Routledge
Taylor & Francis Group

PaleoAmerica

A journal of early human migration and dispersal

ISSN: 2055-5563 (Print) 2055-5571 (Online) Journal homepage: http://www.tandfonline.com/loi/ypal20

Broken Bones and Hammerstones at the Cerutti Mastodon Site: A Reply to Haynes

Steven R. Holen, Thomas A. Deméré, Daniel C. Fisher, Richard Fullagar, James B. Paces, George T. Jefferson, Jared M. Beeton, Adam N. Rountrey & Kathleen A. Holen

To cite this article: Steven R. Holen, Thomas A. Deméré, Daniel C. Fisher, Richard Fullagar, James B. Paces, George T. Jefferson, Jared M. Beeton, Adam N. Rountrey & Kathleen A. Holen (2017): Broken Bones and Hammerstones at the Cerutti Mastodon Site: A Reply to Haynes, PaleoAmerica, DOI: 10.1080/20555563.2017.1396835

To link to this article: https://doi.org/10.1080/20555563.2017.1396835

PALEOAMERICA, 2017
https://doi.org/10.1080/20555563.2017.1396835

Center for the Study of the First Americans
Texas A&M University

Routledge
Taylor & Francis Group

PERSPECTIVE

Broken Bones and Hammerstones at the Cerutti Mastodon Site: A Reply to Haynes

Steven R. Holen[a,b], Thomas A. Deméré[a], Daniel C. Fisher[c,d], Richard Fullagar[e], James B. Paces[f], George T. Jefferson[g], Jared M. Beeton[h], Adam N. Rountrey[c] and Kathleen A. Holen[a,b]

[a]Department of Paleontology, San Diego Natural History Museum, San Diego, CA, USA; [b]Center for American Paleolithic Research, Hot Springs, SD, USA; [c]Museum of Paleontology, University of Michigan, Ann Arbor, MI, USA; [d]Department of Earth and Environmental Sciences, University of Michigan, Ann Arbor, MI, USA; [e]Centre for Archaeological Science, School of Earth and Environmental Sciences, Faculty of Science Medicine and Health, University of Wollongong, Wollongong, New South Wales, Australia; [f]Geosciences and Environmental Change Science Center, U. S. Geological Survey, Denver, CO, USA; [g]Colorado Desert District, Stout Research Center, California Department of Parks and Recreation, Borrego Springs, CA, USA; [h]Department of Earth Science, Adams State University, Alamosa, CO, USA

ABSTRACT
Haynes [2017 "The Cerutti Mastodon." *PaleoAmerica* 3 (3): 196–199] criticizes numerous aspects of our analysis of the Cerutti Mastodon (CM) site, but central among his points is the claim that heavy equipment broke the bones and stones that we interpret as evidence of ancient human activity. This notion can be discounted primarily because most of the relevant CM fragments were found coated in thick crusts of pedogenic carbonate clearly showing that breakage occurred thousands of years ago. Haynes also raises questions about site stratigraphy, radiometric dating, and absence of other artifactual evidence. The stratigraphic context of CM bones and rocks is well-defined, and the Pleistocene site stratigraphy remained intact before excavation. Knapped stone tools are not a requirement in bone processing archaeological sites. In the absence of other plausible explanations for the multiple lines of evidence, we maintain that hominins broke the CM bones using stone hammers and anvils.

KEYWORDS
Cerutti mastodon site; bone modification; site formation; early peopling of the Americas; California

Haynes (2017) states that our conclusions regarding bone breakage are "based on an argument from ignorance," implying that we lacked awareness of alternative explanations, specifically the effects of heavy equipment on the Cerutti Mastodon site's (CM) bonebed. Haynes seems to suggest that equipment damage was responsible for essentially every broken bone at the CM site and at other Pleistocene sites he encounters. Our (TAD, SRH, DCF, GTJ, and JMB) combined experience excavating approximately 60 proboscidean sites in the United States, many of them in active construction areas and in all types of sediment, has given us a clear understanding of the patterns and types of breakage that can result from heavy equipment.

In the case of the CM site, a Caterpillar 235C excavator was in use when the bonebed was first unearthed. The excavator was cutting a 2:1 slope into previously undisturbed and well consolidated Pleistocene strata to create a sound berm to shield the existing homes to the north. There was no artificial fill in the area, contrary to the unfounded speculation of Haynes that "graded fill" was used to build the sound berm. Although a 235C excavator has an operating weight of approximately 38,300 kg, this weight is broadly distributed over a double-track footprint measuring 3.6 × 5.0 m and generates ground pressure at the surface of only about 773 g/cm^2 (11 psi). Even with this minimal amount of ground pressure (a design feature in part for working in the vicinity of buried utilities), it is important to understand that the dead weight of the excavator was never directly above the portion of the bonebed excavated in 1992/93, because the boom and bucket of the excavator were reaching out and down to cut the 2:1 slope and the body of the excavator remained on level ground at the top of the slope. In addition, when the excavator first disturbed the CM bonebed at the toe of this 2:1 slope exposing pieces of tusk (in units A1, A2, B1, and B2), the monitoring paleontologist immediately halted earthwork operations. All disturbed material was removed by hand including all bone, tusk, and rock fragments, and the cut surface was swept clean. Following this initial treatment, the remaining undisturbed sediments were excavated by hand using standard paleontological/archaeological techniques. As the excavation was extended deeper into the berm (i.e., rows 3, 4, and 5), the 235C excavator was employed periodically to remove the majority of the 2–3 m of undisturbed late Pleistocene overburden down to within 20–30 cm above the top of the bonebed (Bed E). Again, the excavator was never positioned directly above the

CONTACT Steven R. Holen ✉ sholen@goldenwest.net

bonebed. Thus, ground compression would not have been a factor affecting buried objects. Regarding bone and rock breakage by heavy equipment, although an unknown amount of the proximal end of the vertical tusk was struck and removed by the excavator in Unit B2, the break was transverse through the tusk (Holen et al. 2017, Extended Data, figure 3c), and the distal 60 cm of the tusk remained intact and buried in consolidated Pleistocene strata underlying the CM bonebed. There was no evidence of disruption of bedding or compression and re-orientation of the tusk by the excavator.

More importantly, bone modification features characteristic of percussion identified on the CM site bones and stones were preserved within heavy encrustations of pedogenic calcium carbonate that formed many thousands of years ago (Holen et al. 2017, Extended Data figures 3a, 3e, 3f). The unfractured carbonate crusts on the bone and stone surfaces established an intact "chain of evidence" clearly demonstrating that the carbonate-covered fractures must have formed prior to carbonate encrustation, and not recently by heavy equipment or ground compression. It was only later that the carbonate crusts were removed in the paleontological laboratory at the San Diego Natural History Museum (SDNHM) to reveal the salient features. It should also be pointed out that fragmentation produced by the weight of heavy equipment acting through sediment cover would result in refitting fragments that, when finally exposed, would be found adjacent to one another. However, at the CM site, it is apparent (as emphasized in our publication) that refitting bone and stone fragments were *not* found adjacent to one another but instead were separated by distances ranging from tens of centimeters to several meters.

Haynes (2017) suggests (without detailed evidence) that features preserved on specimens from the Inglewood Mammoth site in Maryland (Haynes 2016) and the Orleton Farms Mastodon site in Ohio (Thomas 1952) are somehow broadly comparable to those documented at the CM site. However, in Karr's (2015) reanalysis of the Inglewood assemblage, he reported dry bone breakage superimposed on green bone breakage, and logically concluded that the green bone breakage occurred in antiquity, before the bones desiccated. Karr's (2015, 339) assessment was that most of the bones (especially the heavy limb bones) were broken thousands of years ago and "that any damage incurred as a result of earthmoving equipment at the site is easily differentiable from ancient fractures." Further evidence that heavy equipment was not a major causative agent of bone breakage comes from the bonebed map and data published by Haynes (2016). Limb bone fragments are plotted as lying immediately adjacent to complete ribs, and Haynes reports that 18 of 21 ribs recovered over the short four days of site excavation are complete while all limb bones are fragmented. This differential breakage of heavy limb bones without attendant breakage of much lighter ribs does not fit the pattern of heavy equipment breakage (or trampling) where lighter bones would be broken preferentially before thick limb bones. Further, the bone breakage that Haynes discusses at the Orleton Farms Mastodon site (Thomas 1952), as showing helical fractures produced by earthmoving equipment, is not consistent with published descriptions. Thomas (1952, figure 3 and caption) describes the femur as broken "squarely across," not as a helical fracture. Furthermore, Thomas suggests that trampling by other mastodons was the cause of this breakage, and he does not attribute it to earthmoving equipment. Thomas' only report of breakage caused by earthmoving equipment was that a portion of the skull was removed by a ditching machine. An understanding of the breakage patterns on these mastodon bones should be based on personal examination of the specimens, not grainy photographs.

We also take issue with Haynes' interpretation of the impact notch on CM-340 (Holen et al. 2017, figure 2d) as an edge fracture. He suggests that the notch may have formed as a result of "point compression along the edge by sediment crushing." However, there is no explanation of what kind of object (presumably buried) was involved in the point compression. In addition, the mid-shaft location, smooth fracture planes, an opposing percussion bulb, an attached cone flake, and flake scar that extends to the medullary region that accompany the arcuate notch on CM-340 are all features consistent with dynamic percussion. Indeed, the notch interior was completely covered in pedogenic calcium carbonate that was removed in the SDNHM laboratory, after photography, to expose the notch and attached cone flake. Multiple bone fragments with evidence of impact and the cone flakes present at the CM site support our interpretation of intentional bone breakage by percussion, as do the expedient stone tools that exhibit use wear (Holen et al. 2017).

With regard to the apparent lack of evidence of other archaeological sites of Marine Isotope Stage 5 age, we reiterate that North American archaeologists do not routinely survey deposits of this age, do not recognize sites of this age as archaeological, and therefore do not find them. A paleontological crew discovered the CM site. Likewise, the Folsom site was discovered by a paleontological crew in 1926 (Figgins 1927; Meltzer 2006). Archaeologists at the time were not interested in Pleistocene deposits because the prevailing opinion was that humans had not arrived in the Americas this early.

Haynes suggests that the lack of "deliberately shaped lithic tools and cultural features such as hearths" provides evidence that humans were not present and so could not be responsible for bone breakage. However, patterned tools are not required to identify an archaeological site (Lyman 2002), and we state clearly that there is no evidence that the CM site is a kill/butchery site requiring manufactured stone tools and hearths. Neither would be necessary to process bone marrow/fat or to acquire thick cortical limb bone for bone tool manufacture. We interpret this site as a bone processing site occupied for a very short time for a very limited set of activities.

Haynes (2017) implies that the CM age may be problematic without giving specific reasons. He misrepresents a careful online review of our results by Millard (2017), one of the pioneers in developing ^{230}Th/U disequilibrium dating of bone, who concluded that our dating effort is “one of the best-evidenced studies to date.” Haynes (2017) suggests that Millard questioned the difference between optically-stimulated luminescence (OSL) dates (Holen et al. 2017, extended data, section 7) and the CM ^{230}Th/U dates. In fact, Millard acknowledged the upper limit of the OSL method for these sediments, but expressed interest in seeing more detail on why the upper limit was reached, an issue beyond the scope of our *Nature* paper. Indeed, the > 60,000–70,000 yr BP OSL dating results attest to the antiquity of the deposit and are fully consistent with the more accurately determined ^{230}Th/U ages.

We chose not to discuss U-series “dates” presented in the original paleontological report (Deméré et al. 1995). Those analyses were determined by alpha-decay counting, which requires gram-sized samples and yields large analytical uncertainties. More importantly, only three analyses were run: one on a fragment of tusk and two on different components of a pedogenic crust. Tusk is very porous and susceptible to recent U mobility. Isotopic compositions of pedogenic crust were intermediate between those from the tusk and bone in our report. Combined data provide strong evidence that secondary U loss caused elevated Th/U ratios and erroneously old ^{230}Th/U ages in the tusk and crust samples. No additional effort was made in the 1990s to better understand the behavior of U and Th in CM materials. Studies published since then have demonstrated the critical need to more thoroughly characterize U-Th isotope distributions before assigning age significance.

Haynes also mistakenly interprets comments of Millard (2017) regarding our comparison of initial ^{234}U/^{238}U compositions of bone with those measured in shallow groundwater from the Sweetwater River drainage ~2 km west of the CM site. Compositions of ^{234}U/^{238}U in water are *not* required as a “basis for modeling uranium uptake” or deriving ^{230}Th/U ages as implied by Haynes. The comparison was made to provide confidence that the ~130,000 yr BP ages were not the result of recent U loss, which would have yielded systematically higher initial ^{234}U/^{238}U values relative to the original water source. We agree with Millard (2017) that “the closeness of the values is encouraging.”

Geological forces and heavy equipment compression as causes of the limb bone breakage found at the CM site are not supported by field or laboratory observations. There is no evidence for extensive carnivore activity at the site, and no evidence of trampling based on the fact that lighter bones like ribs are more intact and the femora are broken by percussion into small fragments. Flooding could not have caused this damage because the bones and stones are contained in a low-energy overbank deposit of silts and sands and show no size, shape, or density sorting. Heavy equipment did not damage bones or stones except for a few during the initial discovery, and those modern breakage patterns are easily identified. Haynes (2016, 2017) offers no substantive evidence that sediment loading or heavy equipment broke proboscidean bone at the CM site, only his unsupported opinion. The totality of evidence from the CM site supports our claim that hominins broke the mastodon limb bones with hammerstones and anvils 130,000 years ago.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

Steven R. Holen is the Director of Research at the Center for American Paleolithic Research and a Research Associate with the San Diego Natural History Museum. His research area is the dispersal of humans into the Americas. He has 45 years of archaeological experience in the Great Plains including 30 years of excavating and researching mammoth and mastodon sites, several of which exhibit human modification of limb bone.

Thomas A. Deméré is the Joshua L. Baily, Jr. Curator of Paleontology and Director of PaleoServices at the San Diego Natural History Museum. His research interests include the anatomy and evolutionary history of marine mammals, the taphonomy of Cenozoic fossil assemblages, and the Pleistocene paleontology and geology of southern California.

Daniel C. Fisher is the Director of the Museum of Paleontology and the Claude W. Hibbard Collegiate Professor of Paleontology in the Department of Earth and Environmental Sciences at the University of Michigan. His current research addresses the paleobiology, taphonomy, and extinction of Pleistocene proboscideans, especially those of North America and the Siberian Arctic.

Richard Fullagar is a Professorial Research Fellow in the Centre for Archaeological Science, University of Wollongong, Australia. He has worked extensively in the Australia-PNG-Southeast Asia region, and studied the function of stone tools from many archaeological, ethnographic, and experimental contexts. He also developed methods of use-wear and residue analysis to study grinding/pounding stones—primarily to investigate early and later human use of particular plants, foods, bones, stone, and other resources.

James B. Paces is a Research Geologist at the U.S. Geological Survey Southwest Isotope Research Laboratory in Denver, Colorado. He has more than 25 years of experience measuring radiogenic isotopes of uranium and thorium in a wide variety of materials and specializes in their application to Quaternary geochronology using uranium-series disequilibrium methods.

George T. Jefferson is the retired California Associate State Archaeologist and Paleontologist Emeritus with the Stout Research Center, Anza-Borrego Desert State Park, California. His research interests have centered on Plio-Pleistocene vertebrate paleofaunas and taphonomy of the American southwest. He was head curator of the Rancho La Brea collections, and directed the paleontology program for California State Parks.

Jared M. Beeton is a Professor of Earth Science at Adams State University in Alamosa, Colorado. He studies soils and fluvial geomorphology with a focus on the effects of temporal and spatial patterns of landscape evolution on the preservation and visibility of the archaeological record.

Adam N. Rountrey is the Collection Manager for Fossil Vertebrates at the University of Michigan Museum of Paleontology. His research interests include proboscidean paleobiology and three-dimensional data acquisition, curation, and dissemination.

Kathleen A. Holen is founder and Administrative Director of the Center for American Paleolithic Research. Her research interests include non-lithic evidence of human agency at proboscidean sites, expedient tool use, cognitive archaeology, and dog domestication. She currently studies prey animal bone modification.

References

Deméré, T. A., R. A. Cerutti, and C. P. Majors. 1995. “State Route 54 Paleontological Mitigation Program: Final Report.” Unpublished technical report prepared by San Diego Natural History Museum for Caltrans, District 11, 51 pp.

Figgins, J. D. 1927. “The Antiquity of Man in America.” *Natural History* 27: 229–239.

Haynes, G. 2016. “Taphonomy of the Inglewood Mammoth (*Mammuthus columbi*) (Maryland, USA): Green-Bone Fracturing of Fossil Bones.” *Quaternary International* 445: 171–183.

Haynes, G. 2017. “The Cerutti Mastodon.” *PaleoAmerica* 3 (3): 196–199.

Holen, S. R., T. A. Deméré, D. C. Fisher, R. Fullagar, J. B. Paces, G. T. Jefferson, J. M. Beeton, et al. 2017. “A 130,000-Year-Old Archaeological Site in Southern California, USA.” *Nature* 544 (7651): 479–483.

Karr, L. P. 2015. “Human Use and Reuse of Megafaunal Bones in North America: Bone Fracture, Taphonomy, and Archaeological Interpretation.” *Quaternary International* 361: 332–341.

Lyman, R. L. 2002. “Taphonomic Agents and Taphonomic Signatures.” *American Antiquity* 67 (2): 361–365.

Meltzer, D. J. 2006. *Folsom: New Archaeological Investigations of a Classic Paleoindian Bison Kill*. Berkeley: University of California Press.

Millard, A. 2017. *Archaeometer Blog* website. Accessed September 11, 2017. http://archaeometer.blogspot.co.uk/2017/04/extraordinary-claims-require.html

Thomas, E. S. 1952. “The Orelton Farms Mastodon.” *The Ohio Journal of Science* 52 (1): 1–5.