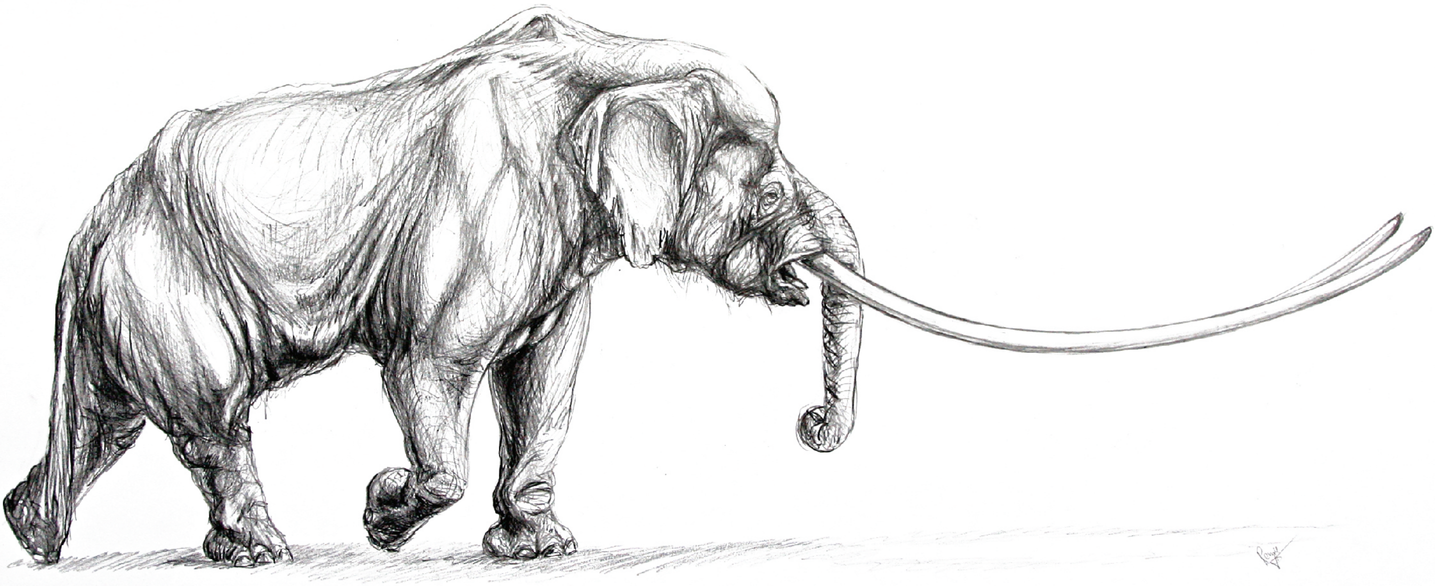
SCIENTIFIC ANNALS of the School of Geology, Aristotle University of Thessaloniki

SPECIAL VOLUME 102



VIth International Conference on Mammoths and their Relatives

GREVENA
SIATISTA
GREECE 2014

ABSTRACT BOOK

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THESSALONIKI, MAY 2014

Scientific Annals, School of Geology, Aristotle University of Thessaloniki, Greece
VI[th] International Conference on Mammoths and their Relatives, Grevena - Siatista
Special Volume 102 55-56 Thessaloniki, 2014

3D models of proboscidean osteology

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Many studies that are essential for our understanding of both evolutionary and paleoecological problems require detailed considerations of skeletal and dental anatomy, taphonomically relevant aspects of site structure, or postmortem modifications of skeletal elements. Such investigations are fundamentally three-dimensional (3D), and we have always struggled to represent critical spatial and configurational relationships in two- dimensional (2D) media. Relatively successful examples drawn from current literature offer a sufficient number of 2D views to convey significant aspects of 3D form (e.g., Göhlich, 1998), but subtle features that show up in only certain views are inevitably under- represented. For mammutids in particular, the most widely cited reference on osteology (Olson, 1972) is not a comprehensive treatment of the skeleton, nor is it entirely consistent and accurate in its labeling. Fortunately, new developments in digital technology have begun to allow us to work and communicate in ways that more nearly approximate the 3D experience of interacting directly with specimens. In cases where demand is sufficient (e.g., human osteology), commercial software has been developed to allow 3D exploration of skeletal anatomy (<http://www.anatronica.com/anatomy-data/skeletal-system-full.html>). To bring these capabilities to studies of proboscidean evolution and paleoecology, we are developing a growing "library" of 3D models of proboscidean osteology and odontology. As a step toward wider use of 3D data, we have developed a complete, articulated, 3D model of an adult male American mastodon (*Mammut americanum*) skeleton (Fig. 1), based principally on a single individual from a late Pleistocene site in northeast Indiana, USA. This model and all its component elements are part of a larger digital resource on proboscidean osteology. Separate skeletal and dental elements of this individual, plus others that are regularly being added, were digitized using several techniques – a point digitizer, a laser scanning digitizer, x-ray computed tomography, and photogrammetry – to capture data on form. While surface models suffice for many purposes, model information content can be significantly enhanced

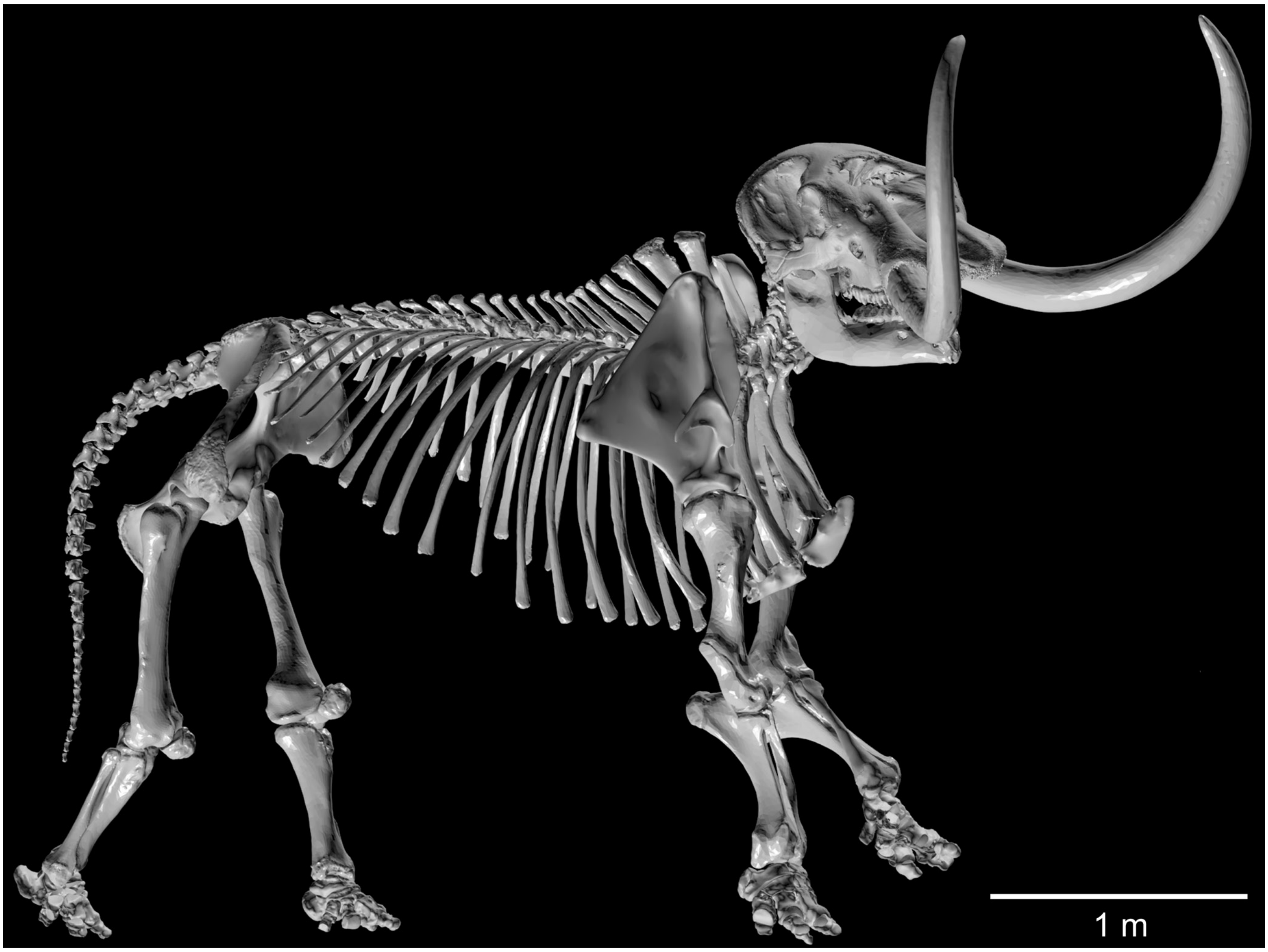

Fig. 1. 3D digital skeleton of the Buesching mastodon, an adult male American mastodon (*Mammut americanum*) excavated near Fort Wayne, Indiana, USA; model articulation based on a mounted cast of the skeleton at the University of Michigan.

through image-based texture mapping. We created texture-mapped models using specialized software (3DSOM Pro, recently upgraded to BOB Capture; <https://bobcapture.bigobjectbase.com/3dsom>) that allowed us to map multiple overlapping images of a skeletal element onto a corresponding surface model. The resulting models are photorealistic and can also be made available through an online interface that allows users to freely rotate, pan, and zoom, exploring morphology as one would with access to a comprehensive comparative collection. Our articulated model skeleton will be used in development of a graphical user interface for selecting individual bones for detailed viewing, supporting both comparative studies and precise identifications of material recovered at additional sites. Bone models, texture-mapped or not, have been articulated to portray anatomical configurations on scales ranging from pair-wise articular relationships to the proportions of entire skeletons. The digital format of models makes it easy to invert symmetry, compute stereo pairs, generate virtual sections, compile animations, or support 3D printing at real or transformed scales. Bone models have also been placed in a 3D reference frame to build an interactive digital replica of site structure. Implementation of an online repository for models of proboscidean osteology is a step in development of tools for digitally mapping sites as they are being excavated. Our models are currently being re-exported from the former 3DSOM standard format, dependent on FlashPlayer, to a more secure and flexible WebGL format. Surface models can also be exported as "live" (i.e., rotatable, zoomable) 3D pdfs, of which an example is available at <http://www.lsa.umich.edu/paleontology/research/danielfisher> (our WebGL models will also be accessible from this location). Future expansion of this project will continue to incorporate scans of additional specimens and taxa, leading to a range of research and educational applications within both academic and museum settings.

References

Göhlich, U.B. 1998. Elephantoidea (Proboscidea, Mammalia) aus dem Mittel- und Obermiozän der Oberen Süddeutschlands: Odontologie und Osteologie. Münchner Geowissenschaftliche Abhandlungen, Reihe A, Geologie und Paläontologie 36, 1– 245.

Olson, S.J. 1972. Osteology for the archaeologist: The American mastodon and the woolly mammoth. Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University 56 (3), 1–47.

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Citation:
Fisher, D., El Adli, J., Cherney, M., Rountrey, A., 2014. 3D models of proboscidean osteology. Abstract Book of the VIth International Conference on Mammoths and their Relatives. S.A.S.G., Special Volume 102: 55-56.