EYED BONE NEEDLES FROM A YOUNGER DRYAS PALEOINDIAN COMPONENT AT TULE LAKE ROCK SHELTER, NORTHERN CALIFORNIA

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The geographic and chronological distribution of eyed bone needles in North American Paleoindian sites led Osborn (2014) to propose that these distinctive artifacts date primarily to the Terminal Pleistocene Younger Dryas Cold Event and were essential to making close-fitting clothes needed to survive frigid winter conditions. Our study of a museum collection from Tule Lake Rock Shelter (CA-SIS-218A) in the high Klamath Basin area supports Osborn's argument. We present nine high-precision accelerator mass spectrometry (AMS) radiocarbon assays from a 2.5 m deep cultural sequence, demonstrating that Paleoindians occupied the site primarily during the Younger Dryas. Although only about .5 m^3 of the Paleoindian deposits at CA-SIS-218A were excavated, fragments of four small bone needles were recovered, three of which contain whole or partial eyes. Two fragments of large mammal cortical bone from the same levels contain remnants of "groove and snap" fractures that may be related to the production of needle blanks. The bone needles from Tule Lake Rock Shelter extend the geographic range of these distinctive Paleoindian artifacts into the high desert region of Northern California.

La distribución geográfica y cronológica de agujas de coser con ojos en los sitios Paleoindios de America del norte inspiro a Osborn (2014) proponer que estos distintivos artefactos pertenecían al Terminal Pleistocene Younger Dryas Evento Enfriado y fueran esencial en la construcción de ropa ceñida la cual que era imperativo para sobrevivir en el clima enfriada del invierno. El estudio de una colección de materia recogida de Tule Lake Rock Shelter (CA-SIS-218A) ubicada en la cuenca de Klamath, ahora guardado en un museo, soporta la posición de Osborn. Presentamos aquí nueve fechas de alta precisión de la AMS ^{14}C que vienen de un deposito de secuencias culturales de los 2.5 m de profundidad que se demuestra que los Paleoindios ocuparon el sitio principalmente durante la época de Younger Dryas. Aunque solamente .5 m^3 de los depósitos Paleoindios del sitio CA-SIS-218A fue excavado, fragmentos de cuatro pequeños agujas de hueso fueron encontrado de los cuales solo tres contenían ojos o enteros o parciales. Dos fragmentos de hueso cortical de mamíferos grandes que se encontraron en el mismo nivel contenían fracturas de ranura y rotura "groove and snap" que puede ser relacionado a la producción de las agujas no completas. Las agujas de hueso de Tule Lake Rock Shelter amplían el alcance geográfico de estos artefactos Paleoindios hasta la región del alto desierto del norte de California.

In a valuable synthesis, Osborn (2014) summarized the distribution of eyed bone needles and spurred gravers in Paleoindian sites in North America. He suggested that nearly all these artifacts date to the unusually cold Younger Dryas period, between ~12,900 and 11,650 calibrated years before present (cal B.P.), and that such needles were associated with the sewing of close-fitting, tailored clothing essential to human survival during frigid Younger Dryas winters. We found support for Osborn's conclusions in our recent studies of a Paleoindian component at Tule Lake Rock Shelter (CA-SIS-218), located in the Klamath Basin, a high desert region in Siskiyou County, California (Figure 1). The Klamath Basin today has relatively cold winters—including his-

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American Antiquity 79(4), 2014, pp. 776–781

DOI: 10.7183/0002-7316.79.4.776

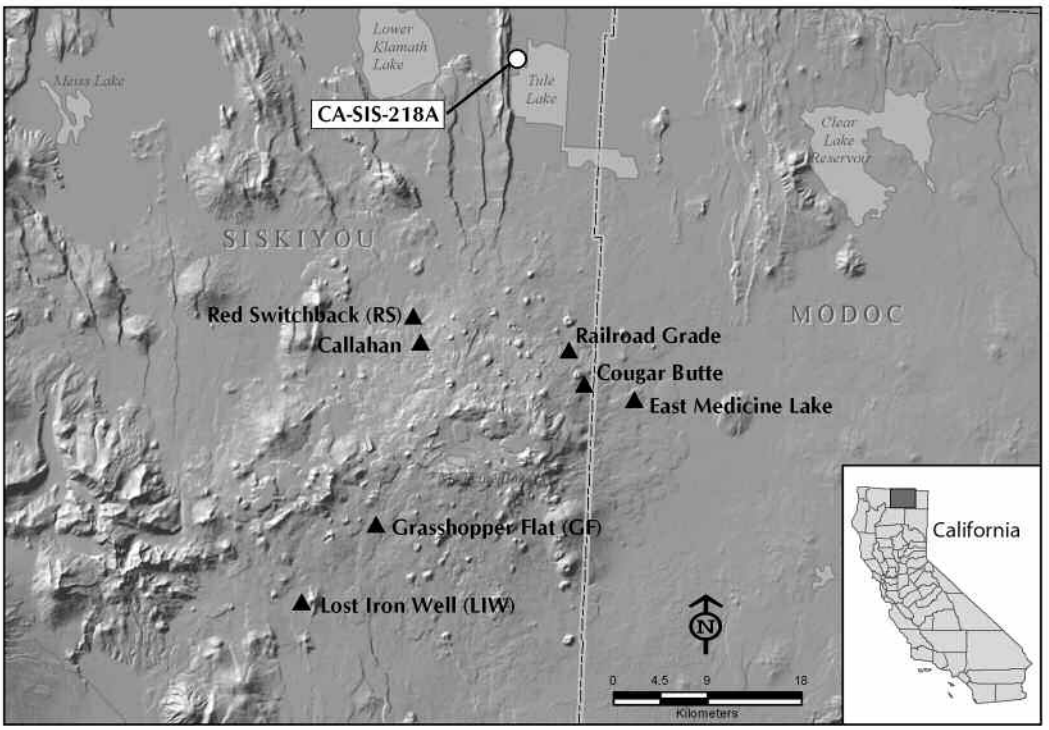

Figure 1. Map of the Tule Lake area, showing the general location of CA-SIS-218 and major obsidian sources utilized by Paleoindian occupants of the site. The Grasshopper Flat, Lost Iron Well, and Red Switchback localities comprise a single geochemically indistinguishable source (GF/LIW/RS). Source locations are from Hughes (1986:284); graphics by J. Thatcher and C. Skinner.

torical low temperatures of -28 degrees Fahrenheit (F.) (The Weather Channel 2014)—which probably would have been even more severe during the Younger Dryas Cold Event.

Background Data

Tule Lake Rock Shelter is situated near the west shore of Tule Lake (Figure 1) at ~4,085 feet above sea level. It contains several shallow rock shelters at the base of a sheer basalt cliff located behind the Tule Lake National Wildlife Refuge headquarters. The cliff face and rock shelters appear to have been formed by erosion associated with a high lake stand, probably during the Last Glacial Maximum. Two of the rock shelters (A and D) were excavated in 1989 and 1990 by archaeologists led by John Beaton of the University of California (UC) at Davis. In Shelter A, Beaton's team excavated a small trench in several contiguous 1-x-1-m test units, one of which (Unit 0S/1W) exposed a 2.5 m deep cultural sequence, the lowest 50 cm (Levels 21–25) of which resulted from Paleoindian occupation. A chunk of charred wood from the uppermost Paleoindian level (21) was dated to 11,450 ± 340 radiocarbon years before present (B.P.) (Beaton 1991; see also Erlandson 1994), suggesting the potential for a pre-Clovis occupation. Beaton noted that the Paleoindian levels contained the bones of birds, fish, and mammals associated with non-diagnostic stone tools. He left UC Davis before his analysis was completed and work on the collection stalled until 2010, when we borrowed it for detailed analysis at the University of Oregon.

The Paleoindian Assemblage at Tule Lake Rock Shelter: Chronology and Contents

Since that time, we have obtained nine accelerator mass spectrometry (AMS) radiocarbon assays for short-lived samples (carbonized twigs) from the deep cultural sequence (Table 1), seven of them from the Paleoindian levels (21–25). Attempts to

Table 1. Radiocarbon Age Estimates for Tule Lake Rock Shelter.

Lab Number	Catalog #	Unit/Level	Material	^{14}C Age	Cal B.P. Range[a]	Comments
UCIAMS-79300[b]	451-1127	OS-1W/11	Carbonized twig	3390 ± 20	3690–3580	Late Holocene
UCIAMS-79296	451-1121	OS-1W/20	Carbonized twig	4655 ± 20	5465–5315	Middle Holocene
UCIAMS-79294	451-1118	OS-1W/20	Carbonized twig	4775 ± 20	5585–5470	Middle Holocene
Beta-40123[c]	N/A	OS-1E/20	Charcoal	5170 ± 90	6185–5715	Middle Holocene
Beta-39545	N/A	OS-1W/21	Burned wood	11,450 ± 340	14,050–12,800	Old wood?
UCIAMS-79293	451-1120	OS-1W/21	Carbonized twig	10,285 ± 25	12,160–11,970	Late Paleoindian
UCIAMS-80836	451-1120	OS-1W/21	Carbonized twig	10,310 ± 25	12,350–11,985	Late Paleoindian
UCIAMS-80839	451-1131	OS-1W/24	Carbonized twig	10,280 ± 40	12,350–11,820	Late Paleoindian
UCIAMS-79297	451-1131	OS-1W/24	Carbonized twig	10,425 ± 25	12,590–12,140	Late Paleoindian
UCIAMS-79295	451-761	OS-1W/24	Carbonized twig	11,100 ± 25	13,090–12,935	Clovis age
UCIAMS-80838	451-761	OS-1W/24	Carbonized twig	11,100 ± 30	13,090–12,930	Clovis age

[a]Calendar age ranges (at 2σ) calibrated with CALIB 7.0 (Stuiver et al. 2005) using the IntCal13 curve (Reimer et al. 2013).
[b]UCIAMS dates obtained by our group. Conventional ages are corrected for fractionation using measured δ13C values following Stuiver and Polach (1977).
[c]Conventional Beta Analytic dates obtained by Beaton.

extract purified collagen from large mammal and bird bones from the Paleoindian levels were unsuccessful. Dates on burned twigs from the Paleoindian levels suggest that Beaton's early radiocarbon age estimate was influenced by the "old wood" effect (Schiffer 1986). An ephemeral Clovis-age occupation may be represented by two nearly identical dates of 11,100 B.P. (13,090–12,935 cal B.P.) from the base of the sequence, but no artifacts diagnostic of a Clovis presence were recovered. This could be interpreted as evidence that Paleoindians of the Western Stemmed Tradition occupied the area during Clovis times (Beck and Jones 2010; Jenkins et al. 2012), but the oldest dated twigs could also be associated with wildfires or later cultural burning of woody debris found on the shelter floor. The recovered assemblage from the basal Paleoindian level is also too small to be confident of its technological affiliation.

A later Paleoindian occupation of CA-SIS-218A is much better supported by five assays from Levels 21–24 that all fall between ~10,500 and 10,300 B.P. (~12,500–11,960 cal B.P.). Overall, the AMS age estimates from the basal levels of the site suggest that Tule Lake Rock Shelter was occupied by Paleoindians primarily during the Younger Dryas Cold Event. During the Middle and Late Holocene, beginning between about 6,200 and 5,500 years ago, roughly two meters of archaeological deposits (Levels 1–20) accumulated in Shelter A, capped with a discontinuous crust of animal dung left by livestock in historic times.

Among the mammal bone remains recovered from Level 23 in Unit 0S/1W, Nelson and Erlandson identified 32 bones from the feet of a single adult human skeleton. Along one wall of the test unit, it seems likely that Beaton's crew inadvertently removed the lowest extremities of a human burial that appears to be of Paleoindian age. Stratigraphic drawings and field notes suggest that the human remains came from (and were sealed) beneath a nearly continuous layer of angular rocks. Without opening the trench and reexamining the site stratigraphy, it is unclear if this rock layer is of natural or cultural origin. Below the rock layer, the human bones were found in a matrix of yellow sandy soil containing rounded pebbles from a beach deposit associated with a late Pleistocene high-stand of Tule Lake. This yellow matrix is quite different from the darker grayish-brown midden soils overlying the Paleoindian levels, and no evidence of a burial pit or intrusive sediments was found to penetrate the rock layer or the yellow sand.

From the Paleoindian levels, Beaton's team recovered 293 chipped stone artifacts, including 280 pieces of debitage and 13 tools. The latter include six bifacial point fragments, two biface fragments, four retouched flakes, and one side scraper. Bifacial points are represented by small fragments that appear to have been heavily reworked; three may represent edge-ground stemmed points. The Paleoindian assemblage also contains seven flakes with heavily ground platforms; these appear to be biface-resharpening

Figure 2. Eyed bone needle fragments from the Paleoindian levels of Unit 0S/1W at CA-SIS-218A. At bottom is a nearly whole needle (451-459) from Level 24; upper left is a needle fragment (451-433) from Level 22; upper middle is a needle mid-section (451-435) from Level 24), and upper right is a medial fragment (451-1057a) from Level 23 (scale in mm; photo by K. Gill).

flakes removed from the edges of edge-ground stems, as the stemmed points were being reworked. No later points (or ground stone tools) were found in the Paleoindian levels, although such points are relatively abundant in the overlying strata.

Further evidence that the Paleoindian stratum is intact comes from a relative abundance (~15 percent) of chert artifacts found in the lower levels compared to the Holocene levels (< 2 percent). Finally, XRF analysis of more than 100 obsidian artifacts (mostly debitage) from the Paleoindian levels documented a strong reliance on obsidian flows to the south in the Medicine Lake Highlands—primarily the Callahan (38.1 percent), East Medicine Lake (21.2 percent), Railroad Grade (13.3 percent), Grasshopper Flat/Lost Iron Well/Red Switchback (GF/LIW/RS, 13.3 percent), and Cougar Butte (2.7 percent) sources (Skinner 2011; see Figure 1). These sources and proportions are very different from those represented among a comparable sample of analyzed obsidian artifacts from the Middle and Late Holocene deposits.

Scattered through the Paleoindian levels of Unit 0S/1W, fragments of four bone needles were recovered (Figure 2). All of these are relatively small, completely shaped by grinding, drilling of

eye holes, and polishing. All appear to have been made from the cortical bone of large or medium mammals. Two fragments, refitted and glued at UC Davis, comprise a nearly complete needle (Acc. #451-459) 37.6 mm long and 2.5 mm wide, with a roughly circular eye perforation 1.5 mm wide. We identified two fragments of another eyed needle (Acc. #451-1057a) among the faunal remains in Level 23, which had been incompletely sorted and analyzed. Two other fragments are medial pieces from two needles of roughly similar size and shape, including a specimen (Acc. #451-433) from Level 22 that is broken across the eyehole near the proximal end. Significantly, no eyed bone needles were found in a much larger artifact assemblage from the overlying two-meter thick deposits dating to the Middle and Late Holocene.

From Level 23, we also identified two fragments of large mammal cortical bone (probably from a single bone, possibly a mammoth bone) with evidence for "groove and snap" fractures that may be related to needle blank removal (Osborn 2014:49). Attempts to extract purified collagen from this bone for radiocarbon dating were unsuccessful. Among the small sample of stone tools from the Paleoindian levels, no spurred flake gravers were found, although one well-worn flake tool made from obsidian could have served as a graver.

Conclusions

Our analyses of the Tule Lake Rock Shelter (CA-SIS-218A) collection supports Osborn's (2014) thesis that Paleoindian eyed bone needles are associated primarily with the Younger Dryas Cold Event and an increased need for carefully tailored winter clothing. Some eyed bone needles have been recovered from younger deposits in the Far West (e.g., Aikens 1970; Wingard 2001), but they are relatively rare compared to Younger Dryas specimens, especially considering that human population levels were almost certainly much smaller during Paleoindian times. The occasional occurrence of eyed bone needles in later deposits suggests that they were not used exclusively during cold climatic events or for making close-fitting tailored clothing, but Osborn's hypothesis is worthy of further testing.

The presence of these distinctive artifacts at Tule Lake extends the range of Paleoindian eyed bone needles (Osborn 2014: Fig. 3) into the high desert region of the Klamath Basin, which spans northern California and southern Oregon. While no spurred gravers were found associated with the bone needles at CA-SIS-218A, the assemblage of chipped stone tools recovered is small and the presence of large mammal bones bearing groove and snap scars suggests that such gravers may be present in the Younger Dryas age deposits remaining in the rock shelter.

Acknowledgments. A loan of the CA-SIS-218 collection, curated at the University of California at Davis' Museum of Anthropology, to Erlandson was kindly facilitated by Robert Bettinger, Lisa Dietz, and Bruce Winterhalder. Support for our research came from our home institutions, the Edna English Trust for Archaeological Research, and the United States Fish and Wildlife Service (USFWS). We are grateful to Anan Raymond and Nick Valentine of USFWS, Perry Chocktoot (The Klamath Tribes), and John Beaton for supporting our study. Chelsea Buell, Edward Davis, Kristina Gill, and John Southon provided laboratory assistance; Jennifer Thatcher helped with the production of Figure 1; and Charissa Cannon translated our abstract into Spanish. Finally, we are grateful to Alan Osborn, Michael Walsh, two anonymous reviewers, Ken Sassaman, and the editorial staff of *American Antiquity* for assistance in the review, revision, and publication of this paper.

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Submitted February 28, 2014; Revised June 16, 2014; Accepted June 16, 2014.