the market for cotton textiles.

Significantly, most of the Tuzigoot phase pueblos with Gila and Tonto Polychrome sherds are in the southern end of the Middle Verde in close proximity to the Salado. In comparing the occurrence of the

Gila Polychromes to Jeddito Black-on-yellow, at the pueblos in the north half of the Middle Verde, Gila Polychrome comprises approximately three percent of these two intrusive types, but this increases to approximately 43 percent at sites in the south end of the Middle Verde and the north end of the Lower Verde (North *et al.* 2003). It is no surprise that pueblos in the lower segment show stronger affinity with the Tonto Basin since Rye Creek and the East Verde River form a natural corridor between the Tonto Basin and the lower end of the Middle Verde. In historic times, this route was known as the "Wild Rye Creek Trail" and was an important travel route during the military campaigns of the late 1880s (Eckhoff and Riecker 1880; Ehrhardt 2012:188). It was probably an important travel and communication route in prehistoric times as well, given the prominent Rye Creek Ruin at its eastern end, and the cluster of contemporaneous pueblos at its western end.

Trade with the south is evident at all sites by a full complement of shell jewelry, including *Glycymeris* bracelets, *Olivella* beads, *Conus* tinklers, pendants, and turquoise mosaics on shell in both the "flying bird" and "frog" or "toad" motifs. Hohokam pottery is basically non-existent in Tuzigoot phase sites although red ware vessel shapes and construction in the Sinagua, Salado, and Classic Hohokam at this time are very similar, if not identical. Although remains of five macaws have been found at several sites (Hargrave 1970), it seems odd that no copper bells have been reported for the Verde, despite occurring in all areas around the Verde Valley (Vargas 1995).

As for the Verde Valley's contributions to the trade network, it does not appear to have been ceramics, since the plain ware and red ware varieties of the Verde Brown and Tuzigoot Plain ceramics are infrequent outside the valley, although these could easily be overlooked in analyses of the Lower Verde and Tonto Basin areas where they closely resemble local ceramic types. It is more likely that minerals, such as argillite, salt, azurite, and malachite were major trade items, although only small quantities of these occur in adjacent areas. Proximity of specific pueblos, such as the Argillite Mine Pueblo and Salt Mine Pueblo, to the sources of these minerals hints that individual sites specialized in trade, and perhaps restricted access to these scarce and valuable commodities.

COULD THE VERDE VALLEY HAVE PRODUCED CROP SURPUSES FOR TRADE? TUZIGOOT PHASE POPULATION ESTIMATES

In historic times, the Verde Valley was settled by Euro-American farmers to produce food for the growing towns of central and northern Arizona and this may have also been true in prehistoric times. The floodplain along the Verde River is ideal for corn and cotton production and substantial field sites have been recorded in the Verde uplands as well. Cotton, in the form of seeds and bolls, as well as woven textiles, has been recovered from many of the dry cave sites. In addition, sherd discs, as well as modeled clay spindle whorls, are common in most sites, suggesting an active cotton producing industry.

Preliminary analyses also indicate the Verde Valley could have easily produced a crop surplus. Room sizes for 65 pueblos over seven rooms in size were measured from existing site plans or estimated using a median size of 16 sq. m. This is considered a conservative estimate based on the median size of rooms at Tuzigoot (17.3 sq. m). Tuzigoot was occupied during the Honanki through late Tuzigoot phases and is the largest data set for an excavated Tuzigoot phase pueblo. Using Narroll's (1962) formula for deriving population from room sizes (population of a site is approximately one-tenth of total floor area), we get a potential maximum population of 7,000 to 8,000 people for the Tuzigoot phase. But this assumes all pueblos were inhabited during the entire time span of the Tuzigoot phase. Although we believe we are able to distinguish between early and late divisions of the Tuzigoot phase, our data are admittedly poor. Only 61 sites out of 135 can be dated, and of these 54 percent are dated by one or two sherds, and nine percent are dated by only a reference to the presence of temporally diagnostic sherd types. However, if these can be accepted as an approximation of the population size during the early and late divisions of the Tuzigoot Phase, this would suggest that about one third of the maximum population lived in both the early and late divisions, one-third only lived during the early Tuzigoot phase, and another third only lived during the late Tuzigoot phase. This reduces the maximum population of 7,000 to 8,000 people to an estimated 4,500 people during the early Tuzigoot phase and an estimated 4,700 people during the late Tuzigoot phase. In terms of the number of sites during these occupations, the number of early Tuzigoot phase sites that did not last through the late Tuzigoot phase is about the same number as the new sites that appear during the late Tuzigoot phase. This suggests a fairly stable population of about 4,600 people, with no large increments of population influx during the AD 1300-1400 time period.

Wilcox (2001:160-161) has also estimated the Tuzigoot phase population of the Verde Valley. Our estimates are almost identical with his estimates of 4,700 to 4,800 people and are a far cry from other

estimates of 20,000 people (Kralj KenCairn and Randall 2007:39). The next part of the question involves determining how much land would be needed to produce crops that would support a population of this size.

By noting the location of known prehistoric field sites onto Forest Service soils maps, we were able to isolate specific soil types used prehistorically as field locations. Using Coconino National Forest Terrestrial Ecosystems Soils Survey data (Miller et al. 1998), the acreages of potentially arable soils within the valley were computed. Five major groups of arable soil types were potentially available for prehistoric use in the Middle Verde Valley. Probably the most important, and most productive, was the alluvial floodplain and first terraces of the Verde River and its perennial tributaries. Next, would be the dryer soils adjacent to the stream terraces, consisting of mesquite, galetta grass, and creosote. Other semi-desert and desert soil types are scattered throughout the Valley below the Mogollon Rim with pinyon, juniper, oak, and grasslands. As the lower flanks of the Mogollon Rim are approached, there is a soil transition between juniper and semi-desert grassland and along the base of the Rim, the pinyon-juniper woodland zone provides soils that were farmed by the Sinagua as early as A.D. 800, based on ceramics found on agricultural sites in that zone.

With this as a basis, production and consumption figures from historic Hopi (Stephen 1936:955), as modified by Bradfield (1971:20-21), potential yield and consumption figures can be determined for these five soil zones. They estimate that one acre would produce 10-15 bushels of corn, with an average of 12 bushels (192 pounds) and that one person consumes approximately the same amount each year. Another 0.5 acre was needed for growing other vegetable crops, and, as a hedge against years of poor production, to provide a supply of seed corn, one more acre was needed. Thus, if we only look at acreage needed for annual consumption, 1.5 acres would be needed per person. If additional acreage for storage and seed corn is included, the figure becomes 2.5 acres per person. Table 2 shows the potential population estimates using each of these figures for the Southern Sinagua Tuzigoot phase population.

Such figures are fraught with potential errors and assumptions that may or may not be warranted. What types of crops were grown in which soil types, different yields from different water control features, climate in relation to soil moisture and chemistry, temperature extremes, amount of land allowed to remain fallow, variable yield depending on soil types, decreased yields as soil nutrients are depleted after several seasons of use, acceptable travel distance between home villages, field houses, and multiple field locations.

Table 2. Potential arable soils and population estimate for the Middle Verde Valley using historic Hopi data (Stephen 1936, Bradfield 1971).

Soil Type	Acres	Population at 1.5 ac/ person	Population at 2.5 ac/ person
1 Floodplain & stream terraces.	19,142	12,761	7,657
2. Desert soils near Verde River	6,727	4,485	2,691
3. Other arable soils below Mogollon Rim	32,019	21,346	12,808
4. Juniper/Semi-desert grassland transition	51,645	34,430	20,685
5. Pinyon-juniper woodland	152,066	101,377	60,826
TOTALS (numbers rounded)	**261,600**	**174,400**	**104,600**

Several caveats are immediately apparent: Coconino National Forest soils maps only provide information for soils within Forest boundaries. Consequently, the acreage figures in Table 2 only indicate riparian and terrace information for the east side of the Verde River, which forms the boundary between the Coconino, Prescott, and Tonto National Forests. Actual available acreage during the Tuzigoot phase would be greater than shown in Table 2 since, with the exception of Salt Mine and Brown Springs Pueblos, no other large Tuzigoot phase pueblos in the Middle Verde are located on the west side of the Verde River. That area could have been available for use by the pueblos on the east side of the river. Secondly, the minimal size Terrestrial Ecosystems Soils Survey mapping unit is about five acres and smaller size units may have been overlooked or combined into larger mapping units. The food potential available from wild plants and animals is not considered in this exercise, and those resources would certainly have been utilized by the Sinagua in addition to cultivated crops.

Nonetheless, such estimates can provide some relative indications of population and consumption figures. As can be seen from Table 2, despite assumptions, potential errors, and omissions, there is little doubt that the amount of potentially arable land was more than enough to have supported the 4,700 to even 8,000 people estimated as the Tuzigoot phase population in the Middle Verde Valley.

A potential direction for the trade of food may have been to the north, where other large populations existed in areas much less agreeable for agriculture than the Verde Valley – Anderson Mesa. Anderson Mesa is well within the 50 km limit identified by

Lightfoot (1979:332) for profitable transport of food staples. Such a northern focus for trade would also parallel known Hopi trade routes (Bartlett 1942:25; Colton 1964). One such major route, named the Palatkwapi Trail by Byrkit (1988), ran from the Hopi Mesas to Homol'ovi, through Sunset Pass to Chavez Pass. From there, the route likely entered the Verde Valley by way of Beaver Creek or Red Tank Draw.

ABANDONMENT?

It is generally accepted that by AD 1400 the great pueblos of the Verde Valley were abandoned, signaling an end to the Southern Sinagua cultural tradition. Reasons for this include the traditional ones of climate change, warfare, disease, and others, yet none individually are convincing. With the mild climate, permanent water, and fertile floodplain of the Verde Valley, as well as the environmental variability afforded by the upland zone, it is inconceivable that the environmental changes indicated by pollen and tree-ring records would have resulted in the abandonment of the region.

Warfare has long been suggested as one reason for an abandonment of the Verde Valley ever since the earliest mountain men and explorers entered the Valley (e.g. Protas 2002:22-23; Caywood and Spicer 1935:106; Fewkes 1913:185; Gladwin and Gladwin 1930:201; Schroeder 1954:18; Schroeder and Hastings 1958:10). Pueblo locations on hill tops or other defensible locations, loopholes, blocked-up exterior doorways, parapet walls, low doorways forcing people to bend over when entering a room, and burned pueblo rooms have been used as support for this theory.

However, while many Tuzigoot phase pueblos are located on high hills, many more are not. Many of the "high places" are simply the terrace edge above a flood plain, overlooking the best farm land. Elevated locations could be desirable for other reasons: view, greater exposure to sunshine during the winter months, to keep above cold sinks, to reduce exposure to mosquitos that breed along the sides of the streams, psychological reinforcement of dominant status in the community system, and others.

Blocked doorways may have been simple remodeling of a structure. Parapet walls can keep children from falling off of roofs. Low doorways help keep heat inside rooms in cold weather. Structures may be burned for reasons other than warfare: accidently during a forest fire, ritual closure upon abandonment of a kiva or pueblo, death of an individual, to eliminate insects from roof materials, and so forth. Within the Sinagua region, many pit houses and pueblos were burned, which is one reason why so much emphasis was placed on the Flagstaff area during the development of tree-ring dating in the 1920s.

At the Northern Sinagua site of Elden Pueblo, for example, a long tradition of burning structures upon abandonment has been recognized, starting with the earliest AD 1070s pit houses and through the latest AD 1275s pueblo occupation as well, and the Southern Sinagua may have had a similar tradition. Furthermore, even though there is little excavation data, there is no evidence of warfare in the valley at this time - no mass graves, no burials with projectile points in them, and only one skull that was theorized to have been crushed by an axe (Jackson and Van Valkenburgh 1954:25), although this is now thought to be post-mortem damage. (However, see Guebard, this issue, for a different perspective). Times of warfare would suggest diminishing trade relationships, yet the occurrence of various intrusive ceramics and other trade items within and outside the valley show no such reduction. What reasons could be suggested for warfare within the valley? The figures cited above show there was no scarcity of potential arable land, water, or abundant natural resources, and there are no monumental constructions that would have required conscripted labor.

Wilcox and colleagues have revived the warfare model, suggesting organized warfare at a much higher organizational level than previously suggested (Wilcox 2001; Wilcox et al. 2001; Wilcox 2005; Wilcox and Holmlund 2007). They see southern and central Arizona in a "posed for war" stance, primarily against the highly organized Hohokam of the Salt River Valley, with raiding and attacks from Perry Mesa into the Salt River Valley, and retaliation from the Hohokam into the Perry Mesa area. It is not clear if Hohokam attacks extend into the Verde Valley as well, but Wilcox and others postulate a "Verde Confederacy," consisting of the Upper, Middle, and Lower Verde areas along with the Polles Mesa and Perry Mesa regions. On the basis of geography, differential distribution of Gila Polychromes, and site lay-out patterns, as discussed above, I can see a unity between the Middle and Upper Verde and Polles Mesa localities but see it as separate from the Perry Mesa and Lower Verde regions. However, the "Confederacy" concept is interesting and is another way of conceiving of local, sub-regional, and regional organization and relationships recognized in this paper. Further examination of these concepts should prove quite interesting and evocative.

Another take on the warfare model invokes immigrant hunter-gatherers, specifically the Yavapai, rather than the indigenous people of central and southern Arizona, as the parties responsible for conflicts that lead to the abandonment of the Verde Val-

ley. The timing of the appearance of the Yavapai/Pai (and Tonto Apache, for that matter) into the archaeological record of the region is debatable, but most sources would place this somewhere in the AD 1300-1400 period (Euler and Green 1978), although others think the AD 1100-1250 period is more likely (Rogers 1945:190), and Yavapai and Apache oral traditions place them in the Verde Valley since the beginning (Kralj KenCairn and Randall 2007) a position Schroeder (1975:61-63) generally agreed with (see also Kwiatkowski et al. 2012). Yet evidence of friction between Yavapai and Sinagua has not been demonstrated and in historic times the Yavapai and Hopi had amicable trading relationships (Ruland-Thorne 1993:17) (See also Ford 1983:712-719 for similar examples between hunter-gatherers and agricultural groups). It is also difficult to imagine small groups of 10 to 20 Yavapai warriors terrorizing pueblos housing 100 to 500 people to such an extent that they could drive the Sinagua agriculturalists from as desirable an area as the Verde Valley. However, the first datable appearance of Yavapai style pottery and projectile points occurs with Pueblo IV period pottery types with beginning dates in the AD 1300s. In addition, a 1380 $\pm$ 50 radiocarbon date from a Yavapai roasting pit within view from Hatalacva, a Tuzigoot phase pueblo, suggests there was at least a century of overlap in occupation between the Sinagua and the Yavapai (Greenwald 1989:103).

Epidemic diseases might be another explanation that has not been suggested as a cause for abandonment of the Verde Valley. Colton (1936) pointed out the sanitation and ensuing health problems that could result from large numbers of people aggregating into concentrated populations, citing examples from historic times at the Hopi Mesas, Europe, and in Philadelphia. But, as with the other explanations, evidence for it is lacking and many contagious diseases do not leave results that could be identified from skeletal remains. There are, however, reports from pot hunters in other regions, such as Homol'ovi and Perry Mesa, where rooms were dug that reportedly contained numerous burials, stacked like cord wood, that could suggest epidemic situations.

Other possible explanations might be sociocultural in nature. Perhaps, in consort with other changes occurring during this period, the support systems required for managing the organization of large aggregated numbers of people, as well as complex external exchange systems, collapsed as those areas became depopulated. The large, aggregated pueblos could have split into smaller, more highly dispersed settlements similar to those that characterized earlier periods of their history. Without the ability to date sites more precisely beyond the broad date ranges given for plain ware pottery, the seven to 19 room pueblos might represent such a reduction in the late population, rather than the first steps towards aggregation. In addition, there are hundreds of small sites, both cavates and small pueblos, that have few ceramics and lack decorated pottery of any sort. They could also date anywhere and could reflect a change after AD 1400 into dispersed settlement pattern. Additional refinement of dating techniques is necessary before these possibilities can be resolved.

Similarly, it has also been speculated that the Sinagua could have altered their agriculturally-based life style and returned to one more attuned to hunting and gathering the abundant wild plant and animal food resources of the Valley, in short, "becoming Yavapai." Both Colton and Schroeder postulated that a population with a Yavapai-like economy had always lived in the uplands, separate from the Sinagua, which reasserted itself with the collapse of the agricultural life style, and Yavapai and Apache traditions indicate they lived peacefully in the valley at the same time as the Sinagua (Ruland-Thorne 1993:14).

In this respect, it is interesting to note that the places where Espejo encountered groups of people correspond to the locations of large Tuzigoot phase pueblos such as Montezuma Castle, Montezuma Well, and Tuzigoot (Bartlett 1942). A close reading (perhaps too close) of Luxan's narrative suggests two separate groups may have been living along Beaver Creek. As the Spanish descended into Beaver Creek from the Mogollon Rim, they found a "rancheria belonging to mountainous people who fled from us." When the party reached Montezuma Well, they found the "mountainous people who had fled awaited us" and gave the Spanish gifts of food and metals and offered to take them to the mines. There is then an apparent contextual change with the next sentence: "In this locality we found many *peaceful rustic people. They had planted maize."* (emphasis added) (Bartlett 1942:29-30). This is intriguing speculation, and perhaps another translation might clarify if "mountainous people" were the same as the "peaceful rustic people." However, it might imply that the "mountainous people" could have been Yavapai, and the "peaceful rustic people" relict Southern Sinagua families, continuing to farm and occupying their traditional localities following the dissolution of the Tuzigoot phase society.

Yavapai traditions attribute the prehistoric cliff dwellings to ancestors of the Hopi and Zuni (Burns 1923: Part IV) and have no stories indicating they displaced the earlier occupants of the land (Gifford 1932:243). Several Hopi clans, such as the Water and

Bluebird clans, claim relationship with specific sites such as Bridgeport, Tuzigoot, Montezuma Castle, and Montezuma Well.

The most commonly accepted explanation, which agrees with archaeological data as well as Yavapai and Hopi traditions (Schroeder 1975:9-10) is that the Sinagua moved north to join the emerging "Proto-" Hopi and Zuni cultures along the Little Colorado River. The main problem with this idea is that it is the favored explanation for ending most of the prehistoric traditions in north and north-central Arizona and it seems unlikely that the Hopi Mesa country could have accommodated such a vast number of people in such a relatively short time.

Available evidence at the present time simply is not sufficient to support one or more of the traditional explanations, and other possibilities need to be considered.

CONCLUDING REMARKS

Despite more than 150 years of scientific investigation, our understanding of the late prehistoric and proto-historic time period in the Verde Valley has not advanced much beyond the speculations of its early explorers. Only shreds of evidence have been unearthed to support whole cloths of inference, speculation, and "just so" stories, most of which have been recounted here. It is clear that considerably more survey and excavation work is needed before our comprehension of human life in the Verde Valley reaches a level comparable to that of surrounding areas. In recent years, there has been an up-swing of archaeological activity in the Valley on the part of avocational, scientific, and governmental organizations that is beginning to demonstrate the importance and wealth of information that the cultural resources of the Verde Valley offer, if they can only be tapped. Continued work of this sort is needed if we are to progress beyond our limited understanding of this most important area of Southwestern prehistory.

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SINAGUA SOLAR OBSERVATION METHODS IN THE VERDE VALLEY

Kenneth J. Zoll

ABSTRACT

The prehistoric farming people of the Verde Valley, identified as the Sinagua, occupied the area from about AD 600 to 1400. The Hopi of Northeastern Arizona are culturally affiliated with the prehistoric Sinagua culture. The sun watching techniques of the Hopi have been well documented, so similar associations were likely present in Sinagua society. This paper presents the results of field investigations at several Sinagua sites, some of which have ancestral affiliations with current Hopi clans. These investigations identified and documented sun watching features of the Sinagua that included sun watching stations, rock art markers with light and shadow interactions, and the construction or manipulation of features to produce a desired effect. These sites show that the Sinagua utilized a variety of simple to complex techniques and methods in order to track the seasons and mark important times of the year.

DEVELOPING CONCEPTS OF TIME AND CALENDAR

> People's lives were governed by observations of objects and events in the world around them... CALENDARS, however rudimentary, were necessary for survival in all types of human society: for the smallest bands of hunter-gatherers; for farming villages controlled by local chiefs; and for complex urban societies seeking to support the higher social echelons of elite specialists, craftsmen, priests, and kings. (Ruggles 2005:x)

The development of the concept of time seems rather obvious today when we are surrounded by clocks, watches, smartphones and calendars. The daily newspaper, or more likely a computer or smartphone "app," tells us when the sun will rise and set so we can plan our day. But think back to a time before these conveniences were available. A person woke up when the sun's light entered their cave or dwelling, and they often slept when the sun departed and left them in darkness. They might notice that over time some days would be long and warm and others would be short and cold. They might even notice that a pattern of longer and shorter days repeated again and again.

Hardman and Hardman (1992:157) have observed that prehistoric people were knowledgeable observers of the objects and events around them, especially relating to solar observations, and that they "systematically observed the apparent movements of the sun on the horizon and attached relationships between the horizon positions of the sun and seasonal and related phenomena of survival importance to the culture." Hardman and Hardman (1992) proposed a developmental model that consists of a sequence of increasing awareness and complexity in observational techniques. They identified eight levels of solar observation from a basic awareness of the position of the sun on the horizon (Level I) to developing instruments (Level VIII) such as a sundial.

This paper describes several types of solar observations that we made at seven different sites by the Southern Sinagua Culture, prehistoric agriculturalists of the Verde Valley. These include one example of sun shrines, two examples of sun watcher locations for viewing the horizon, and four devices or instruments for recording important dates.

Methods

Ethnographic examples of Zuni and Hopi solar calendars and their ceremonial significance are pre-

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sented as useful analogs. The Hopi claim cultural affinity with the Sinagua and the ancestors of the Zuni may well have interacted with the Sinagua. The seven Sinagua sites were studied systematically over the course of an entire year, and in some cases multiple years, to ensure that all significant calendrical events were observed. The results of this study demonstrate that the Sinagua were well aware of the sun's annual movement through the sky and had developed various methods to record and mark those movements for calendrical purposes.

The methods used to track the sun's annual movement are:

1. Observing the sun's location along the horizon at sunrise or sunset from a standard location within or nearby the pueblo
2. Marking the sun's location at sunrise or sunset with horizon markers or shrines
3. Tracking the sun's location through the use of light and shadow as the shaft of sunlight passes across man-made glyphs

PUEBLO ANALOGS

Puebloan sun watchers, or Sun Priests, made daily observations of the horizon at sunrise or sunset from a designated location to observe the position of the sun (Ellis 1975; Reyman 1971; Williamson 1984). The Zuni sun watcher, called *Pekwin*, made his observations "from a special position within or close to the pueblo. He must stand at the same spot to ensure repeatable and useful observations" (Zeilik 1985:586). Frank Hamilton Cushing (1998:40-41), who lived among the Zuni in the 1880s, noted that the Zuni Sun Priest at dawn "approached a square open tower and seated himself just inside upon a rude, ancient stone chair, and before a pillar sculptured with the face of the sun, the sacred hand, the morning star, and the new moon. There he waited with prayer and sacred song the rising of the sun." The accuracy of the Sun Priest was checked by individuals who had windows or portholes in their houses that let sunlight into the room only during the solstice sunrise. Parsons (1939:123) stated that the Pekwin was "the keeper of the calendar" who "determines the solstices by watching the sunrise in winter from a petrified stump on the east edge of town, and the sunset in summer, from a hill below Corn Mesa." Sun shrines were also placed at key points along the horizons (Zeilik 1985), and sacred prayer sticks were planted in their fields during a winter solstice ritual (Stevenson 1904:119-120).

Alexander M. Stephen, ethnographer of the Hopi, observed in 1892 that in order to set the timing of the Winter Solstice Ceremony, the Sun Chief observed the sunset on the horizon in December from a flat house roof in anticipation of when the sun would set in "the notch made where Eldon Mesa intersects" (Stephens 1936:30) with the San Francisco peaks. Two years later, Stephen recorded that the Sun Chief began his constant observation of sunset at the same location as the previous year, the roof of the Bear person's house, "from whence one has a clear view of the San Francisco Mountains" (Stephen 1936:62). Stephen prepared a sketch of the San Francisco Peaks and identified where the sun set on Winter Solstice, December 22, 1891 (Stephen 1936: Figure 16).

The Hopi Sun Chief's knowledge of the movement of the sun was very accurate, since his observations revealed to him that during the winter solstice, the sun "stays permanently in the same house for four days, then he will begin to travel northward, i.e. on the 24th" – this changing of the position of the sun on the horizon was described as the "sun turns back" (Stephen 1936:61). At the village of Walpi, Fewkes (1898:67) observed Hopi Sun priests participating in celebrations of the summer and winter solstices. On December 21 (winter solstice) in 1897, Fewkes watched a *katsina* and two *katsina* maids emerge from a kiva, singing songs and performing dances.

The Hopi *Soyal* ceremony occurs at the winter solstice and begins the new ceremonial year. Fred Eggan describes this important ceremony:

> The kivas are opened by the Soyal katsina, who is impersonated by the village chief and head of the Bear clan, and the main chiefs or priests of the village are involved. The sun is started back on his path toward his summer home by Sotuknangu, the Star or Sky God, impersonated by a Sun clan leader twirling a sun shield, and prayer offerings are made for relatives and friends, for plants and animals, and for known ancestors and placed on shrines nearby. The dead have been invited to come and share the offerings and food. The first Katsinas also come at this time and inaugurate the seasons of katsina dances which continue at intervals until the *Niman*, or 'home going' in July, when other societies take over the task of providing rain for the crops. (Eggan 1994:15)

The making of Hopi sacred prayer sticks were timed to precede or follow the winter and summer solstice events. At Walpi, Fewkes (1898:104) observed that a large number of prayer-sticks were

made by the priests on the days following the winter solstice ceremony, with some of these were deposited in shrines about the pueblos. Parsons (1939:180) states that the farthermost points of the sun on the horizon (winter and summer solstice) were the "proper time to receive the prayer sticks for his [the sun's] children. Being a man and unstable, he must be helped on his journey; he must be 'turned back' or 'pulled back'. " One of the Hopi ceremonial altars was made "when the sun gets past the meridian," or shortly after noon (Stephen 1936:837). Although the moon was primarily used by the Hopi to establish a monthly calendar, the day was divided into 13 hours based on the position of the sun in the sky (Stephen 1936:1042).

Important Dates other than the Solstices and Equinoxes

In mid-May 1893, Stephen noted that the Sun Chief announced when the sun had reached the appropriate position for planting corn (Stephen 1936:390). Don Talayesva, a Hopi Sun Chief, stated in his autobiography that he planted his melons every year "when the sun lifted itself from the 'melon-planting point' in May (Simmons 1942: 231). Stephen in 1891 recorded the Sun Chief observing the location of the sun in association with the *Niman Katsina* dances, which took place around the summer solstice (Stephen 1936:540).

The Horned Water Serpent among the Hopi specializes as the god of waters (Tyler 1964:244). A special fertility ceremony is held in February to March. For this ceremony there is a preliminary planting of corn in the kiva. Stephen observed (1936:265) that "Last evening [February 12] corn was planted in *Nasha'bki* in preparation for the Horned water serpent dance, *Pa'lulukonti*, to be celebrated next moon."

Clearly, the sun played an important role in the timing of important economic and ceremonial events for the Hopi, and a specific person was designated the role of watching the sun throughout the year. McCluskey (1977, 1982) analyzed reported Hopi observations of the sun on the horizons and determined that they were within 4 arc minutes, or one-seventh of the apparent size of the sun's disk, which is very accurate for naked eye observations.

SUN WATCHER LOCATIONS

The existence of Pueblo sun watcher stations demonstrates several levels of observational development. Following the levels identified by Hardman and Hardman (1992), they express an awareness of the movement of the sun along natural features on the horizon and that such features can be used as markers to record certain time points during the year (Level I). These stations also note the movement of the sun at natural features (Level II) that refines the concept of directions. And lastly, horizon features are used as markers to record solstice positions (Level III). Three probable Sinagua sun watcher stations have been located in the Verde Valley and documented; they are described below.

Sun Shrines Associated with Sacred Mountain Pueblo

I preface my description of the sun watcher location at Sacred Mountain Pueblo with a few points about a nearby and related site. The V Bar V Heritage Site is a Sinagua rock art site that contains petroglyphs which align with light and shadow patterns throughout the year, creating a calendar, as described later in this paper. One of the questions that arose during the survey of the petroglyph panels at V Bar V was how did the Sinagua know what day to create the petroglyph images so that they would coincide with the equinox, solstices and planting times. The most likely answer is that they observed the horizon from the Sacred Mountain Pueblo nearby, and transferred that knowledge to the petroglyph panel at the V Bar V site.

There is no evidence of any large dwelling at the V Bar V site. However, little more than a half-mile (1 km) east of V Bar V is an isolated white-limestone butte known as Sacred Mountain. It contains the remains of a 60-room pueblo around a central plaza; some of the rooms may have been multistory. A ballcourt was recorded at the base of Sacred Mountain, but it may actually be a reservoir, and an extensive agricultural field system containing rock bordered fields, canals, and fieldhouses has been recorded (Fish and Fish 1984). The Sacred Mountain pueblo is thought to be the pre-eminent village of what is known as the Beaver Creek Community. This site dates from A.D. 1000 to 1400 based on pottery analysis (Schroeder 1949). The butte is 1,257 m in elevation and is west of the surrounding plateau which averages 1,463 m in elevation.

The first case is an example of "sun shrines" associated with the Sacred Mountain pueblo that marked the points on the eastern horizon where the sun rose on the equinoxes and solstices. We first positioned an observer on the highest point among the dwellings of Sacred Mountain pueblo on the equinox and solstices and recorded the positions of the rising sun along the Mogollon Rim to the east. Subsequently we visited these points on the Mogollon Rim during sunrise on the equinoxes and solstices. At each location, a pair of stone cairns was found. Zeilik (1985) noted that "one of the important aspects of Hopi Sun shrines is their location on the tops of me-

sas at places that mark important times of the solar calendar when viewed from the Sun-watching station of the Sun Priest." These shrines may consist of a natural features or man-made pile of rocks. The discovery of a pair of stone cairns at each calendric location suggests that they were sun shrines. The equinox shrine was composed of two cairns of stones about 108 cm apart. One cairn still stood about 90 cm high (Figure 1), while the second cairn appeared to have been about the same height but had been knocked over. When standing between these piles the declination, as observed from Sacred Mountain, is a straight line from the sun-watching station to the position of the rising sun on the equinox. These twin cairns gave the appearance of a gateway, or portal, through which the sun would rise on these important calendric dates. At the location of the summer solstice sunrise on the Mogollon Rim as observed from the same Sacred Mountain location, the same twin stone cairns were found, again at about the same height and separation.

The winter solstice sunrise location was much more difficult to locate because of difficult terrain as well as significant shrubbery growth. The declination recorded from Sacred Mountain was followed to the very edge of the Rim. The edge rises from the Rim floor and at the very edge were three small cairns composed of stacked stones. Sacred Mountain was framed by the two outer cairns while the center cairn was at the declination point between Sacred Mountain and the sunrise position.

The discovery of these shrines at the expected calendric locations suggests that prior to the creation of the V Bar V petroglyph calendar, the Sinagua sun watchers used horizon sighting from Sacred Mountain for calendric determinations.

Figure 1. Cairn located at equinox location observed from Sacred Mountain.

Honanki Heritage Site Sun Watcher Location

The second case is the "sun watcher" position used by the population at the Honanki cliff dwelling. The Honanki Heritage Site (A.D. 1150-1300) is the largest cliff dwelling in the Verde Valley after Montezuma Castle National Monument. Honanki, or Bear House (Fewkes 1896), originanlly stood two stories tall in places and had about 40 ground floor rooms. The cliff-dwelling was not an isolated community, but was the main center for a substantial dispersed population perched high above the canyon bottoms on the flanks and top of Loy Butte. There is evidence of numerous sites in the surrounding canyons including Archaic stone artifacts, field houses, agricultural terraces, water catchments and rock art.

With the area's agricultural terraces, a sun watcher would have been essential to insure the proper planting times. The cliff dwellings face southwest, so they do not provide for sunrise observation. Looking for a possible observation point, the base of the butte was traced to the eastern horizon. When the eastern horizon became visible, an outcropped ridge of sandstone under a natural overhang (Figure 2, left side) was noted. Near the center of the outcropping was a rounded section that protrudes from the ridge. On top of this protrusion (Figure 2, right side) was an area that had been smoothed to produce an elliptical bowl shape in a southeastern direction. At the top of the bowl was a half-sun petroglyph, with its rays pointing out toward the horizon.

This outcropped area with a sun-like glyph afforded the first eastern horizon view from the Honanki dwelling area. The smoothed top would have provided a consistent observation point. Yava (1978:2) describes how his father, a Sun Priest, would observe the horizon from "a natural bowl in the rock, a kind of smoothed-out pothole, and he would record his readings inside that bowl." This somewhat isolated location, away from the main dwelling, affords the first available view of the eastern horizon produced by a dendritic ridge of Secret Mountain between Loy and Hartwell canyons. This ridge, rang-

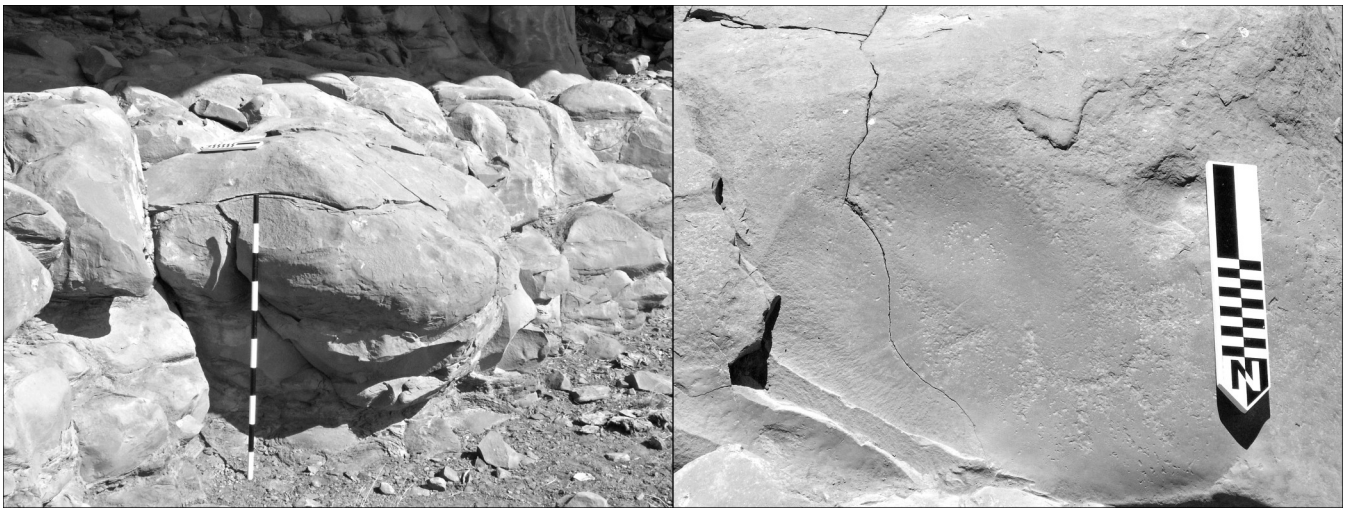

Figure 2. Honanki sun watcher station. Left is the observation boulder and on the right is the smoothed "seat" and sun-like petroglyph on the boulder.

ing in elevation from 5,465 to 6,523 ft. (1,666 to 1,988 m) would have produced distinctive features to encompass sunrises from summer through winter solstice. These conditions suggest that this was the sun watching station for the Honanki sun watcher.

Palatki Sun Watcher Station

A pictograph under a protective overhang at the Palatki Heritage Site is a record of where sunrise will occur on the horizon on the dates of the solstices and equinoxes.

The Palatki Heritage Site is a complex of cliff dwellings and several rock art areas. Palatki, or Red House, was also named by Fewkes (1896). The Sinagua presence is dated between A.D. 1150 and 1300. The main rock art area is referred to as the "Grotto" because of its unique protective overhang and seasonal water catchment. At the back of the Grotto is a pictograph composed of a jagged white line (Figure 3, bottom). Two portions of the line are filled in white. Under the far right notch in the line is a black triangle. Two more black triangles are present near the middle of the line. Above the line at the far left is a large white ball-like image.

This pictograph closely resembles a mirror-image of the opposite (eastern) horizon (Figure 3, middle). It is composed of four red sandstone features, and two white limestone features that correspond to the flattened and pointed portions of the pictograph that are filled-in white. Because of the similarity of the pictograph to the eastern horizon, compass readings were taken of the eastern horizon features that corresponded to the pictograph. The position of the triangles and white orb suggested that the locations of the solstice and equinox sunrises were being recorded in the rock art.

To confirm this hypothesis the site was visited each month for sunrise observations over the course of one year. A composite of the sunrise positions on the equinox and solstices is shown in Figure 3 (top). The winter solstice sunrise corresponds to the last horizon feature and the last portion of the pictograph with the single black triangle. The equinox sunrise corresponds to the portion of the pictograph with the two black triangles (vernal and autumnal). The white ball-like feature corresponds to the summer solstice sunrise that appears to the left of the white rectangular limestone feature on the horizon.

These sunrise positions were observable from the outer edge of the Grotto, directly in line with the pictograph. It would appear that this pictograph was created as a marker of the important sunrise positions and to indicate the sun watcher's station.

ROCK ART DEVICES FOR RECORDING DATES

In addition to sighting the horizon, the sun watchers took notice of important times when sunlight entered their rooms or illuminated specific images. This imaging technique of calendrical observation involved the sun casting its effect on an image or architectural feature at sunset, sunrise or during the day. Solar calendars based on this imaging method have been identified at Ancestral Puebloan sites including Chaco Canyon, Hovenweep, Chimney Rock, Yellow Jacket and Mesa Verde (Williamson 1984). Similar solar markers have been identified at Northern Sinagua locations at Wupatki (Bates 2005). Eighteen potential solar marker sites have been identified in or near the Petrified Forest National Park (Preston and Preston 1987). Solstice and equinox markers and

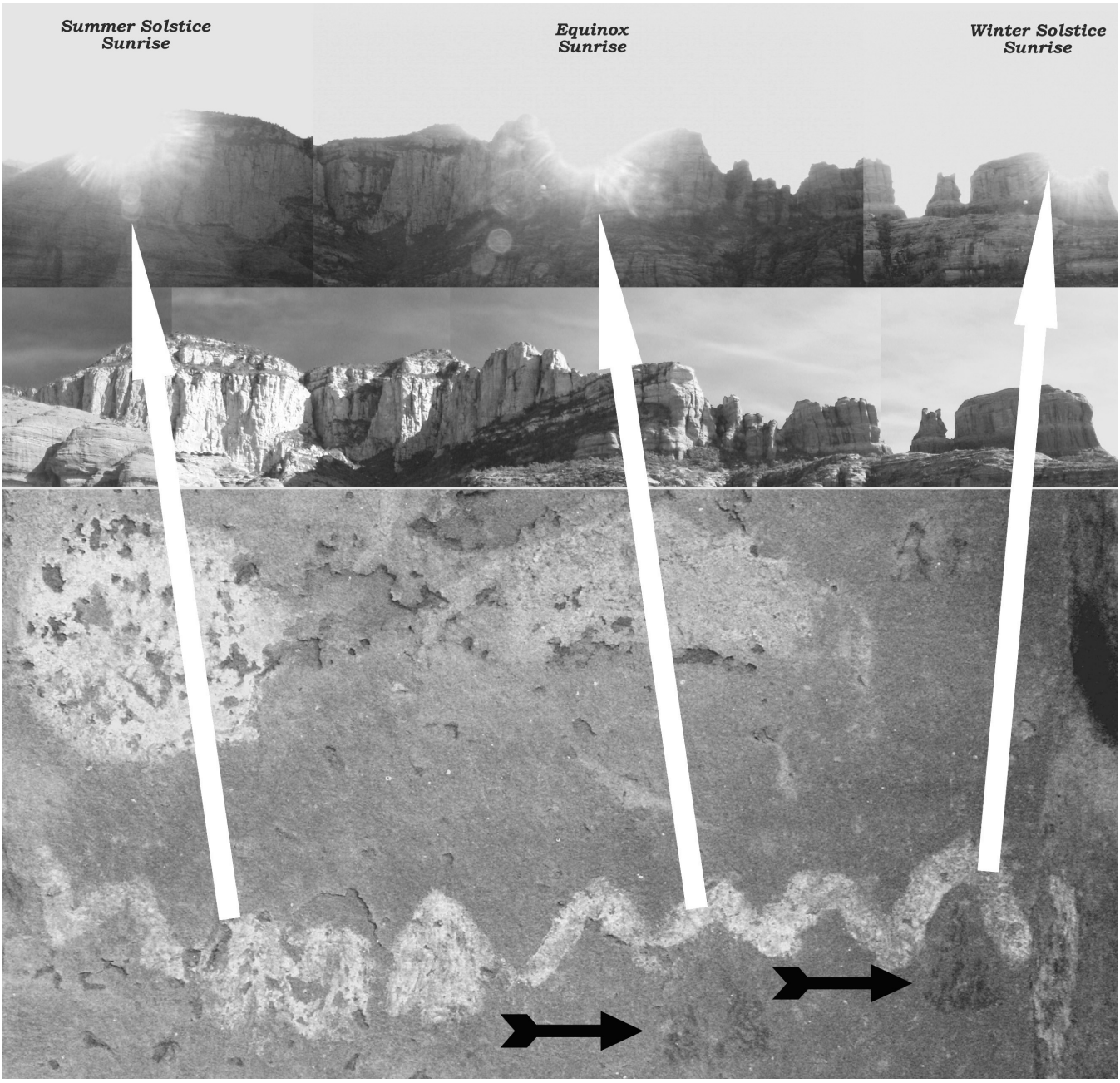

Figure 3. Palatki horizon petroglyph. Arrows point to the double and single black triangle glyphs associated with sunrise on the winter solstice and the equinox.

shrines have been found in the Mimbres/Mogollon region (Ellis and Hammack 1968). In addition, Hohokam calendrical sites have been recorded at twenty-two locations in the Phoenix region that employed architectural alignments, imaging locations and horizon markers (Bostwick and Krocek 2002).

Rock Art with Register Marks

While observing several rock art sites, discussed below, the author observed probable interactions of the rock art with a light/shadow effect at important calendric times. During the observations it was noted that some glyphs included small marks or secondary features that did not initially seem significant. However, when viewed at the time of a seasonal interaction, the marks were in line with the shadow effects. These appear to be intentional marks to "register" the specific day for the event. It appears that this was done to improve the accuracy of the reading as will be shown in the following examples.

Palatki Sun Shield Pictograph

Register marks on the large "sun shield" pictograph at the Palatki Heritage Site coincide with shad-

Figure 4. The sun shield glyph. Light-shadow patterns at equinox sunrise (left) and at sunset 30 days following the equinox (right); arrows point to register marks along the shadow edge.

ow lines at sunrise on the equinoxes and at sunset thirty days after the fall equinox and thirty days before the spring equinox. The sunset observations could have been used to determine the date for an observation similar to the Hopi bean-planting ceremony, which occurs in mid-February. At the Palatki Heritage Site there is an area of rock art in the roasting pit area west of the Grotto described earlier.

One of the Sinagua rock art elements at the roasting pit area is a large circular element referred to as the "sun shield." It measures 64 cm in height and 68 cm wide. A smaller circle in the center is connected to a larger outer circle by four sets of three parallel lines that create four quadrants. Within the lower right and both upper quadrants are short lines extending from the smaller central circle near the center of those quadrants. I refer to these short lines as "register marks" for reasons to become evident.

Because of the pictograph's name, the author was requested by Coconino National Forest archaeologist, Peter Pilles, to study this image for any possible astronomical purposes. Observations were made at sunrise and sunset each month over the course of one year. The result of these observations is shown in Figure 4. At equinox sunrise (both vernal and autumnal) the shadow of the overhang bisects the shield in line with the lower right quadrant register mark (Figure 4 left). Observations were made monthly during the rest of the year, as well as "bracketing" the equinox and solstices on the days before and after the event date, but no other sunrise effects were noted.

The register mark in the upper right quadrant was not touched by a shadow line during the entire year of sunrise observations. To attempt to resolve this anomaly it was decided to visit the site for another year at sunset. A "sun wedge" was observed at sunset that pierced the shield in alignment with the register marks in the upper right and lower right quadrants, 30 days after the autumnal equinox (October 21) and again 30 days before the vernal equinox (February 20) (Figure 4 right). The lower right quadrant was not touched at any other time during the year of sunset observations. A possible purpose in marking February 20 was to set the date for an observance such as the Hopi *Powamu*, or bean -planting ceremony. This ceremony celebrates the return of the *kachinas* who have been away since July. It also involves the exorcism of evil spirits from youth and man and is placed in the month of February to denote the purification and renovation of the earth for the upcoming planting season.

The photographs in Figure 4 suggest that the short lines in the two quadrants were added to ensure that the correct day of alignment was observed. Determining the potential purpose of recording these dates is speculative, but their proximity to the large agricultural fields below this area suggests the rock art may have served as a seasonal marker related to agricultural activities.

Rarick Canyon

Small register marks on a large spiral petroglyph at the Rarick Canyon site mark the alignment of a light-shadow line on the equinoxes. The Rarick Canyon rock art site is on a narrow basalt ledge of the canyon's northeast face. Several Sinagua masonry structures are nearby, but none are adjacent to this site. At the end of the ledge is a large boulder with two spiral petroglyphs. The small spiral is 18 cm in width. The large petroglyph is slightly elliptical at 92 ×

102 cm. There is also a small double concentric circle below the smaller spiral.

There were rumors that the site was a summer solstice marker, so Peter Pilles of the Coconino National Forest suggested the site should be observed and recorded. The site was visited monthly over the course of year. Systematic observations determined that on the summer solstice, the large spiral was bisected by a linear shadow. During the course of the year, it was observed that the winter solstice and the equinoxes were also marked with shadow lines, through the mid-section of the large spiral, albeit at slightly different angles.

The equinox appeared to again be associated with the use of "register marks." During the equinoxes the large spiral was bisected as shown in Figure 5. Using such a large spiral could introduce a miscalculation if not read on the correct day. A small, 7 cm diagonal mark is present at the bottom center of the large spiral. As the equinox shadow line passes through the spiral it continues outside of the spiral and passes in perfect alignment with the diagonal mark. It then proceeds down further to bisect the small concentric circles glyph. It appears that the diagonal line and the small concentric circle were added to insure that only the correct day was used. The equinox observation was bracketed by visiting the site the day before and the day after the equinox. Neither feature was in alignment on those days.

Figure 5. Rarick Canyon boulder at equinox with arrow indicating register mark along shadow line.

CONSTRUCTED OR MODIFIED GNOMON

The Horned Water Serpent Construct

The position of a large sandstone slab has been culturally modified so it acts as a gnomon that casts a shadow line on a pictograph on February 13th. This is a time of the year in which the Hopi ceremonially plant corn in front of an altar in a kiva to ensure plentiful rain during the growing season. The site with the gnomon is in a remote side canyon, sometimes called "Thompson Terrace" because of the graffiti by the Thompson family at the turn of the 20th century. While remote, it is easily reached from several major Sinagua habitation sites. This side canyon contains many Sinagua, Yavapai and Apache rock art images. There are numerous serpents and other suggested spiritual images.

Behind a large boulder is a pictograph of a round image with a single horn, round eyes, rectangular mouth and multiple short lines on the top half of the image (Figure 6, right). This image is similar to *Pa'lülükona*, the horned water serpent of the Hopi (cf. Stephen 1936). Peter Pilles confirmed that the Hopi had previously identified this image as the horned water serpent. Pa'lülükona lives in springs and moisture, and is associated with the Hopi Winter Solstice Ceremony (Stephen 1936:16, 28).

The site presented a very intriguing feature, namely the apparent manipulation of a slab of sandstone above the boulder (Figure 6, left) that is in front of the serpent image. Paul Lindberg, a geologist, inspected the slab and confirmed that it had naturally broken away from the above cliff face. The slab, however, had been artificially raised at both ends. The left side (when facing the pictograph) of the slab has been lifted up by two overlapping sandstone rocks that apparently were inserted under the slab. The right side of the slab has been raised with a stone that was worked into a rectangular shape. It was notched and then wedged under the slab to firmly hold it in place with the weight of the slab. While it may be argued that the overlapping rocks had been there when the slab broke away, the rectangular stone appears to have been wedged into place to the notch. The bulk of the stone is suspended in mid-air and is only held in place by the wedge and weight of the slab. Such a construct could be interpreted as a shadow-casting "gnomon."

To determine whether this feature was a gnomon, the site was visited at sunrise on the 21st of each month for an entire year. This date was selected because it is the general date for the equinoxes and solstice. During that time, it was observed that the slab did produce a shadow at various times but nothing that could be definitive of those calendric dates. Reviewing Stephen (1936:289) again it was noted that he had observed that the Hopi, before the Horned Water Serpent Dance, planted corn in a Kiva on February 12 in 1893; this corn was placed before the Pa'lülükona altar and served as a prayer for abundant rain on the corn planted in fields. The author

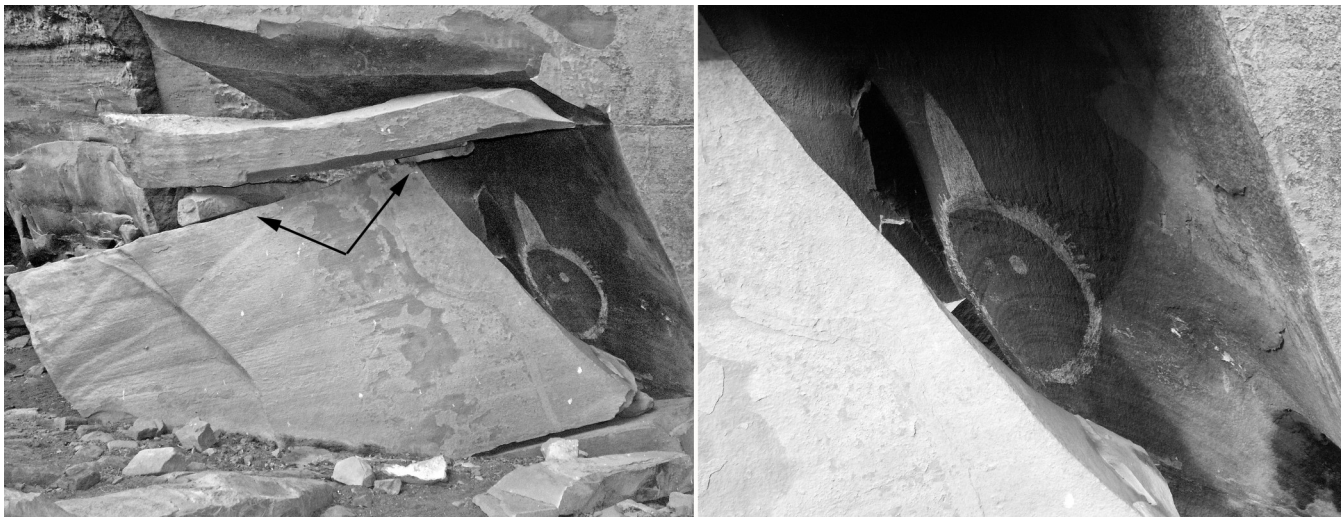

Figure 6. Horned serpent glyph. The rock slab supported on wedges (left) and shadow-light pattern on February 13 (right).

then decided to visit the site on February 12, 13 and 14 to record any possible effects. The raised slab produced a sun wedge that touched the edge of the pictograph on February 13 (Figure 6, right).

The details of observances recorded by Stephens in other years is brief and lacks the detail of planting dates; however, the similarity of the image, the timing of events and the numerous serpent images in close association with this location is suggestive that this location may have been a predecessor site for a similar ceremony. The slab gnomon may have been constructed to designate the time for this important ceremony as done at other sites to mark other calendric dates.

V Bar V Heritage Site Calendar

At the V Bar V site a natural arrangement of rock fragments wedged in a rock crevice act as a pair of gnomons, casting parallel shadows against the adjacent rock face when the sun first passes over the ridge above. Over the course of the year the shadows swing from nearly vertical on the summer solstice to nearly horizontal on the winter solstice. This drew the attention of prehistoric peoples who covered the face with petroglyphs, including seven sun symbols below the shadow-casting stones.

The V Bar V Heritage Site is located about 12 miles southeast of Sedona, Arizona, within the Red Rock District of the Coconino National Forest. A sandstone bluff, heavily coated in desert varnish, contains 1,032 petroglyph images on several panels. The overall width of the images on the panel in this study is 2.89 m. The height of the panel from the current ground level to the highest glyph is 2.92 m but excavations in 2005 established that there is up to 80 cm of sediment at the base of the panel deposited since the images were created. It was believed that the site location was used by the Sinagua between A.D. 1150 and 1400, although the 2005 excavations suggest the site may have been used as early as A.D. 600 when the Sinagua first entered the Verde Valley (Pilles personal communication 2006). The site is located along Wet Beaver Creek, a perennial creek with many pueblos the length of the creek including Montezuma Well and Montezuma Castle National Monument.

Only one panel, referred to as the *Solar Panel*, contains seven concentric circle petroglyphs with central dots, a petroglyph design that Ellis and Hammack (1968: Figure 4) argue is a Pueblo sun symbol. To determine if this panel represented a solar calendar a two-year survey (Zoll 2008) was undertaken to document any light and shadow effects on the Solar Panel (Figure 7).

The light and shadow effect on the Solar Panel is created by a trilogy of boulders wedged in a crevice in the rock face that separates the Solar Panel from the petroglyph panels to the right. Two boulders protrude from the cliff face while a third boulder acts as a wedge to hold them in place. The panel face is only eight-degrees west of north so that the azimuth at which the sun passes over the panel's meridian line has a small variance ranging from 204.9 degrees to 208.4 degrees. When the sun crests the bluff shortly after mid-day, the sunlight strikes the protruding boulders resulting in a shaft of sunlight between two lines of shadow. In its most basic form, the stones act as dual sundials, or gnomons. During the year, the shadows pass along the panel like a pendulum. At the summer solstice the shadow lines are almost vertical while at winter solstice the shad-

Figure 7. The solar gnomon at the V Bar V Site, showing shadow-light patterns on the winter solstice.

ow lines are nearly horizontal (Figure 8). The "swing" of the lines provides the time of the year.

Upon viewing the boulder placement, the casual observer could conclude that the boulders were placed within the crevice to produce the desired effect. In order to determine whether the gnomons were natural or had been enhanced in any way, construction scaffolding was erected along the rock art surface to closely examine the gnomons, which produce the shadows on the bluff. The two rocks were studied up-close and in detail by Todd W. Bostwick, Paul A. Lindberg, and the author in 2011. The participants in this study concluded that all of the rocks in the upper part of the rock art site are naturally occurring boulders that have been frost-heaved outward to their current positions. However, it was discovered that a series of stone wedges were placed around the gnomons to secure them into place so they would maintain their shadow casting effects over time with minimal change due to erosion or other disturbances (Bostwick et al. 2014:77-78). A waterworn pebble with use wear had been placed in between two of the shadow-casting stones, perhaps as an offering, and a long, slender stone with a triangular rock on top located in a deep crevice had the appearance of a *Katsina* figure emerging from the cliff (Bostwick et al. 2014:78, Figures 7.14 and 7.15).

The first effect that was observed in 2005 was during the vernal equinox. The top of the shadow is tangent to a concentric circle image that is within the sun while a second concentric circle that lies within the shadow is tangent to the same shadow line. A third concentric circle image is within the shadow and is tangent to the bottom of the shadow (Figure 8). The site was visited on the days before and after the equinox and this geometric alignment of the three concentric circles only occurred on the equinox.

The panel was monitored monthly over the next two years, generally on the 21st of each month as this date coincided with most of the equinox and solstice dates. The intervening months were observed for any other effects. On April 21 it was noted that the next large concentric circle was in the sun and tangent to the shadow edge while a small concentric circle was in the shadow but tangent to the same shadow edge. Following the shadow line, one of the three corn plant glyphs on the panel was touched at its root. Early studies of Hopi planting practices[4] documented that successful farming in a drier climate depended on knowing when to plant various crops. A series of plantings was observed – an early crop was planted during the third week of April, the main crop followed during the third week of May, and a late crop was planted during the third week of June. The corn plant involvement on April 21 may have been an indicator to plant the early crop.

On May 21 two concentric circles were again tangent to the upper edge of the left shadow line, either in the sun or in shadow. A corn plant image was directly in the center of the sun-shaft between the two shadow lines. The roots of a second corn plant were tangent to the outer edge of the other shadow line. The prominence of two corn plants at this time is suggestive of the time for the second or main corn planting.

At the summer solstice on June 21, two concentric circles were tangent to the outer edges of the left shadow line. Once again a corn plant was touched at its root by a shadow line, corresponding to the time of the late corn planting. The sun-shaft and shadow lines have been making a steady path across the Solar Panel as the sun moves toward the summer sol-

Figure 8. The solar gnomon at the V Bar B Site on the equinox.

stice. With the sun now at its highest point in the sky, the movement stops with the right shadow line being tangent to a glyph with a sun-like asterisk and two arched lines. At the bottom of each of the arched lines are two short attached lines, suggestive of feet.

The announcement of the date for the *Niman* ceremonies at Hopi on the summer solstice brings a potential interpretation to this unusual sun-like glyph with the arched lines that only comes into the astronomical cycle at this time. The arched lines are reminiscent of dancing figures. The fact that a shadow line touches this image only on the summer solstice suggests that it may have been intended to mark the beginning of preparations for the *Niman* "Home Dance" ceremonies.

The winter solstice is marked with two events. The main event is an interaction with a notch in the bluff's structure. This *Solar Notch* is a natural crevice between the solar panel's bluff face and a natural pillar of red sandstone. As the Sun proceeds southward, it is framed by this notch beginning in late November. On December 21 the sun passes across the Solar Notch at its lowest point. The effect is to produce a "sun dagger" at the foot of the Solar Panel (Figure 9) that extends up the boulders to the north of the panel. Since the 2005 excavation established that there is at least 80 cm of sediment against the panel it is possible that the entire dagger would have been presented on the boulder. It would be consistent to find a concentric circle glyph on the boulder at the tip of the dagger, but this must await a later excavation

This study suggested that great care was taken to mark the passage of time and the arrival of specific points in time, and supports the primary hypothesis that a cycle of annual, calendrical-based rituals and practices were associated with the Sinagua archaeological culture that occupied this site from as early as A.D. 950 to 1450.

SUMMARY AND CONCLUSIONS

Anthropological studies have long recognized the Hopi calendar as being based upon careful observations of the sun. The primary goal of these observations was to develop a calendar that would serve to regulate agricultural activities as well as the religious ceremonies that defined their community. Their astronomical system was based on observing the rising and setting sun against known landmarks on the horizon. The data presented in this paper documents that the Sinagua (ancestral Hopi) were competent and systematic observers of the sun, and that their level of awareness permitted them to develop complex observational tools. The agricultural nature of the surrounding countryside in the Verde Valley required a reliable method to determine planting times. Astronomical associations documented at Hopi as indicators for the scheduling of planting and ceremonies were similarly present in Sinagua society.

This multi-year study of various sites documented the solar observation techniques and methods of the Sinagua culture. They employed the technique of sun watching stations that correlated the position of the rising sun on the horizon on certain dates in the annual cycle with natural landscape features. The introduction of rock art using shadow and light effects to mark calendric events added a higher level of sophistication that transferred the horizon positions to more easily recognized and shared demonstrations of time knowledge. The use of register marks to enhance the accuracy of these observational tools added another level of intricacy. And lastly, the building of "instruments" such as the Horned Water Serpent marker and the V Bar V gnomons, demonstrate a refinement of shadow manipulation for the purposes of tracking time.

Note

1. Leigh Jenkins (Kuwanwisiwma), Director of the Hopi Cultural Preservation Office, has stated that ancestral clans of the Hopi and Zuni lived together at Chaco Canyon, where their ceremonial cycles began (Jenkins in Lekson and Cameron 1995:194).

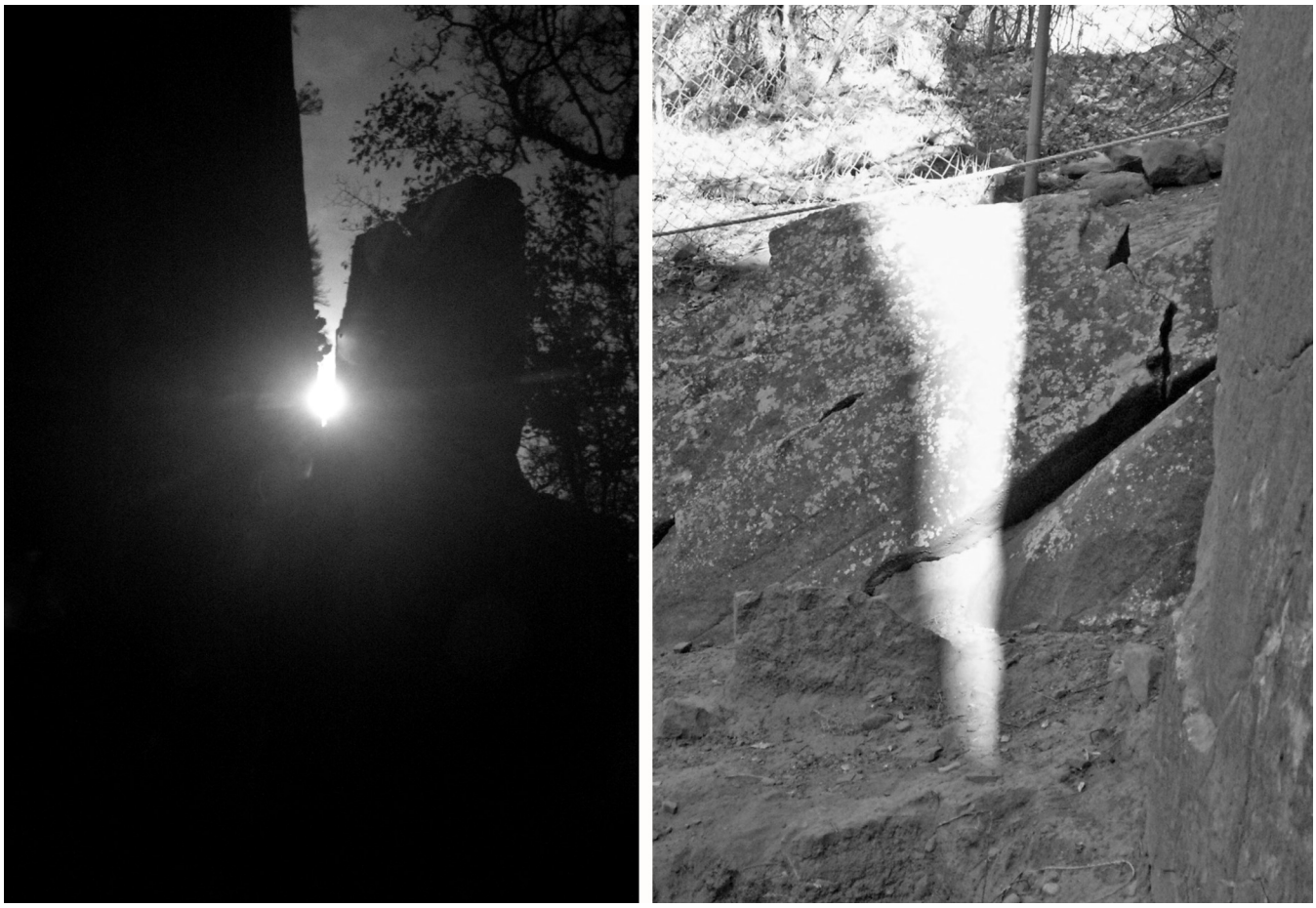

Figure 9. The "notch" at the V Bar B Site. Left: Image taken through a solar eclipse filter of the sun passing across the "notch" on the winter solstice. Right: Resulting sun dagger produced at the base of the solar panel.

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BIFACIAL LITHIC TECHNOLOGY AT TUZIGOOT AND MONTEZUMA CASTLE NATIONAL MONUMENTS: A SOUTHERN SINAGUA CASE STUDY

William D. Bryce
Ashlee M. Bailey

ABSTRACT

A diverse collection of projectile points and bifaces have been recovered from the Tuzigoot and Montezuma Castle National Monuments. This paper presents the preliminary findings of a recent analysis that focused on spatial and temporal patterns of stone tool manufacture and lithic material use. We briefly discuss biface manufacture and use followed by discussion of evidence for expert biface manufacture during the Formative era. The main focus of this paper centers on the projectile point collection. While arrow points vastly dominate, the Verde Valley inhabitants collected earlier dart points for use in functional and symbolic activities. Finally, use of the term "Sinagua" to designate the pre-Columbian inhabitants of the Verde Valley is considered through a comparison of Northern Sinagua projectile point data and the Verde Valley National Monuments data.

The first Verde Valley Conference convened in 2012 to discuss the cultural historical characteristics of the Southern Sinagua. Colton (1946) originally defined the Southern Sinagua on the basis of material culture, primarily pottery, and similarity to habitation structures of the Northern Sinagua who occupied the Flagstaff area. Here, we take into consideration the Southern Sinagua archaeological culture label through flaked stone tools. This paper presents bifacial implement data from the Verde Valley National Monuments of Tuzigoot, Montezuma Well, and Montezuma Castle. Comparisons with Northern Sinagua data follow. Recent analysis of the bifacial tool collections from the Verde Valley National Monuments resulted in the examination of 383 implements, comprising approximately 82 percent of the total bifacial flaked stone tool collection.

The paper begins with a brief overview of the collection followed by a discussion of the typology used in the analysis. The variability within the bifacial tool collection is then discussed with an emphasis on the projectile points. Finally, the primary projectile point types within the collection are compared with collections from sites in the Northern Sinagua territory.

SITE OVERVIEWS

The flaked stone collection was recovered from multiple sites within the Verde Valley of central Arizona (Table 1). While the various sites of the Verde Valley have been the focus of archaeological investigations for over 150 years (Fish and Fish 1977; Mearns 1890; Powers and Pearson 2008), the collection results from nearly a century of excavation, surface collection, and grab samples. Unfortunately, the data we had provided minimal contextual information beyond the site. The majority, 74 percent, of the collection originated from unknown contexts within the respective sites. Twenty-four percent of the collection is reported from rooms, one percent from middens, and one percent from surface contexts.

Absolute dating methods, including radiocarbon, dendrochronology, and archaeomagnetometry in combination with ceramic cross dating indicate that Tuzigoot Pueblo, Montezuma Well, Castle A, Swallet Cave, and Hatalacva Pueblo were occupied between the Honanki and Tuzigoot Phases, from AD 1125 to 1400 (AZSite database online; Powers and Pearson 2008; Shepard et al. 1998; Wells and Anderson 1988). Castle A lies immediately west of Montezuma Castle at the base of a southwest-facing limestone cliff and overlooks Wet Beaver Creek. Castle A includes an estimated 45 total rooms on six levels, with 26 excavated surface and cavate rooms (Wells and Anderson 1988, also Guebard, this issue). Cavate rooms refer to culturally manipulated or manufactured alcoves cut into vertical cliff faces that commonly include the addition of masonry walls. Montezuma Castle is a five story cliff dwelling consisting of approximately 20 rooms

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Table 1. The Verde Valley National Monuments Site Information.

Monument/ Area	Site Number	Site Name	Occupation Dates	Site Type	Tool Frequency
Tuzigoot	AZ N:4:01 (ASM)	Tuzigoot Pueblo	AD 900/1125-1400	~100-110 room, three story pueblo	285
	AZ N:4:20 (ASM)		AD 1000-1300	Artifact Scatter	2
	AZ N:4:3 (ASM)	Hatalacva Pueblo	AD 1125-1400	60-80 room, 2-3 story pueblo	5
Montezuma Castle	AZ O:5:15 (ASM)	Montezuma Castle	AD 1125-1400	~20 room, five story cliff dwelling	2
	AZ O:5:95 (ASM)	Castle A	AD 1125-1400	~45 room, 6 story cliff dwelling	26
	AZ O:5:78 (ASM)		AD 1125-1400	Artifact Scatter; 3 indeterminate features	2
	AZ O:5:41-42 (ASM)		AD 1125-1400	Rockshelter	1
	n/a		n/a	Isolated find	1
Montezuma Well	AZ O:5:92 (ASM)		AD 1125-1400	Pueblo	3
	AZ O:5:46 (ASM)		AD 600/900-1125	Pithouse habitation	6
	AZ O:5:93 (ASM)	Swallet Cave	AD 1125-1400	10 room cliff dwelling	6
	NA 4609A		Unknown	Rockshelter	5
	AZ O:5:92 (ASM)		AD 1125-1400	Burial ground with at least 30 burials looted in 1930s	27
Sycamore Canyon	n/a		n/a	Isolated find	1

and located within a naturally eroded overhang in the limestone cliff face (Wells and Anderson 1988). Located in the inner rim of Montezuma Well is a 10 room dwelling designated Swallet Cave (Wells and Anderson 1988). Tuzigoot Pueblo consists of 86 terraced ground-floor rooms with 100-110 rooms estimated on two to three levels (Powers and Pearson 2008). Tuzigoot pueblo was occupied intensively during the Honanki (AD 1150-1300) and Tuzigoot phases (AD 1300-1425) (Shepard et al. 1998), but was likely occupied as early as the Camp Verde phase from AD 900 to 1125 based on ceramics recovered from early refuse deposits on the hilltop (Powers and Pearson 2008). Another large habitation, Hatalacva pueblo, consisting of approximately 75-100 rooms (Powers and Pearson 2008; Tagg 1986), is located one and a half miles from Tuzigoot Pueblo. One pithouse at Montezuma Well dates to the Camp Verde Phase (AD 900 to 1125), while a nearby, smaller pithouse dates to the Squaw Peak phase (circa AD 1 to 600) (Powers and Pearson 2008; Tagg 1986).

TYPOLOGY

The typology employed in this analysis was based largely on morphological attributes of the artifacts, drawing from multiple previous typologies. An initial rough sort divided points into large (dart) and small (arrow) points. Large points are typically manufactured through percussion and pressure flaking, with larger overall dimensions, including mean thickness over 5.0 mm and mean weight over 3 grams. In contrast, small points are typically manufactured through pressure flaking flake blanks resulting in a mean thickness of 3.2 mm and mean weight of less than 3.0 grams. Large points were categorized following previously established types (Guernsey and Kidder 1921; Holmer 1986; Huckell 1995; Stevens and Sliva 2002; for projectile point type overviews see Justice 2002; Lorentzen 1998; Whittaker and Bryce, in press), while small points were classified following a descriptive typology created by Whittaker (1999) for Lizard Man Village, as well as the GRIN typology being developed for the Flagstaff region (Whittaker et al. 2012). "GRIN" is the moniker of the typology and refers to Grinnell College, the affiliate institution of the primary author, Whittaker. We also employ the work of Hoffman (1997) for Hohokam types. While more recent typologies address Hohokam projectile points (Justice 2002; Loendorf and Rice 2004), Hoffman's dissertation involves an exhaustive analysis without conflating type designations typical of more anthological approaches (see Justice 2002) and covers the greater Phoenix Basin region rather than specific to a smaller area (Loendorf and Rice 2004). The overall collection exhibits substantial diversity based on morphological attributes including outline form, notch shape, notch placement, haft form (e.g. notched, stemmed, etc.), and blade treatment.

VERDE VALLEY BIFACES AND THE FORMATIVE ERA

For the purposes of this paper, the Formative era is defined as the time after the introduction of ceramics and agriculture and before the arrival of the Spanish. Based on Pilles (1981; see also Reid and Whittlesey 1997 and Sorrell et al. 2007), we date this era to circa AD 700-1500. Accordingly, the bifacial collections used in this paper all originate from Form-

Figure 1. Examples of biface morphologies within the Verde Valley National Monument collection.

ative era contexts, with pre-Formative projectile point types presumably the result of the human predisposition toward collection.

Thirty-one bifaces were analyzed, being divided into small and large forms. The biface category includes implements without haft modification, subsuming preforms and knives (bifaces exhibiting use-wear confined to one edge). Large bifaces are defined as being at least 75 mm long or 30 mm wide. This measure is based on the size of Early Agricultural preforms used in dart point manufacture (for examples see Bryce 2010; Geib 2011; Lindsay et al. 1968), which microscopic analysis has shown functioned as hafted knives (Phil Geib, personal communication, August 2007). While bifaces do not equate to preforms, the measurements are based on the concept that any biface larger than a large dart preform is considered a large biface. Large bifaces outnumber smaller bifaces with manufacture varying from decent to expert. The manufacturing technique typically consists of percussion flaking. Pressure flaking was used to finish shaping or later rejuvenate the edges after use.

The morphology of the biface collection varies greatly from well made and symmetrical to asymmetrical (Figure 1). Many of the asymmetrical forms exhibit rejuvenated edges as well as the opposite edge being dulled, or backed, possibly so that the implement could be held in the hand. Based on backing and the presence of multiple asymmetrical bifaces, we believe that this was an intentional form used as a handheld implement rather than a hafted tool. In addition, three of the bifaces exhibit symmetry in form, finished edges, and thinness indicative of preforms for large points or perhaps knives.

One biface in particular displays expert percussion flaking. The size of the fragment and skill of manufacture have lead to the presumption (as stated at the Tuzigoot National Monument Visitor's Center) that it is a Clovis biface. However, the biface does not exhibit indications of Clovis manufacturing techniques. The flaking consists of selective full facial or near full facial percussion flaking initiated from one margin. The initial flaking was followed by overlapping marginal horizontal percussion flaking from the opposite margin (Figure 2a). This manufacturing method was repeated on the opposite face. None of these flake scars exhibit attributes indicative of overshot flaking, which Bradley and others (2010:68) define as, "where flakes travel from one margin across a face of a biface… and remove part of the opposite margin." Bradley and Stanford (2004; see also Bradley et al. 2010) suggest that overshot flaking was a thinning method that was *intentionally* used by Clovis knappers. In addition, Bradley and others (2010) note that flakes are first removed from one edge, and subsequently the opposite edge, with spacing between the flake removals. This manufacturing method varies considerably from the method used to produce the Tuzigoot biface.

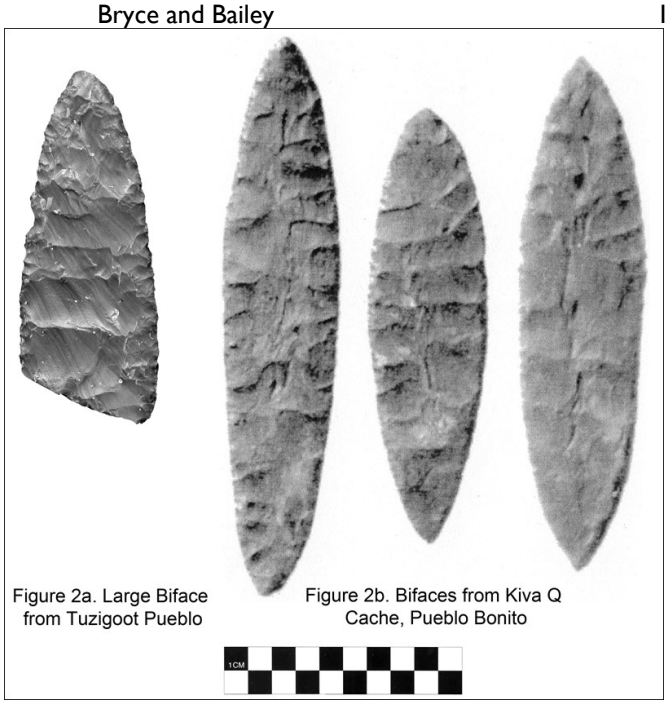

Figure 2. Images of the largest Tuzigoot biface and the Kiva Q bifaces; image of Kiva Q bifaces adapted from Judd (1954, Plate 28).

The Tuzigoot biface, however, is similar to other large, well made bifaces from Puebloan (Cameron 2001; Judd 1954; Lekson 1997), Mogollon (Whittaker 1984; Whittaker et al. 1988), Sinagua (McGregor 1943; Whittaker et al. 2013), and at least one unpublished Hohokam assemblage. This last, referred to as the "Queen Creek cache," consists of three large lanceolate bifaces recovered by Soil Systems, Inc. from a Classic Period Hohokam site. In comparison to the Tuzigoot biface, the cached bifaces from Kiva Q at Pueblo Bonito (Cameron 2001; Judd 1954; Lekson 1997) exhibit similar overall form. Furthermore, the metric measurements obtained by Bruce Bradley (Bruce Bradley, personal communication, January 2012) also display similarity to the Tuzigoot biface (Table 2). Unfortunately, the base of the Tuzigoot biface is missing, so we cannot know the overall form. However, as Bradley notes,

> While being more like the Kiva Q bifaces, it [the Tuzigoot Biface] displays a somewhat different finishing technology… The Kiva Q bifaces are all finished with highly controlled diving flaking… I think you are correct in pointing out that your piece is not Clovis-like, yet at the same time it isn't really all that similar to the Kiva Q (or the Wyoming [Whittaker et al. 1988]) bifaces… The Formative large biface technologies are very poorly published and I believe are significant in understanding regional and super-regional interactions (Bruce Bradley, personal communication, 26 March 2013).

We suggest two conclusions from these data. First, the Tuzigoot biface was manufactured during the occupation of the pueblo. It is not a collected Clovis biface. Second, based on the differences noted by Bradley (see above) with other well crafted and contemporary large bifaces, the Tuzigoot biface was arguably manufactured by an inhabitant of Tuzigoot Pueblo.

PROJECTILE POINTS FROM THE VERDE VALLEY NATIONAL MONUMENTS

Projectile points vastly dominate the bifacial collection. Both large points (darts) and small points (arrows) comprise the collection. Parsing the difference between dart and arrow points is an on-going effort (see Shott 1997; Sliva 1999; Thomas 1978; Van Pool 2006) currently relying on equivocal discriminate analyses (Shott 1997; Thomas 1978) to divide between what constitutes a dart point versus an arrow point. An in-depth discussion of the current views on the difference is beyond the scope of this paper. Suffice it to say that the discriminant analyses currently being used remain equivocal and were not used for our analysis. As Justice notes, "the fact remains that most stratified archaeological sites demonstrate a gradual decrease in the average size of projectile points through time" (2002:16). Along those lines, larger, heavier points, typically manufactured through both percussion and pressure, that conform to well established dart point types are considered dart points. Arrow points are considered as those specimens that are generally small, narrow, thin, and exhibit light weight. In regards to weight, dart points from the collection average 3.2 grams compared to arrow points that average 0.7 grams. This section briefly discusses the dart points within the collection followed by a more in-depth consideration of the arrow points.

In brief, dart points occur in a variety of contexts, but do not comprise a large portion of the collection (n=27, 8.0 percent of projectile points). Presumably, the large points were collected from earlier sites (for examples see Bryce 2011; Hesse 2009; ; Whittaker 2012). Use of earlier large points by later groups for both utilitarian and symbolic activities is well documented (Bryce 2012, 2013; Hesse 1995; Parry and Christenson 1987; Sedig 2014; Wendorf 1953; Whittaker 2012; Whittlesey and Benaron 1997).

The dart point forms are diverse, and include corner notched (n=9), side notched (n=6), stemmed (n=4), and forms without haft modification (n=1). Five of the dart points were missing the haft element and two were broken at the notches. One San Pedro

Table 2. Tuzigoot Biface and Kiva Q Biface Data Compared; Kiva Q Data Courtesy of Dr. Bruce Bradley.

Biface Provenience	Maximum Length (mm)	Maximum Width (mm)	Maximum Thickness (mm)	Notes
Tuzigoot Pueblo	150.8	59.8	10.3	maximum length is incomplete; selective percussion
Pueblo Bonito, Kiva Q	238.8	47.0	5.1	selective percussion, no sequence obvious; non-invasive pressure retouch
Pueblo Bonito, Kiva Q	219.0	57.0	5.6	selective percussion, no sequence obvious; non-invasive pressure retouch
Pueblo Bonito, Kiva Q	184.0	50.0	5.6	selective percussion, no sequence obvious; non-invasive pressure retouch

point (sub-cat. no. MOCA 1002/2) recovered from Castle A has the distal end reworked into a drill. A torque break fragmented the drill bit. The distal end of a second San Pedro point (sub-cat. no. TUZI 2295) was broken through impact. The end was later reworked into a scraper and presumably used as a hafted tool. A third collected dart point, an Agate Basin point (sub-cat. no. TUZI0870) from Tuzigoot Pueblo, exhibits potential indicators of symbolic use. The blade edges are ground down and the flake scar ridges are heavily worn down and rounded creating a polished appearance. This wear may be attributed to being carried around in a pouch or bag (see Whittaker 1999) and suggests the point may have served a symbolic use.

ARROW POINT TYPOLOGIES

With the exception of the Squaw Peak phase pithouse, all of the sites discussed herein date to centuries after the adoption of the bow and arrow around AD 500 (Blitz 1988; Roth et al. 2011; Whittaker 2012; but see Geib and Spurr 2000; Sliva 1999; Van Pool 2006). A diverse range of small points are present including all twelve types established by Whittaker (1999) for Lizard Man Village, a Northern Sinagua habitation site (Kamp and Whittaker 1999). The typology more recently developed by Whittaker and others (2012), based on synthesis with previously established typologies and the attributes of outline, haft form, notch placement, base treatment, and blade form includes twenty-five types present within the Verde Valley Monuments (Table 3).

In general, it appears that the Verde Valley collection is most similar to Northern Sinagua assemblages, with high side notched, low side notched, and unnotched triangular forms common in both areas. However, we would be remise if we did not note that these three types become common place across the southwest post AD 1150. For this paper and based on these similarities, we compared the Verde Valley collection to points from two sites of similar age from the Flagstaff Area.

FROM SOUTH TO NORTH: A COMPARISON

Assemblages from Elden and Wupatki Pueblos are used for the comparison. Elden Pueblo is an approximately 70 room pueblo located at the base of Mount Elden near the northeastern edge of Flagstaff. Wupatki Pueblo consists of a four story, approximately 100 room pueblo in the Wupatki Basin northeast of Flagstaff. While the Verde Valley site occupations extend well into the AD 1300s, a time when most of the Northern Sinagua sites were largely uninhabited, Elden and Wupatki Pueblos were two exceptions, with occupations extending past AD 1250. Therefore, the Elden Pueblo and Wupatki Pueblo assemblages are chronologically comparable to the Verde Valley sites. Both assemblages underwent the same analytical procedures using the same typology as the Verde Valley collection. In addition, a large sample (N=765) of projectile points provides a robust database from these sites. Nine attributes including maximum length, maximum width, maximum thickness, notch height, shoulder width, neck width, weight, material type, and material source were compared for notched points. Unnotched points were compared for all applicable attributes, which does not include notch height, shoulder width, or neck width (Figure 3). Notch height refers to the length of the hafting element, measured from base to the center of the notches.

Large points occur in relatively low frequencies within the collections from the two regions. Corner notched and stemmed types are more frequent in the Northern Sinagua site collections, while side notched dart points occur more frequently at the Verde Valley sites. The small sample size and lack of a

Table 3. Verde Valley National Monument Projectile Point Types and Frequencies.

GRIN Typology	Lizard Man Village Type	Flagstaff Area		Verde Valley	
		Count	Percent	Count	Percent
Red Lake	Unnotched	18	2.59	4	1.32
Anasazi Side notched	Low notched	11	1.58	7	2.32
Eastern Anasazi Side notched	Low notched	4	0.58	0	0.00
Concave Based Long Low Side notched	Low notched	7	1.01	0	0.00
Fish-tailed Side notched	Low notched	0	0.00	2	0.66
Other Side notched	Low notched	12	1.73	2	0.66
Early Pueblo	Corner notched	3	0.43	10	3.31
Sinagua Corner notched	Corner notched	9	1.29	2	0.66
Yavapai	Low notched	0	0.00	7	2.32
Red Lake notched	Low notched	2	0.29	0	0.00
Red Lake Serrated	Serrated	30	4.32	3	0.99
Red Lake Serrated notched	Serrated	1	0.14	3	0.99
Sinagua Triangular	Unnotched	227	32.66	90	29.80
Sinagua Ovate	Unnotched	1	0.14	0	0.00
Snaketown Serrated	Serrated	0	0.00	2	0.66
Short Serrated	Serrated	53	7.63	9	2.98
Short Serrated notched	Serrated	6	0.86	0	0.00
Hohokam Serrated	Serrated	3	0.43	10	3.31
Citrus Side notched	Low notched	0	0.00	2	0.66
Long Triangle	Unnotched	98	14.10	5	1.66
Long Triangle Serrated	Serrated	13	1.87	4	1.32
Mogollon Triangular	Unnotched	4	0.58	0	0.00
Elden Side notched	High notched	115	16.55	49	16.23
Ridge Ruin Side notched	High notched	7	1.01	0	0.00
Sinagua Side notched	Low notched	47	6.76	62	20.53
Indeterminate	Indeterminate	24	3.45	29	9.60
Total		**695**	**100**	**302**	**100**

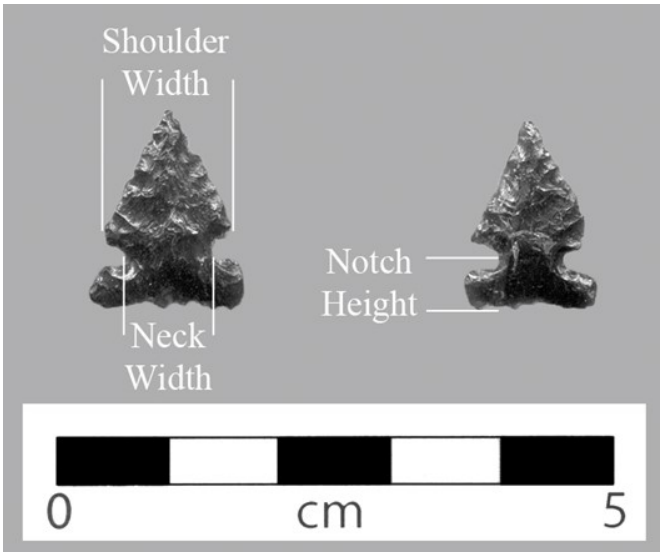

Figure 3. Diagram of three measurements taken in addition to maximum extents and weight.

regional consideration of pre-Formative sites in the respective areas negates any inferences as to the whether or not the frequencies reflect type preferences, either functional or symbolic; local availability; or the potential for dart points as trade items. However, the presence of dart points, reworking/ juvenation, and usewear show that earlier bifacial tools were procured and used for multiple purposes.

COMMON PROJECTILE POINT TYPE COMPARISONS

This section focuses on the three arrow point types that occur most frequently in both regional assemblages: unnotched, low notched, and high notched small triangular forms (Figure 4). In both regions, the unnotched, small triangular points are typically nearly equilateral in outline, relatively broad and short; usually less than 30 mm long, and have concave or straight bases. Blade edge serration occurs equally, 23.0 percent in the northern assemblages and 22.8 percent in the southern collections. Low notched, small triangular points have side notches along the lateral edges less than one-third the length of the point from the base, differentiating the blade margins from the haft. When the side notch placement occurs at or higher than one-third of the length from the base then the point is considered high notched.

The four maximum metric attributes compared for small triangular unnotched points were not statistically significantly different between the northern

Table 4. Statistical Outcomes of Quantitative Comparisons between the Verde Valley (V.V.) and Flagstaff Area (F.A.) Data.

High Notched Form							
Variable	Length	Width	Thickness	Notch Height	Shoulder Width	Neck Width	Weight
N (Sample Size)	F.A.=89 V.V.=44	F.A.=120 V.V.=39	F.A.=121 V.V.=50	F.A.=119 V.V.=50	F.A.=117 V.V.=47	F.A.=120 V.V.=50	F.A.=121 V.V.=50
Mann-Whitney U	1856.00	1638.00	2036.50	1128.50	1383.00	2590.00	2766.50
Wilcoxon W	5861.00	8898.00	9417.50	2403.50	8286.00	3865.00	10147.50
Z Value	-0.49	-2.81	-3.36	-6.36	-4.97	-1.48	-0.89
Asymp. Sig. (2-tailed)	0.63	0.00	0.00	0.00	0.00	0.14	0.37
Low Notched Form							
Variable	Length	Width	Thickness	Notch Height	Shoulder Width	Neck Width	Weight
N (Sample Size)	F.A.=63 V.V.=74	F.A.=76 V.V.=65	F.A.=80 V.V.=83	F.A.=75 V.V.=77	F.A.=72 V.V.=78	F.A.=78 V.V.=79	F.A.=80 V.V.=83
Mann-Whitney U	1780.50	1900.00	2583.50	2155.50	1865.50	1051.00	1772.00
Wilcoxon W	4555.50	4045.00	6069.50	5158.50	4946.50	4211.00	5258.00
Z Value	-2.38	-2.36	-2.45	-2.70	-3.55	-7.13	-5.17
Asymp. Sig. (2-tailed)	0.02	0.02	0.01	0.01	0.00	0.00	0.00
Unnotched Form							
Variable	Length	Width	Thickness	Notch Height	Shoulder Width	Neck Width	Weight
N (Sample Size)	F.A.=280 V.V.=78	F.A.=350 V.V.=85	F.A.=358 V.V.=100	n/a	n/a	n/a	F.A.=357 V.V.=100
Mann-Whitney U	9964.00	14349.50	17587.50	n/a	n/a	n/a	15999.50
Wilcoxon W	13045.00	75774.50	81848.50	n/a	n/a	n/a	21049.50
Z Value	-1.18	-0.51	-0.27	n/a	n/a	n/a	-1.59
Asymp. Sig. (2-tailed)	0.24	0.61	0.79	n/a	n/a	n/a	0.11

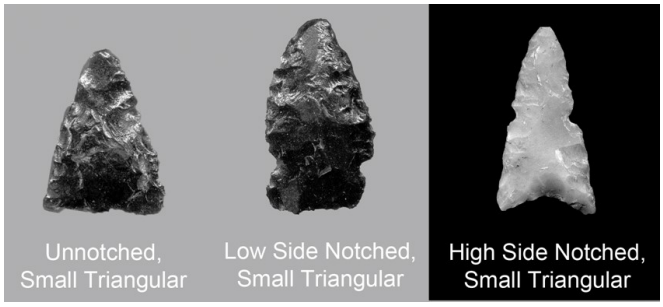

Figure 4. Examples of the three most common arrow point types from the Verde Valley National Monuments collection and the Flagstaff area sites.

and southern collections (Table 4). High side notched points exhibit similar lengths, neck widths, and weights, but width, thickness, notch height, and shoulder width are statistically different between the northern and southern regions (Table 4). High notched points from the Verde Valley are generally wider and thicker, and the notches are placed on average 2.3 mm lower than the similar type from the Flagstaff area. Low side notched forms differ statistically in all of the measurements. Low side notched points from the Verde Valley are smaller and have notches placed lower than points from the Flagstaff sites.

Raw Material Sourcing

Tool stone identification plays an important role in considerations of mobility patterns (Andrefsky 1998; Binford 1979; Jones et al. 2003; Kooyman 2000; Parry and Kelly 1986; Roberts et al. 2015; Shackley 2005; Smith 2010), technological organization (Andrefsky 1994; Nelson 1991; Huckell et al. 2010), and socioeconomic interactions (Cameron 2001; Geib 2011; Loendorf 2012; Loendorf et al. 2013; Whittaker 1987; Whittaker et al. 1988). While geochemical sourcing methods, such as x-ray fluorescence spectrometry (XRF), provide an ideal method for extrusive igneous material sourcing (Shackley 1988, 1995, 2005; Roberts et al. 2015), constraints on the current project did not allow for XRF analysis. Although macroscopic identification of raw material is difficult, the senior author analyzed all of the materials using low power microscopy (20X), and reference to an extensive comparative collection, resulting in tentative source determinations. In instances where materials could not be assigned to a specific source (i.e. Government Mountain obsidian) due to similarities with other nearby sources a more general

source area was assigned (i.e. Spring Valley Group). Materials that lacked confident source assignment were categorized as unidentified. In general, raw material usage is inter-regionally similar.

In both areas extrusive igneous materials (obsidians, rhyolite, dacite, etc.) primarily originate from the Spring Valley Group (obsidians) and Mount Floyd Volcanic Field (other extrusive igneous materials) sources located west of Flagstaff. Although the sources are closer to Flagstaff, the Spring Valley materials occur more often at the Verde Valley sites. Relevant to noting extrusive igneous source proximity to these two areas is the presence of Sycamore Canyon. Approximately 15 miles south of Spring Valley (the location of Government Mountain, Sitgreaves Mountain, and RS Hill), Sycamore Canyon meanders south, connecting with the Verde River approximately 8 miles north of Tuzigoot Pueblo. Accordingly, Sycamore Canyon provides a natural corridor for both direct procurement and interaction between the two areas. Spring Valley Group obsidians dominate both collections comprising 61.0 percent overall of the Flagstaff collection and 79.0 percent overall of the Verde Valley collection. Extrusive igneous materials from the Mount Floyd Volcanic field constitute 11.0 percent of the northern sites and 5.0 percent of the southern site collections. In addition, a small amount of Topaz Basin obsidian from the Verde Valley (Shackley 2009) occurs in both collections; 1.0 percent from the Flagstaff sites and 3.0 percent from the Verde Valley sites. Additional extrusive igneous materials include less than one percent of Kendrick Peak obsidian, a lower quality material (see Roberts et al. 2015; Shackley 1988) at the Flagstaff sites and Strawberry Dacite from the Payson area within the Verde Valley collection.

In contrast to extrusive igneous materials, it is difficult to chemically assess the source locations of cryptocrystalline silicates (chert, chalcedony, petrified wood, and jasper) because of the commonly high variability in chemical composition of even a single procurement area, which may occur as extensive geological deposits. With that in mind, similar cryptocrystalline materials occur in both locations. In many cases, these materials originate from the same primary geological sources, but occur in secondary depositional contexts affording procurement from a variety of locations. In which case, the materials could have been locally procured or obtained through interaction between the regions.

Cryptocrystalline silicates constitute a low frequency of the collections: chert (15.9 percent), jasper (1.9 percent), chalcedony (1.8 percent), and petrified wood (0.8 percent). Low power microscopy in combination with a comparative collection suggests that these materials are local to middle and northern Arizona, and derive from the Kaibab (Kaibab chert), Martin (Perkinsville jasper), and Chinle (petrified wood) geological formations. These materials, along with additional unsorted cryptocrystalline silicates, are also available in secondary quaternary deposits, such as the Little Colorado River Valley in the Northern Sinagua area and the Verde River in the Southern Sinagua area.

Dart points from both areas were made from a variety of material types (Figure 5a). Cryptocrystalline silicates, in particular chert, were preferred for large point manufacture in both regions, employed to manufacture 51.2 percent of the Flagstaff area dart points and 65.5 percent of the Verde Valley points. Comparison of all material types by region resulted in no statistical difference (Table 5). However, the cryptocrystalline raw materials show differential source material use (Figure 6a) and suggest that locally available raw materials were preferential in both regions. Extrusive igneous materials from both areas primarily originated from the northern sources of the Spring Valley group (Government Mountain, Sitgreaves Mountain, and RS Hill) (Roberts et al. 2015) and Mount Floyd Volcanic Field (Partridge Creek and Presley Wash) (Roberts et al. 2015; Shackley 1988, 1995).

Arrow points display an opposing trend. Extrusive igneous materials, particularly obsidians, were preferred for small point manufacture employed to manufacture 75.0 percent of the Flagstaff area points and 94.0 percent of the Verde Valley points. While comparison of all material types by region resulted in statistical difference (Table 5), percentages show a strikingly similar trend (Figure 5b). Similar to dart points, the cryptocrystalline silicate raw materials display differential source use (Figure 6b). Extrusive igneous materials from both areas primarily originated from the northern sources of the Spring Valley group (Government Mountain, Sitgreaves Mountain, and RS Hill) (Roberts et al. 2015) and Mount Floyd Volcanic Field (Partridge Creek, Presley Wash, and Black Tank) (Roberts et al. 2015; Shackley 1988, 1995). Minor frequencies of Kendrick Peak and Topaz Basin obsidians as well as unidentified other extrusive igneous materials are also present.

While cryptocrystalline silicates constitute a small amount, approximately one-fifth, of the sample, the materials may be obtained from multiple extensive local primary and secondary procurement locations, as well as traded, and collected from nearby sites. In contrast, extrusive igneous materials occurring in much more confined locations are far more frequent, indicating that extrusive igneous materials were preferred over cryptocrystalline silicates. This

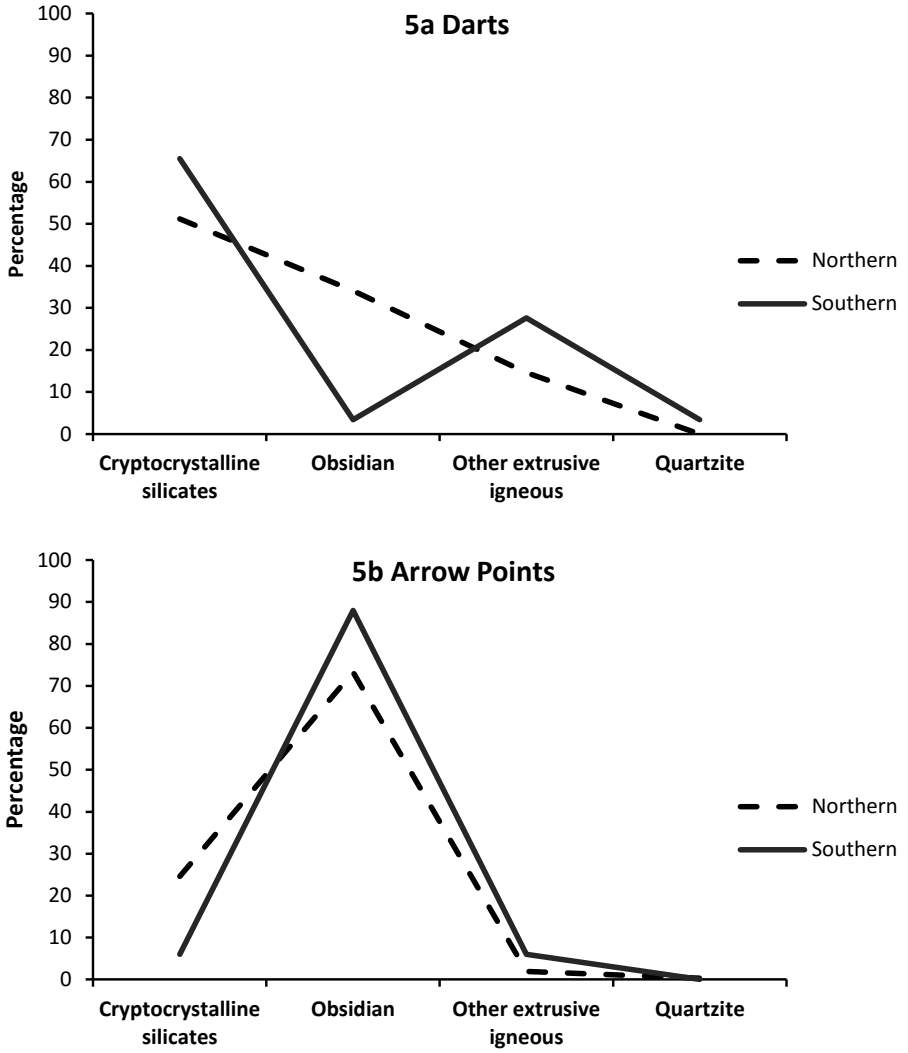

Figure 5. Percentages of material types used in the manufacture of dart (5a) and arrow (5b) points by region.

preference resulted in a general dismissal of cryptocrystallines (at least for bifacial tools) leading to concerted primary acquisition trips, inter-regional trade, or a combination of both to obtain extrusive igneous materials.

SUMMARY AND CONCLUSIONS

The bifaces and projectile points from sites within the Verde Valley National Monuments display substantial variability in form. The collection includes both large and small bifaces of varying forms used in utilitarian and likely symbolic contexts. Biface attributes also suggest use through both hafted and unhafted methods. Furthermore, the workmanship of some bifaces demonstrates that competent as well as masterful biface manufacture continued well into late pre-Columbian times. The projectile point collection also provides circumstantial evidence that large points were collected and continued to be used for both utilitarian activities, such as cutting, scraping, and drilling, as well as symbolic activities.

The small projectile point collection demonstrates substantial diversity in morphology, with forms commonly present in artifact collections from the Sinagua, Cohonina, Prescott, and Hohokam culture areas. Quantitative statistical comparisons of the three most common types with points from Northern Sinagua sites indicate that the unnotched point morphologies are similar, but both low and high side notched points exhibit differences. Verde Valley points generally exhibit lower notch placement on both high and low notched forms. We interpret the statistical differences in notch height as functional and may reflect slightly differing hafting techniques between the two regions or a preference for a longer blade in the Verde Valley.

Stone artisans in both areas employed similar materials in comparable frequencies. In particular, obsidian, which is the most common material in both

Table 5. Statistical Outcomes of Projectile Point Material Types and Sources Between Regions.

Variable	Region	n	Mean Rank	Sum of Ranks	Statistical Test	Outcome
			Dart Points			
Material	Flagstaff Area	41	34.71	1423.00	Mann-Whitney U	545.00
	Verde Valley	27	34.19	923.00	Wilcoxon W	923.00
	Total	68			Z Value Asymp. Sig. (2-tailed)	-0.116 0.908
Source	Flagstaff Area	41	26.05	1068.00	Mann-Whitney U	207
	Verde Valley	27	47.33	1278.00	Wilcoxon W	1068
	Total	68			Z Value Asymp. Sig. (2-tailed)	-4.399 0.000
			Arrow Points			
Material	Flagstaff Area	696	466.92	324978.00	Mann-Whitney U	82422.00
	Verde Valley	300	571.76	171528.00	Wilcoxon W	324978.00
	Total	996			Z Value Asymp. Sig. (2-tailed)	-7.291 0.000
Source	Flagstaff Area	696	528.08	367544.50	Mann-Whitney U	82135.50
	Verde Valley	300	429.87	128961.50	Wilcoxon W	127285.50
	Total	996			Z Value Asymp. Sig. (2-tailed)	-6.374 0.000

regions, originates from the same sources. These similarities suggest socioeconomic interactions occurred between the two areas. Overall, the projectile point collections from the Verde Valley sites show similarities to the point types present at the Northern Sinagua sites of Elden and Wupatki Pueblos. While distinct in some respects, the Southern Sinagua shares overall similarities with Northern Sinagua projectile points. To paraphrase Alison Wylie (2002), although flaked stone is only one strand in the metaphorical cable necessary to support a scientific hypothesis, the bifacial tool collection from the Verde Valley National Monument sites suggests that there is, indeed, a Southern Sinagua cultural tradition.

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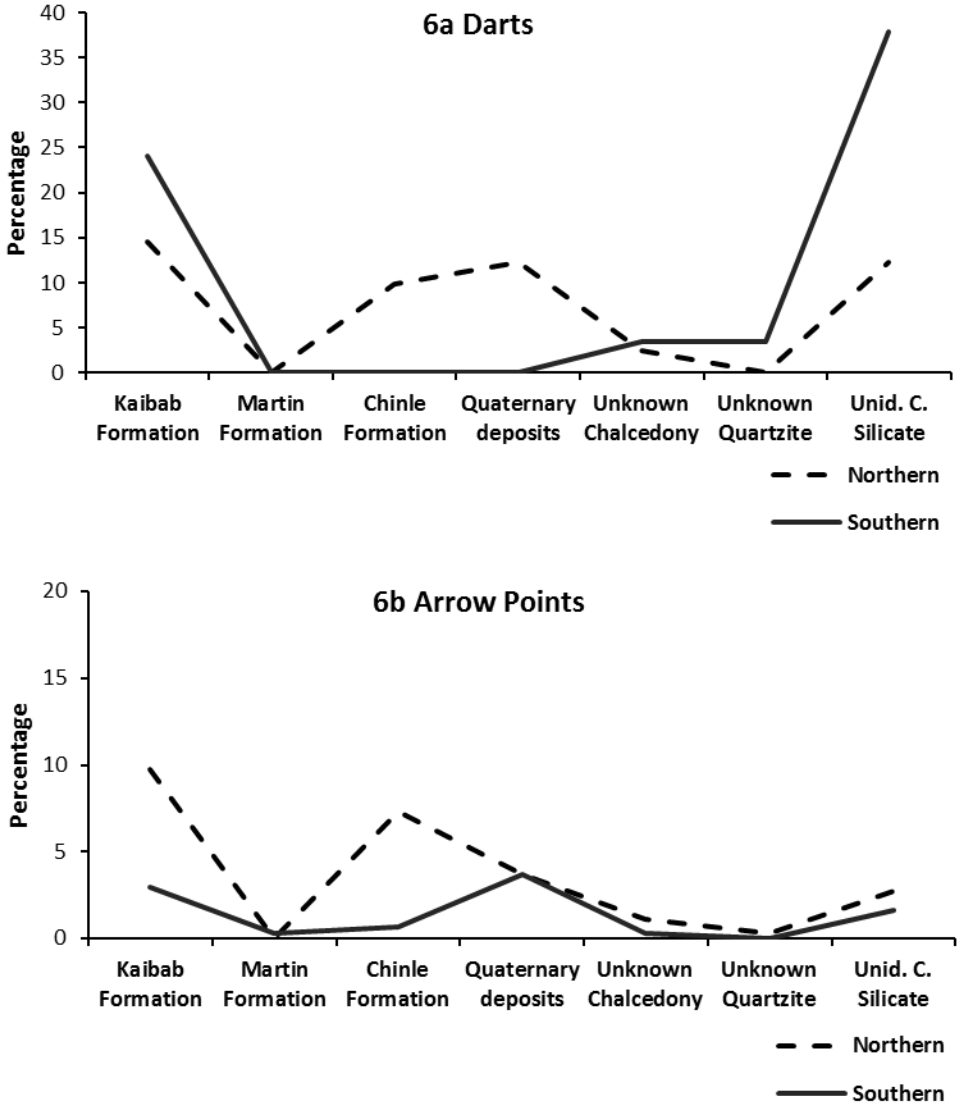

Figure 6. Percentages of general cryptocrystalline silicate sources used in the manufacture of dart (6a) and arrow (6b) points by region.

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DIFFERENTIAL USE OF FLAKED STONE DURING THE EARLY AGRICULTURE TO EARLY FORMATIVE TRANSITION AT GREY FOX RIDGE

Gregory M. Haynes

ABSTRACT

Grey Fox Ridge is a multicomponent habitation site on the first terrace above the Verde River near Tuzigoot Pueblo. Excavations by EnviroSystems Management, Inc. in 2008 revealed 69 cultural features, of which 17 were pit houses that generally date from the Late Archaic through the early Formative period (A.D. 120-1040). An analysis of flaked stone at Grey Fox Ridge revealed that the use of these artifacts was geared towards a core-and-flake technology and the storage of raw material packages. Substantial differences in flaked stone assemblages, however, were found between habitation features that date to the earliest Dry Creek phase and later Formative phases, in particular, the Cloverleaf and Camp Verde Phases. In general, the number of raw materials and artifact types gradually increased, suggesting significant changes in the overall length of residential occupation during different phases. Comparisons with Honanki phase sites show that the kinds of flaked stone artifacts present at these habitations are roughly comparable to those at Grey Fox Ridge, although specialized, short term fieldhouses contained significantly different assemblages.

Before the widespread use of masonry pueblos after A.D. 1150, Southern Sinagua populations lived in relatively small, scattered, pit house sites. Grey Fox Ridge, Site AZ N:4:110(ASM), positioned on the first terrace above the Verde River about 1.4 km south from what would later become Tuzigoot Pueblo, is one of these early pre-Honanki phase habitation sites (Figure 1). In 2008, EnviroSystems Management, Inc. conducted excavations at Grey Fox Ridge in advance of residential development on a 23-acre parcel. As a result of data recovery efforts, 69 cultural features were identified, including 17 prehistoric pit structures, 21 burials, 29 special function pits, and one protohistoric hut or wickiup foundation (Deats 2011:Table 2.2). In addition, over 11,000 artifacts were recovered during these excavations, including 3,163 pieces of flaked stone. While initial indications suggested that Grey Fox Ridge was a relatively large prehistoric village, chronometric data from the pit houses would prove otherwise. Besides a number of burials and the protohistoric hut, the site was occupied for a very long time from roughly A.D. 120, or the Dry Creek phase, to A.D. 1040, or the Camp Verde phase (Deats 2011:10.1-10.4). Moreover, these data show that no more than one or two of the habitations were occupied at any given time, indicating that the size of the co-resident group at Grey Fox Ridge was only a nuclear or extended family, rather than a large residential village with multiple families.

Because the occupational history of Grey Fox Ridge is prolonged, with habitations that date from the early agricultural period to the establishment of sedentary agricultural populations in the middle Verde Valley, it is well suited to diachronic analyses. Grey Fox Ridge offers a unique opportunity to evaluate the composition of artifact assemblages in different types of features, how that composition changed through time, and what these changes may mean for Southern Sinagua populations that inhabited the Verde Valley before substantial organizational changes occurred at ca. A.D. 1150. This is particularly true for flaked stone artifacts, as well as ceramics, because of their ubiquity across various feature types.

In this paper, I analyze the composition of flaked stone for well-dated, excavated pit house features, highlighting how assemblage composition changed through time. Because changes in assemblage composition have direct bearing on site function, inferences

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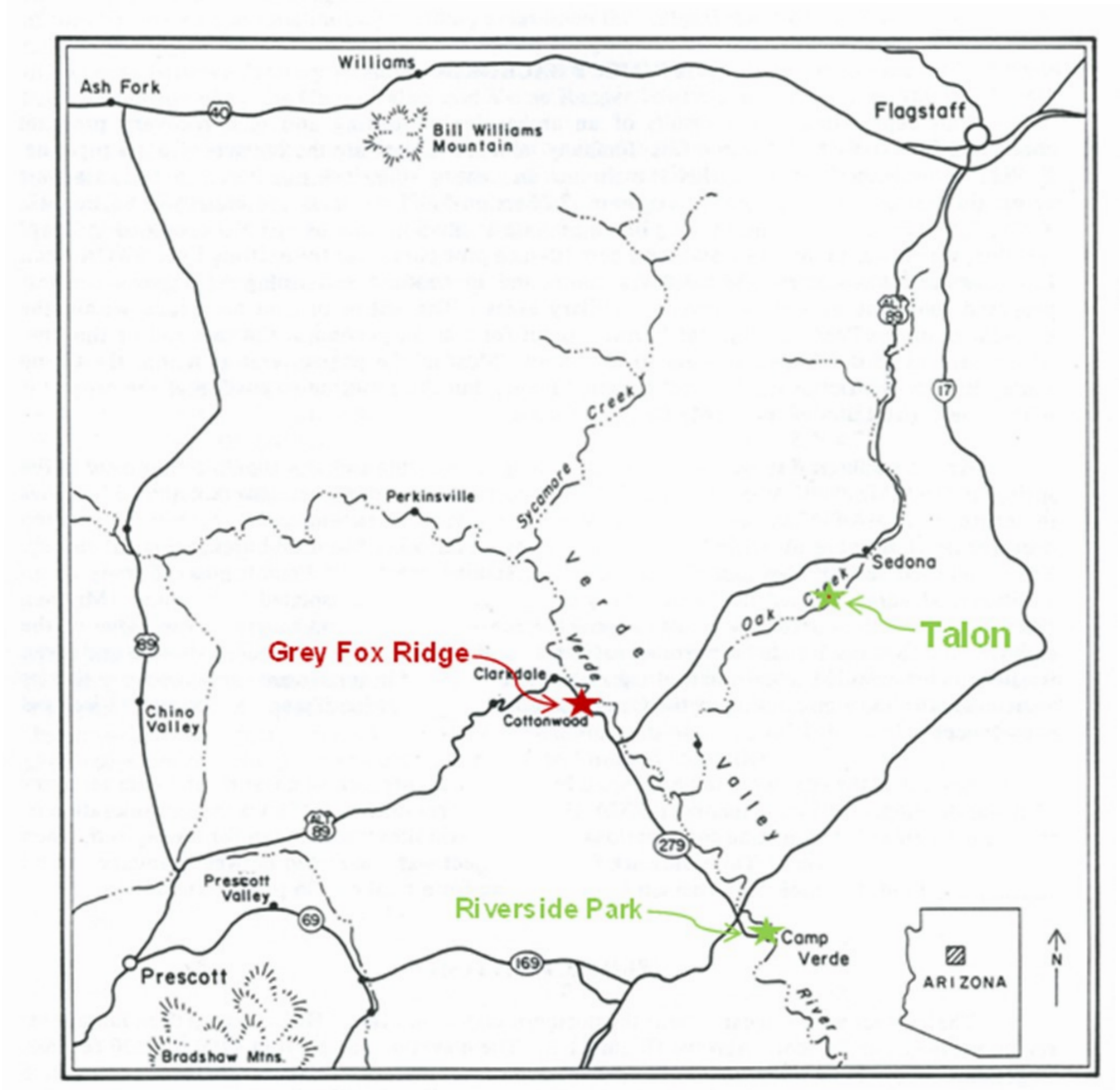

Figure 1. The location of Grey Fox Ridge, the Talon Site and the Riverside Park Site in the Middle Verde Valley.

will be made regarding the range of activities undertaken by families at different time periods, and what bearing this information may have on other sites across the middle Verde Valley. Then I will compare the flaked stone assemblage at Grey Fox Ridge with two small Honanki phase habitation sites in very different topographic settings, the Talon Site (AZ O:1:141[ASM]) at Cross Creek Ranch in the middle Verde uplands (Edwards 2005), and Site AZ O:5:188 [ASM]) along the Verde River in Camp Verde (Gilpin et al. 2010), hereafter referred to as the Riverside Park Site. The purpose here is to evaluate to what extent the reorganization of Southern Sinagua populations after A.D.1150 altered their use of flaked stone.

GREY FOX RIDGE FLAKED STONE ASSEMBLAGE

Data recovery efforts at Grey Fox Ridge collected a total of 3,163 flaked stone artifacts, of which 3,095 (97.9 percent) are pieces of debitage, 41 (1.3 percent) are core or nodular tools, and 27 (0.8 percent) are facially flaked tools (Table 1). Of these artifacts, 2,111 (66.7 percent) were obtained from habitation features, while 618 (19.5 percent) were collected from burial features. The rest of the flaked stone, or 434 artifacts (13.7 percent), were obtained from a number of different archaeological contexts (e.g., storage/roasting pits, depression/barrow pits, extra-

Table 1. Grey Fox Ridge Flaked Stone Artifact Types by Raw Materials.

Raw Material	Debitage		Facially Flaked Tools		Cores and Nodular Tools		Totals	
	n	%	n	%	n	%	n	%
Cryptocrystalline Rock								
Perkinsville Jasper	71	2.29			1	2.44	72	2.28
Chert – NFS*	2,373	76.67	13	48.15	30	73.17	2,416	76.39
Chalcedony	161	5.20	1	3.70	1	2.44	163	5.15
Quartzite – NFS	104	3.36			1	2.44	105	3.32
Vein Quartz	3	0.10					3	0.09
Sub-Total	**2,712**	**87.62**	**14**	**51.85**	**33**	**80.49**	**2,759**	**87.23**
Fine-Grained Igneous Rock								
Basalt	239	7.72	1	3.70	2	4.88	242	7.65
Igneous – NFS	54	1.74			3	7.32	57	1.80
Rhyolite			1	3.70			1	0.03
Sub-Total	**293**	**9.47**	**2**	**7.40**	**5**	**12.20**	**300**	**9.48**
Other Rock								
Siltstone/Mudstone	65	2.10			2	4.88	67	2.12
Metamorphic – NFS			1	3.70			1	0.03
Obsidian – NFS	25	0.81	10	37.04	1	2.44	36	1.14
Totals	**3,095**	**100**	**27**	**100**	**41**	**100**	**3,163**	**100**

*NFS = not further specified

mural surfaces, mechanical scrapes, excavation units) (Haynes 2011:Table 5.1).

The overwhelming majority of these items, 2,759 artifacts (87.2 percent) of the assemblage, are made from different types of cryptocrystalline rock (CCR). Most of these rock types, including chalcedony, quartzite, vein quartz, and variously-colored cherts, were probably obtained locally, that is, within a day's walk to and from the site. A small quantity of Perkinsville jasper (n=72) is also represented in the assemblage, the source of which is located about 25 km to the northwest. However, it may be that cobbles of this material had been secondarily deposited down the Verde River and would, therefore, also have been obtained locally near Grey Fox Ridge. A much smaller number of items, 299 artifacts (9.5 percent), are made from fine-grained volcanic rocks (FGVR), like basalt, rhyolite, and other igneous materials. Like CCR, most of the FGVR was probably obtained locally. In addition, 37 artifacts (1.2 percent) of the flaked stone are made from obsidian, which represents the only raw material that could not have been obtained immediately near Grey Fox Ridge. X-ray fluorescence analysis of 15 pieces of obsidian debitage revealed that these items are all derived from northern Arizona sources, such as Government Mountain (n=11), RS Hill/Sitgreaves Mountain (n=3), and Presley Wash (n=1). The rest of the assemblage (68 artifacts, 2.1 percent) is composed of locally available siltstone or mudstone (n=67), and metamorphic rock (n=1).

Of the 3,095 pieces of debitage, only 2,605 were analyzed in the laboratory (Table 2). The other 490 flakes were associated with burials, so only the raw material of these artifacts was determined. With the exception of non-local obsidian, most of the debitage is represented by direct freehand percussion flakes or shatter; and together these two flake types compose 94.5 percent of the waste debris. Biface thinning flakes, pressure flakes, and 'other' flakes, compose a meager 5.5 percent of the debitage. This suggests that for most locally obtained raw material, the completion of facially flaked tools was not an important activity at Grey Fox Ridge. A generalized core-and-flake technology was employed, while the completion and use of specialized facially flaked tools occurred elsewhere. Obsidian tools, however, were likely rejuvenated and/or resharpened on site.

The above inference regarding the general reduction technology at Grey Fox Ridge is borne out by the kinds of tools present at the site (Table 3). A total of 68 tools were recovered during data recovery, and of these 41 are core/nodular tools. These kinds of implements are generally used in the manufacture of facially flaked tools, as well as the production of sim-

Table 2. Grey Fox Ridge Flaked Stone Debitage by Raw Materials.

Raw Material	Shatter		Percussion		Biface Thinning		Pressure		Other*		Totals**		With Burials
	n	%	n	%	n	%	n	%	n	%	n	%	n
Cryptocrystalline Rock													
Perkinsville Jasper	8	21.1	27	71.1	1	2.6	2	5.3			38	100	33
Chert – NFS***	322	16.1	1,569	78.3	53	2.7	59	3.0			2,003	100	370
Chalcedony	19	11.9	127	79.4	8	5.0	4	2.5	2	1.3	160	100	1
Quartzite	6	5.8	96	92.3					2	1.9	104	100	
Vein Quartz			3	100.0							3		
Sub-Total	355	15.4	1,822	78.9	62	2.7	65	2.8	4	0.2	2,308	100	
Fine-Grained Igneous Rock													
Basalt	9	4.3	187	89.9	3	1.4	4	1.9	5	2.4	208	100	36
Igneous – NFS	10	18.5	43	79.6					1	1.9	54		
Sub-Total	19	7.3	230	87.8	3	1.1	4	1.5	6	2.3	262	100	
Siltstone/Mudstone	3	18.8	13	81.3							16	100	49
Obsidian – NFS	4	16.7	14	58.3	3	12.5	2	8.3	1	4.2	24	100	1
Totals	**381**	**14.6**	**2,079**	**79.7**	**68**	**2.6**	**71**	**2.7**	**11**	**0.4**	**2,610**	**100**	**490**

*Other = all five basalt flakes are ground stone production flakes; the obsidian flake is a bipolar flake; all others flakes could not be classified

**Totals do not include the unanalyzed debitage associated with burials

***NFS = not further specified

ple expedient flakes and durable chopping/scraping tools. Conversely, of the entire flaked stone assemblage, only 27 artifacts can be characterized as facially flaked tools, or implements used in the processing of foods or in the manufacture of crafted implements. Of these 27 facially flaked tools, 14 are projectile points, 8 are generalized preform bifaces, 1 is a specialized graver, while the other 4 are either utilized or retouched flakes. Thus, the flaked stone assemblage at Grey Fox Ridge emphasized an expedient core-and-flake technology and raw material storage, as opposed to the manufacture and use of specialized facially flaked tools.

Diachronic Analysis of Flaked Stone in Habitation Features

Of the 17 pit houses identified during EnviroSystems' data recovery efforts, six could be firmly dated to specific chronological phases (Figure 2). Two pit houses date to the Dry Creek phase (Features 22 and 28), two others date to the Hackberry phase (Features 6 and 19), while the last two date to the Cloverleaf and Camp Verde phases (Features 14 and 59). The other 11 pit houses were not excavated or spanned multiple phases. For this analysis, the flaked stone assemblages for each of the habitation features associated with a given phase or phases are combined to enhance trends in these data.

It is important to highlight that the abandonment process for any given habitation is always somewhat different and these processes have direct effects on assemblage composition. Some habitations may be cleaned out before abandonment, leaving only a few stray artifacts. Other houses are meant to be reused at a later time, so that many artifacts are stored or left in place. At Grey Fox Ridge, Deats (2011:10.4) identified two modes of abandonment, one where pit houses were left to deteriorate over time and another where the structure was purposefully burned. In both cases, pit structure features were permanently abandoned, although in the former mode the occupants may have intended to return, but ultimately did not do so. While abandonment processes directly affect assemblage composition, taken together one-third of all flaked stone recovered from Grey Fox Ridge (1,073 artifacts) was obtained from these 6 features.

The most obvious differences in flaked stone occurs between the earliest Dry Creek phase, a phase associated with the introduction of agriculture in the Late Archaic, and the other, later, Formative phases. Table 4 presents the numbers of flaked stone artifacts, both debitage and tools, by raw material categories (CCR, FGVR, obsidian). What is apparent is the low number of tools associated with the two Dry Creek phase habitations and the relatively heavy reliance on locally obtained CCR. No Perkinsville jasper

Table 3. Grey Fox Ridge Flaked Stone Tools by Raw Materials.

Raw Material	Facially Flaked Tools					Cores and Nodular Tools						Total
	Preform Bifaces	Retouched Flakes	Utilized Flakes	Gravers	Projectile Points	Core-NFS	Uni-Core (≤ 3 flakes)	Uni-Cores (≥ 4 flakes)	Bifacial Cores	Amorphous Cores	Hammer stones	
Cryptocrystalline Rock												
Perkinsville Jasper								1				1
Chert – NFS*	6	1		1	5	2	2	5	1	20		43
Chalcedony			1							1		2
Quartzite										1		1
Fine-Grained Igneous Rock												
Basalt					1		1			1		3
Igneous – NFS						1				1	1	3
Rhyolite					1							1
Other Rock												
Siltstone/Mudstone						1				1		2
Metamorphic – NFS	1											1
Obsidian – NFS	1		2		7	1						11
Totals	**8**	**1**	**3**	**1**	**14**	**5**	**3**	**6**	**1**	**25**	**1**	**68**

*NFS=not further specified

and only two tools, a chert unifacial core and a typologically unidentifiable obsidian projectile point, were recovered. During the Hackberry phase, and even more in the Cloverleaf/Camp Verde phases, there is a trend towards increased use of FGVR, as well as in the use of exotic raw materials, in particular Perkinsville jasper and obsidian. In addition, the absolute number of tools associated with these later features increases four-fold in the Hackberry phase and seven-fold in the Cloverleaf/Camp Verde phases, as opposed to the Dry Creek Phase.

Table 5 presents the kinds of debitage (shatter, direct freehand percussion, biface thinning/pressure flakes) by raw material categories recovered from habitation features. These data highlight the same general trend as discussed above. During the Dry Creek phase, all three kinds of debitage are made from locally available CCR, while only a handful of FGVR direct freehand percussion flakes are present, and there are no flakes whatsoever from obsidian. During the Hackberry phase, all three kinds of debitage are made from CCR, along with two other kinds of debitage made from FGVR and obsidian. Finally, in the Cloverleaf/Camp Verde phases, each of the three kinds of debitage, that is shatter, direct freehand percussion, and biface thinning/pressure flakes, are made from each of the three major material types, CCR, FGVR, and obsidian. Thus, the number of different kinds of debitage within habitation features increases through time.

Another way to look at this general trend of increasing numbers and kinds of flaked stone artifacts at habitations through time is by reviewing assemblage *richness*. Richness, in an archaeological sense, is defined as the number of artifact classes present in a collection that contains a specified number of artifacts (Dunnell 1989). The number of different artifact classes present is typically related to the absolute number of artifacts in the assemblage: as the number of artifacts increase, so, too, does the number of different artifact classes, although this is not a direct relationship (Dunnell 1989). Table 6 presents the number of artifact classes per habitation feature by phase. The two Dry Creek phase habitations have 7 and 8 debitage classes, while the number of tool classes range from 0 to 2. Similarly, the two habitations that date to the Hackberry phase have 7 and 14 debitage classes, and the number of tool classes range from 1 to 3. However, the two pit houses that date to the Cloverleaf/CampVerde phases contain 16 and 19 debitage classes, and 5 and 9 tool classes. Simply put, the number of artifact classes is relatively low during the early Dry Creek and Hackberry phases, and substantially increases during the later Cloverleaf/Camp Verde phases.

Temporal Periods		Calendar Years	Phases	Grey Fox Ridge Habitation Features	Honanki Phase Sites
MODERN		Last 50 years			
HISTORIC		1580—	Historic		
PROTOHISTORIC			Yavapai and Apache		
		1450—	Abandonment?		
FORMATIVE		1400—	Tuzigoot		Talon
		1300—			
		1200—	Honanki		
		1100—	Camp Verde		
		1000—			
		900—			Riverside Park
		800—	Cloverleaf		
		700—	Hackberry		
		600—			
		500—			
ARCHAIC	LATE	400—	Dry Creek / Late Archaic		
		300—			
		200—			
		100—			
		A.D.			
		B.C.			
	MIDDLE	2000—	Middle Archaic		
		3000—			
		4000—			
		5000—			
	EARLY	6000—	Early Archaic		
		7000—			
		8000—			
PALEOINDIAN			Paleoindian		

Figure 2. Chronological framework for the middle Verde Valley.

Table 4. Grey Fox Ridge Habitation Features: Flaked Stone Artifacts by Time Period.*

Phase/Artifact Type	Cryptocrystalline Rock		Fine-grained Volcanic Rock		Obsidian		Totals
	Counts	Percent	Counts	Percent	Counts	Percent	Counts
Dry Creek							
Debitage	99	93.4	7	6.6	0	0.0	106
Tools	1	50.0	0	0.0	1	50.0	2
Perkinsville Jasper	0		*		*		0
Hackberry							
Debitage	239	89.5	24	9.0	4	1.5	267
Tools	5	62.5	2	25.0	1	12.5	8
Perkinsville Jasper	3	100.0	*		*		3
Cloverleaf/Camp Verde							
Debitage	619	89.7	57	8.3	14	2.0	690
Tools	12	80.0	1	6.7	2	13.3	15
Perkinsville Jasper	13	100.0					13
Global Site Values							
Debitage	2712	89.5	293	9.7	25	0.8	3030
Tools	47	72.3	7	10.8	11	16.9	65
Perkinsville Jasper	72	100.0	*		*		72

*67 siltstone/mudstone artifacts and 1 metamorphic artifact are not included in these values

Table 5. Grey Fox Ridge Habitation Features: Debitage by Time Period.

Phase/Artifact Category	Cryptocrystalline Rock		Fine-grained Volcanic Rock		Obsidian		Totals
	Counts	Percent	Counts	Percent	Counts	Percent	Counts
Dry Creek Phase							
Shatter	13						13
Direct Freehand Percussion Flake	61		7				68
Biface thinning/Pressure Flake	25						25
Total	**99**	**93.4**	**7**	**6.6**			**106**
Hackberry Phase							
Shatter	36		4		1		41
Direct Freehand Percussion Flake	239		20		3		262
Biface thinning/Pressure Flake	13						13
Total	**288**	**91.1**	**24**	**7.6**	**4**	**1.3**	**316**
Cloverleaf/Camp Verde Phase							
Shatter	108		3		1		112
Direct Freehand Percussion Flake	476		53		8		537
Biface thinning/Pressure Flake	35		1		5		41
Total	**619**	**89.7**	**57**	**8.3**	**14**	**2**	**690**
Global Site Values							
Shatter	355		19		4		378
Direct Freehand Percussion Flake	1822		230		14		2066
Biface thinning/Pressure Flake	127		9		5		141
Total	**2304**	**89.1**	**258**	**10**	**23**	**0.9**	**2585**

Table 6. Grey Fox Ridge Habitation Features: Flaked Stone Richness by Time Period.

Phase/Feature Number	Debitage Classes	Tool Classes	Total Classes
Dry Creek Phase			
Feature 22 (n = 73)	7	0	7
Feature 28 (n = 35)	8	2	10
Hackberry Phase			
Feature 6 (n = 47)	7	1	8
Feature 19 (n = 228)	14	3	17
Cloverleaf/Camp Verde Phase			
Feature 14 (n = 430)	19	5	24
Feature 59 (n = 375)	16	6	22
Global Site Values (n = 2605)	25	24	49

Excludes 490 pieces of debitage associated with burial features and 68 siltstone/mudstone/metamorphic artifacts.

A simple regression analysis was conducted to analyze the relationship between the number of flaked stone artifact classes and assemblage size at Grey Fox Ridge. When the six habitation features at Grey Fox Ridge are analyzed, 88.6 percent of the variation in the number of artifact classes can be predicted simply by knowing how many artifacts are present in any of these features (p=0.003). This proves that there is a strong relationship between the number of artifact classes present in habitations at Grey Fox Ridge and assemblage size. When a line-of-best-fit is plotted, along with a 95 percent confidence interval, the strength of this relationship can be observed (Figure 3). The only habitation feature that cannot be predicted by this model is Feature 19, a Hackberry phase habitation; this pit house contains more artifact classes than predicted by this particular model. What is interestingly portrayed in Figure 3 is that both Dry Creek phase habitations and one of the Hackberry phase habitations (Feature 6) cluster near the lower left corner, representing those pit houses with small numbers of artifacts and artifact types. Conversely, both Cloverleaf/Camp Verde habitations and the other Hackberry phase habitation (Feature 19) cluster near the upper right corner and represent those pit houses with greater numbers of artifacts and artifact types.

Interpretations

The flaked stone assemblages associated with habitation features at Grey Fox Ridge show a consistent trend towards a wider variety, or richness, in the types of raw materials and artifact types through time. This trend confirms general archaeological expectations regarding populations that move from a mobile foraging lifeway, with low residency times at any specific habitat, to a sedentary agricultural lifeway, where residency time is relatively high and populations are generally stable across the landscape. The flaked stone assemblage associated with the two Dry Creek phase habitations contain, almost exclusively, debitage made from locally available CCR. The inference is that these populations were not spending long periods of time at Grey Fox Ridge. They did not store raw materials in their houses, nor did they transport non-local materials obtained from other habitats for use at Grey Fox Ridge. Conversely, the increasing diversity of raw materials and artifact types in the Hackberry Phase, and even more during the Cloverleaf/Camp Verde phases, including high-quality jasper and non-local obsidian, indicates increased residency time at Grey Fox Ridge by these residents and stable interactions with groups in adjacent regions. Feature 19, the Hackberry phase habitation that proved to be an outlier in the regression model, supports this inference. The Hackberry phase may be interpreted as a time of transition between those families that still practiced a mobile foraging lifeway, as indicated by Feature 6, and other families that began to practice a more sedentary lifeway, as indicated by Feature 19.

COMPARISONS WITH HONANKI PHASE SITES

Throughout the early phases of the Formative period, the Southern Sinagua lived in scattered pit house sites throughout the middle Verde Valley, with strong ties to the Hohokam (Powers and Pearson 2008). After ca. A.D. 1150, these populations experienced a significant reorganization. People began living in masonry surface structures and aggregated pueblos, of which the most well-known are Tuzigoot and Montezuma's Castle. In addition, most painted ceramic vessels were obtained from Anasazi-related groups, suggesting that kinship and trade/exchange networks were oriented towards these northern populations, rather than to Hohokam-related populations to the south (Pilles 1996; Powers and Pearson 2008).

A number of Honanki and Tuzigoot phase habitations have been excavated over the years. Unfortunately, only a few have undergone data recovery using modern analytic and documentation standards (e.g., Edwards 2005; Gilpin et al. 2010; Logan and Horton 1997). Consequently, while a relatively good deal is understood about how ceramic assemblages changed as a result of this reorganization, little if anything is known about how this change affected the use of flaked stone and the composition of such assemblages at habitation sites.

Recently, two Honanki phase sites have been excavated by cultural resource management firms and

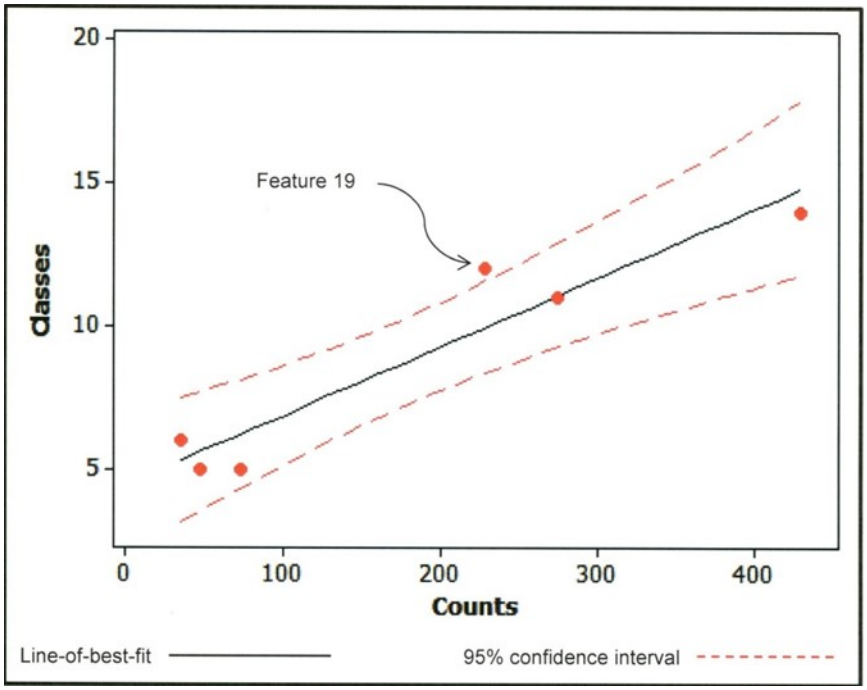

Figure 3. Regression model for Grey Fox Ridge habitation features.

comprehensive data recovery reports have been published. The Riverside Park Site (AZ O:5:188[ASM]) was a small habitation site in the town of Camp Verde on the broad floodplain immediately above the Verde River (Gilpin et al. 2010) (Figures 1 and 2). Its topographic position, therefore, was very similar to that of Grey Fox Ridge. Likewise, the kinds of flaked stone material immediately available to the occupants were probably the same. Data recovery efforts uncovered three pit houses and four storage features dating from ca. A.D. 1150 to A.D. 1200 (Gilpin et al. 2010:91). Based on several lines of evidence, including flaked stone, Gilpin and others suggest that the site was probably a fieldhouse or farmstead for the Camp Verde Ruin, located on the north side of the Verde River near the mouth of Beaver Creek (Gilpin et al. 2010:97-99). A total of 1,560 artifacts were recovered during data recovery efforts in 2007, including 203 pieces of flaked stone (Gilpin et al. 2010:56-61).

The Talon Site (AZ O:1:141[ASM]) was a small habitation located in the uplands of the middle Verde Valley along Oak Creek near Red Rock State Park (Edwards 2005) (Figures 1 and 2). It was composed of four surface masonry rooms that dated to the latter half of the twelfth century, from about A.D. 1250 to A.D. 1300. Although likely representing a single family, the settlement was probably associated with Cross Creek Pueblo, located about 100 m away. In all, 956 pieces of flaked stone were recovered during data recovery efforts in 2002-2003 (Edwards 2005). Because it is located in the uplands of the middle Verde, the kinds of flaked stone materials available to the occupants were probably different than for either Grey Fox Ridge or the Riverside Park Site, offering an interesting contrast between the two sites located along the floodplain of the Verde River.

Table 7 presents flaked stone assemblage data for Grey Fox Ridge, the Talon Site, and the Riverside Park Site. What is immediately apparent is that, unlike Grey Fox Ridge and the Talon Site, Riverside Park relies heavily on both CCR and FGVR, whereas Grey Fox Ridge and the Talon Site are dominated by CCR. In fact, only six flaked stone artifacts out of the 956 at the Talon Site are made from FGVR. There is also an inverse relationship between the kinds of tools made of CCR and FGVR at Riverside Park; facially flaked tools are generally made from CCR, while core and nodular tools are of FGVR. Another important finding is that the Grey Fox Ridge assemblage contains the smallest proportion of obsidian, or 1.1 percent, as opposed to the Talon and Riverside Park Sites, where obsidian composes 4.1 and 5.0 percent, respectively. Interestingly, Grey Fox Ridge and the Talon Site are generally similar in the proportion of facially flaked tools made from each of the major material types, including FGVR, although Grey Fox Ridge has a greater proportion of facially flaked tools made from CCR (51.9 percent), while the Talon Site has a greater proportion made from obsidian (57.7 percent). Facially flaked tools at Riverside Park are, conversely, dominated by CCR (70.0 percent), with limited quantities of FGVR (15.0 percent) and obsidian (15.0 percent).

Table 7. Intersite Comparison of Flaked Stone Artifacts by Raw Materials.

Raw Material	Debitage		Facially Flaked Tools		Cores and Nodular Tools		Totals	
	n	%	n	%	n	%	n	%
Cryptocrystalline Rock								
Grey Fox Ridge	2,712	87.6	14	51.9	33	80.5	2,759	87.2
Talon Site	885	96.8	10	38.5	16	100	911	95.3
Riverside Park	97	62.2	14	70	7	25.9	118	58.1
Fine-Grained Volcanic Rock								
Grey Fox Ridge	293	9.5	2	7.4	5	12.1	300	9.5
Talon Site	5	0.6	1	3.9			6	0.6
Riverside Park	47	30.1	3	15	17	63	67	33
Other Rock								
Grey Fox Ridge	65	2.1	1	3.7	2	4.88	68	2.2
Talon Site								
Riverside Park	5	3.2			3	11.1	8	3.9
Obsidian								
Grey Fox Ridge	25	0.8	10	37	1	2.4	36	1.1
Talon Site	24	2.6	15	57.7			39	4.1
Riverside Park	7	4.5	3	15			10	5
TOTALS								
Grey Fox	**3,095**	**100**	**27**	**100**	**41**	**100**	**3,163**	**100**
Talon Site	**914**	**100**	**26**	**100**	**16**	**100**	**956**	**100**
Riverside Park	**156**	**100**	**20**	**100**	**27**	**100**	**203**	**100**

The differences discussed above are further highlighted by the kinds of flaked stone tools found at each site (Table 8). Grey Fox Ridge and the Talon Site have a wide variety of both facially flaked and core/nodular tools made from CCR. The Riverside Park Site, however, primarily contains utilized flakes and amorphous cores. In terms of FGVR, Grey Fox Ridge contains two projectile points and a variety of cores, while the Talon Site has a single projectile point. Conversely, the FGVR tools recovered from Riverside Park are completely different and include three utilized flakes and 17 core tools. Obsidian tools at Grey Fox Ridge and the Talon Site are dominated by projectile points, while the Riverside Park site contains a single obsidian point, along with two utilized flakes. Unlike Grey Fox Ridge and the Talon Site, where there are a wide variety of different tool types, the Riverside Park Site is heavily skewed towards two types of tools: utilized flakes and core tools.

When a simple regression analysis is conducted using the six Grey Fox Ridge habitation features and the aggregate assemblages of two Honanki phase sites, 70.6 percent of the variation in the number of artifact classes can be predicted by knowing how many artifacts are in a given assemblage. While this is not as strong a relationship when only the Grey Fox Ridge habitation features are used (see above), it nonetheless remains statistically significant ($p=0.006$). When a line-of-best-fit is plotted, along with a 95 percent confidence interval, the only site that cannot be predicted by this particular model is the Riverside Park Site (Figure 4). Interestingly, the Talon Site falls well within the 95 percent confidence interval, as do the six Grey Fox Ridge pit house features. The reason the Riverside Park Site cannot be predicted by the regression model is because it has a very small assemblage size (n=195), yet still contains a large number of artifact types for all three material classes.

Comparative Interpretations

Grey Fox Ridge and the Riverside Park Site are similar in that they contain a range of material types that are locally available on or near the floor of the Verde Valley. Conversely, the Talon Site has virtually no FGVR or other kinds of raw materials. Where the Riverside Park and the Talon Sites are similar is the relatively high proportion of obsidians that comprise their flaked stone assemblages, as opposed to Grey Fox Ridge, indicating stable connections with populations to the north. This is, however, where their similarities end. Both Grey Fox Ridge and the Talon Site contain a wide range of facially flaked, and core/nodular tools, indicating a habitation site where a variety of different activities took place. This finding is brought out by the regression model, where the Talon Site and the Grey Fox Ridge houses fall within the 95 percent confidence interval.

The assemblage from the Riverside Park Site contains a more equitable range of material types but is significantly skewed towards utilized flakes and

Table 8. Intersite Comparison of Flaked Stone Tools by Raw Materials.

Raw Material	Facially Flaked Tools					Cores and Nodular Tools						Total
	Preform Bifaces	Retouched Flakes	Utilized Flakes	Specialized Tools*	Projectile Points	Core-NFS	Uni-Core (≤ 3 flakes)	Uni-Cores (≥ 4 flakes)	Bifacial Cores	Amorphous Cores	Core Tools	
Cryptocrystalline Rock												
Grey Fox Ridge	6	1	1	1	5	2	2	6	1	22		47
Talon Site	1	1	6	1	1	6		2	2	6		26
Riverside Park			13	1						5	2	21
Fine-Grained Volcanic Rock												
Grey Fox Ridge					2	1	1			2	1	7
Talon Site					1							1
Riverside Park			3								17	20
Other Rock												
Grey Fox Ridge	1					1				1		3
Talon Site												
Riverside Park											3	3
Obsidian												
Grey Fox Ridge	1		2		7	1						11
Talon Site	1		3		11							15
Riverside Park			2		1							3

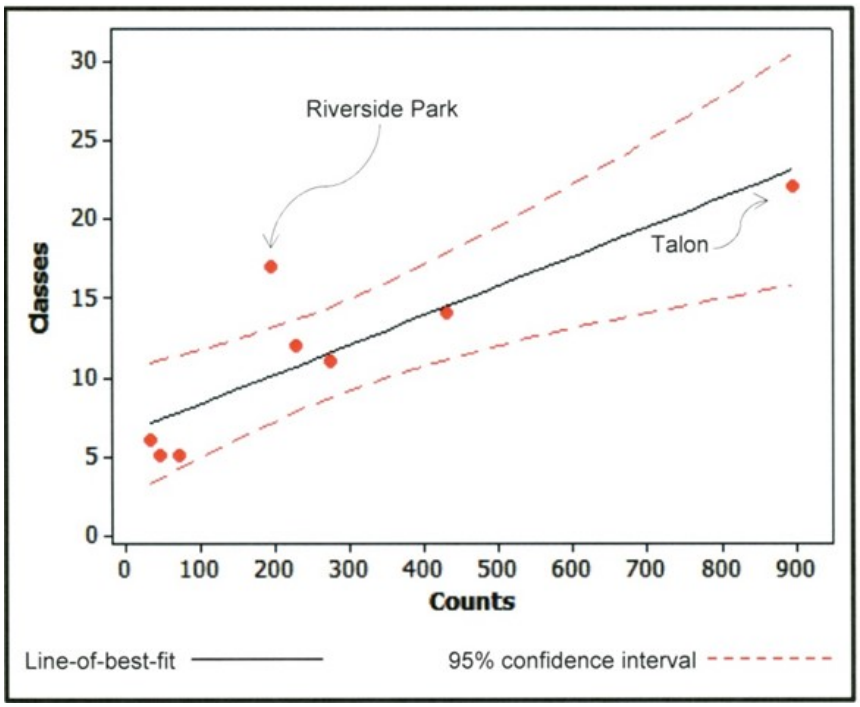

Figure 4. Regression model for Grey Fox Ridge habitation features, the Talon Site and the Riverside Park Site.

heavy core tools, indicating that specialized activities took place there. Despite the fact that three pit houses and four storage features are present at Riverside Park, Gilpin and others (2010:97-99) recognized this and classified the site as a fieldhouse or farmstead, rather than a full time habitation. The prevalence of FGVR core tools at Riverside Park, as opposed to Grey Fox Ridge and the Talon Site, is particularly intriguing because these tools must have been related to certain specialized functions that occurred there; what these particular functions were remains unknown.

CONCLUSIONS

Grey Fox Ridge is one of only a few large pre-Honanki phase habitation sites excavated along the floodplain of the middle Verde River. As such, information provided by EnviroSystems' data recovery offers unique perspectives about the earliest Southern Sinagua. The flaked stone assemblages recovered from the two Late Archaic habitation features indicate a short residency time. The inference is that these residents were still mobile foragers that incorporated use of the Verde River floodplain in a seasonal round. This began to change during the early Formative, ca. A.D. 500-800, where some habitations contain limited flaked stone assemblages (Feature 6), while others express a much wider range of raw material and artifact types (Feature 19). Indeed, the only habitation at Grey Fox Ridge that had more artifact classes present than could be accounted for by a regression model was Feature 19, a Hackberry phase pit structure. During the Cloverleaf/Camp Verde phases, a wide range of material and artifact types, including formed tools and non-local raw materials, are present within habitation features. The inference here is that these families were sedentary agriculturalists, with long residency times that allowed for the accumulation of a wide variety of raw material and artifact types. Moreover, a relatively large proportion of non-local obsidians, and perhaps Perkinsville jasper in both Hackberry and Cloverleaf/Camp Verde habitations, indicate regular participation in exchange networks with adjacent populations.

Flaked stone at Honanki phase habitations, like the Talon Site, have assemblages that are generally similar in content to earlier phase habitations, like Grey Fox Ridge. This is particularly noted in the range of formed tools expressed at the Talon Site and Grey Fox Ridge and supported by a simple regression model that predicted the range of variation in all six of the Grey Fox Ridge habitation features and the Talon Site. However, unlike Grey Fox Ridge and the Riverside Park Site, a specialized field house or farmstead, the Talon Site indicates that Honanki phase habitations may not have used FGVR. Even though FGVR was probably available to residents of the Talon Site, it represents only a very small proportion of its flaked stone assemblage. Another difference between Grey Fox Ridge and the two Honanki phase sites is that the latter sites contained a relatively greater proportion of non-local obsidians. This suggests that pre-Honanki Southern Sinagua trade and exchange ties with populations to the north may have been less formalized, perhaps even serendipitous, as opposed to later Southern Sinagua populations. Finally, the abundance of FGVR and, in particular, FGVR core tools at the Riverside Park Site, as opposed to the Talon Site, indicates a substantial difference in function between habitations and temporary, special function fieldhouses or farmsteads that date to the Honanki phase.

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SPECIALIZED HOHOKAM PRODUCTION AND EXCHANGE PRIOR TO THE BALLCOURT AND MARKET SYSTEM

David E. Doyel

ABSTRACT

The emergence of specialized production and exchange of commodities in the Hohokam Early Formative period established some initial social conditions that led to subsequent economic and cultural elaboration that included the ballcourt and market networks. Excavations at the Mustang site (AZ U:6:87 [ASM]) in the lower Verde River Valley east of the Phoenix Basin documented an Early Formative period occupation that included structures and other features. Sweetwater phase (ca. A.D. 600-700) pottery (N=10, 021 sherds) was dominant that contained spatially discrete temper types from multiple production sources indicating that about 70 percent of the pottery was not locally produced. The decorated pottery contained temper types specific to the middle Gila River valley with smaller amounts specific to the lower Salt River valley. Temper types present in the plain ware and red ware indicate multiple local and non-local production sources.

One focus of contemporary research is specialized production and exchange among the ancient communities in the Sonoran Desert. Important questions include: when did specialized production begin, and where and how did production occur? How was specialized production integrated into local and regional economic systems? Contract archaeology has produced a growing regional database to address such questions. For example, we now know that hard fabric products including pottery, obsidian, marine shell, and ground stone were exchanged in great quantities (Abbott 2009; Doyel 1991a; 2012; Nelson 1991; Shackley 2005). Some communities specialized in producing plant products including cotton and agave (Gasser and Miksicek 1985).

One strong focus has been on the distinctive Hohokam red-on-buff pottery. The pottery of the later phases is well-defined and known to have been produced by specialists and widely traded (Abbott 2009). Less is known about Early Formative pottery because excavated collections are rare, the largest coming from Snaketown. The Early Formative types Estrella Red-on-gray and Sweetwater Red-on-gray are the earliest decorated types produced by Hohokam potters, and are two of the earliest painted types in the Southwest (Haury 1976).

Excavations at multiple sites funded by the Bureau of Reclamation undertaken by Archaeological Consulting Services (ACS) for a road expansion project on the Fort McDowell Indian Community in the lower Verde River Valley provided a rare opportunity to investigate interaction among regional populations at an early point in Hohokam prehistory (Hoffman and Phillips 1997). Excavations at one of the ACS project sites, the Mustang site (AZ U:6:87[ASM]), produced a sizeable assemblage of Early Formative (Sweetwater phase) pottery. Analysis revealed that most of the pottery contained non-local tempers, and available data suggested a regional pattern (Doyel and McDonnell 1997a, 1997b, 2001). Temper materials identified in most of the decorated sherds are unique to the middle Gila River Valley, about 90 km distant. Most of the red ware and half the plain ware also had non-local tempers. These data indicate that a historical trajectory was initiated in the Early Formative period that led to subsequent economic and cultural elaboration, a pattern anticipated by Abbott (2009) based on more limited data. Herein I suggest possible social mechanisms that may account for the circulation of pottery and other materials in this early time period.

The prehistoric ceramic horizon occupation of the lower Verde is often ascribed to the "Verde tradition" related to the Hohokam cultural tradition in the nearby Phoenix Basin (Doyel and Plog 1980; Doyel and Crary 1995; Lerner 1985; McGuire 1991; Whittlesey 2007; Wood 1985). The lower Verde has been vari-

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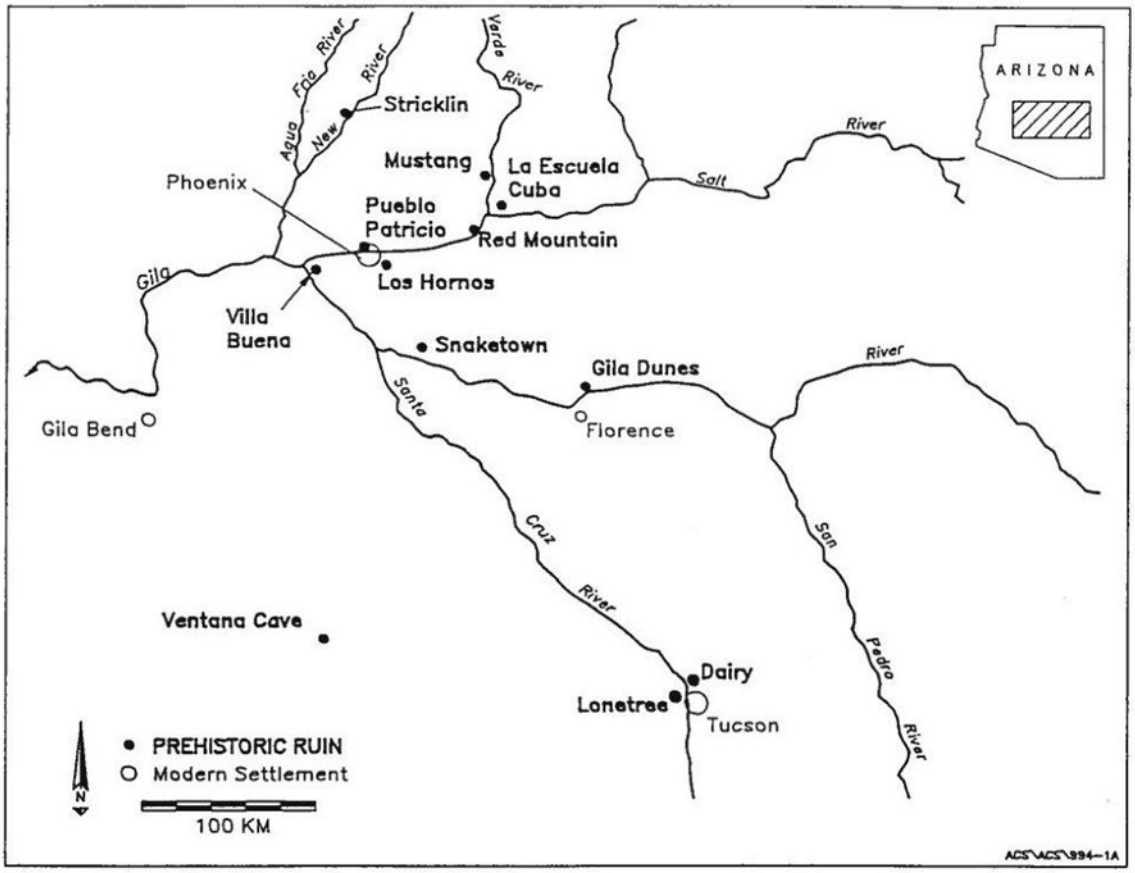

Figure 1. Location of the Mustang site in the lower Verde River Valley and other Early Formative sites in the Sonoran Desert.

ously described as part of the "Inner Core" and "Northern Periphery" of the Phoenix Basin tradition and also as a distinct regional polity. Research clearly indicates that until A.D. 1100 the occupants of the lower Verde shared many characteristics with the Phoenix Basin culture that included village plans, public architectural features, ritual practices, and participation in regional trade and exchange systems.

THE MUSTANG SITE

The Mustang site is located on the Fort McDowell Mohave-Apache Indian Community situated on an alluvial terrace (Blue Point) on the west side of the Verde River within a Lower Sonoran environment at an elevation of 440 m (Figure 1). Initially thought to cover 8,400 sq m, the site area was later increased ten-fold (87,500 sq m) (Canouts 1975:27; Crownover 1997); the site was considered a primary habitation associated with dry farming features. Artifacts from two trash mounds indicated a lengthy Late Formative occupation but there was little surface evidence suggestive of a substantial Early Formative component.

Excavations by ACS within a narrow 15-m-wide, 260-m-long corridor along Mustang Road on the southern edge of the site identified three feature clusters spaced 35 to 100 m apart (Crownover 1997; Doyel 1997) (Figure 2). Each feature cluster contained at least one pit house structure, one or more midden areas, and extramural features including roasting and storage pits; a total of 33 cultural features were excavated at the site. Several of the middens were extensive with moderate to high artifact densities and high levels of organic debris suggesting intensive occupation. At least one additional Early Formative structure was identified but not excavated. Sweetwater Red-on-gray was the dominant associated painted pottery. The limited excavations indicate a substantial Early Formative presence at this site and others in the area.

Structure Feature 24 had few floor-associated artifacts, but over 500 sherds in the fill indicated an occupational sequence within the Sweetwater phase. This small rectangular structure (11.25 sq m floor area) had a floor groove and a framed entryway but a hearth was not located. Structure Features 14 and 17 were sub-rectangular and had between 20 and 25 sq m

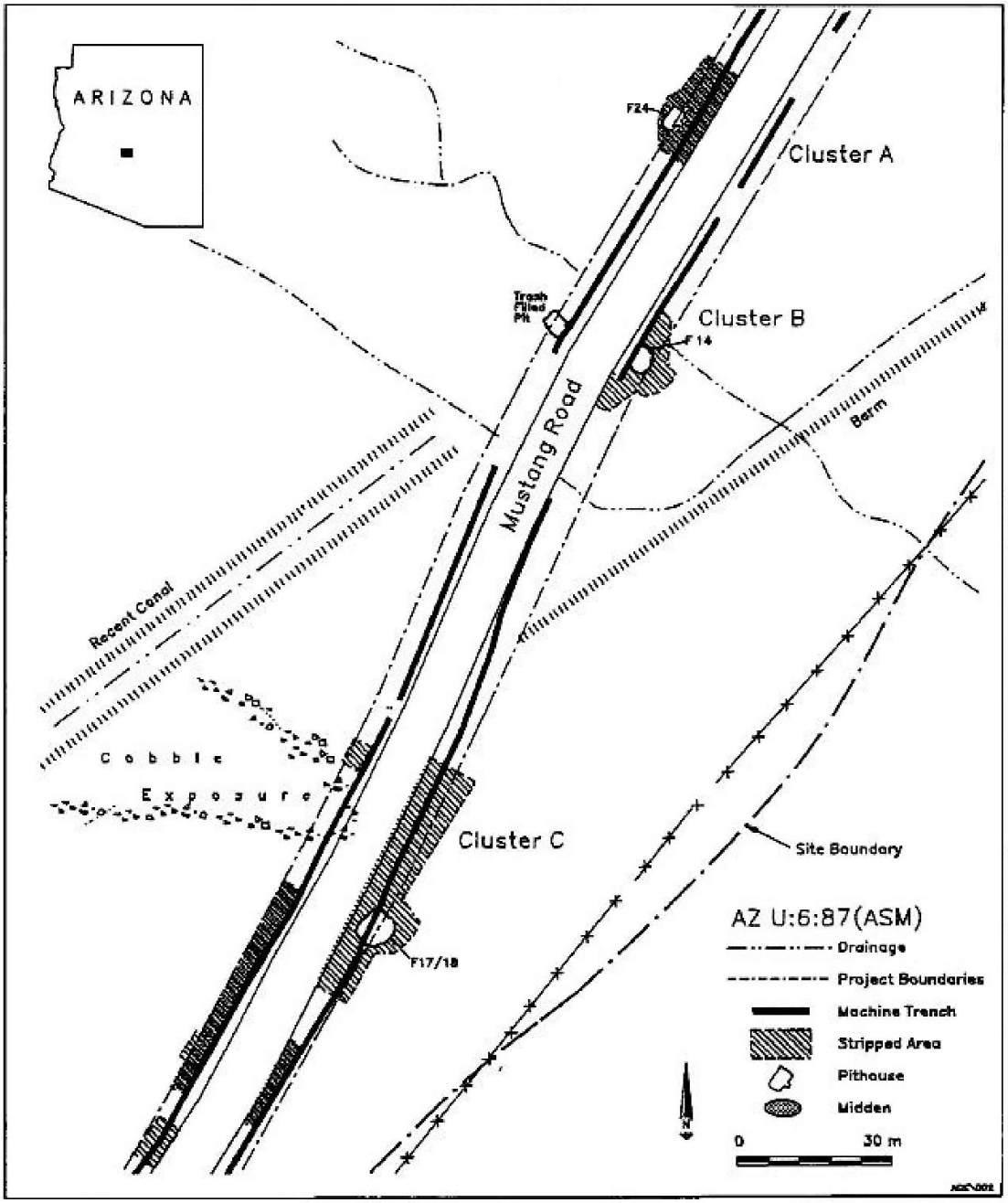

Figure 2. Excavated feature clusters at the Mustang Site.

of floor area (Figure 3). Both had clay-lined hearths and floor-associated pits, and Feature 17 had a plastered floor; entryways were not located but this may be due to post-occupation disturbances. Main support beam post holes and other post holes were present in all cases but difficult to identify due to heavy rains during the excavations. Feature 17 had been remodeled and Features 14 and 24 had burned. All three structures exhibited attributes of residential, storage, and processing functions. Variation in size and morphology was observed for Sweetwater phase houses at Snaketown (Haury 1976), and four Sweetwater phase structures at Los Hornos in south Phoenix had between 13.6 and 31.4 sq m of floor area (average 22.0 sq m) (Motsinger and Chenault 1993).

Features 14 and 17, and probably Feature 24, date to the early-to-middle Sweetwater phase. Feature 24 produced an archaeomagnetic date option of A.D. 580 to 720, and the magnetic signals from Features 14 and 17 were indistinguishable (Deaver and Murphy 1997). Five radiocarbon samples from Features 14 and 17 produced mixed results that could be

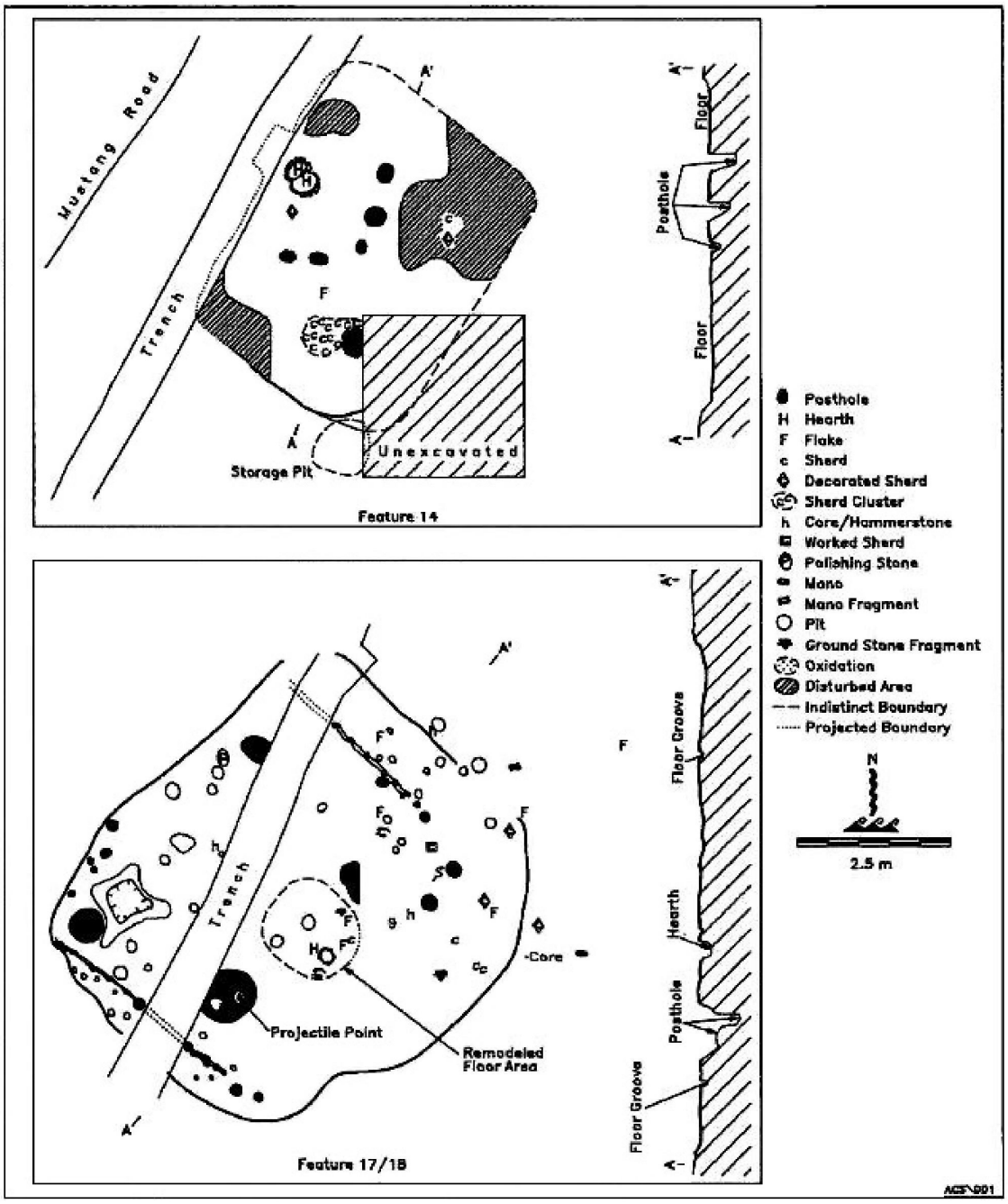

Figure 3. Excavated pit house Features 14 and 17.

expected from composite charcoal samples taken from floor and floor-fill contexts (Crownover 1997). Calibrated one-sigma dates between A.D. 435 and 980 were obtained, with overlap between A.D. 600 and 700 consistent with a Sweetwater phase placement (Dean 1991:80-81, 90; Deaver 1997). Three radiocarbon dates from "Estrella / Sweetwater" contexts at Los Hornos produced a date range of A.D. 440-677 (Chenault and Ahlstrom 1993:580).

Artifacts recovered from the structures and surrounding areas included chipped stone tools and lithic debris (n=3,826, with 96 percent debitage). Ground stone tools (n=27) included both one-hand and two-hand mano types and trough metates, most made of vesicular basalt (Rapp and Gage 1997). Also present were projectile points (n=5) and shell artifacts (n =79; mostly fresh water *Anodonta* sp.). Plant remains included corn, cactus, squash, and mesquite, and animal remains included large mammal (deer?), jackrabbit, cottontail, squirrel, birds, and fish (Crownover 1997; Phillips 1997). A strong emphasis on agriculture supplemented by hunting, gathering and per-

Table 1. Recovery Contexts for Pottery Sherds from the Mustang Site.

Feature Type	Number	Percent
Middens	4,645	46
Structures	3,989	40
Pits	1,303	13
Surface	84	01
Total	10,021	100

Table 2. Pottery Ware Frequencies at the Mustang Site.

Ware	Sherd Count	Percent
Plain ware	9,521	95.0
Red ware	327	3.3
Red-on-gray ware	168	1.7
Total	10,021	100.0

haps fishing is suggested for the Sweetwater phase. The Early Formative component at the Mustang site had middens, substantial architecture, extramural features, thousands of artifacts and subsistence remains indicative of long-term occupation.

POTTERY FROM THE MUSTANG SITE

In total, 86 percent of the 10,021 sherds recovered were from the structures, trash / midden, pit-fill and surface contexts (Table 1). Of these, 95 percent (9,525 sherds) were plain ware, 3.3 percent (327) were red ware, and 1.7 percent (168) were decorated (Table 2). These red ware and decorated frequencies are a bit lower than those for Snaketown, a production center and a possible source of the pottery recovered from the Mustang site, where plain ware represented 91 percent; red ware 4 percent; and decorated (Sweetwater Red-on-gray) 5 percent (Haury 1976: 217, 222). Based on analysis of rim sherds, body sherds and other attributes I estimated that about 160 vessels were represented in the excavated assemblage (only a small sample of all the pottery present at the site) including about 100 plain ware (62.5 percent), 40 red ware (25.0 percent), and 20 decorated (12.5 percent) vessels (Doyel and McDonnell 1997a).[1]

Decorated bowls outnumbered decorated jars by at least three to one. Variation in vessel size and shape suggests a variety of functions (Figure 4). Much of this pottery, especially the red and plain wares, was well-made, with hard, thin walls, well-polished surfaces, and in a variety of forms. Given that pottery has been dated to 350 B.C. in the nearby Queen Valley area (Garraty 2011), the Mustang site pottery post-dates that by almost 1,000 years and is a product of a long sustained development and elaboration.

Plain Ware

Over 50 percent of the plain ware conformed to Vahki Plain or Gila Plain. Key attributes include paddle and anvil construction, tool polishing, striated surface finish, brown-to-gray color and fire clouding. Many sherds had polished exterior surfaces, dark surface colors, thin vessel walls and abundant mica-schist temper consistent with Vahki Plain (Haury 1976). Rim, neck, and body profiles matched Estrella and Sweetwater forms at Snaketown. Most vessels were small-to-medium in size, but some large jars were present, up to 50 cm high. In addition, a good portion of the plain ware was relatively nondescript brown ware.

Red Ware

Seventy-one percent of the red ware (about 200 sherds) was identified as Vahki Red. Key attributes include smoothed and polished surfaces, thin vessel walls, dark red to magenta slips, light brown-to-buff or tan core color, and abundant mica-schist temper. This pottery was well made, as Haury (1976) noted for Vahki Red at Snaketown. Twenty-four percent was identified as Savik Red, a local non-micaceous schist and quartz–tempered type defined by Wood (1987:27) that resembles Vahki Red. The remaining 5 percent were unidentified red.

Decorated Ware

A fragment of a late Estrella Red-on-gray bowl was recovered from a roasting pit feature in a midden a short distance east of pit house Feature 24 (Figure 5); it was similar to middle Gila examples, a small shallow bowl about 30 cm in diameter and 8 cm high with highly micaceous temper. It is considered late Estrella due to the presence of a quartered design. The Sweetwater Red-on-gray sherds conformed to published descriptions (Haury 1976:217-219; Abbott et al. 2012). Characteristics of Sweetwater Red-on-gray and how it is distinguished from the earlier type Estrella Red-on-gray are provided in an accompanying table that generally represents the assemblage from the Mustang site (Table 3). Surface treatment included typical incised

Table 3. Attributes of Sweetwater Red-on-gray (Abbott et al. 2012; Gladwin et al. 1965; Haury 1976).

Type or Variety / Defining Attributes
Sweetwater Red-on-gray
• quartered, banded, and sectioned design fields; designs include large triangles and terraces
• wide-line hachure introduced, used primarily to fill large design units like triangles
• use of small design units increased but infrequent
• vessel shapes: bowls, flare rim bowl, scoop, effigy, censor, seed jar, necked jars rare
• 20-25 percent had grooved or incised exterior surfaces; exterior also painted; production was four to five percent
Late Variety
• exterior grooving did not follow coil lines; more closely spaced
• incised design patterns introduced in grooved exteriors; some have corrugated effect; interlocking scroll designs
Early Variety
• designs include triangles, terraces, and hatched units, small elements, non-interlocking scroll
Attributes Shared by Estrella and Sweetwater Red-on-gray
• use of both paddle and anvil and continuous coil technology
• hand-smoothed surfaces
• dark surface colors with prominent fire clouds; designs poorly visible
• exterior grooving
• use of red paint to create designs on interior and exterior surfaces; vessel wall thickness 2-7 mm, average 4 mm

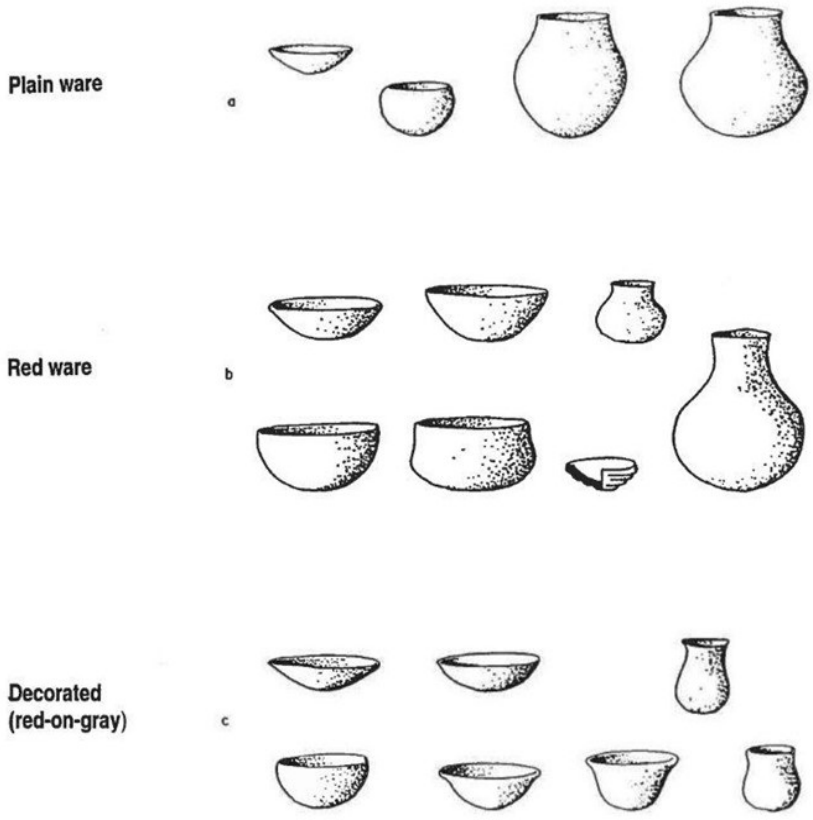

Figure 4. Vessel shapes represented in the Mustang site pottery.

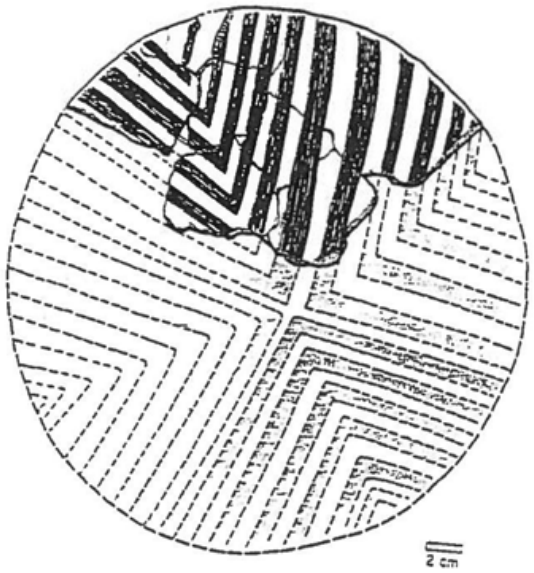

Figure 5. A fragment of a late Estrella Red-on-gray bowl from the Mustang site.

and painted exteriors and painted interiors. (Figures 6, 7, and 8).

In total, 11 Sweetwater phase decorated vessel rims and additional decorated sherds were recovered from Features 14 and 17. Visually, the surface colors of this pottery fit a description of red-on-brown equally well as red-on-gray. Fire clouds were common on hand-smoothed surfaces. The use of paddle and anvil and coil technology was apparent. Design execution was variable from good to sloppy, the latter including paint blobs, paint runs into exterior grooves, and fair to uneven line work. Designs included broad line triangles, terraces, and hatched units. Only three crude examples of scroll designs were present that may suggest an early Sweetwater date. The repeated association of Sweetwater Red-on-gray and Vahki Red in unmixed contexts that lacked Estrella Red-on-gray at this site supports the temporal separation of these two decorated types as observed at Snaketown.

Spatial variation of the intra-phase decorative styles represented is worth noting. None of the seven bowl rim sherds from pit house Feature 17 exhibited exterior grooves but five had painted exteriors. In contrast, all four bowl rims from pit house Feature 14 had both grooved and painted exteriors. In total, of the small sample of 11 vessel rims from these two pithouses, four of them (36 percent) had exterior grooving in contrast to the 20 percent for Sweetwater Red-on-gray at Snaketown (Haury 1976).

LOCUS OF PRODUCTION

Research has identified the locations of bed rock and associated sources of raw materials used as temper to enhance the firing and performance properties of pottery. Plotting the distributions of temper types identified in the pottery provides a measure of production and exchange. Temper materials were identified using a binocular microscope and thin-section analysis (Kamilli and Miksa 1997). Eleven temper types were identified that included six from the Phoenix Basin and five other types (Table 4). Based on their spatial distributions, for purposes of this analysis the tempers were collapsed into four groups: a middle Gila group, two in the lower Salt River Valley, and a group of "Verde tempers" (Table 5). The unidentified schist and quartzite tempers in the Verde group may or may not represent local sources (Table 6); research has shown that the geology and resulting petrofacies in the Lower Verde Valley is complex and varied (Heidke et al. 1996; Miksa and Heidke 1995).

At least four production loci are indicated for the plain ware including the middle Gila, lower Verde, and Phoenix areas. More than half of the plain ware had tempers specific to the middle Gila River (Figure 9). At least five production sources are represented in the red ware with middle Gila mica-schist temper dominant with 71 percent. The finest execution of Vahki Red co-occurred with sherds containing middle Gila temper.

Two production sources were identified in the decorated ware but 96 percent had middle Gila tempers. Several vessels represented a South Mountain Variety of Sweetwater Red-on-gray, recognized by attributes including dull, dark brown, unpolished surfaces, thicker vessel walls, and South Mountain granodiorite temper. This finding further documents the production of decorated brown ware in the lower Salt River Valley by the Sweetwater phase.

In sum, vessels with middle Gila tempers comprised 64 percent (102) of the estimated 160 vessels. Only 31 percent (47) of the 160 vessels were produced locally which included none of the decorated ware. Seven vessels with South Mountain granodiorite temper were third in frequency. Least common were several vessels with tempers from the eastern Salt River Valley near the lower Verde including near the McDowell Mountains.

ORGANIZATION OF PRODUCTION

The pottery ware frequencies observed at the Mustang site clearly indicate that spatial proximity

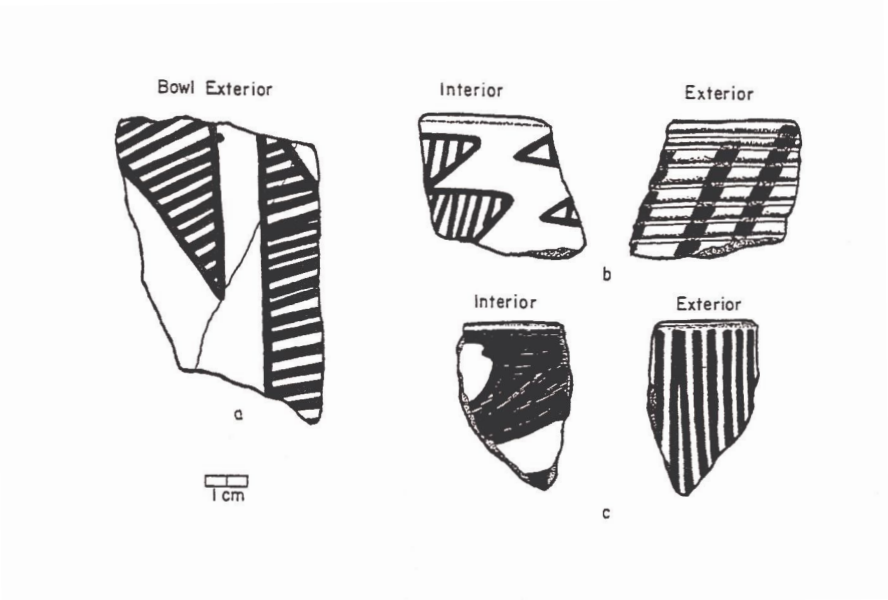

Figure 6. Sweetwater Red-on-gray bowl sherds from pithouse Feature 14: a., exterior surface; b., painted rim, c., unpainted rim.

was not a factor in the acquisition of non-local pottery, since the pottery from the greatest distance is the most frequent. Middle Gila pottery was also present at other Early Formative sites in the lower Verde, including Esquela Cuba to the south (Hackbarth 1992; Henderson 1992), suggesting regional scale interaction between the lower Verde and the middle Gila (Figure 10).

So, an important question is: how to account for the high frequency and large numbers of imported pots in this early time period? Was the Early Formative presence in the lower Verde a result of pioneering populations who brought their possessions with them? This may be problematic, as the lower Verde likely contained a sizeable resident population by the early ceramic horizon. It should be noted that ACS excavations at a nearby site, AZ:U:6:105[ASM]) (see Figure 1), documented the presence of multiple architectural features that both predated and were contemporary with the Early Formative occupation at the Mustang site.

Can disjunctive settlement patterns or seasonal mobility account for the imported pottery? This possibility also seems unlikely, as the Mustang site had middens, substantial architecture, extramural features, and artifacts and subsistence remains indicative of long-term occupation. The limited excavations preclude strong statements about ritual and other behaviors that may have occurred there. Even less likely is that middle Gila pottery was produced in the lower Verde with imported mica-schist temper, as the distinctive paste and production technologies present mirror the middle Gila wares.

Although other options are possible, one scenario is that the presence of large amounts of non-local pottery is a result of persistent interaction and exchange. The middle Gila Vahki plain and red wares exhibit a superior technology relative to the local wares that likely had positive intrinsic properties. Along with the decorated pottery, these wares also likely had symbolic and/or ideological significance. As I've previously suggested (Doyel 1994), the abundant mica-schist temper and characteristic surface sheen of the Middle Gila pottery reflects light, for example, like light reflected from canals or other bodies of water. The symbolic associations with water and sun were integral elements of an evolving ideology becoming increasingly committed to agriculture. Early on in the Early Formative period the middle Gila villages had assumed a leadership role in promulgating this ideology as materialized by the extensive distribution of their distinctive pottery throughout the region (Doyel 2007).

The most direct route to the Mustang site from Snaketown is about 95 km, 80 km across the Queen Creek delta and another 15 km up the Verde River. This distance (about 97 km) is well within the 150 km range for food transport for the region (LeBlanc 1989:350; Lightfoot 1979). Depending on multiple factors the Mustang site would have been a three-to-four day walk. Abbott (1994:416; 1996:150) suggested that plain ware vessels represented low value items that were exchanged among socially close par-

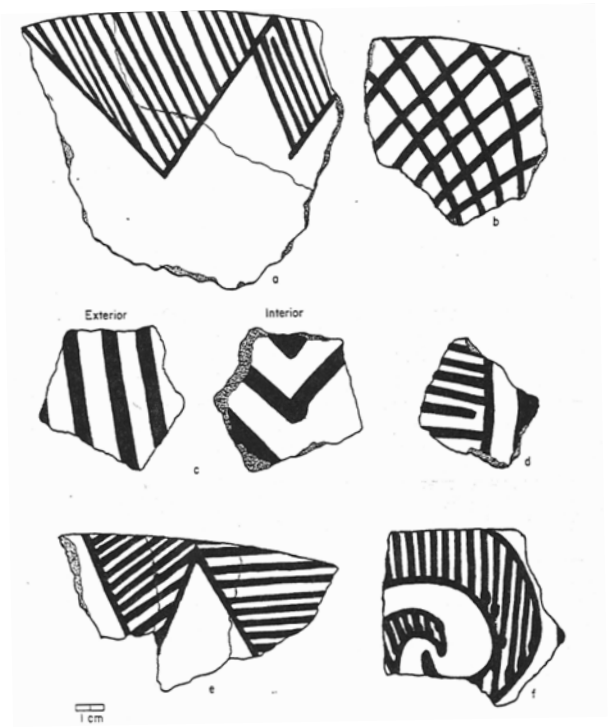

Figure 7. Sweetwater Red-ongray bowl sherds from pit house Feature 17. All designs interior unless noted; a and e are rim sherds; a has the same design on the exterior surface.

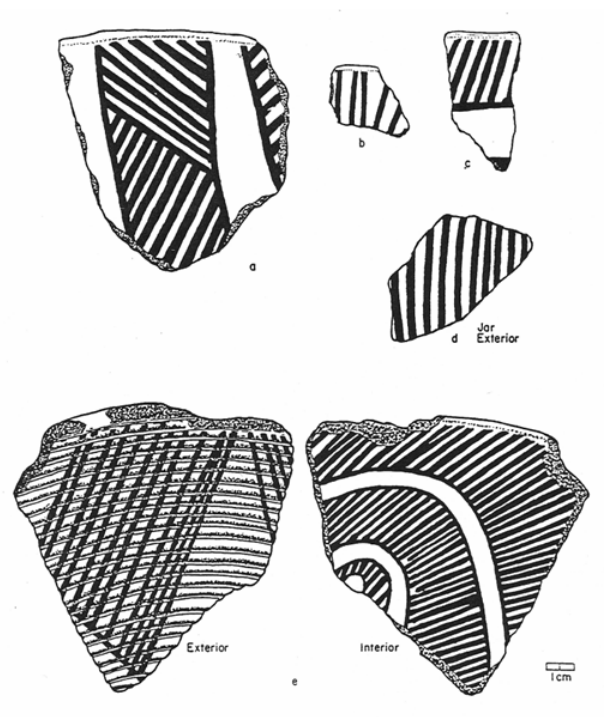

Figure 8. Sweetwater Red-on-gray sherds from the Mustang site: all are bowls except d; e is from the floor of Feature 14 and its maximum diameter is 9.5 cm.

ties. In contrast, red ware vessels were higher value items that circulated in broader spheres of exchange beyond kinship networks. If so, then the Mustang site assemblage, with its high frequencies of polished red and decorated wares, reflects the operation of more formally structured exchange systems than would be expected for reciprocal, kin-based systems.

As indicated, sites in the Snaketown area were the likely source for the middle Gila pottery in the Lower Verde Valley. By A.D. 700, at least 30 villages had been established in the Phoenix Basin including Villa Buena, Los Hornos, Pueblo Patricio, Pueblo Grande, Mesa Grande and others (Cable and Doyel 1987:70; Doyel 1991b; Wallace and Lindeman 2012, Appendix 2). Middle Gila Vahki Plain and Vahki Red are present at most if not all of all these sites. In addition to the middle Gila producers, specialists were present at Los Hornos, a production center for brown paste wares, given its Early Formative occupation and proximity to sources of South Mountain granodiorite temper. Middle Gila Estrella and Sweetwater decorated wares accounted for three percent at Los Hornos, indicating that this site both produced and imported pottery (Gregonis 1993).

In sum, by the Sweetwater phase settlements allied with an emerging Hohokam identity were present in the Lower Verde Valley that were in possession of quantities of imported pottery, most of which derived from the middle Gila. The question remains "why?" These and other data indicate the presence of extensive regional exchange networks centuries prior to the development of the Late Formative period ballcourt network. I and others (Abbott 2009; Abbott et al. 2007; Doyel 1979, 1991a; Wilcox and Sternberg 1983) have postulated that the ballcourt institution was associated with trade and the marketplace. So, an important question is: how were products circulated in the region prior to the development of ballcourts and marketplaces?

O'odham ethnography may provide clues to how the Early Formative exchange networks were organized. Trade was of great importance to the historical period populations in the region (Russell 1975; Underhill 1969:103). O'odham society was based on village exogamy, which promoted inter-village interaction to obtain mates. Institutions existed that required travel for purposes of interaction, including after-harvest festivals and visiting dances (Russell 1975:183-184; Underhill 1946, 1969, 1982; Webb 1992:29). Whole villages of related families traveled up to several days to camp next to another village. For example, the "naming dance" focused on gift giv-

Table 4. Pottery Tempers Identified at the Mustang Site.

Phoenix Basin Tempers	Other Tempers
1 Middle Gila micaceous-schist	7 Granite-quartz-feldspar (Verde)
2 South Mountain granodiorite	8 Unidentified schist
3 McDowell Mountain schist	9 Unidentified sands
4 McDowell Mountain phyllite	10 Quartzite
5 Phoenix Mountain phyllite-slate	11 Unidentified fine temper (rare)
6 Squaw Peak schist	

Table 5. Temper Groups at the Mustang Site for all Pottery.

Temper Group	Group Number	Percent of sherds	Number of sherds
Middle Gila micaceous-schist	1	62.3	6,244
Verde: granite, quartz, feldspar, quartzite, schist, unidentified sands	2	36.3	3,637
South Mountain granodiorite	3	1.0	100
Western McDowell Mountains schist and phyllite, Phoenix Mtn., Squaw Peak	4	0.4	40
Total		100.0	10,021

Table 6. Temper Groups by Pottery Wares at the Mustang Site (In Percent).

Temper Group / Ware	Middle Gila	Verde Group	South Mtn. Gran-odiorite	Mtn. Group Composite	Percent	Sherd Count
Plain	58	38	3	2	100	9,521
Red	71	24	3	2	100	327
Red-on-gray	96	00	4	0	100	168
Total						10,021

ing by one village to another that had experienced a poor harvest. Such social conventions provided contexts for obtaining mates while serving to even out resource imbalances. Significant volumes of goods were exchanged including through gambling on competitive events and games of chance. Underhill noted (1969:139) that "There was probably no more large scale exchange of goods in the betting on games in any other situation (for the Tohono O'odham) not excepting marriage." Similar institutions likely existed among the ancient inhabitants of the productive but sometimes fickle Sonoran Desert.

DISCUSSION

Specialized production for exchange was in place in the Phoenix Basin by the Sweetwater phase, earlier than generally proposed, which likely represents one of the earliest documented cases of specialized production in the Southwest. These data further erode the old model of local production for local consumption, and does so for an early time period (see papers in Mills and Crown 1995 [eds.]). So far, two of three criteria identified by Mills and Crown (1995:7) have been met for investigating the organization of specialized pottery production in the Early Formative. Mineralogical analysis has identified the presence of non-local materials in multiple areas, and the presence of quantities of vessels outside their production locus confirms this finding. The search for strong evidence for pottery production - the tools, materials, and facilities - should continue.

Elsewhere (Doyel 1981, 1991a) I have suggested that specialized production was present by the Vahki

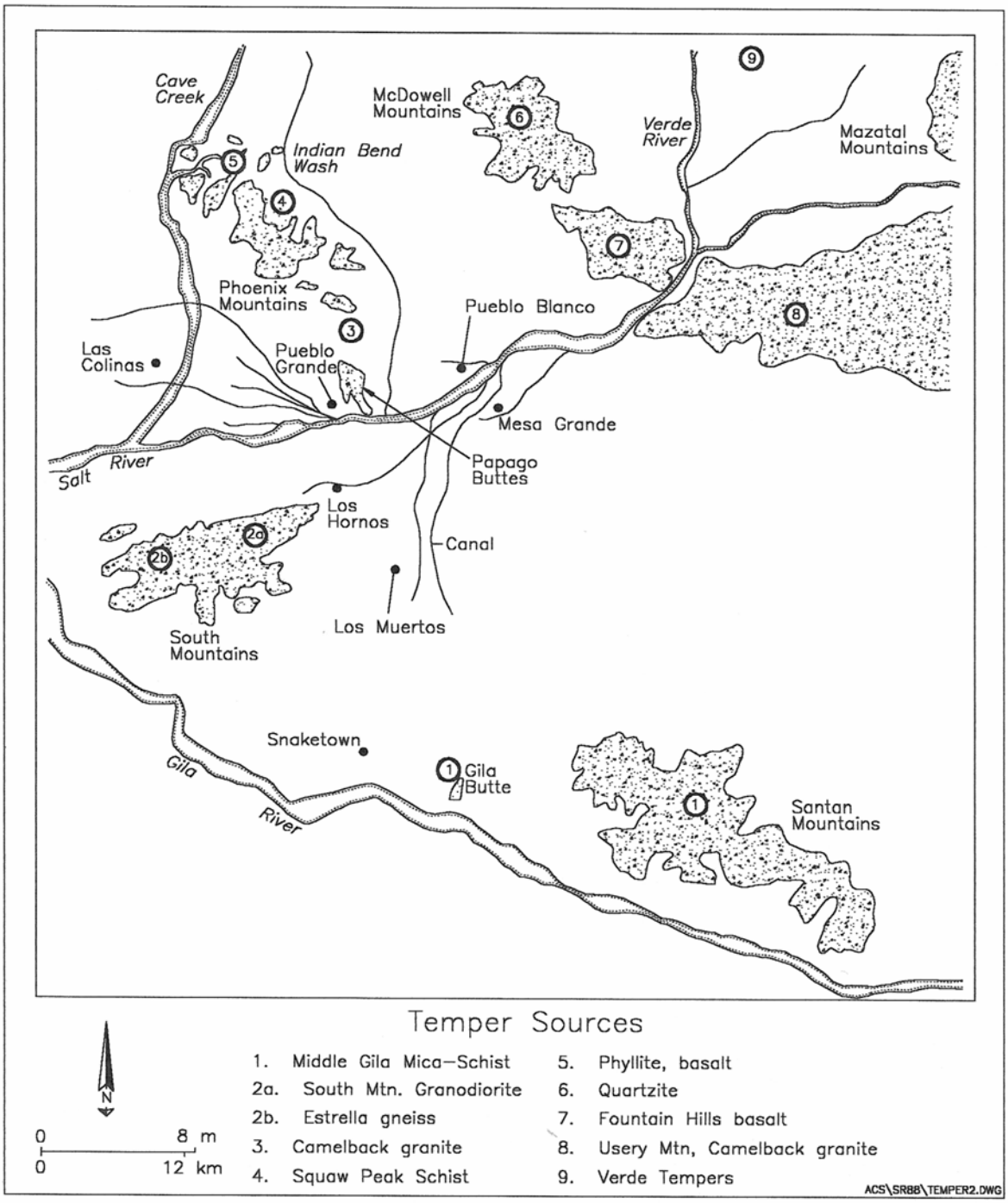

Figure 9. Selected sand composition zones in the Lower Verde Valley and Phoenix Basin.

phase, and that specialized production was integral to Hohokam economic and identity systems throughout their history. Certainly by the seventh century, residents of the region were relying on specialist producers for their pottery, often coming from relatively long distances. This pottery may have signaled group identity through alliance and/or other social practices shared by the producers and consumers (Abbott et al. 2007; Doyel 1979, 2007; Plog 1984).

Another question is: what products and/or resources did the inhabitants of the Mustang site and other uplands villages control to underwrite their access to and involvement in regional exchange systems? Unlike the lower Salt River, the Verde River below the Mogollon Rim is noted for high quality lithic materials, especially chert and chalcedony (Stafford 1979), such as materials recovered from Estrella-Sweetwater contexts at Los Hornos (Chenault and Motsinger 1993:571). At Los Hornos,

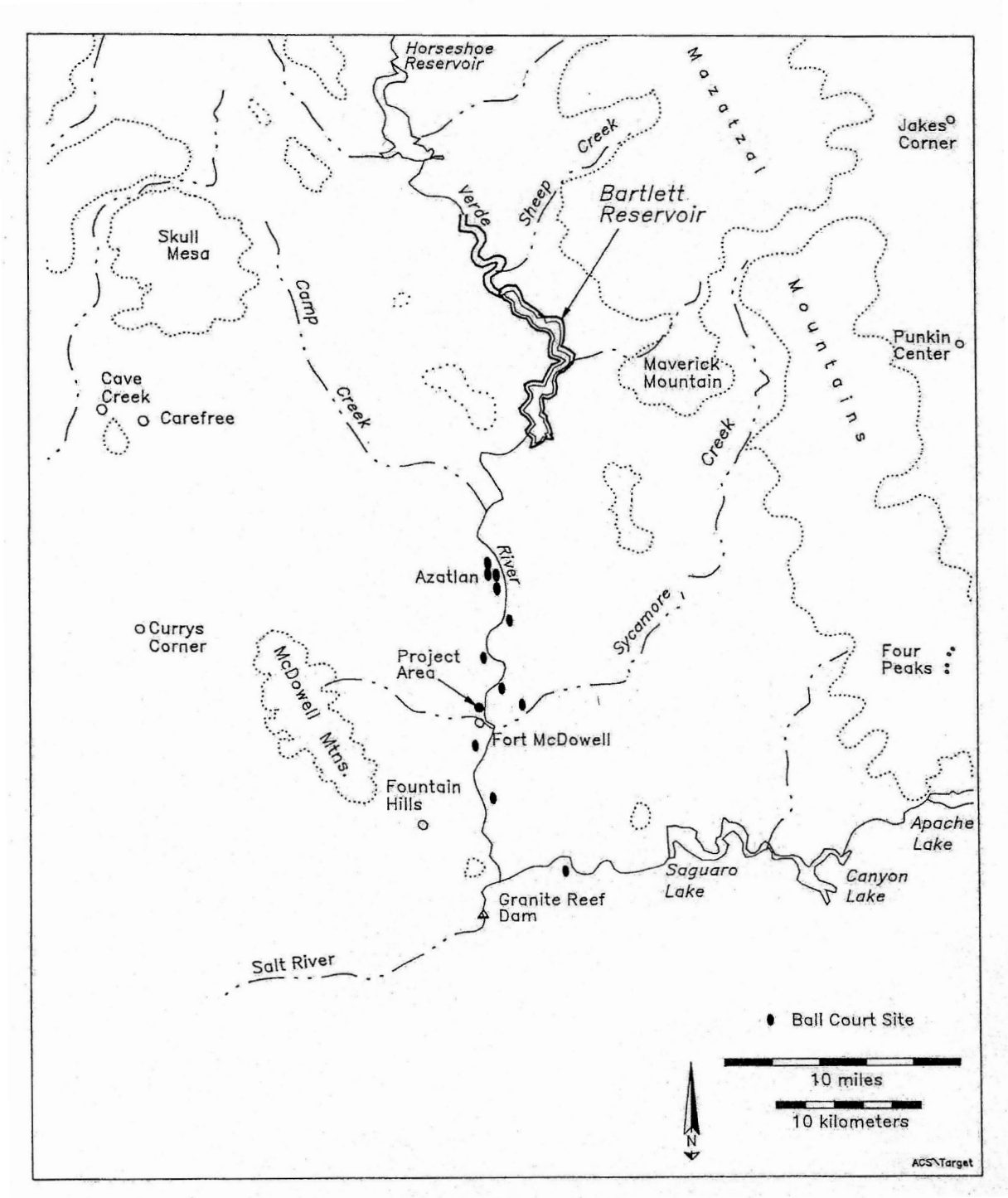

Figure 10. Late Formative ball courts in the lower Verde River Valley.

in addition to pottery, agave, and perhaps corn and cotton (agricultural products), may have been trade resources (Chenault and Motsinger 1993:571, 574).

Other non-local products found at upland and riverine sites in the lower Verde included worked marine shell and exotic stone (Howard 1990; Neily and Kisselberg 1991). Perhaps the Verde villages traded rare resources, including lithic materials, turquoise, upland subsistence products, and other resources. The villages were located along trade routes that may have offered down-the-line trade opportunities.

Whatever the case, it is clear that quantities of pottery and other manufactured goods were leaving the Phoenix Basin while the evidence for what was

being "exchanged" is not well documented. To learn more, it would be advantageous to monitor production and consumption patterns of exotic materials, such as pottery, obsidian, shell, turquoise, and other rare resources, through the use of spatial and quantitative measures (e.g., Bayman and Sanchez 1998; Doyel 1996; Miksa 1998). Concepts emerging from this research can then be evaluated relative to models of socio-economic interaction (Bayman 1995; Brumfiel and Earle 1987; Plog 1984: Whittlesey 1997).

I have maintained that Hohokam society was highly social, highly interactive, and highly interdependent (Doyel 2012:12). The findings at the Mustang site are consistent with these inferences for the Early Formative period. When placed within a historical trajectory, the presence of specialized production in the Early Formative period provided some initial conditions for subsequent economic and cultural elaboration when the regional economy became integrated by the ballcourt network. A context and framework for regional exchange was already operative prior to the advent of the regional system materialized by the ballcourt and village-plaza pattern. Early Formative ideology was materialized by regional distributions of pottery, clay figurines, and architecture. Regional economic organization was likely closely tied to the formation of an ideology related to fertility, agriculture, and the ancestors, with the Phoenix Basin communities providing a leadership role.

This pattern continued into the later phases. Formal analysis of Gila Butte and Santa Cruz buff ware sherds from site AZ U:6:105 [ASM]) near the Mustang site indicated that 44 percent of all the pottery (plain, red and decorated) was still being imported, 28 percent of which was from the middle Gila (Kamilli and Miksa 1997). These data point to long-standing social and exchange arrangements between the Phoenix Basin, the lower Verde, and elsewhere. By the Late Formative period the lower Verde replicated many of the organizational and material attributes defined for the Phoenix Basin core area that included 23 ballcourts located at villages along the lower Verde River, with 10 of these near the Verde-Salt River confluence in the vicinity of the Mustang site (Craig et al. 2012:52) (Figure 10). Azatlan, the largest of the lower Verde villages, had five ballcourts, numerous plazas, and over 100 trash mounds, suggesting peer status with Phoenix Basin sites including Snaketown, Grewe, Villa Buena, and others (Doyel and Crary 1995). But by the late Sacaton phase, constraints on agricultural production likely limited further developments, perhaps due to the inability to construct irrigation systems on a comparable scale to the Phoenix Basin, coupled with the dissolution of the regional system at that time.

The evidence reveals that the Lower Verde Valley villages were well connected with pottery producers in the Phoenix Basin. The exportation of thousands of vessels from middle Gila production centers and perhaps others to surrounding areas including the lower Verde is one striking aspect of an integrated Formative period economy that provides evidence to counter the claim that only limited quantities of durable goods were actually exchanged or sold (Haury 1976:347; Whittlesey 1997a:624). The lower Verde-Phoenix Basin interaction network functioned, if not flourished, for 500 years, indicating a remarkable stability and a notable accomplishment of the Native Americans. Continued pursuit of these issues with new data will lead to further insights regarding productive specialization, regional organization and the evolution of Native society in the Sonoran Desert.

Notes

1. The derived estimates relied heavily on rim and decorated sherds; while the sherd to vessel ratio is similar for the red and decorated wares (1-to-8.2 and 1-to-8.4 respectively) it is not for plain ware (1-to -95.2). It is possible that plain ware vessels were underestimated due to fewer attributes to use to discriminate individual vessels.

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