

Final Report for Antarctic Science Bursary, awarded to Nerida G. Wilson 2009

Proposed research extension: Assessment of the circum-Antarctic species paradigm

This funding was to support an extension of work on two emerging model species Antarctica, the crinoid *Promachocrinus kerguelensis* and the nudibranch slug *Doris kerguelensis*.



Both of these species had been subject to mitochondrial DNA analyses, which suggested cryptic speciation had prevented a robust test of the circumpolar paradigm. This work specifically addressed the following:

- Do mitochondrial phylogroups represent cryptic species, distinguishable by bi-parentally inherited nuclear data?
- If they do represent definable species, do any of these phylogroups show their own circumpolar distribution?

Work on the crinoid *Promachocrinus kerguelensis* has continued in collaboration with PhD student Lenaig Hemery (Muséum national d'Histoire naturelle, Paris). We have now prepared and submitted a manuscript which has through one round of review at Molecular Ecology.

Comprehensive sampling reveals circumpolarity, sympatry and widespread dispersal in the Southern Ocean *Promachocrinus* “*kerguelensis*” species complex (Echinodermata, Crinoidea)

Abstract: Sampling at appropriate spatial scales in the Southern Ocean is logistically challenging, and may unduly influence estimates of diversity by missing intermediate representatives. With the assistance of sampling efforts especially influenced by the International Polar Year 2007-2008, we gathered nearly 1500 specimens of the crinoid species *Promachocrinus kerguelensis* from around Antarctica. We used phylogeographic and phylogenetic tools to assess its genetic diversity, demographic history and evolutionary relationships. Six putative clades of cryptic species identified in an earlier study are corroborated here, with the addition of one new clade. All clades recognised herein are circumpolar, sympatric, and not bathymetrically structured, even in areas of overlap. None of the clades appear to be diagnosable by macro-morphological traits (colour, pattern, arm number) so they are considered to be truly cryptic species, and likely represent one of Antarctica’s first examples of a marine invertebrate species flock. Genetic diversity indices vary dramatically within clades, and within populations, suggesting multiple Antarctic shelf refugia. The phylogeny of *Promachocrinus* clades reveals that the two principal trends of demographic history are consistent within lineages: A, B, C and D represent a monophyletic group and show high genetic diversity, whereas the lineage containing E1, E2 and F seem to have undergone strong demographic events. The inferences of gene flow also vary among the cryptic species, showing discordant spatial patterns. In particular, clade A is the only one found in the Sub-Antarctic region, although without evident connectivity between Bouvet and Kerguelen populations. The Scotia Arc region shows high levels of connectivity between populations in most of the clades. Barriers to gene flow are evident in East Antarctica, and appear to affect both brooding and broadcast spawning organisms.

Work on the sea slug *Doris kerguelenensis* is continuing in collaboration with Bill Baker (University of South Florida). To date we have developed a single copy nuclear DNA marker that appears to be evolving fast enough to inform on a phylogeographic scale. We have generated this new data from more than 100 animals and are looking at linking this data with secondary metabolite data. This manuscript is in preparation, and we hope it will be submitted in 2012.

Career Development

During the tenure of this Bursary, the applicant has taken up a tenure-track research position at the Australian Museum. Her Antarctic research was also funded by a successful application to the National Science Foundation (USA) for a grant entitled **“Using molecular data to test connectivity and the circumpolar paradigm for Antarctic marine invertebrates”**. The work supported here contributed substantially to forming a basis for that application, and I would like to thank the directors and members of Antarctic Science Ltd for their support.