Endless forms most beautiful: the evolution of skeletal diversity and complexity in tetrapod animals

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Location The Open University, Milton Keynes, United Kingdom

Full-time

Duration & Funding 3 year 3 month studentship. This research studentship is funded by the Faculty of Science, Technology, Engineering and Mathematics (STEM) at The Open University, and provides a stipend of £18,622 per year (2023/24 rate, indexed annually) and all academic fees are covered.

Application due date: February 4th, 2024

Notification of shortlisting: February 9th, 2024

Interview: Will likely take place during the week commencing 12th February 2024 on Microsoft Teams (can be flexible on date if needed)

Final Funding Decision: March 2024. This is part of a pooled School process, so the selected applicant will be put forward to a reviewing panel in March for final decisions. Applicants will be notified if they are selected and will be informed of the panel decision afterwards.

Start date: October, 2024

Science-related enquiries: thomas.stubbs@open.ac.uk

Process-related enquiries: STEM-LHCS-PHD@open.ac.uk

Research area/keywords: evolution, biodiversity, morphology, tetrapod, palaeobiology

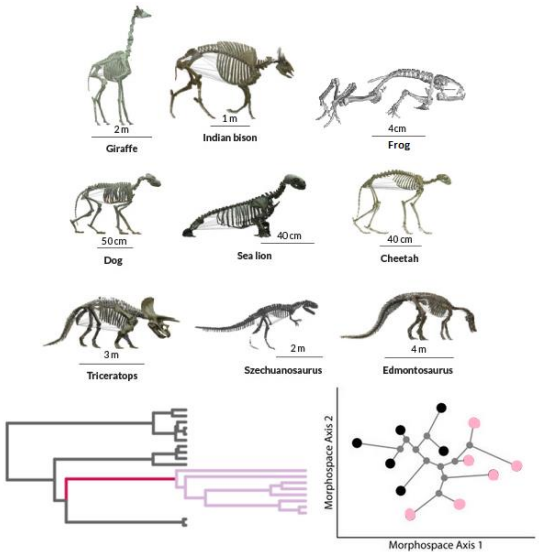
Project background and description

Tetrapod animals have incredible biodiversity, represented by all living amphibians, mammals, reptiles and birds, and all their extinct representatives back to the Late Devonian ~365 million years ago. This biodiversity is reflected by both huge species numbers and exceptional variation in morphology and ecology; everything from frogs to dinosaurs!

All tetrapods share a basic body plan and many of the same structural skeletal components; typically consisting of a head, neck, thorax, limbs, girdles, and tail. Evolutionary processes acting on these components drive body plan diversity, or 'morphological disparity'. The origins and expansions of major groups often involve major body plan innovation as groups expand into new ecological spaces, such as flight in birds, or aquatic transitions like in whales.

Many important questions remain about the evolution of skeletal diversity and complexity in tetrapods, both through geological time and across the Tree of Life. This project aims to quantify the skeletal diversity of all living and extinct tetrapod animals in a unifying morphological space ('morphospace') and phylogenetic framework. We can then answer many questions about the importance of evolutionary radiations and extinction events, and the roles of potential triggers such as environmental conditions or genomic controls. For example, which tetrapod groups show greatest body plan variation, and is this linked with high taxonomic diversity or ecological dominance? Do certain groups evolve faster, with more dynamic evolutionary histories? When, in geological time, did tetrapods achieve their full range of forms, and how does this compare to modern times? Are some areas of morphospace saturated, and what do these forms represent?

This project aims to answer these questions, and to understand and quantify the processes behind the diversity of tetrapod body plans, with an emphasis on evolutionary flexibility, disparity, directionality, and tempo. This will be achieved by sampling all tetrapod families and using a combination of morphometric techniques and phylogenetic comparative methods. Skeletal disparity will be quantified with anatomical network analysis (e.g. Esteve-Altava et al. 2019), geometric morphometrics (e.g. Maher et al. 2022) and traditional morphometrics (e.g. Gutarra et al. 2023). Disparity will then be analysed in a phylogenetic framework examining rate variation (e.g. Stubbs et al. 2021) and changes to evolutionary landscapes incorporating directional changes and cases of significantly increased disparity (Pagel et al. 2022).



Sample of skeletal body plan disparity in tetrapod animals (Images from Clauss et al. 2016). Also figured are schematic illustrations of evolutionary rate variation and morphospace distribution.

An important component of this project is training in advanced computational skills and high-performance computing, including R coding and specimen digitization. These skills will be widely applicable in future research or in many data science careers outside academia. You will also develop skills in comparative anatomy, presentation skills at national/international conferences, and will lead and contribute to peer-reviewed publications.

Clauss et al (2016) Journal of Anatomy 230, 325-336. https://doi.org/10.1111/joa.12557
Esteve-Altava, B. et al (2019) Science Advances 5, eaau7459. 10.1126/sciadv.aau7459
Gutarra, S. et al (2023) Palaeontology 66, e12645. https://doi.org/10.1111/pala.12645
Maher, A. et al (2022) Nature Communications 13, 4340. https://doi.org/10.1038/s41467-022-32028-2
Pagel et al (2022) Nature Communications 13, 1113. https://doi.org/10.1038/s41467-022-28595-z
Stubbs et al (2021) Proceedings of the Royal Society B 288, 20210069. https://doi.org/10.1098/rspb.2021.0069

Eligibility

1. Applicants will ideally have a First Class or Upper Second undergraduate degree or Masters degree (or equivalent experience) in an area related to the project (e.g. Biology, Zoology, Palaeobiology or Computer Science)
2. The student would be required to live in the UK and within commuting distance to The Open University in Milton Keynes.

Desirable Criteria

1. First Class or Upper Second undergraduate degree or Masters degree (or equivalent experience) in Biology, Zoology, Palaeobiology or Computer Science.
2. Experience with, or willingness to learn, computational methods in evolutionary biology. Particularly, previous experience with 'R'.
3. Broad knowledge of tetrapod animal evolution and palaeobiology.

We are committed to widening participation and awarding PhD studentships to a diverse community of applicants. We particularly welcome applications from under-represented groups. Equal Opportunity is University policy.

How to apply

Please check this page for application entry requirements: https://www.open.ac.uk/postgraduate/research-degrees/degrees-we-offer/doctor-of-philosophy-phd

Please submit to STEM-LHCS-PHD@open.ac.uk an:

- application form, and
- 2-page (A4) personal statement outlining your suitability for the studentship, what you hope to achieve from the PhD and your research experience to date

You do not need to submit a research proposal.

Information and the application form is found here: https://www.open.ac.uk/postgraduate/research-degrees/how-to-apply/mphil-and-phd-application-process. Note that as part of the application form, you will be asked to submit further documents (CV, degree transcripts, etc.)