



SCIENTIFIC ANNALS of the School of Geology,  
Aristotle University of Thessaloniki

**SPECIAL VOLUME 102**



## **ABSTRACT BOOK**

**Editors:**

**Dimitris S. KOSTOPOULOS, Evangelos VLACHOS, and Evangelia TSOUKALA**

**THESSALONIKI, MAY 2014**

## Climate forcing of mammoth range shifts in the countdown to extinction

Adrian M. LISTER ✉, and Anthony STUART

Reviews of megafaunal range changes and extinction have sometimes been hampered by uncritical harvesting of published and unpublished radiocarbon determinations. Here, a global database of some 2400 published and new radiocarbon dates on woolly mammoth (*Mammuthus primigenius*) has been audited, using objective criteria, to around 1900 'good' dates for northern Eurasia and North America. Criteria for exclusion include dates obtained on apatite, burnt bone or an aggregate of more than one specimen; incorrect or uncertain species identification; ambiguous locality; reported laboratory problems (e.g. low collagen or suspected contamination); date superseded using more recent purification or analytical methods; date obtained before 1980; and all associated site dates not directly on mammoth fossils (Lister & Stuart 2013).

Time-sliced maps show changes in woolly mammoth distribution across northern Eurasia and North America from 40 ka to extinction, in comparison with known climate change. The number of good dates in North America (excluding Alaska/Yukon) is relatively low, partly because species identification of dated remains (*M. primigenius/columbi/jeffersoni*) is not always clear.

The first possibly significant change in mammoth distribution within the range of radiocarbon dating is an apparent contraction in Siberia to the far north in the interval ca. 35-32 ka (all dates calibrated), which may explain an observed loss of genetic diversity around this time (Palkopoulou et al. 2013). Mammoth distribution then re-expands, but the species vacates western and central Europe entirely for the interval 21.5-19.5 ka, in the middle of GS-2 and corresponding to the maximum extent of the European ice sheet. The range expands again in late GS-2, but in the Bølling warming (14.6-13.9 ka) both the European and Siberian ranges become restricted and possibly disjunct. Re-dating of key specimens now suggests that with the afforestation of the Allerød (13.9-12.8 ka), Europe and western Siberia were completely vacated by mammoths; this corresponds closely in time with the global extinction of woolly rhino (*Coelodonta antiquitatis*) and cave lion (*Panthera spelaea*) (Stuart & Lister 2011, 2012). The Younger Dryas (GS-1, 12.8-11.7 ka) saw North American woolly mammoth extinct, and Eurasian populations restricted to northernmost Siberia with a short-lived re-invasion of north-east Europe. By 11 ka (within the earliest Holocene), mammoth was extinct in mainland Eurasia. Terminal island populations

in the Beringian region expired on St Paul (Pribilof Islands) around 6.5 ka and Wrangel Island around 4ka.

The major shifts in mammoth range after 40 ka correspond to climatic and vegetational events, suggesting these as the main driving force. Although distributional gaps are hard to deduce from fossil data, the terminal distribution of *M. primigenius* is consistent with severe range reduction, and probably fragmentation. Human impact on these fragmented, climatically-stressed populations cannot be ruled out as a contributing factor to extinction, but direct evidence of mammoth hunting is limited, especially in the far northern 'refugial' areas, and the significance of celebrated mammoth-bone assemblages is unclear. Thus, Yana River (ca. 32ka) is anthropogenic but too early to be directly relevant to extinction; Berelekh (ca. 12 ka) is fluvially-accumulated and may largely precede local human reoccupation (Pitulko & Nikolskiy 2012). Thus far there is no clear evidence for human occupation of either St Paul or Wrangel Island until after the extinction of their respective mammoth populations.

### References

- Lister, A.M. & Stuart, A.J. 2013. Extinction chronology of the woolly rhinoceros *Coelodonta antiquitatis*: reply to Kuzmin. *Quaternary Science Reviews* 62, 144-146.
- Palkopoulou, E., Dalén, L., Lister, A.M., Vartanyan, S., Sablin, M., Sher, A., Nyström Edmark, V., Brandström, M.D., Germonpré, M., Barnes, I., Thomas, J.A. 2013. Holarctic genetic structure and range dynamics in the woolly mammoth. *Proceedings of the Royal Society B: Biological Sciences* 2013 280, 20131910.
- Pitulko, V.V. & Nikolskiy, P.A. 2012. The extinction of the woolly mammoth and the archaeological record in Northeastern Asia. *World Archaeology* 44, 21-42.
- Stuart, A.J. & Lister, A.M. 2011. Extinction chronology of the cave lion, *Panthera spelaea*. *Quaternary Science Reviews* 30, 2329-2340.
- Stuart, A.J. & Lister, A.M. 2012. Extinction chronology of the woolly rhinoceros *Coelodonta antiquitatis* in the context of Late Quaternary megafaunal extinctions in Northern Eurasia. *Quaternary Science Reviews* 51, 1-17.

✉ a.lister@nhm.ac.uk



#### Citation:

Lister, A., Stuart, A., 2014. Climate forcing of mammoth range shifts in the countdown to extinction. Abstract Book of the VI<sup>th</sup> International Conference on Mammoths and their Relatives. S.A.S.G., Special Volume 102: 109.