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2012 A Glimpse into the 2012 University of Oregon Archaeology Field School at Rimrock Draw Rockshelter. *Current Archaeological Happenings in O*regon 37(2-3):4-7.

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2012 ABCs at the Paisley Caves: Artifact, Bone, and Coprolite Distributions in Pre-Mazama Deposits. *Current Archaeological Happenings in O*regon 37(2-3):7-12.

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ABCs at the Paisley Caves: Artifact, Bone, and Coprolite Distributions in Pre-Mazama Deposits

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The Paisley 5 Mile Point Caves is a world-class heritage site where the earliest directly-dated human remains (DNA) yet discovered in the Western Hemisphere were found in human coprolites dated to 14,280 cal. BP (Gilbert et al. 2008). More recently, projectile points of the Western Stemmed series have been excavated from well-stratified deposits, dating from 12,800 to 13,000 cal. BP (Jenkins et al. 2012a). Bone fragments of many large extinct and extant mammals have also been preserved in early deposits, but the relationship between cultural and faunal remains is still unclear. To examine this relationship, and to investigate the human utilization of large mammal resources during the terminal Pleistocene through Early Holocene period, we statistically analyzed the distributions of artifacts, bones, and coprolites (ABCs) as they occurred below Mount Mazama tephra.

The Paisley Caves are located near the town of Paisley in the Summer Lake Basin of south-central Oregon. Research at this site has primarily focused on three of the eight caves and rockshelters that were eroded into a ridge of scoriacious basalt by wave action from pluvial Lake Chewaucan (Figure 1). The first professional excavations here were carried out under the direction of Luther Cressman between 1938 and 1940 (Cressman et al. 1940). Cressman discovered proof of human occupation in the region, predating the eruption of Mount Mazama (ca. 7,600 cal. BP). He also believed he had established associations of cultural materials with Pleistocene megafauna, and found evidence that humans had exploited these animals. However, these claims were disputed due to a lack of precise provenience records, and inadequate quantification of the excavated materials (Heizer and Baumhoff 1970:5; Krieger 1944; Jennings 1986:115).

Following Cressman's work, the caves were not professionally excavated again until 2002. The University of Oregon has since completed six seasons of excavations at the site. During this time, the issue of human and megafauna contemporaneity has been resolved (Jenkins 2007, Gilbert et al. 2008, Jenkins et al. 2012a). Meticulous excavation and analysis methods have shown that cultural and megafauna remains occur in horizontal, vertical, and stratigraphic association in the caves (Jenkins 2007: 75, Jenkins et al. 2012b). Dates obtained for ancient human coprolites (14,280 cal. BP), in association with Western Stemmed projectile points (12,800-13,000 cal. BP), a polished hand stone tool exhibiting *Equus* protein (14,525 cal. BP), a polished and battered hand stone exhibiting proboscidean (elephant-related) protein, grass and Apiacea pollen and starch granules, and an edge-modified

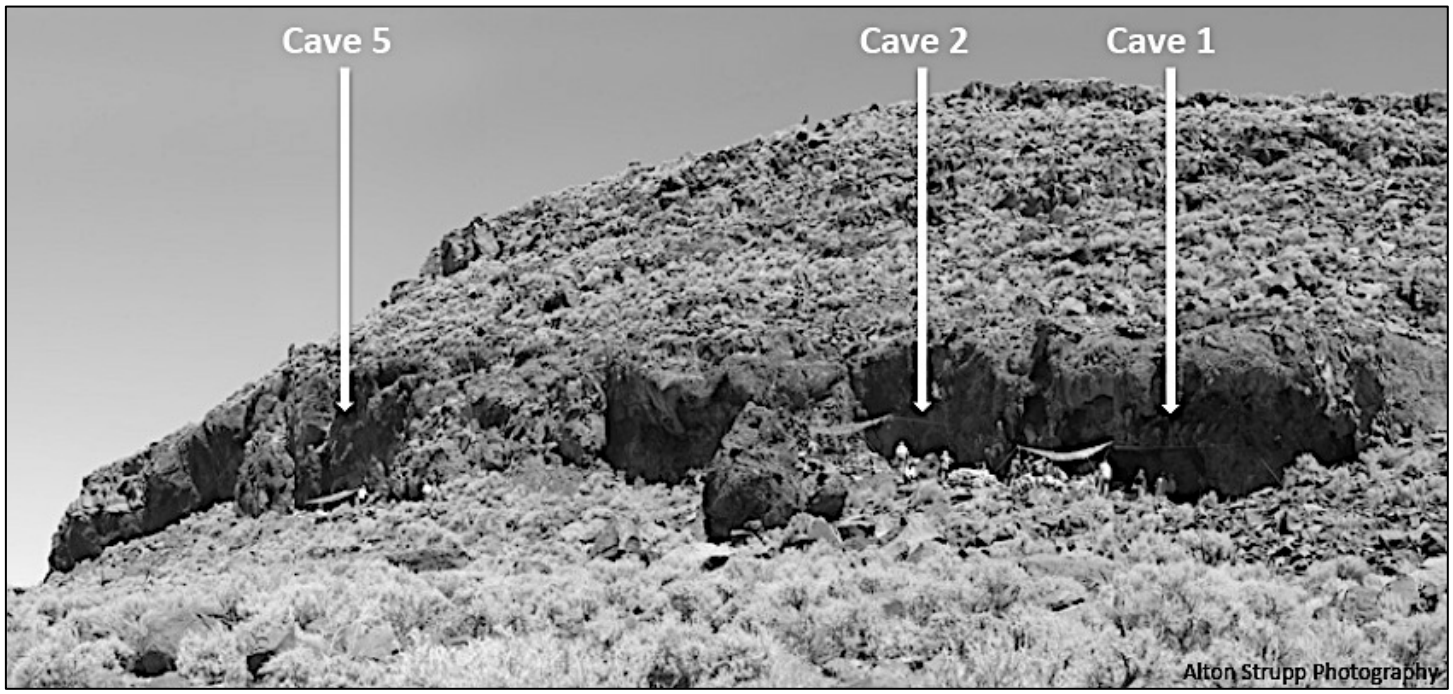


Figure 1. Paisley Caves, Oregon. Photo by Alton Strupp Photography.

obsidian flake exhibiting proboscidean protein, coincide well stratigraphically with those of *Camelid* and *Equus* bones also recovered from this site. These data show that humans were present in the region by at least 14,280 years ago, and that their presence overlapped with that of megafauna for approximately 1,000 years (~14,280-13,300 cal. BP).

Site formation processes, such as the transportation of faunal remains by predators, and the natural death of animals within the site, have surely contributed to the bone accumulation in early cave deposits. To investigate whether humans were also contributors of faunal remains during the terminal Pleistocene through Early Holocene period, we tested for statistical trends in the ABCs. Mount Mazma tephra, which has been dated to 7,640 cal. BP at this site, provides a clear and convenient time marker for our purposes. We statistically analyzed the distributional data for the ABCs from deposits below the Mazama stratum (ca. 7,640-16,190 cal. BP), and examined the results for significant correlations that may be indicative of human utilization of large mammal resources.

Our null hypothesis states that if large mammal bones were deposited naturally by predators, the associations of artifacts, bones, and coprolites would appear random, and there would be no statistically significant correlations between the material types. Our alternative hypothesis is that if large mammal bones were deposited by cultural activity, the associations of artifacts, bones, and coprolites would not appear random, and there would be statistically significant correlations between, at least, the bone and artifact distributions.

A Microsoft Excel database was compiled for this study, containing 4,695 artifacts, 2,139 large mammal bones, and 1,827 coprolites recovered from caves 1, 2, and 5. These materials were plotted in concordance with the 5-centimeter levels from which they were excavated. Following Barnosky et al. (2004) in defining megafauna, a protocol of standards for inclusion was applied to each bone or bone fragment examined, so that only bones likely to have come from an animal of at least 44 kg (100 pounds) gross body mass were included. At the lower limit, this group includes deer, pronghorn, and mountain sheep. At the upper limit, it includes horse, camel, bison, bear, American lion, ground sloth, mammoth, and mastodon. To consistently select the sample, an electronic digital caliper was used to measure the maximum length, width, total thickness, and wall thickness of each specimen. Long bone fragments were rejected if the thickest cortical wall measurement was less than 2.0 mm, or the marrow cavity of the long bone fragment was less than 10 mm in cross-section. Spongy bone fragments, ribs, crania, and vertebra elements were included or rejected from the study based on similar protocol. Identifications to size class were verified by a University of Oregon zooarchaeologist.

Table 1. Spearman Rank Correlation values (R) and probability values (*P*-value) for overall ABC distributions below Mazma tephra (>7,600 BP) by cave. * *P*-value < 0.05, **P*-value < 01.

	Artifacts and Bones		**Artifacts and Coprolites**		**Bones and Coprolites**	
	R	***P*-value**	***R***	***P*-value**	***R***	***P*-value**
Cave 1	+0.287**	0.0004	-0.015	0.8543	-0.06	0.4636
Cave 2	+0.405**	<0.0001	+0.197**	0.0002	+0.039	0.4549
Cave 5	+0.266**	<0.0001	+0.155**	0.0017	+0.107*	0.0309

Artifacts included in this study were basketry, cordage, twisted threads, modified bulrush, projectile points, bifaces, cores, lithic debitage, ground stone, and human hair. Due to the inability to positively identify the source of coprolites without DNA analysis, we included all coprolites 2 centimeters or more in diameter, recognizing this group to include human and non-human specimens.

Spearman Rank Correlation analyses were performed with the SAS® statistical software program to assess the associations between the distributions of the ABCs excavated from deposits below Mazama tephra. Spearman Rank Correlations detect trends in data by measuring the strength and direction of the relationship between variables. A probability value of less than 5% (p <0.05) was considered statistically significant in this study. We analyzed for associations between distributions of artifacts and bones, artifacts and coprolites, and bones and coprolites in each excavation unit. Groups of excavation units in each cave were also tested for overall correlations between the ABCs throughout all pre-Mazama deposits.

Significant correlations between artifact and bone distributions were found in all three caves (Table 1). Caves 2 and 5 had artifact and bone correlations with strong probability values less than 0.01% ($p < 0.0001$). Cave 1 also had a high correlation of artifacts and bones, with a probability value of 0.04% ($p = 0.0004$). These results show that the trends of bone distributions in Terminal Pleistocene through Early Holocene deposits significantly, and positively, correlate with artifacts, so that as the presence of bone increases, so does the presence of artifacts. Likewise, as bone counts decrease, so do artifacts.

Artifacts and bones were not the only correlated variables. In Cave 2, artifacts and coprolites were also significantly and positively correlated. In Cave 5, the correlations between all three sets of variables were significant. Therefore, we have rejected the null hypothesis in favor of the alternative.

While interpreting these results, we recognize that correlation does not imply causation. High levels of association between the distributions of artifacts, bones, and coprolites could mean that one class of material is responding positively to the presence of another class of material. However, correlation coefficients do not determine which class of material is the independent, and which is the dependent variable. It is possible that the material classes are responding to variables other than cultural activity. Several of the most logical alternative causes are considered unlikely under the conditions of this study. These alternatives include the erosion of sediments,

Table 2. Number of statistically significant positive and negative correlations, and total quadrants analyzed per cave. A = Artifacts, B = Bones, C = Coprolites

	Quadrants Analyzed	**Statistically Significant Correlations, Positive**			**Statistically Significant Correlations, Negative**		
		A & B	**A & C**	**B & C**	**A & B**	**A & C**	**B & C**
Cave 1	8	2	2	0	0	0	0
Cave 2	14	5	4	3	0	1	0
Cave 5	21	3	3	0	0	0	0
Total	**43**	**10**	**9**	**3**	**0**	**1**	**0**

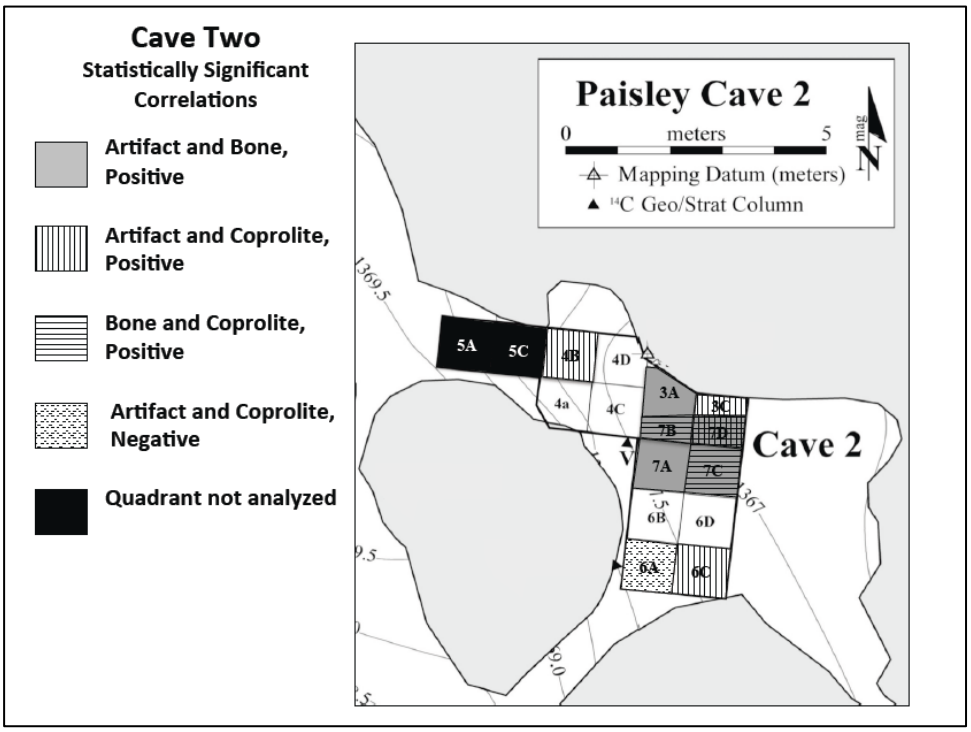


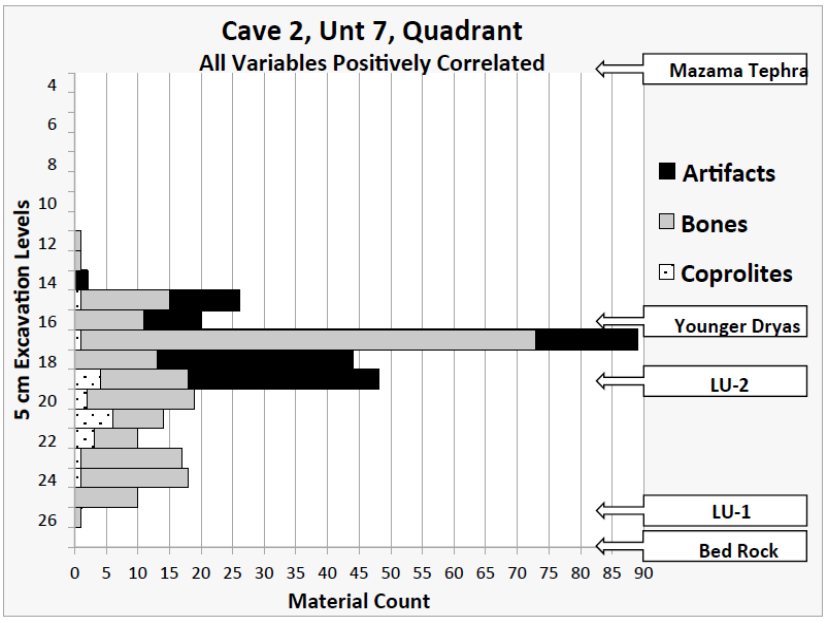
Figure 2. Cave 2 location-specific correlations mapped by quadrant.

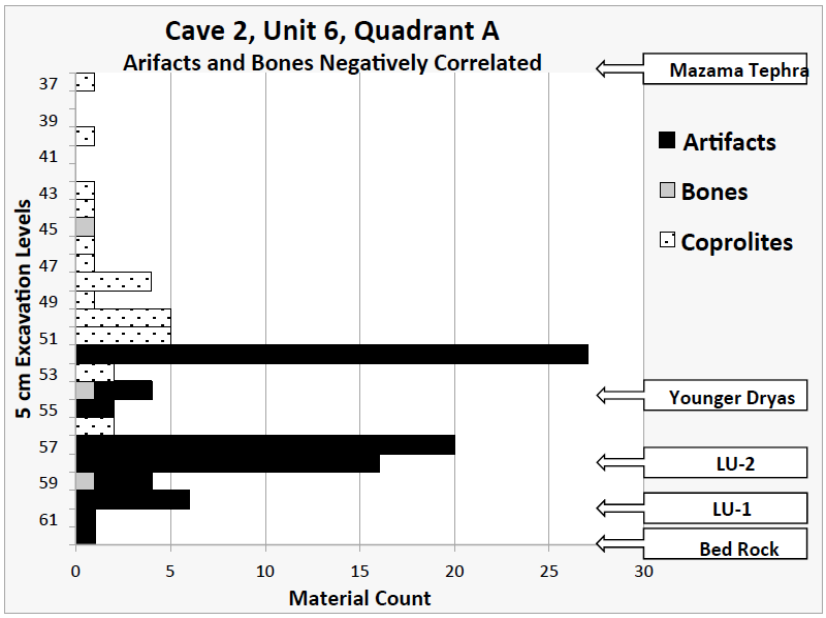
disturbance from rodent activity, or artifacts sinking through loose sediments to rest on more compact surfaces below. These variables are not likely to have caused the significantly correlated trends detected in all three caves, considering that all materials from disturbed deposits were eliminated from the sample, and very little erosion has been detected within the well-dated stratigraphy below the Mt. Mazama tephra. Therefore, we have interpreted these results as an indication that when humans were present at this site, they affected the bone distributions significantly enough to be detectable in the archaeological record, suggesting that humans had indeed exploited large mammal resources here. If cultural activity is the cause of these correlations, trends of this statistical significance could not have resulted from a single event, and therefore must be a product of repeated cultural activities in which large mammal resources were utilized.

The positive correlations between artifacts and coprolites in Caves 2 and 5, offer supplemental support to the alternative hypothesis, as correlations between artifacts and coprolites should not occur if the bone distributions were deposited naturally by predators. If we had been able to positively identify all the included coprolites as being human in origin, the correlation between this variable and the bones would have also supported the rejection of the null hypothesis. Since we are presently unable to do so, this correlation is not supportive of either hypothesis, as bone and coprolite correlations may have resulted from predator activity when the site was unoccupied by humans.

We found correlations of the ABC variables to be location specific. A total of 43 excavation quadrants were individually analyzed, resulting in 23 statistically significant correlations (Table 2). These individual quadrant analyses have shown us where in the caves correlations occur. Figure 2 offers an example of correlations mapped by quadrant in Cave 2. Units where significant positive correlations were found have been graphed in comparison to the single unit in which a negative correlation was detected, as well as with units lacking correlations of significance (Figure 3). These interesting and spatially specific correlations are deserving of future examination.

In sum, the distribution of large mammal bones and artifacts are strongly correlated in three of the Paisley Caves. Correlations of these materials with coprolites have also been detected. While it seems intuitive that artifacts and bones would be significantly correlated if humans processed bones where the artifacts occur, this cannot yet be proved. The present work has identified important significant correlations, but further work is needed to prove the causes of these correlations.





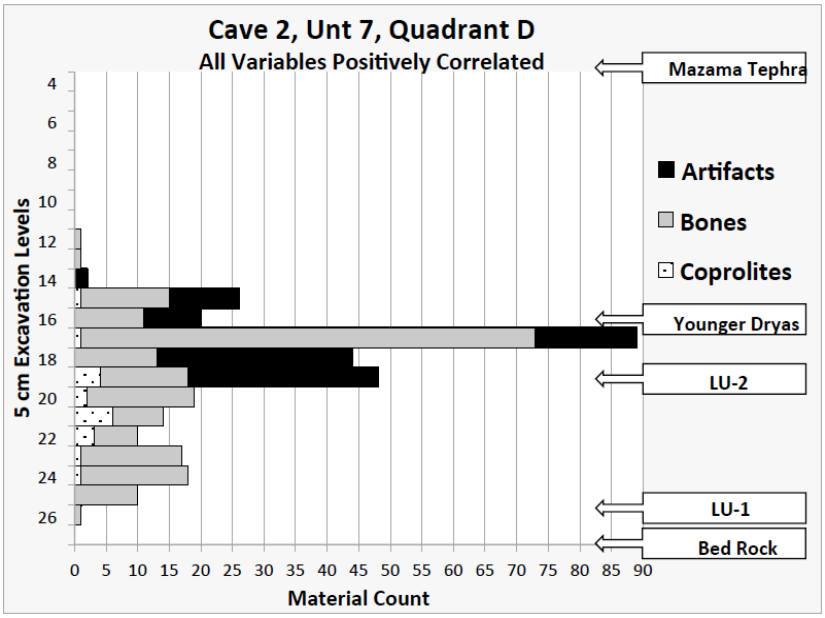


Figure 3. Graphed data of three comparative quadrants in Cave 2. Positive correlations between all three variable were found in some units (top), a single significant negative correlation was found one unit (middle), and no significant correlations were found in some units (bottom).

We will continue to analyze the Paisley data by dividing the sample plots into finer temporal units. Preliminary investigations suggest strong correlations between artifact and bone distributions occurring in Younger Dryas aged deposits, particularly in Cave 2, where a nicely sealed-in 12,000-12,600 cal. BP deposit in LU3 contains large quantities of bone and artifacts. This component is underlain by Pleistocene strata LU1 and LU2 deposits, which contain significantly varying obsidian source and CCS lithic assemblages, as well as stone tools with proboscidean protein on them, indicating that the Younger Dryas and Pleistocene assemblages do not derive from a single cultural component. This presents us with a unique opportunity to compare the ABC trends in two very old components. By doing this, we hope to learn more about when the events causing our observed correlations occurred and to determine patterns of distributions that distinguish older pre-Clovis and Clovis aged assemblages from overlying Younger Dryas assemblages.

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