



PRESS RELEASE

Natural History Museum Stuttgart

Paleontologists reconstruct and study sensory organs of prehistoric reptiles using computed tomography.

Study provides new insights into the significance of shape and size of the balance organs in the inner ear of archosaurs for the biology of the animals. This reptile group includes dinosaurs, birds, pterosaurs and crocodiles.

Stuttgart, 21.05.2021. In a recent scientific article, an international team of researchers, with participation of paleontologist Dr. Gabriela Sobral of the Natural History Museum of Stuttgart, has studied the structure of the balance organs of the inner ear using fossils of a reptile group called "Archosauria." The team analyzed the shape and size of the semicircular canals of living and extinct archosaurs with different locomotion habits to test whether their ecology could be inferred from the balance organ. Semicircular canals serve as a kind of gyroscopic stabilizer that helps our brains know where up is and where is down, helping keep our bodies in balance. The semicircular canals are part of a sensory system that coordinates the movements of the eyes and neck. They also help stabilize the visual image on our retina.

In their work, scientists were unable to confirm, on the one hand, previously assumed correlations between the shape and size of the semicircular canals and the animals' way of life, such as their ability to fly. On the other hand, the differences in the sensory systems found in fossils show that the archosaurs living today, crocodiles and birds, represent only a limited subset of a greater diversity of sensory organs that already existed in the oldest relatives of birds and crocodiles more than 240 million years ago.

The results of the study have now been published in the journal "Current Biology". Scientists from the University São Paulo, Oxford University, and University of the Witwatersrand in South Africa and other institutes and universities in Brazil, Argentina, Great Britain, Switzerland, Germany and the USA participated in the research work.

New technical possibilities enable the study of sensory organs

Over the course of Earth's history, archosaurs achieved incredible ecological diversity, conquering habitats in the air, on land and in the water. The resulting diversity in locomotion is relatively well understood through the study of the body anatomy. "The changes in the sensory systems that facilitate locomotion, however, have received little attention. CT scans of fossil skulls allowed us to study and reconstruct the semicircular canals of many prehistoric reptiles, for which we used 3D digital models. We did not expect to find such a great diversity in the inner ear of the early members of the archosaur group", said Dr. Gabriela Sobral of the Natural History Museum in Stuttgart.



The rich evolutionary history of archosaurs is documented by numerous fossils found in natural history collections around the world. Among them are some famous extinct groups of animals such as (non-avian) dinosaurs, pterosaurs, and many different species of crocodile relatives, among them completely terrestrial and completely marine animals. Living archosaurs include birds and crocodiles. The oldest fossils studied by scientists were 250 million years old.

Looking into the past helps to better understand today's animals

Until now, it was suspected to exist a correlation between the shape and size of the semicircular canals and the way different species moved. As a result, the semicircular canals have been used in many paleontological studies as an important clue to infer the habits of extinct animals. Unfortunately, the research team was unable to prove this correlation in their study. Paleontologists now suspect that the differences in the canals are due to other specializations, such as extremely good eyesight, and general cranial anatomy.

The large semicircular canals seen in birds, for example, have historically been interpreted as an adaptation for flight. However, pterosaurs, extinct flying reptiles, have semicircular canals that are smaller than those of many other non-flying archosaur species. This is an indication that large canals are not required for flight. Interestingly, the largest sensory ducts found are present in some of the non-bird dinosaurs and in birds with specialized vision. Therefore, it is likely that larger semicircular canals are important for increased visual acuity, which helps animals hunt prey, for example.

Insights into the lifestyle of prehistoric reptiles

“The lack of a link between inner ear shape and animal locomotion, which we initially assumed, is unfortunate for us paleontologists trying to assess the biology of extinct animals. Nevertheless, the possible association of shape and size of the semicircular canals with the visual acuity of archosaurs, may offer us very interesting tools to explore in the future. It was very exciting to be part of this project”, said Dr. Gabriela Sobral.

For the study, which involved numerous scientists, examination of fossil data from many parts of the world were brought together and analyzed. Among them were objects from the paleontological collection of the Natural History Museum in Stuttgart, such as the skull of the 210-million-year-old dinosaur *Plateosaurus*. The extensive cooperation allowed the researchers to build up a very large data set for their studies of semicircular canal morphology.

For the editors

Original publication:

Bronzati, Benson and coauthors': 'Deep evolutionary diversification of semicircular canals in archosaurs', Current Biology, publication date: 4/29/2021.

<https://www.sciencedirect.com/science/article/abs/pii/S0960982221004590>

DOI: <https://doi.org/10.1016/j.cub.2021.03.086>



Contact:

Dr. Gabriela Sobral
State Museum of Natural History Stuttgart, Germany
Tel. ++49/(0)711/89 36/170
E-mail: gabriela.sobral@smns-bw.de
www.naturkundemuseum-bw.de

Press contact:

Meike Rech
State Museum of Natural History Stuttgart, Germany
Phone ++49/(0)711/8936/107
E-mail: meike.rech@smns-bw.de

Tobias Wilhelm
State Museum of Natural History Stuttgart, Germany
Phone ++49/(0)711/8936/104
E-mail: tobias.wilhelm@smns-bw.de

Image material:

Image 1:



Bild1_Image1_Illustration_of_various_animals.jpg

Description: Illustration of different animals that were analysed in this study, and their respective semicircular canals.

Creator of photo/illustration: Viktor Radermacher

Copyright: Bronzati, Benson and co-authors' (CC-BY)

Image 2:



Bild2_Image2_Phylogenetic_tree_semicircular_canals.jpg

Description: Overview of the semicircular canals analysed in the study depicted in a phylogenetic tree showing the relationships between the groups studied.

Creator of photo/illustration: Rodolfo Nogueira

Copyright: Bronzati, Benson and co-authors' (CC-BY)



Image 3:



Bild3_Image3_Skulls_semicircular_canals.jpg

Description: Part of the skull that contained the semicircular canals of a lagerpetid, a relative of the pterosaurs, 235 Million years old. Semicircular canals are not in scale.

Creator of photo: Rodolfo Nogueira

Copyright: Bronzati, Benson and co-authors' (CC-BY)

Image 4:



Bild4_Image4_Skulls_with_semicircular_canals.jpg

Description: Skulls with the semicircular canals in their original position within it.

Creator of photo: Rodolfo Nogueira

Copyright: Bronzati, Benson and co-authors' (CC-BY)

Image 5:



Bild5_Image5_Skull_plateosaur.jpg

Description: Skull of a 210 million year old plateosaur from the collection of the State Museum of Natural History Stuttgart.

Creator of photo: Tobias Wilhelm

Copyright: SMNS, Tobias Wilhelm

Image 6:



Bild6_Image6_Paleontologist_Gabriela_Sobral.jpg

Description: Paleontologist Dr. Gabriela Sobral in front of a model of a plateosaur at the Stuttgart Museum of Natural History. The scientist was part of the international team of researchers who conducted the study on archosaurs.

Creator of photo: Tobias Wilhelm

Copyright: SMNS, Tobias Wilhelm

Image 7:



Bild7_Image7_Reconstructions_semicircular_canals.jpg

Description: Semicircular canals of: bird, caiman, pterosaur, and an arboreal extinct animal.

Creator of photo: Rodolfo Nogueira

Copyright: Bronzati, Benson and co-authors' (CC-BY)



Use of the image material is permitted with copyright notice in connection with the study described.

Download image material:

www.naturkundemuseum-bw.de/presse

Video "Evolution of the sensory systems in archosaurs".

<https://www.youtube.com/watch?v=J6FkxKw5vE>

All contributing authors and institutions can be found at:

<https://www.sciencedirect.com/science/article/abs/pii/S0960982221004590>