



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**

## Holarctic genetic structure and range dynamics in the woolly mammoth

Eleftheria PALKOPOULOU ✉, Love DALEN, Adrian M. LISTER, Sergey VARTANYAN,  
Mikhail SABLIN, Andrei SHER, Veronica NYSTRÖM EDMARK, Mikael D. BRANDSTRÖM,  
Mietje GERMONPRE, Ian BARNES, and Jessica A. THOMAS

The woolly mammoth is not only the most iconic Ice Age species but also one of the best candidates for genetic and genomic studies given the abundance of permafrost fossil material. Being widespread and abundant during the late Pleistocene, it disappeared from most of its geographical range at ca. 11,000 years before present (BP; Lister and Stuart, 2008) and finally became extinct at ca. 3,500 years BP on Wrangel Island (Vartanyan et al., 1993).

Using mitochondrial DNA (mtDNA) variation from the species' holarctic distribution over the last 200,000 years, we revealed a complex history of demographic changes, range expansions and genetic turnovers (Palkopoulou et al., 2013). In particular, we found that Europe was inhabited by a previously undocumented major mtDNA lineage up to ca. 34,000 years BP when it was replaced by another major mtDNA lineage. Moreover, we recovered genetic signals of population expansions at ca. 121,000 years BP, close to the time when the previous interglacial period, the Eemian, came to an end. Our data further support a following demographic expansion at ca. 66,000 years BP that led to the colonization of Eurasia by the North American mtDNA lineage. This event appears to coincide with the first time that the Bering Land Bridge became exposed since the penultimate glacial period (Hu et al., 2010). Levels of genetic variation through time depict a dramatic drop in effective population size towards the end of the last Ice Age. These findings suggest that climate induced environmental changes, such as warm periods and sea-level changes could have been instrumental in shaping the demographic history of the woolly mammoth. The role of climate on the woolly mammoth's final extinction still remains under debate (Lorenzen et al., 2011; MacDonald et al., 2012); however, our results indicate that climatic changes could have contributed to the disappearance of the species from most of its distribution. Genomic data from the last surviving population are anticipated to help us resolve the mystery of the woolly mammoth's final extinction.

### References

- Hu, A., Meehl, G.A., Otto-Bliesner, B.L., Waelbroeck, C., Han, W., Loutre, M.-F., Lambeck, K., Mitrovica, J.X., Rosenbloom, N., 2010. Influence of Bering Strait flow and North Atlantic circulation on glacial sea-level changes. *Nature Geoscience* 3, 118-121.
- Lister, A.M., Stuart, A.J., 2008. The impact of climate change on large mammal distribution and extinction: evidence from the last glacial/interglacial transition. *Comptes Rendus Geosciences* 340, 615.
- Lorenzen, E.D., Nogues-Bravo, D., Orlando, L., Weinstock, J., Binladen, J., Marske, K.A., Ugan, A., Borregaard, M.K., Gilbert, M.T.P., Nielsen, R., Ho, S.Y.W., Goebel, T., Graf, K.E., Byers, D., Stenderup, J.T., Rasmussen, M., Campos, P.F., Leonard, J.A., Koepfli, K.-P., Froese, D., Zazula, G., Stafford, T.W., Aaris-Sorensen, K., Batra, P., Haywood, A.M., Singarayer, J.S., Valdes, P.J., Boeskorov, G., Burns, J.A., Davydov, S.P., Haile, J., Jenkins, D.L., Kosintsev, P., Kuznetsova, T., Lai, X., Martin, L.D., McDonald, H.G., Mol, D., Meldgaard, M., Munch, K., Stephan, E., Sablin, M., Sommer, R.S., Sipko, T., Scott, E., Suchard, M.A., Tikhonov, A., Willerslev, R., Wayne, R.K., Cooper, A., Hofreiter, M., Sher, A., Shapiro, B., Rahbek, C., Willerslev, E., 2011. Species-specific responses of Late Quaternary megafauna to climate and humans. *Nature* 479, 359-364.
- MacDonald, G.M., Beilman, D.W., Kuzmin, Y.V., Orlova, L.A., Kremenetski, K.V., Shapiro, B., Wayne, R.K., Van Valkenburgh, B., 2012. Pattern of extinction of the woolly mammoth in Beringia. *Nat Commun* 3, 893.
- Palkopoulou, E., Dalén, L., Lister, A.M., Vartanyan, S., Sablin, M., Sher, A., Edmark, V.N., 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* 280.
- Vartanyan, S.L., Garutt, V.E., Sher, A.V., 1993. Holocene dwarf mammoths from Wrangel Island in the Siberian Arctic. *Nature* 362, 337-340.

✉ [eleftheria.palkopoulou@nrm.se](mailto:eleftheria.palkopoulou@nrm.se)



#### Citation:

Palkopoulou, E., Dalen, L., Lister, A., Vartanyan, S., Sablin, M., Sher, A., Nyström Edmark, V., Brandström, M., Germonpre, M., Barnes, I., Thomas, J., 2014. Holarctic genetic structure and range dynamics in the woolly mammoth. Abstract Book of the VI<sup>th</sup> International Conference on Mammoths and their Relatives. S.A.S.G., Special Volume 102: 149.