PROJECT TITLE: Taking a breath: Costovertebral joint diversity and the evolution of amniote breathing mechanics

Project Science Theme: Evolution and Biodiversity
Project keywords: Palaeobiology, Anatomy, Ventilation, Biomechanics, Amniotes

Lead Institution: University Bristol
Lead Supervisor: Dr Katrina Jones, Bristol, School of Earth Sciences
Co-Supervisor: Susannah Maidment, Natural History Museum, Vertebrate Palaeontology
Co-Supervisor: Emily Rayfield, University of Bristol, School of Earth Sciences

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Project description:

Amniotes evolved diverse solutions to the challenge of ventilating lungs on land, from diaphragm-assisted tidal ventilation in mammals to air-sac-based ventilation in birds. How these mechanisms evolved through deep time remains difficult to reconstruct because lungs rarely fossilise. However, ventilation depends partly on rib mobility, which is constrained by costovertebral joints linking ribs to the vertebral column. Despite their potential for reconstructing respiratory evolution, the morphological and functional diversity of these joints across amniotes remains poorly understood.

Questions: This project asks: (1) How has costovertebral morphology diversified across living and fossil amniotes? (2) How does joint morphology influence rib mobility and thoracic expansion? (3) Can these relationships reveal evolutionary transformations in breathing mechanics?

Methodology: The Doctoral Researcher will quantify costovertebral morphology across extant and fossil amniotes using CT data and geometric morphometrics; test relationships between joint form and rib mobility using cadaveric manipulation and passive inflation experiments; and use digital biomechanical models to estimate joint mobility in fossils. Phylogenetic comparative methods will integrate morphological, functional and evolutionary data.

The researcher will take ownership of the project by co-developing taxonomic sampling and hypotheses with the supervisory team and choosing whether to emphasise comparative, experimental or computational approaches. Training will span comparative anatomy, dissection, experimental biomechanics, CT-based reconstruction, geometric morphometrics, digital modelling, phylogenetic comparative analysis, reproducible data science and scientific writing. Jones and Rayfield will provide hands-on training in vertebrate anatomy, synapsid evolution, quantitative morphology and biomechanics, complemented by Maidment's expertise in archosaur anatomy, fossil interpretation and museum collections.

Partners: The partnership links Bristol's Palaeobiology Research Group and its expertise in functional and quantitative palaeobiology with the Natural History Museum's exceptional comparative collections of living and extinct species. Regular cross-institutional supervision and collection-based research will embed the researcher within both groups, providing complementary training, networks and perspectives spanning living and fossil amniotes.

Useful recruitment links:

For information relating to the research project please contact the lead Supervisor via: katrina.jones@bristol.ac.uk

Bristol NERC GW4+ DTP Prospectus:
https://www.bristol.ac.uk/study/postgraduate/research/great-western-four-doctoral-training-partnership-nerc/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

The application deadline is Thursday 7 January 2027 at 2359 GMT