

3D models related to the publication: Evolution of the sauropterygian labyrinth with increasingly pelagic lifestyles

Neenan, James M.^{1*}, Reich, Tobias², Evers, Serjoscha W.³, Druckenmiller, Patrick, S.⁴, Voeten, Dennis F. A. E.^{5,6}, Choiniere, Jonah N.⁸, Barrett, Paul M.^{7,8}, Pierce, Stephanie E.⁹, Benson, Roger B. J.^{3,8}

¹Oxford University Museum of Natural History, Parks Road, Oxford, OX1 3PW, UK

²University of Zurich, Department of Paleontology and Paleontological Museum, Zurich, Switzerland

³Department of Earth Sciences, University of Oxford, South Parks Road, Oxford, OX1 3AN, UK

⁴University of Alaska Museum and Department of Geology and Geophysics, University of Alaska Fairbanks, 907 Yukon Dr, Fairbanks, AK 99775, USA

⁵European Synchrotron Radiation Facility, 71 Avenue des Martyrs, 38000, Grenoble, France

⁶Department of Zoology and Laboratory of Ornithology, Palacký University, 17. listopadu 50, 771 46 Olomouc, Czech Republic

⁷Department of Earth Sciences, Natural History Museum, Cromwell Road, London SW7 5BD, UK

⁸School of Geosciences and Evolutionary Studies Institute, University of the Witwatersrand, 1 Jan Smuts Ave, Braamfontein 2000, Johannesburg, South Africa

⁹Museum of Comparative Zoology and Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, Massachusetts, USA

*Corresponding author: james.m.neenan@gmail.com

Abstract

The present 3D Dataset contains the 3D models analyzed in "Neenan, J. M., Reich, T., Evers, S., Druckenmiller, P. S., Voeten, D. F. A. E., Choiniere, J. N., Barrett, P. M., Pierce, S. E. and Benson, R. B. J. Evolution of the sauropterygian labyrinth with increasingly pelagic lifestyles. *Current Biology*, 27." <https://doi.org/10.1016/j.cub.2017.10.069>

Keywords: ecomorphology, endosseous labyrinth, geometric morphometrics, palaeoecology, semicircular canals

Submitted:2017-11-22, published online:2017-07-12. <https://doi.org/10.18563/journal.m3.62>

INTRODUCTION

We present endosseous labyrinth surface models of nine sauropterygian marine reptiles (Fig. 1A-I and table 1), the extant marine iguana (*Amblyrhynchus cristatus*, Fig. 1J), and three turtles (Fig. 1K-M). These models were created in order to study how labyrinth shape and relative size change with increasingly aquatic habitats (Neenan et al. 2017). Sauropterygian semicircular canals underwent major changes during the transition from nearshore to pelagic lifestyle. Triassic, nearshore sauropterygians (i.e. *Placodus*, *Nothosaurus*, *Simosaurus*) have dorsoventrally compact but anteroposteriorly elongate labyrinths, resembling those of living and extinct crocodylians. In contrast, pelagic plesiosaurs have compact, bulbous labyrinths, and bear some resemblance to sea turtles. In addition, sauropterygian relative labyrinth size corresponds to locomotory differences: bottom-walking placodonts have relatively larger labyrinths than more actively swimming taxa (i.e. all other sauropterygians). Furthermore, independent radiations of short-necked, large-headed "pliosauro-morph" plesiosaurs are associated with reductions of labyrinth size, paralleling the evolutionary history of cetaceans. Sauropterygian labyrinth evolution is therefore correlated closely with both locomotory style and body proportions, and these changes are consistent with isolated observations made previously in other

marine tetrapods. This study presents the first digital reconstructions of plesiosaur endosseous labyrinths and the first large-scale, quantitative study on the effects of increasingly aquatic lifestyles on labyrinth morphology among marine reptiles.

METHODS

The 3D surfaces were created by manual segmentation in Mimics 18 (Materialise). The 3D surface models are provided in .ply format, and can therefore be opened with a wide range of freeware.

ACKNOWLEDGEMENTS

Our sincere thanks go to the numerous curators, technicians and others who made specimen access and scanning possible (see Neenan et al. 2017). This research was primarily funded by Swiss National Science Foundation (SNSF) grant P2ZHP3_162102 awarded to JMN. TR is funded by SNSF grant 31003A_173173, and JNC is funded by the National Research Foundation of South Africa's African Origins Platform (grant 98800) and the DST/NRF Centre of Excellence in Palaeosciences (grant OP2015/11JC).

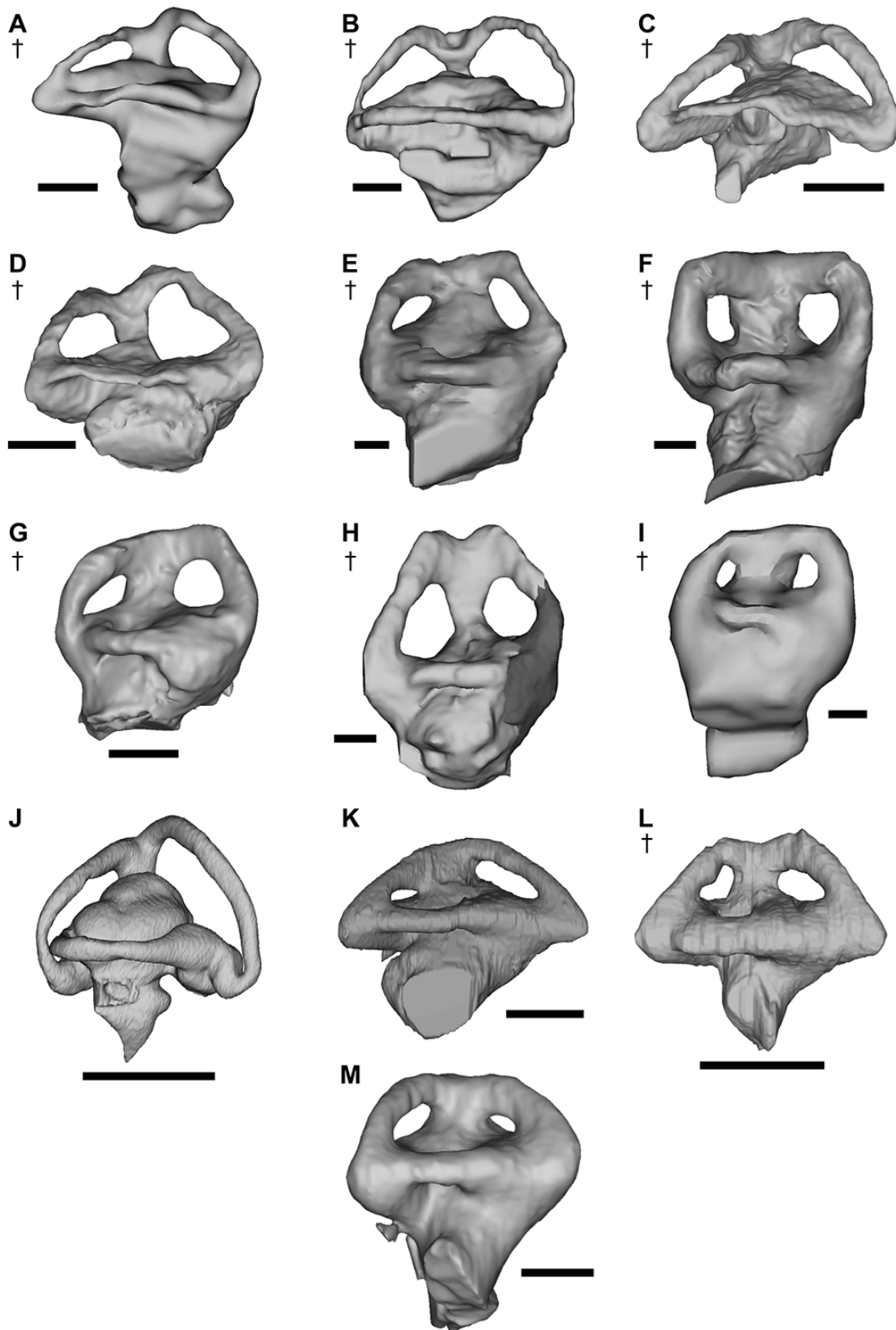


Figure 1. Right endosseous labyrinth models in lateral view. A, *Placodus gigas* (UMO BT 13); B, *Simosaurus gaillardoti* (GPIT/RE/09313); C, *Nothosaurus* sp. (NME 16/4); D, *Augustasaurus hagdorni* (FMNH PR 1974); E, *Macroplata tenuiceps* (reflected; NHMUK R5488); F, *Peloneustes philarchus* (reflected; NHMUK R3803); G, *Microcleidus homalospondylus* (NHMUK 36184); H, *Callawayasaurus colombiensis* (light region reflected from UCMP V-38349, dark region from right prootic of UCMP V-125328); I, *Libonectes morgani* (SMUSMP 69120); J, *Amblyrhynchus cristatus* (OUMNH 11616); K, *Macrochelys temminckii* (reflected; FMNH 22111); L, *Puppigerus camperi* (reflected; NHMUK R 38955); M, *Lepidochelys olivacea* (reflected; SMNS 11070). † denotes extinct taxa. Scale bars = 5 mm.

Model IDs	Taxon	Description	Collection
OUMNH11616	<i>Amblyrhynchus cristatus</i>	Right labyrinth	OUMNH, Oxford, UK
FMNHPR1974	<i>Augustasaurus hagdorni</i>	Right labyrinth	FMNH, Chicago, USA
UCMPV-38349/UCMPV-125328	<i>Callawayasaurus colombiensis</i>	Left labyrinth*	UCMP, Berkeley, USA
SMNS11070	<i>Lepidochelys olivacea</i>	Left labyrinth	SMNH, Stuttgart, Germany
FMNH22111	<i>Macrochelys temminckii</i>	Left labyrinth	FMNH, Chicago, USA
NHMUKR5488	<i>Macroplata tenuiceps</i>	left labyrinth	NHM, London
NHMUK36184	<i>Microcleidus homalospondylus</i>	Right labyrinth	NHM, London
NME16/4	<i>Nothosaurus sp.</i>	Right labyrinth	NME, Erfurt, Germany
NHMUKR3803	<i>Peloneustes philarchus</i>	Left labyrinth	NHM, London
UMOBT13	<i>Placodus gigas</i>	Right labyrinth	UMO, Bayreuth, Germany
NHMUKR38955	<i>Puppigerus camperi</i>	Left labyrinth	NHM, London
GPITRE/09313	<i>Simosaurus gaillardoti</i>	Right labyrinth	GPIT, Tübingen, Germany
SMUSMP69120	<i>Libonectes morgani</i>	Right labyrinth	SMP, Dallas, USA

Table 1. List of specimens. *: the majority of the model is from the holotype (UCMP V-38349), but the anterior portion is formed from the right labyrinth (reflected) from the paratype (UCMP V-125328).

BIBLIOGRAPHY

Neenan, J. M., Reich, T., Evers, S., Druckenmiller, P. S., Voeten, D. F. A. E., Choiniere, J. N., Barrett, P. M., Pierce, S. E. and Benson, R. B. J. Evolution of the sauropterygian labyrinth with increasingly pelagic lifestyles. *Current Biology*, 27. <https://doi.org/10.1016/j.cub.2017.10.069>