

EDITORIAL

This supplement of the *Journal of Morphology* presents over 750 abstracts of contributions to the 12th International Congress of Vertebrate Morphology, held July 21 – 25, 2019 in Prague, Czech Republic. The *Journal of Morphology* and the International Congress of Vertebrate Morphology have a long and fruitful relationship, supporting and promoting animal morphology – the roots of that relationship date back to 1983, when Carl Gans, at that time editor of the *Journal of Morphology*, promoted establishing the first Congress of Vertebrate Morphology in Giessen, Germany. We are proud and delighted to continue this relationship now using modern online publishing tools, allowing free access to all those enthusiastic about morphology.

Morphology as science is as diverse as life is and the topics of the conference range from macroscopic studies to ultrastructure, and from experimental research in functional morphology to comparative studies exploring the historical perspectives conserved in fossils. Morphology indeed provides two kinds of explanations in biology, functional explanations based on experiments, and historical / evolutionary explanations based on comparative studies. The diversity of topics and explanations provided are integrated by the simple fact that morphology is central to all biological science because it analyzes the structures that ultimately carry the functions of life. The diversity of topics is orchestrated by a breathtaking array of methods. This year's conference, in particular, witnesses a surge of microCT-scanning, 3D-reconstruction and 3D-morphometrics as a means for understanding complex morphologies. Technological advances in non-destructive imaging methods, such as microCT, have been and are undoubtedly beneficial for the field of

morphology. The challenge is not to ignore the limited resolution that microCT offers for small vertebrates, hence potential data loss, nor to neglect the time-consuming, yet rewarding contemplative observations associated to low throughput systems.

From the first conference in 1983 on, the aim of the congress has been to provide a platform for presentation, discussion and exchange of research on vertebrate morphology for the community of morphologists. Over the 36 years of its existence, the congress has continuously grown, from about 300 participants to now over 800 forecasted for the meeting in Prague. The topics cover all aspects of vertebrate morphology, presented in no less than 20 symposia, around 350 contributed talks and close to 200 posters. For delegates from more than 35 countries, ICVM-12 offers the appropriate setting to share knowledge, interpretations and ideas in an informal and stimulating environment. Achieving this aim is central to ISVM's goal of promoting international collaboration and cooperation in vertebrate morphology and between vertebrate morphology and other biological sciences.

Matthias Starck

Editor in Chief

Journal of Morphology

Munich, May 2019

Ann Huisseune

Chair Scientific Program Committee

International Congress of Vertebrate Morphology

Ghent, May 2019

pinniped was found from the latest Miocene to early Pliocene of Japan in the Northwest Pacific. This specimen (NMNS-PV 24611) preserves almost all the skeletal bones, except for cervical vertebrae and a few others. NMNS-PV 24611 is identified as an adult male walrus in the family Odobenidae by the following features: the greater trochanter of the femur is lower than the femoral head, the lesser trochanter is not developed, the neuropore of the lumbar is large in diameter, the posterior process of the astragalus is well developed medioventrally, epiphyses of each of the bones are almost fused, and the specimen has an exceedingly long baculum. In addition, we newly discovered a tusk-like, upper canine from the same individual in this locality. The length of the tusk is 21.2 cm and the radius of arc along its posterior side is 52.4 cm, indicating that NMNS-PV 24611 belongs to the extinct walrus, *Ontocetus* sp. This taxon is well known from the Pliocene of the North Atlantic realms, but mostly known by fragmented isolated teeth and bones, which is the reason that the paleoecology of this taxon has not been clearly revealed. NMNS-PV 24611 is the only specimen consisting of almost the entire skeleton and it is therefore morphologically and ecologically informative. We compared the new fossil to the skeletons of the extant walrus (Odobenidae) and that of the Stellar sea lion (Otaridae) to reveal the paleoecology of *Ontocetus* sp. The robustness of the forelimb of *Ontocetus* sp. suggests that it was used more frequently than in the extant walrus. This indicates that *Ontocetus* sp. had a behavioral ecology more closely like that of sea lions, and accordingly suggests that there was stronger intraspecific male aggression as compared to the extant walrus.

Shape Change Throughout the Body of the Tongue during Lapping in Small Carnivorans

Olson RA¹, Curtis HE², Williams SH³; ¹Ohio University, Athens, USA, ²Ohio University, ³Ohio University Heritage College of Osteopathic Medicine (ro603313@ohio.edu)

In mammals that lap during drinking, the tongue transports fluid into and through the oral cavity. Like all other oral behaviors involving the tongue, lapping is performed with only a partial reliance on an external bony support system, the hyoid. Rather, the tongue is able to engage in complex movements because it functions as a muscular hydrostat. In muscular hydrostats selective contraction of intrinsic and extrinsic muscle fibers produce movements and deformations of the tongue. The objective of this study is to characterize tongue movements and deformations in three-dimensions relative to timing and phase parameters of the gape cycle during drinking in small carnivorans using marker-based XROMM (X-ray Reconstruction of Moving Morphology) with additional beads implanted in the body of the tongue. The omnivorous striped skunk (*Mephitis mephitis*, N=2) and raccoon (*Procyon lotor*, N=2) as well as the carnivorous ferret (*Mustela putorius*, N=2) were used as a model for rhythmic lapping while drinking a bariumized broth. During rhythmic drinking, the middle and posterior tongue underwent the most variation in length change in ferrets and skunks, while raccoons showed more individual variation. Maximum tongue length occurred just before maximum

gape, i.e., during jaw opening, in all but one individual. In one skunk, maximum tongue length occurred just after maximum gape, i.e., during jaw closing. Minimum tongue length occurred near minimum gape in all individuals. In ferrets and raccoons, the posterior tongue underwent more variation in width than the anterior tongue, while skunks were the opposite. These results provide preliminary insight into how the tongue functions as a muscular hydrostat in order to perform complex oral behaviors. This project was supported by grants from Ohio University Student Enhancement Award and National Science Foundation (USA) grants (DBI-0922988 and IOS-1456810).

A New Paradigm for Pharyngeal Tooth Formation?

Oralová V¹, Rosa JT², Larionova D³, Witten PE⁴, Huisseune A⁵; ¹Biology Department, Ghent University, Ghent, Belgium / Institute of Animal Physiology and Genetics, Czech Academy of Sciences, Brno, Czech Republic, ²Biology Department, Ghent University, Ghent, Belgium / Centre of Marine Sciences, University of Algarve, Faro, Portugal, ³Biology Department, Ghent University, Ghent, Belgium, ⁴Biology Department, Ghent University, Ghent, Belgium, ⁵Biology Department, Ghent University, Ghent, Belgium (211812@mail.muni.cz)

As a corollary to the 'modified outside in' hypothesis about the evolutionary origin of vertebrate teeth (Huisseune et al., 2009, J. Anat. 214: 465-476), we previously hypothesized that the development of, allegedly endoderm-derived, pharyngeal teeth in teleost fish requires ectodermal contribution or signaling. This may have been facilitated by ectoderm invasion via the pharyngeal pouches. Here, we examine the development of pharyngeal teeth in the zebrafish (*Danio rerio*) in light of the above hypothesis, using transgenic and mutant lines, by perturbing pouch morphogenesis, and by interfering with signaling pathways. We show that (1) the epithelial component of pharyngeal teeth (the enamel organ) is derived from medial endoderm located posterior to the sixth pharyngeal pouch (P6). Still, (2) dental epithelial morphogenesis starts only after P6 endoderm has made contact with the ectoderm, and (3) invariably only after a layer of periderm-like cells have covered the odontogenic endodermal epithelium. Both, P6 contact with ectoderm, and the presence of periderm-like cells, are required, albeit not sufficient, to elicit pharyngeal tooth formation. Teeth form prior to opening of the pouches into gill slits, and late invasion of periderm through the gill slits does not contribute to formation of first-generation teeth. Signaling pathways that perturb tooth formation (Fgf and Hh signaling) do not affect P6 contact with ectoderm or spreading of periderm-like cells in the pharynx, nor does perturbation of delta/notch, ectodysplasin or Wnt signaling. Taken together, a new paradigm for pharyngeal tooth formation in zebrafish appears to emerge: three rather than two tissue layers interact to produce a tooth - a periderm-like epithelium, endodermal epithelium and (neural crest-derived) mesenchyme. Supported by Ghent University Research Fund (n° BOF24J2015001401) and by the Czech Science Foundation (17-14886S).