

Mammoth Footprints from the Upper Pleistocene of the Tularosa Basin, Doña Ana County, New Mexico

*Spencer G. Lucas, Bruce D. Allen,
Gary S. Morgan, Robert G. Myers, David W. Love
and David Bustos*

Introduction and Background

Researchers conducted a study on footprints made by upper Pleistocene artiodactyls (camels) and proboscideans (mammoths) along the floor of the Tularosa Basin on the White Sands Missile Range. Footprints on the Alkali Flat in Doña Ana County were discovered as early as 1932; however, they were speculated to be those of a giant human. Further examination did not take place until a 1981 investigation of the footprints resulted in identification of the tracks as those of mammoth, camel, and an undetermined mammal. In 2002, researchers documented the tracksite noting that footprints were exposed over an area of about 75,000 m², which included 25 mammoth and 64 camel footprints. Since then, extensive mammoth trackways have been discovered on the southern shore of Lake Lucero in the White Sands National Monument. This report has the dual purpose of: presenting preliminary radiocarbon dating results that provide age estimates for the deposits associated with the footprints and documenting the newly discovered mammoth trackways.

Methods

Lucas et al. (2007) used three samples of plant fragments taken from the lower, track-bearing beds of the Tularosa Basin. They performed radiocarbon dating techniques to age the tracks, in combination with a review of the stratigraphic context. Two additional trackways were mapped from the Lake Lucero sites. The researchers examined the sediment and geological context and measured and recorded the track sizes. In addition, researchers used a formula factoring gravity, stride length, and shoulder height to determine the walking speed of the individual (Alexander, 1976).



Four mammoth tracks on the Alkali Flat.



PROJECT SUMMARY



Researcher examines tracks at Lake Lucero.

NPS photo/ M. Powell

Results

Age of the Tracks

The samples from the tracks yielded radiocarbon ages slightly greater than 31,000 carbon-14 years before present (¹⁴C yrs B.P.), although accuracy is uncertain due to possible contamination of the samples and other complications. Samples of ostracode valves, plant fragments, and charcoal from overlying deposits have yielded radiocarbon dates ranging from 22,800 to 19,430 ¹⁴C yrs B.P. These dates are comparable with chronologies for the onset of significantly wetter climatic conditions in adjacent lake basins during the last glacial maximum, when sea levels were lowest and glaciers were at their largest. The contextual information indicates that the tracks were made before this major episode and thus predate the arrival of humans in New Mexico (as documented by Clovis and Folsom sites at ~12,000 ¹⁴C yrs B.P.).

Tracksites

The tracks found in 2002 are mostly preserved in convex relief, although erosion of the soft gypsite matrix provides poor preservation for the tracks. There are also two tracksites on the Alkali Flat and, most recently discovered, extensive mammoth trackways on the southern shore of Lake Lucero. Hundreds of east-west-bearing mammoth tracks are present at these sites.



Mammoth track from Lake Lucero.

Lake Lucero Tracks

The tracks found at the Lake Lucero localities are ovoid to round gypsite casts that contrast with the sediment surrounding them. Upon being impressed in the moist gypsum silt and sand, the tracks compacted the underlying gypsum and provided a micro-environment for the growth of coarse gypsum crystals, so that they became more resistant to erosion than the surrounding sediments. Few separated toe imprints have been preserved; however, there is a wide range of variation in size and shape attributed to: 1) undertracks (usually smaller); 2) incomplete overstepping, where two tracks are nearly superimposed producing a single, relatively long and ovoid shape; 3) erosion; and 4) differential cementation and recrystallization of the tracks.

Trackmaker and Classification

Given the large size of these tracks, their late Pleistocene age, and the presence of mammoth body fossils in the Otero Formation, the tracks from the southern shore of Lake Lucero are certainly those of mammoths. The earliest name for proboscidean tracks, *Proboscipeda enigmatica*, was determined in 1962 from a trampled surface from the Miocene of Romania. The tracks were described as having an oval shape, pockmarked texture, specific dimensions, and mostly lacking toe imprints. Lucas et al. (2007) advocate the application of the footprint group name *Proboscipeda* to all Neogene tracks (those from 23 million years ago to the present) and diagnose the group as being very large, ovoid to circular depressions that may show digit impressions and in trackways, typically show overstepping. In another study, a second footprint group of *Proboscipeda*, *P. panfamilia*, was coined for Pleistocene tracks from western Canada. The smaller, ovoid tracks of *P. enigmatica* can be dis-

tinguished from the larger, circular tracks of *P. panfamilia*, and thus the proboscidean footprints from the Tularosa Basin were assigned to *P. panfamilia*.

Size and Gait

One of two trackways measured appeared to be made by a relatively small mammoth, likely a juvenile. The second is relatively narrow and has a stride length much less than those of modern Asian elephants. The soft, gypsiferous ground surface they walked on may have had an effect on their gait.

When analyzing the diameter of a mammoth foot, it should be considered that foot diameter based on bones is much smaller than the actual diameter of the foot with the fleshy pads (that all elephants have). Using the equation in the Methods to determine walking speed, one Lake Lucero mammoth was walking 5.51 ft/sec (~3.76 mi per hour), and a second was walking 6.39 ft/sec (~4.36 mi per hour); these are quick paces for an elephant.

Literature Cited

Lucas, S.G., B.D. Allen, G.S. Morgan, R.G. Myers, D.W. Love and D. Bustos. 2009. Mammoth footprints from the Upper Pleistocene of the Tularosa Basin, Dona Ana County, New Mexico. Pages 149-154 in S.G. Lucas, J.A. Spielmann, and M.G. Lockley, eds., *Cenozoic Vertebrate Tracks and Traces*. Albuquerque: New Mexico Museum of Natural History.

Contacts

Spencer G. Lucas, Curator of Paleontology, New Mexico Museum of Natural History and Science

1801 Mountain Road N.W., Albuquerque, NM 87 104
spencer.lucas@state.nm.us

<http://www.nmnaturalhistory.org/science/curators/spencerlucas.html>

David Bustos, Biologist, White Sands National Monument
P.O. Box 1086, Holloman AFB, NM 88330
david_bustos@nps.gov

www.nps.gov/whsa