A NEW SCIENCE PROGRAMME

The Australian Government Antarctic Division Science Branch recently amalgamated two former science programmes – Impacts of Human Activities in Antarctica and Adaptations to Environmental Change – to form the new Environmental Protection and Change (EP&C) programme.

The programme aims to understand how the biodiversity of Antarctica responds to human-induced environmental change and to develop new techniques to remediate past environmental impacts. Scientists in the program will work across five priority themes:

Antarctic biodiversity – life in a highly fragmented environment

This theme aims to contribute to better protection of the natural heritage of the Antarctic, through the understanding of its biodiversity at all levels – from DNA to ecosystem interactions. Antarctic animals, plants and micro-organisms have evolved in an environment quite different from other regions of the world and have many unusual features which may influence their ability to tolerate environmental change. In addition, the landscape of Antarctica is unusual in having many distinct 'islands' of biodiversity that are separated by enormous distances; such as the pockets of ice-free land, lakes, and the shallow near-shore sea bed. For many species there are few opportunities for natural dispersal and spreading between individual islands of biodiversity. This has the potential to create genetically distinct sub-populations around the margin of Antarctica, with implications for the protection of this biodiversity.

Global climate change – biological responses in the Antarctic and Southern Ocean

This theme will investigate and monitor the effects of global climate change on the biota of the Antarctic and the Southern Ocean. Some of the first effects of climate change on the biosphere are appearing in polar regions because of the close interactions between temperature-dependent physiological processes in the biota and physical processes such as melting, freeze/thaw cycles, increasing exposure to ultraviolet-B radiation, de-glaciation on subantarctic islands, and the changing extent of sea ice. Plankton, coastal marine organisms and terrestrial biota are the focus of research, as they may serve as early warning indicators of detrimental or accelerated change in global climate.

DENNIS CRAWFORD

The Antarctic landscape has many distinct 'islands' of biodiversity that are separated by enormous distances, such as these lakes in the Vestfold Hills, near Davis.

MARCUS SCHORTEMEYER

On some subantarctic islands such as Heard Island, coastal and terrestrial organisms may serve as early warning indicators of detrimental or accelerated change in global climate.

Acidification of the Southern Ocean – biological impacts and feedback mechanisms

Scientists have only recently recognised ocean acidification, caused by increased concentrations of dissolved carbon dioxide (CO_2), as a serious threat to the Earth's ocean ecosystems (*Australian Antarctic Magazine* 10: 26-27). Acidification can reduce the ability of plants and animals to form calcium carbonate shells and may reduce photosynthetic efficiency in calcifying algae. Higher CO_2 concentrations may also make it harder for gill-breathing animals to obtain sufficient oxygen. The impacts of acidification to individual organisms are in addition to those caused by global warming and are likely to make marine ecosystems less robust and more vulnerable to other stresses. The impacts of acidification are predicted to be most severe on coral reefs and the Southern Ocean. Scientists within the Australian Antarctic programme are uniquely positioned to make a significant contribution to understanding the problem of ocean acidification, because of their regular voyages through the Southern Ocean, their expertise in broad-scale ocean sampling and their ability to conduct experiments under controlled conditions.

Environmental guidelines for Antarctica

Research in this theme will provide the scientific basis for environmental standards that are appropriate to Antarctic conditions and to the sensitivities of the species that live there. Environmental standards for contaminants in the environment are commonly based on dose-response data from temperate latitudes. Virtually no toxicology data is available from polar regions and it is not yet possible to say whether standards based on data from other regions are appropriate for Antarctica. Clean-up of contaminated sites cannot possibly remove every trace of environmental contamination, but how clean is clean enough for Antarctica?

Zero-discharge stations and contaminated sites remediation

Australia led the world to establish very high standards of environmental stewardship for Antarctica in the early 1990s when the Madrid Protocol was signed. However, there are still some

How clean is clean enough for Antarctica?

1-10 million cubic metres of contaminated material in Antarctica and stations continue to discharge waste into the environment – most of it concentrated on the narrow coastal ice-free fringe which makes up only 0.05 percent of Antarctica. If the principles of the Madrid Protocol are to be met, it is important that we continue to improve our operational practices, by developing new and affordable technologies for discharge reduction and site remediation that work under Antarctic conditions.

With environmental change happening at many scales and for a variety of reasons, the challenges for science are: to separate the meaningful signals of change from the background of natural variability, identify interactions of multiple drivers of change that may accelerate the detrimental effects and, as a priority, identify in advance the threshold conditions that could trigger irreversible phase shifts in the Antarctic and Southern Ocean ecosystem.

The merger of the Human Impacts and Adaptations to Environmental Change programmes provides new opportunities to understand the interacting effects of global and local processes; for example, how might stress caused by global warming exacerbate the effects of pollutants or create new opportunities for invasive alien species? Importantly, it also increases our opportunities to develop preventive measures and remediation techniques in response to a greater range of environmental pressures.

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