



Natural Bridges National Monument, Southeast Utah Group

NOTE: This is an abbreviated version of the final project report. It has been created for the general public; site location information and park-specific administrative data have been removed.

An Examination of the Prehistoric Sandal Collection of Natural Bridges National Monument, Utah

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Introduction

During 2010, archeologists with the Southeast Utah Group (SEUG) of the National Park Service (NPS) documented and assessed the condition of archeological sites containing prehistoric and historic architecture at Natural Bridges National Monument. The major goals of the project were to re-locate sites, many of which were first identified in the 1960s, assess the condition of the prehistoric and historic features, document the sites using current archeological site forms and technology, and put forward management recommendations.

While in the field, the archeologists noticed the theme of sandals repeatedly appeared on pecked rock art panels and incised plaster. Woven sandals have been found at several archeological sites in the park. It seemed that an analysis of the Natural Bridges sandal collection would supplement the information gathered from studies of lithics, ceramics, dendrochronology (tree-ring analysis), and corn cobs, and would add to the overall impression of prehistoric life at Natural Bridges.



Figure 1. Petroglyph sandal tracks documented at a NABR prehistoric site.

Standard analysis techniques were used, based on the work of Baldwin (1936, 1938a, 1938b, 1939), Deegan (1993, 1995, 1996), Hays-Gilpin et al. (1998), and Kankainen (1995). The following report provides an overview of sandal terminology, and presents the results of the Natural Bridges Sandal Collection analysis.

Eight sandals were examined: two are housed at the Western Archaeological Conservation Center (WACC) in Tucson, Arizona; four are housed at the SEUG curation facility in Moab, Utah; and two are protected in-situ at the sites where they were found. The SEUG curator requested a loan of the two sandals housed at WACC for this analysis. Once the entire collection was assembled, the sandals were analyzed at SEUG headquarters in Moab. The sandals were scrutinized with the aid of a Meiji EMZ Stereo Zoom Microscope (10-40X), digital calipers, digital weighing scale, and a Munsell color code guide. All of the sandals were photographed using an Olympus Stylus Tough 800 (12mp) digital camera.



Figure 2. A sandal petroglyph found on a panel at a NABR prehistoric archeological site.

An Overview of Prehistoric Sandals

Many researchers have noted that the construction techniques used to manufacture woven perishable and textile artifacts are a learned behavior that is passed down from one generation to another (see Adovasio 1977, 1986, 2002; and Webster and Hays-Gilpin 1994:315). For that reason, it is possible to distinguish the work of one ethnic group from another. Sandals show standardization according to time and place, and in fact can be placed in a developmental sequence (Deegan 1995, Hays-Gilpin et al. 1998, Matson 1991, Geib 2000).

Two types of sandals are prevalent during the Archaic period: warp-faced plain weave and open-twined. Archeologist Phil Geib has noted that the warp-faced plain weave sandals seem to be found more on the Southern Colorado Plateau, whereas the open-twined sandals are found more often on the Northern Colorado Plateau during this time period. However, after 5,800 B.C., sandals on the northern Colorado Plateau are plain weave in construction method, though still distinct from those found on the Southern Colorado Plateau. Because the sandals are slightly different, we may infer that the sandals represent a diffusion of ideas among prehistoric people, and not population migration from the south to the north.

During the transition between the Archaic and Basketmaker periods, sandals types changed. Basketmaker sandals, in general, are constructed using a twined method and have square-shaped toes and heels. Several studies

have described Basketmaker-age sandals, including Kidder and Guernsey (1919), Nusbaum, Kidder and Guernsey (1922), Guernsey (1931), Baldwin (1938), Matson (1991), Webster and Hays-Gilpin (1994), Hays-Gilpin et al.(1998), and Deegan (1996).

By the Pueblo I through Pueblo III periods, sandal styles had changed. Very little is known about sandals dating to the Pueblo I period, because as several researchers have pointed out (Baldwin 1938, Yoder 2010), these sites tend to be located in open areas where perishable artifacts are not likely to be well-preserved. More information has been gathered about sandals from later-age Pueblo sites, and in particular Pueblo III sites. Sandals from these sites tend to be constructed using a braided/plaited method.

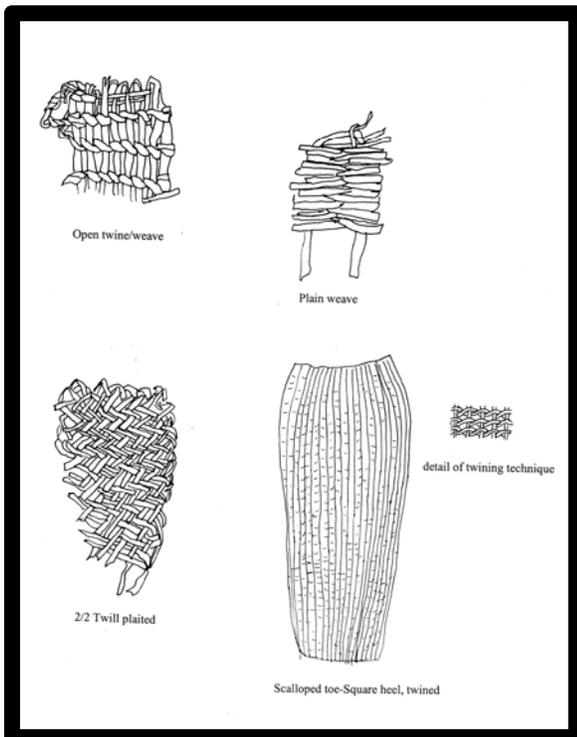


Figure 3. Sandal Construction Styles. Illustration by author, adapted from Kankainen 1995 and Hays-Gilpin et al. 1998.

Some researchers note that leather moccasins and leather sandals appear, albeit rarely, at sites in southern Utah, northern Arizona, and southwestern Colorado as early as the Basketmaker II period (see Ambler 1968, Guernsey 1931, Fewkes 1909, and Nordenskiöld 1979). By most accounts, Puebloan people stopped constructing sandals of vegetal fibers between 1300 and 1540 AD in favor of leather footwear (Deegan in Hays-Gilpin et al. 1998:37). When Spanish contact occurred with the pueblos along the Rio Grande, it was noted in journal entries that the Puebloans were wearing leather footwear. At least one researcher has speculated this type of footwear is the result of contact between the Rio Grande Pueblo people with Plains tribes (Selwen 1960). Western Pueblo people (Hopi, Zuni, and Acoma) obtained the leather in trade with Rio Grande Pueblo people (Deegan in Hays-Gilpin et al. 1998:37).

Sandal Terminology and Technology

Any discussion of sandals involves a description of the construction technique, body shape (silhouette), and type of element used in the manufacture of the foot covering. It is these attributes that constitute the evidence of the learned behavior, and lead to an understanding of the cultural affiliation of the sandal maker. The following is a more thorough presentation of sandal construction techniques, silhouette style, and sandal raw material elements.

Sandal Body Construction

Prehistoric sandals vary in construction from simple weaving to more complicated and time-consuming weaves. Three major construction styles are recognized, including plain weave, twining, and braiding/plaiting. Also, there are variations within these three categories. Additionally, several different constructions techniques can be found within one sandal.

Plain weave is a technique of taking an element over-one, under-one another element. The warp elements run from toe to heel and the weft elements are woven side to side. Sometimes the warps are the visible elements (warp-faced), and sometimes the wefts are the visible element (weft-faced). The raw material elements that are used to construct the sandal are generally yucca leaves that may or may not be twisted, or thickly twisted yucca yarns. Generally, there are no patterns woven into the sandal, or use of color motifs. The body shape is almost always an oval to rectangular configuration with rounded toes and rounded heels. The method used to tie the sandal to the foot is generally a toe-heel tie system.

Twining is considered to be the most sophisticated method of sandal construction. It involves taking two or more weft elements and criss-crossing them around the warp. The wefts thus completely encircle the warp element. Twining is often hard to distinguish from plain weave because of the practice of tight yarn packing. Often the technique is only discernible if the sandal is de-constructed.

During the Archaic era, an open-twining technique was prevalent, quite the opposite of a tight yarn packing technique. Typically, 3 to 5 yucca leaves were bent in half to create warps. The bent portion was at the toe. Yucca leaves were then used as wefts and were woven in such a way as to leave a lot of space between the rows as the weaving extended from the toe area to the heel. These sandals were attached to the foot using side loops that were pulled up over the foot and laced together with a cord. Padding of grasses and juniper bark were employed to fill in the gaps of weaving and create a more durable, or useable, sandal.

The more tightly packed twining sandals are found at sites dating from the Basketmaker II through Pueblo III periods, but are mainly associated with Pueblo III times (Deegan in Hays-Gilpin et al. 1998:49). These sandals are often constructed using a small loom to hold very finely twisted yucca cordage as the warp. Finely twisted yucca yarn is then used as the weft. Various styles occur over time, e.g. fringed toes appear on sandals dating to the Basketmaker II period. The surface of these sandals may show a raised pattern, or color motifs. Also variable are the body shapes which range from scalloped toes with square heels, round toes with puckered heels, and shaped toes with cupped heels. Methods used to tie these sandals to the foot also varied from side loop methods to toe-heel tie systems.

The third technique of constructing sandals is the braiding or plaiting technique, which uses one set of elements (warps) that interweave diagonally from one side of the sandal to the other. Patterns vary from taking an element over one element, then under one element (1/1) to over-two, under-two (2/2). Sometimes changes from one pattern to another are noted in one sandal; these changes were used to accommodate shaping of the sandal or to create a particular braiding along the selvage (side) of the sandal. Whole leaf material, generally yucca, is used in this construction technique, and the width of the leaf varies. Generally the narrower elements are seen in 2/2 twill sandals, and wider leaf varieties are seen in 1/1 twill sandals.

Other Considerations

In general, prehistoric sandals are constructed of leaf fibers. Sometimes the leaves are left whole, at other times the leaf fibers are first twisted first into cordage. Hence, sandal analysis includes information about the plant material, leaf manipulation, and whether the raw material is twisted into yarn. Leaves can be used in several manners, such as flat, rolled, or crushed. It is often difficult to discern if entire leaves or partial leaves are used when the sandal exhibits tight weft packing. Also, if yucca is used, it is difficult to discern the variety of yucca employed in the sandal construction.

If the leaf is twisted into yarn, attributes such as ply and twist direction should be noted. Obviously, the two directions to twist fiber are clockwise (denoted in text with a “Z”) or counterclockwise (denoted in text with an “S”). It has been shown by previous research that the direction of the twisting correlates to cultural groups (see Adavosio 1977, 1986). Ply refers to the number of yarns twisted together, generally to improve strength and durability.

Sandal silhouette mainly refers to the toe and heel shape, attributes that influence the overall shape of the sandal. When discussing toe shape, different aspects are noted such as rounded or pointed, whether or not jogging or notching is present, if it is shaped for the right or left foot, and whether or not fringing or padded toe bolsters are present. Heels are generally defined as either flat or three-dimensional (puckered or cupped). Finally, how the sandal is attached to the foot via a tie system is noted. There are three tie systems found in the Ancestral Puebloan sandal assemblage: side-loop, toe-heel, and criss-cross.

Sandal Collection Description

Eight sandals were analyzed that represent the Natural Bridges National Monument collection. A ninth sandal listed as part of the Natural Bridges collection is housed at the Museum of Northern Arizona, and it was not examined. Additionally, a sandstone object listed as a sandal last was analyzed. It is a shaped slab that might be better cataloged as an artifact of worked stone, without assigning the function of a sandal last.

Sandal NABR 32

This sandal exhibits 2/2 twill construction with shifts of 1/2 twill to facilitate shaping. It is manufactured of whole leaf yucca. The fabric density is 3 elements (or leaves) per cm, and the sandal measures 15 cm length by 7.8 cm width by .04 cm thick, with a weight of 33.94 grams.



The main toe shape is pointed at the center and the heel shape is cupped. The selvages are intact and are braided. A few leaf ends are exposed along the sole and are shredded. A toe loop is evident on the sole; it is a Z-twisted yucca leaf. Heel tie stubs are evident at the heel. The sandal is bent in the middle, at approximately the foot arch level. Overall, it is in good shape with the exception of the bent nature and the selvage that is torn along the upper left side.

Sandal NABR 43

This sandal is manufactured of whole leaf yucca and is constructed using a 2/2 twill plaiting technique. The sandal measures 18 cm long by 8.84 cm wide by 0.46 cm thick, and weighs 43.01 grams. The fabric density is 3.5 elements per cm, with the average leaf width being 3.5 mm. The plaiting method shifts along the selvage to 1/2 twill plaiting to assist with shaping.



The exhausted leaf ends are left frayed on the sole. Remnants of whole leaf side loops are present. The toe section is missing, but the arc of the left side of the sandal suggests the toe was rounded. Much of the heel section is missing, but it appears to be squared.

Sandal NABR 110

This sandal is constructed of whole leaf yucca employing a 2/2 twill plaiting technique. The sandal measures 11 cm long by 7.16 cm wide by 0.78 mm thick and weighs 26.30 grams. The fabric density is 3 elements per cm, with leaves averaging 3.5 mm in width. In places, the construction technique shifts to a 1/2 plait. Exhausted leaf ends are evident on the sole and are frayed. The sandal has a black-brown coating that could be a pitch coating, or could be residue of pack rat excrement. Both the toe and the heel sections are missing.



Sandal NABR 1201

This sandal is manufactured of whole leaf yucca employing a 2/2 twill plaiting technique, with shifts of 1/2 plaiting. The fabric density is 3 elements per cm. The sandal measures 25 cm long by 10.5 cm wide by 0.3 cm thick, and weighs 61.55 grams. Several leaf ends are exposed and frayed on the sole of the sandal. One possible remnant of a toe loop is present; the sandal is folded over at this point and the exact placement of the loop is difficult to discern. The heel section is slightly rounded with the right side missing/shredded; it was likely cupped. The toe is shaped or scalloped, and it is shaped for the right foot. A sample from this sandal was submitted to a lab specializing in radiocarbon testing, and it yielded a radiocarbon age of Cal AD 1220 to 1300. This radiocarbon data suggests that the sandal was manufactured during the Pueblo III period. Ceramic sherds were found on this site that also date to the Pueblo II to Pueblo III periods.



Sandal NABR 1202

This sandal is manufactured from whole leaf yucca (average width of 3.5 mm) and is constructed in a 2/2 twill pattern with 2/1 shifts in order to shape the sandal. No ties or loops are present. The fabric density is 5 elements per cm. The heel area shows wear; the exact shape is difficult to discern but the sandal was likely a shaped toe-cupped heel variety. The soles are matted and caked with dirt. A sample from this sandal was submitted to a lab specializing in radiocarbon dating and it yielded a radiocarbon age of Cal AD 1210 to 1290. This radiocarbon data suggests that the sandal was manufactured during the Pueblo III period.



The soles are matted and caked with dirt. A sample from this sandal was submitted to a lab specializing in radiocarbon dating and it yielded a radiocarbon age of Cal AD 1210 to 1290. This radiocarbon data suggests that the sandal was manufactured during the Pueblo III period.

Sandal NABR 1833

This sandal is a weft-faced tightly packed plain weave sandal utilizing a Z-spun, S-twist 2-ply yucca yarn for the warp and both untwisted and Z-twisted single ply yucca yarn for the weft. A sample from this sandal was submitted to a lab specializing in radiocarbon dating, and it yielded a radiocarbon age of Cal AD 550 to 660. This radiocarbon data indicates that the sandal was manufactured during the Basketmaker III period, and adds important information about the chronology of cultural groups who lived in the Natural Bridges area.



Sandal NABR--B01

This sandal is manufactured of whole leaf yucca and uses a 1/1 twill plaiting technique. The fabric density is 1 element per cm, with the average width of a leaf being 1.25 cm. The sandal measures 26 cm long by 8.8 cm wide by 1.2 cm thick. The main toe shape is indeterminate, and the heel shape is square. Side loops are present and use S-twisted whole leaves. A 6.7 cm long segment of cordage is attached to a side loop that is S-spun, Z-twist 2 ply.



The yucca leaves show wear and shredding on the sole (dorsal) surface of the sandal. The selvage consists of a working leaf being folded over and incorporated back into the body of the weaving. This is a very expedient method of sandal construction.

Sandal NABR--D01

This sandal is manufactured of whole leaf yucca and utilizes a 2/2 twill plaiting technique, with occasional shifts of 1/1 and 1/2 along the selvages. The sandal measures 25 cm long by 9.8 cm wide, by 5.5 cm thick. The fabric density is 2.5 elements per cm, with the average leaf width being 5.2 mm. The main toe shape is scalloped and the heel is squared. It is shaped for the right foot. The selvage is braided, and overall the sandal exhibits a very nice tight weave. Exhausted leaf ends are frayed on the sole.



Summary

The NABR prehistoric sandal collection consists of 8 specimens that range in age from the Basketmaker III to Pueblo III periods. Archeological investigations within the boundaries of the park have indicated a high number of sites that date from Basketmaker through Pueblo III periods. Archeologists assess when a site was occupied by examining the architectural style of structures, and by analyzing rock art panel elements and types of ceramic and lithic artifacts that are present at the site. The findings at NABR are similar to those of projects that took place in areas surrounding the park. For example, prior investigations on the Cedar Mesa have revealed that occupation of the region was heaviest during the Basketmaker II, Basketmaker III, and Pueblo II to Pueblo III periods (Matson and Lipe 1978, Matson et al. 1983, Kramer et al. 1991:13).

The eight sandals in the Natural Bridges National Monument collection conform well to those collected from regional sites. The majority of the NABR sandals are constructed using a plaiting technique that is commonly seen at Pueblo II-III sites. One of the sandals is of plain weave construction, and it conforms to sandals found at sites culturally affiliated with Pueblo I-Pueblo II periods. Radiocarbon dating of a sample from this sandal (NABR1833) places its manufacture during the Basketmaker III period. Specific comparisons with the Natural Bridges collection and those depicted in the University of Utah sandal collection catalog, *Treading in the Past: Sandals of the Anasazi* (Kankainen 1995) and the Mesa Verde collection depicted in *The Wetherill Collections and Perishable Items from Mesa Verde* (Osborne 2004), are found in the larger report on file at the SEUG cultural resources offices.

Further Reading

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