Guest editorial

Evolution in the cold

Theodosius Dobzhansky once remarked that nothing in biology makes sense other than in the light of evolution, thereby emphasising the central role of evolutionary studies in providing the theoretical context for all of biology. It is perhaps surprising then that evolutionary biology has played such a small role to date in Antarctic science. This is particularly so when it is recognised that the polar regions provide us with an unrivalled laboratory within which to undertake evolutionary studies. The Antarctic exhibits one of the classic examples of a resistance adaptation (antifreeze peptides and glycopeptides, first described from Antarctic fish), and provides textbook examples of adaptive radiations (for example amphipod crustaceans and notothenioid fish). The land is still largely in the grip of major glaciation, and the once rich terrestrial floras and faunas of Cenozoic Gondwana are now highly depauperate and confined to relatively small patches of habitat, often extremely isolated from other such patches. Unlike the Arctic, where organisms are returning to newly deglaciated land from refugia on the continental landmasses to the south, recolonization of Antarctica has had to take place by the dispersal of propagules over vast distances. Antarctica thus offers an insight into the evolutionary responses of terrestrial floras and faunas to extreme climatic change unrivalled in the world. The sea forms a strong contrast to the land in that here the impact of climate appears to have been less severe, at least in as much as few elements of the fauna show convincing signs of having been completely eradicated. Geophysical evidence shows that the great continental ice sheets have previously extended further over the continental shelf than they do at present, but most marine organisms appear to have survived, perhaps by migration down the continental slope into deeper water. The exception appears to be the fish fauna. Here the rich cosmopolitan fauna represented in Eocene fossils appears to have vanished effectively without trace, to be replaced by a spectacular radiation of a single group of demersal fish, the notothenioids. The key innovation in this process appears to have been the evolution of antifreeze, and molecular techniques are currently providing insights into the surprising origin of this adaptation. It is thus already clear that Antarctica provides a wonderful defined climatic and tectonic setting for evolutionary biologists to undertake novel and important work. Furthermore, this work contributes to our fundamental understanding of evolutionary biology, to the extent that selected Antarctic studies have already achieved the status of textbook studies! The new SCAR programme on the Evolutionary Biology of Antarctic Organisms is thus warmly to be welcomed, providing unrivalled opportunities for inter-disciplinary science and profound insights into the way the world became what it is. Much of the groundwork is already done, as can be seen by the reviews in this issue. The challenge now is to build on this and connect the Antarctic results to mainstream evolutionary studies. The powerful combination of traditional molecular studies, combined with the context provided by modern geophysical, glaciological and climatic work, will provide a window on evolutionary processes unique in modern science. The next decade promises to be amongst the most exciting yet in Antarctic science.

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