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Special Issue: THREE-DIMENSIONAL IMAGING IN VERTEBRATE PALEONTOLOGY

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A great deal of paleontology is about shape — through the shape of fossils we interpret paleoecology, phylogeny and function of extinct organisms. However, the majority of paleontological work over the last century has neglected any quantification of full three-dimensional (3D) shape, and therefore has not considered full biological complexity. However, we are on the brink of a significant change: the world is now entering the 3D age, and it is important for the advancement and public image of paleontology to be a part of this revolution.

To bring this into focus, we convened the "3D Imaging: New Techniques and Applications Symposium" at the Annual Meeting of the Society of Vertebrate Paleontology in Ottawa, Canada, on October 20, 2006. This special issue of *Palaeontologia Electronica* showcases some of the presentations made during that Symposium, illustrating the multitude of ways in which 3D imaging is becoming part of modern paleontology.

In the first paper of this issue, Claeson et al. (2008) show the great advantages of 3D imaging where traditional observational description is not possible. It had previously been unfeasible to describe the fine details of the minute catfish *Sarcoglandis simplex*, but microCT has allowed them to resolve several predictions of the internal skeletal morphology.

The next two papers look at advances in methodologies for dealing with 3D data. Boyd and Motani (2008) test the validity of reconstructing fragmented fossils by 'puzzle piecing' according to the criterion of symmetry. They find that symmetry is not a sufficient condition for assessing the puzzle piecing method. In search for the ability to compare complex 3D shapes, Polly and MacLeod (2008) demonstrate the new method of 'eigensurface analysis', which uses geometric morphometrics on a grid of surface points to allow shape modelling and comparisons. The eigensurface method is applied to calcaneum shape of modern carnivorans, allowing the inference of stance and locomotor style for fossil carnivorans.

One of the great powers of 3D imaging is to be able to visualize relationships between interacting complex morphologies. This promise is achieved in the next two papers. Rybczynski et al. (2008) investigate the pleurokinetic hypothesis for chewing in the hadrosaur *Edmontosaurus* and find that extensive secondary movements at intercranial joints would be necessary for this mode of chewing. Evans and Fortelius (2008) reconstruct possible jaw movements and tooth contacts in a range of carnivorans. The modelling revealed that tooth movements are consistent with facet development on teeth, validating the common methods used for reconstructing chewing movements in fossil mammals.

The final paper shows the next phase of morphology with interactive online databases of 3D data. Smith and Strait (2008) demonstrate the online database PaleoView3D, as well as the steps required to scan and standardize the specimen to be entered into the database.

It is our hope that this small sample of the cutting-edge research into 3D imaging and visualisation in paleontology will inspire current and future generations of paleontologists to explore the realms of 3D imaging and go beyond the second dimension.

Strait, Suzanne G. and Evans, Alistair R, 2008. Special Issue: Three-Dimensional Imaging in Vertebrate Paleontology. *Palaeontologia Electronica* Vol. 11, Issue 2; 6E:2p;
http://palaeo-electronica.org/paleo/2008_2/commentary/intro.htm

REFERENCES

Boyd, A.A., and Motani, R. 2008. Three-dimensional re-evaluation of the deformation removal technique based on "jigsaw puzzling." *Palaeontologia Electronica*, 11.2.7A. http://palaeo-electronica.org/2008_2/131/index.html

Claeson, K.M., Hagadorn, J.W., Luckenbill, K., and Lundberg, J.G. 2008. Anatomy of the very tiny: first description of the head skeleton of the rare South American catfish *Sarcoglanis simplex* (Siluriformes: Trichomycteridae). *Palaeontologia Electronica*, 11.2.6A. http://palaeo-electronica.org/2008_2/130/index.html

Evans, A.R., and Fortelius, M. 2008. Three-dimensional reconstruction of tooth relationships during carnivoran chewing. *Palaeontologia Electronica*, 11.2.10A. http://palaeo-electronica.org/2008_2/133/index.html

Polly, P.D., and MacLeon, N. 2008. Locomotion in fossil Carnivora: an application of eigensurface analysis for morphometric comparison of 3D surfaces. *Palaeontologia Electronica*, 11.2.8A. http://palaeo-electronica.org/2008_2/135/index.html

Rybczynski, N., Tirabasso, A., Bloskie, P., Cutherbertson, R., and Holliday, C. 2008. A three-dimensional animation model of *Edmontosaurus* (Hadrosauridae) for testing chewing hypotheses. *Palaeontologia Electronica*, 11.2.9A. http://palaeo-electronica.org/2008_2/132/index.html

Smith, N.E., and Strait, S.G. 2008. PaleoView3D: from specimen to online digital model. *Palaeontologia Electronica*, 11.2.11A. http://palaeo-electronica.org/2008_2/134/index.html