Phylogenomic analysis of Brachiopoda and Phoronida: implications for morphological evolution, biomineralization, and the Cambrian radiation

Aodhan Dermot Butler[1], **Michael Eitel**[2], **Gert Wörheide**[2], **Sandra J. Carlson**[3], **Erik A. Sperling**[1]
[1]*Stanford University*
[2]*Ludwig-Maximilians-Universität, Munich*
[3]*University of California, Davis*

Brachiopods are among the first appearing biomineralised Cambrian metazoans and represent a major component of the early animal fossil record. While their fossil record is ultimately key to determining character homology and polarity during evolution of the brachiopod body plan, reading this pattern has been clouded by phylogenetic uncertainty among the crown clades; specifically, monophyly of brachiopods with respect to phoronids, and the relationships of the calcitic to phosphatic brachiopods. Much of this phylogenetic uncertainty stems from difficulties in rooting the tree of brachiopods within Lophotrochozoa. Phylogenomics—the analysis of hundreds to thousands of orthologous genes—has been instrumental in resolving difficult phylogenetic relationships in diverse metazoan clades through reduction of random error in combination with careful evolutionary model selection. We have conducted the first extensive phylogenomic investigation of Brachiopoda/Phoronida with analyses that combine novel sequence data with all publicly available transcriptomes and a broad range of protostome outgroups. Analyses were run under best fitting evolutionary models (LG and gamma) utilising a published 106-gene lophotrochozoan ortholog set. Preliminary results strongly support a monophyletic Brachiopoda with Phoronida as sister group within Lophotrochozoa, with weak support found for Inarticulata, thus constraining possible scenarios for the evolution of brachiopod biomineralisation.