**PhD studentship Project information**

**Funding Source:** CENTA DTP

**Proposed start date:** 25th September 2023

**Closing date for applications:** 11th January 2023

**Eligibility:** UK/International

**Department/School:** SGGE

**Supervisors:** PI: Prof Mark Purnell

Co-I: Prof Phil Donoghue, University of Bristol, phil.donoghue@bristol.ac.uk;

Co-I: Dr Duncan Murdock, Oxford Museum of Natural History, duncan.murdock@oum.ox.ac.uk;

Co-I: Dr Tom Harvey, University of Leicester thph2@le.ac.uk.

**Project Title:** Conodont element function: unlocking 300 million years of ecological signals in the conodont fossil record

**Project Description:**

**Project Highlights:**

* Use cutting edge approaches to analyse conodont feeding mechanisms and interpret the conodont fossil record in terms of their functional ecology and the differential evolutionary success and survival of ecological guilds
* Exploit the exceptionally good fossil record of conodonts to analyse major evolutionary drivers before, during and after major perturbations in the biosphere
* Opportunities to travel overseas to collect data from fossil collections

**Overview:**

The conodont fossil record is among the best of any organisms. The morphological complexity of the teeth of this long-lived group of primitive vertebrates and the rate at which they evolved have made them paramount tools for biostratigraphy, with millions of elements amassed in collections around the world. But the ecological signals entrained in their fossil record are only now starting to be decoded. It is becoming clear that conodonts were more significant components of Palaeozoic and Triassic marine ecosystems than previously thought, potentially outnumbering other fishes and sharks for much of their 300 million year range. Their dental morphology reflects a rich history of dietary adaptation, and the perception that conodonts were small, and restricted to low trophic levels, may be nothing more than a bias imposed by the processes used to extract them from rocks. This project will address major questions of conodont functional ecology through exploration and testing of a number of broad research themes and hypotheses.

Conodont elements generally outnumber the microvertebrate remains of fishes and sharks; how widespread and common is this pattern, and what are the biological, ecological and taphonomic drivers? Does the higher abundance of conodonts really mean they were dominant components of Palaeozoic marine ecosystems?

New techniques applied to conodonts, many pioneered in Leicester (see *Further Reading*) have demonstrated that wear and 3D dental topographic analysis provide powerful insights into feeding mechanisms and dietary changes through time (Figure 1). This provides new ecological perspectives on the conodont fossil record and the ecosystems they were part of, but much remains to be done, including:

Figure 1. 3D digital elevation models of conodont element morphology and dental topographic analysis (complexity, shown by the coloured patches with different orientations, increases left to right).

* Assessing how the morphological details of complex P1 elements reflect trade-offs between adaptation to food processing and the constraints on occlusion;
* Quantifying the degree of functional convergence between the teeth and claws of extant animals and cone-shaped conodont elements – which dominate the early part of the conodont fossil record – to elucidate their functional disparity, evolution, and ecological role in Early Palaeozoic ecosystems;
* Applying similar approaches to understanding convergence and the biomechanics of conical feeding structures to fill the major gaps in our knowledge regarding the functional disparity of the conodont raptorial array of ‘ramiform’ elements, and its role of food acquisition.

**Methodology:**

Quantitative approaches lie at the core of this project, so you should be keen to engage with quantification of 3D structure, and computational/mechanical and statistical methods of analysis. Although a series of well-constrained analyses lie at its core, this project also offers scope for an excellent student to develop the research in new directions.

Dietary and functional analysis will be based largely on 3D morphological data: analysis of dental topography (Pineda-Munoz 2017; Stockey *et al*. 2021; see Figure 1); further development of techniques developed by Murdock and Donoghue (Murdock *et al*. 2013); and the application to conodonts of new approaches to functional and dietary analysis of conical structures (Evans *et al*. 2021; Fischer *et al*. 2022).

**References:**

Evans, A. R., T. I. Pollock, S. G. C. Cleuren, W. M. G. Parker, H. L. Richards, K. L. S. Garland, E. M. G. Fitzgerald, T. E. Wilson, D. P. Hocking & J. W. Adams 2021: A universal power law for modelling the growth and form of teeth, claws, horns, thorns, beaks, and shells. *BMC Biol*, **19,** 58.

Fischer, V., R. F. Bennion, D. Foffa, J. A. MacLaren, M. R. McCurry, K. M. Melstrom & N. Bardet 2022: Ecological signal in the size and shape of marine amniote teeth. *Proc Biol Sci*, **289,** 20221214.

Murdock, D. J. E., Sansom, I. J. & Donoghue, P. C. J. 2013: Cutting the first ‘teeth’: a new approach to functional analysis of conodont elements. *Proceedings of the Royal Society B: Biological Sciences 280*,

Pineda-Munoz, S., I. A. Lazagabaster, J. Alroy, A. R. Evans & N. Cooper 2017: Inferring diet from dental morphology in terrestrial mammals. *Methods in Ecology and Evolution*, **8,** 481-491.

Purnell, M. A. 1995: Microwear on conodont elements and macrophagy in the first vertebrates. *Nature 374*, 798-800.

Purnell, M. A. & Donoghue, P. C. J. 2005: Between death and data: biases in interpretation of the fossil record of conodonts. *In* Purnell, M. A. & Donoghue, P. C. J. (ed.): *Conodont biology and phylogeny - interpreting the fossil record. Special Papers in Palaeontology 73*, 7-25. Palaeontological Association,

Purnell, M. A. & Jones, D. O. 2012: Quantitative analysis of conodont tooth wear and damage as a test of ecological and functional hypotheses. *Paleobiology 38*, 605-626.

Stockey, C., N. F. Adams, T. H. P. Harvey, P. C. J. Donoghue & M. A. Purnell 2022: Dietary inference from dental topographic analysis of feeding tools in diverse animals. *Methods in Ecology and Evolution*, **13,** 1464–1474.

**Funding details:**

NERC CENTA studentships are for 3.5 years and are funded by NERC. In addition to the full payment of your tuition fees, you will receive the following financial support:

* Annual stipend, currently set at £ 17,668 (2022/3 – new figures to be confirmed spring 2023)
* Research training support grant £8,000 (RTSG)

\* If you do not meet the criteria for UK Fees you will need to fund the difference between UK and International fees for the duration of your studies.

\* A limited number of top up studentships to fund the difference between UK and International fees may become available but are not guaranteed.

For more details of the CENTA consortium please see the CENTA website: [www.centa.org.uk](http://www.centa.org.uk) .

**Entry requirements:**

Applicants are required to hold/or expect to obtain a UK Bachelor Degree 2:1 or better in a relevant subject or overseas equivalent.

The University of Leicester [English language](https://le.ac.uk/study/research-degrees/entry-reqs/eng-lang-reqs) requirements apply where applicable.

**Application advice:**

To apply please refer to

<https://le.ac.uk/study/research-degrees/funded-opportunities/centa-phd-studentships>

With your application, please include:

* CENTA Application form - available to download on the How to Apply section of the above link
* CV
* Personal statement explaining your interest in the project, your experience and why we should consider you
* Degree Certificates and Transcripts of study already completed and if possible transcript to date of study currently being undertaken
* Evidence of English language proficiency if applicable
* In the reference section please enter the contact details of your two academic referees in the boxes provided or upload letters of reference if already available.

In the funding section please specify that you wish to be considered for Ref CENTA2-SGGE4-PURN

In the proposal section please provide the name of the supervisors and project title (a proposal is not required)

**Project / Funding Enquiries to:** **CENTA@le.ac.uk** **or** mark.purnell@le.ac.uk

**Application enquiries to** **pgradmissions@le.ac.uk**

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