AME takes aim

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Antarctic petrels roosting on an eroded iceberg

The Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) has as one of its four themes one which focuses on the relationships between the physical environment of the Southern Ocean and the biological productivity of the region. This Program, the Antarctic Marine Ecosystems (AME) Program, has a broad and ambitious goal:

To gain an understanding of the links between Southern Ocean sea ice and ocean circulation patterns and the productivity that sustains penguins, great whales and the region's fisheries so that the effects of physical changes can be predicted.

The predecessor of the ACE CRC, the Antarctic CRC, conducted far-reaching research which enabled Australian scientists to gain a better understanding of how the atmosphere, oceans and ice were involved in the global climate system. This research also provided a much improved understanding of the oceanography of the East Antarctic coastline. In parallel with these efforts of the physical sciences community, ecologists at the AAD were developing food web models and models which are driving the ecosystem approach to the sustainable harvest of the living resource of the Antarctic region. As our knowledge of the physical world developed it became possible to make predictions about the magnitude and direction of projected change on the Antarctic region. It also became apparent that the ecosystem modelling efforts were unable to match the physical models in their ability to predict the effects of change on the living systems of the region. This is partly because of the complexity of ecological systems but it is also because there is a lack of observations that link physical variability and change with associated ecological change. The ACE CRC has as one of its aims the provision of a sound observational basis on which to build realistic scenarios for the future based on an understanding of the natural environment.

Climate predictions indicate that the Antarctic marine environment will change and this change may come rapidly. Major changes could include a reduction in annual sea ice – although this may well have occurred already (see 'Ice core evidence for 20% decline in Antarctic sea ice ...', p. 18) – and changes in the vertical and horizontal circulation of the Southern Ocean. It has been known for some time that there are strong relationships between biological productivity and the annual advance and retreat of the sea ice and that the ocean circulation patterns are critical in enhancing and sustaining productivity of the region. Because the exact mechanisms for these relationships have not been quantified, there is currently no ability to predict the possible effects of these changes if they occurred in isolation, let alone if they occurred together, as would be most likely. Research in the AME Program seeks to better understand the underlying causality of biological variability in the sea ice zone and to improve the ability to predict the effects of long term change.

East Antarctica is a wonderful laboratory for the examination of ecological relationships in the sea ice zone. The extent of winter sea ice varies by a factor of three from east to west which allows an examination of the effects of ice on biological communities. In addition, the circulation patterns vary considerably across the area despite the coastline running at a roughly constant latitude. Because of research carried out as part of the Australian Antarctic program over the last decade, this area is now relatively well studied and there are large-scale datasets which can be examined for ecological relationships. It is hoped that new technology will also be brought to bear on these studies. This will include autonomous underwater vehicles, advanced remote sensing techniques and the results of the ARGO float program.

In parallel with the observational research there will be a new focus on ecosystem modelling. The aim of this effort will be twofold. Firstly, it will involve a critical examination of the hypotheses that have been developed to explain co-variation between physical and biological variables in the sea ice zone. Secondly, the physical climate models will be integrated with the ecological and management models so that the effects of various climate change scenarios on sustainable harvesting levels can be examined.

The ACE CRC has set itself some ambitious goals but perhaps the most difficult of these will be to bring together the physical and biological scientists to address a common theme. There is no doubt that the Antarctic region faces some critical changes over the next several decades but understanding of the effects of these changes can only come through focussed interdisciplinary study.

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