NATURAL ENVIRONMENT RESEARCH COUNCIL

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Details of Award

NERC Reference : NE/E015298/1

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Rates, patterns and divergence times among the Bryozoa: integrating fossil, molecular and morphological data

Principal Investigator: Dr DTJ Littlewood, The Natural History Museum, Zoology

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Co-Investigator: Dr P Taylor, The Natural History Museum, Palaeontology

Grant held at: The Natural History Museum, Palaeontology

Grant Award

Science Area:	Earth Freshwater Marine	**ENRIs:**	Biodiversity Global Change
Secondary Classification:		**Science Topics:**	Community ecology Palaeobiology Population genetics and evolution Systematics and taxonomy

Science Classification details

Overall Classification: Marine

PRC: Peer Review College Panel D

Abstract: Marine communities are complex and are subject to changes driven by both abiotic and biotic factors. Many communities are characterized by the presence of ubiquitous animal groups, regardless of latitude, depth or biogeography. Few of these groups have excellent fossil records that are easily interpreted in the light of extant taxa and biology. One such group of animals that exhibits these characteristics is the phylum Bryozoa, which has the further defining feature of being colonial. Bryozoans, or moss-animals, are colonial invertebrates found predominantly in marine environments, although one group is restricted to freshwaters. Most of the >6000 living species have fossilizable mineralized skeletons of calcium carbonate and their fossil record indicates an evolutionary history stretching back over 450 million years. Bryozoans are important components of many modern sea-bed communities. They are often early settlers on hard surfaces such as rocks, shells and seaweeds. They grow rapidly and compete actively for space and planktonic food resources. They provide three-dimensional habitats for other animals and plants in the process of community succession. Their complex skeletons are amenable to detailed morphometric analysis. Evidence of interactions with competitors may be 'frozen' in the fossil record, and modes and timings of sexual reproduction are frequently preserved in the skeleton. They are also model organisms for studying the evolutionary palaeobiology of coloniality. However, many key questions and hypotheses remain unanswered and untestable because the interrelationships between different bryozoan groups (across many taxonomic levels) are uncertain. Thus, there is an acute need for a robust evolutionary framework. We will concentrate on cyclostomes, a ubiquitous and key bryozoan group, that have maintained an important role as members of the epibenthos since their first appearance some 470 million years ago. The longevity of cyclostomes is at odds with their poor ability to compete with other bryozoans, and their relatively slow rate of morphological evolution. We will use a multigene, molecular systematic approach to investigate rates and patterns of evolution and extinction among the phylum, addressing three questions that have long been contentious: (1) When did the major subgroups of cyclostomes that live today diverge? (2) How are the three classes of bryozoans interrelated? (3) Have slow morphological rates of evolution in cyclostomes been matched by slow molecular rates of evolution? We will resolve bryozoan interrelationships using molecular markers. The phylogenies will be calibrated with well-established divergence events from the fossil record using modern statistical techniques to date divergence times. We will establish a robust framework for understanding the radiation of the entire phylum in terms of palaeobiology, patterns of extinction, developmental biology and life history strategies. Anticipated results will have an immense impact on our understanding of bryozoan evolution and systematics. This will provide an understanding of key components of present day marine biodiversity. Molecular phylogenies are critical to advancing knowledge of the phylum and will allow bryozoans to be better used as model organisms of coloniality and as indicators of marine community ecology. Our findings promise to have a major bearing on several wider issues concerning evolutionary patterns and processes, namely: (1) the relationship between molecular and morphological rates of evolution and speciation rate; (2) the influence of sustained competition between clades over geological time on evolutionary rates; (3) the effect of larval type and life-history strategies on evolutionary rates; (4) mass extinction intensities at high taxonomic level; and (5) the origin of biomineralized skeletons in aquatic invertebrates and their possible secondary loss when colonizing freshwater habitats.

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Award State: 70 - Started

Period of Award: 13 Oct 2007 - 12 Oct 2010

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JeS Grant State: 3 - Active

(FY details)

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Authorised funds only

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This grant award has a total value of **£284,357**

FDAB - Financial Details (Award breakdown by headings)

Estate Costs	Indirect Costs FeC	Investigators DA	Other Directly Incurred Costs	Other Staff	Travel & Subsistence

£28,089	£107,001	£26,868	£31,037	£85,719	£5,642

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