The Science Program - the Present

Michael Stoddart

INTRODUCTION

The present Antarctic scientific research program has its origins in a report written by the Antarctic Science Advisory Committee (ASAC) entitled “Antarctic Science - the Way Forward” in response to Report 297 (1989) of the Joint Committee on Public Accounts “Management of the Antarctic Division”. The Joint Committee charged ASAC with examining and reporting on “the extent to which science should be conducted within the universities or research institutes as distinct from the Australian Antarctic Division (AAD) but within ASAC’s priority research framework.” ASAC’s report concluded that the research performance of staff at the AAD was comparable to that of scientists in other organisations, and recognised both the long term ‘monitoring and observation programs’ and hypothesis-driven studies. It remarked “All this scientific work also supports Australia’s claim to be heard on matters relating to the Antarctic, and so is a direct and important support to matters of government policy.”

“The Way Forward” sets in place the current structure of the science program. There are a number of broad discipline groups (though Human Impacts [HI] and Antarctic Marine Living Resources [AMLR] are interdisciplinary) with clear lead agencies. It called for the development of clear strategic plans, noting that “The value of the Antarctic science program will be enhanced if the strategic programs are clearly related to national and international priorities, particularly in relation to the environment and environment change.” In the nine years since there have been a few modifications made to the original six programs, with the cleaving of the AMLR program from Biology, and the separation of Meteorology and Atmospheric and Space Physics, but the basic structure persists.

The first Strategic Plan for science was created in 1995, with the Parliamentary Secretary of the day articulating the four goals for Australia’s Antarctic Program as:

- maintaining the Antarctic Treaty System and Australia’s influence in the system
- understanding global climate change
• undertaking scientific work of practical importance; and
• protecting the Antarctic environment

At the time the Parliamentary Secretary noted that given the long lead times for Antarctic activities he had asked ASAC to report to him in October 1997 on the “broad future directions for our Antarctic Program beyond the year 2000”.

In 1997 ASAC undertook a foresight analysis to examine the future uncertainties in the external environment over the first quarter of the new century. ASAC reported a need for the Australian Antarctic Program to become more able to respond and adapt to changing national and international needs and demands. The report was wide ranging and, in keeping with the Parliamentary Secretary’s directions, was not restricted solely to science. ASAC re-examined the goals for the program and recommended a few subtle changes. They are:

• to undertake scientific work of practical, economic and national significance
• to understand global climate change
• to protect the Antarctic environment; and
• to enhance Australia’s influence in the Antarctic Treaty System.

In May 1998 the Government responded to ASAC’s report accepting all recommendations with some minor changes. In particular it amended the goals for the Program to:

• maintaining the Antarctic Treaty System and enhancing Australia’s influence within the System
• to protect the Antarctic environment
• to understand the role of Antarctic in the global climate system; and
• to undertake scientific work of practical, economic and national significance.

In 1999/00 the AAD undertook a Priority Based Budgeting exercise to assist in the allocation of resources according to these Goals.

THE PRESENT SCIENTIFIC RESEARCH PROGRAM

By any standard, Australia runs a large and comprehensive scientific research program. In ASAC’s 1992 report there is a comparison between the publications
output of the Australian and the UK programs. It notes that the British program supported nearly twice as many scientists as Australia and this results in Britain producing “significantly more papers per year”. Nine years later the situation is much improved.

<table>
<thead>
<tr>
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<th>AUSTRALIA</th>
<th>UK</th>
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<tbody>
<tr>
<td>Average # scientists to Antarctic/year</td>
<td>209</td>
<td>200</td>
</tr>
<tr>
<td>Average # papers/scientist/year</td>
<td>1.5</td>
<td>1.19</td>
</tr>
<tr>
<td>Average # papers/year</td>
<td>313</td>
<td>238</td>
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A representative snapshot of the present annual scientific program would be something like this:

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Average # applications for support - internal and external</td>
<td>175</td>
</tr>
<tr>
<td>Average # seeking funding</td>
<td>80</td>
</tr>
<tr>
<td>Average # supported by Antarctic Science Grants funds</td>
<td>50</td>
</tr>
<tr>
<td>Average # of scientific projects undertaken annually</td>
<td>134</td>
</tr>
<tr>
<td>Average time spent by summer scientists in Antarctica</td>
<td>83 days</td>
</tr>
<tr>
<td>Average cost of each publication</td>
<td>$44,996</td>
</tr>
<tr>
<td>Average annual leverage through Antarctic Science Grants scheme</td>
<td>$10 million</td>
</tr>
<tr>
<td>Average # scientists (summer) working away from stations</td>
<td>31</td>
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</table>

The Government’s Budget papers for 2001-02 show clearly where the emphasis of the 2001-02 program lies.
<table>
<thead>
<tr>
<th>GOAL</th>
<th>ALLOCATION</th>
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<tbody>
<tr>
<td>To maintain the Antarctic Treaty System and increase Australia’s</td>
<td>$15.926m</td>
</tr>
<tr>
<td>influence in the System</td>
<td></td>
</tr>
<tr>
<td>To protect the Antarctic environment</td>
<td>$40.704m</td>
</tr>
<tr>
<td>To understand the role of Antarctic</td>
<td>$24.340m</td>
</tr>
<tr>
<td>in the global climate system</td>
<td></td>
</tr>
<tr>
<td>To undertake scientific work of practical, economic and national</td>
<td>$19.770m</td>
</tr>
<tr>
<td>significance</td>
<td></td>
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</table>

While some of these funds are expended other than in support of science, the bulk of them are attributable to the Discipline Programs as follows:

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>ALLOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antarctic Marine Living Resources</td>
<td>$7.21m</td>
</tr>
<tr>
<td>Atmospheric Science*</td>
<td>$24.25m</td>
</tr>
<tr>
<td>Biology</td>
<td>$32.41m</td>
</tr>
<tr>
<td>Geoscience</td>
<td>$6.64m</td>
</tr>
<tr>
<td>Glaciology</td>
<td>$10.66m</td>
</tr>
<tr>
<td>Human Impacts</td>
<td>$12.38m</td>
</tr>
<tr>
<td>Human Biology and Medicine</td>
<td>$0.41m</td>
</tr>
<tr>
<td>Oceanography</td>
<td>$1.84m</td>
</tr>
<tr>
<td>Antarctic Data Centre (including Mapping activities)</td>
<td>$3.27m</td>
</tr>
</tbody>
</table>

[*This heading includes work undertaken at the Antarctic CRC and LIDAR studies at Davis Station, Australian Antarctic Territory.]

Note that these are accrual figures and therefore represent the true cost of maintaining a particular activity. People on stations, and days of ship time are major cost drivers.
ASAC constructed, and the Minister approved, a Strategic Plan for the Antarctic Science Program. The document sits on the AAD website and is accessible by all. No project is accepted for support unless and until it has gained approval by ASAC. It does this through the operation of two external committees - one for Physical Sciences and one for the Life Sciences, known as Antarctic Research Assessment Committees (ARAC). Each proposal is reviewed by two referees external to the ARACs, one of whom should be from overseas. ARACs score all proposals in terms of the scientific merit (ex 10), relevance to the Strategic Plan (ex 10) and individual standing and institutional support (ex 5). A cut-off point is determined at the level where there are no further resources left for support. I am confident that our program withstands the strictest scrutiny; the process to determine it is transparent and accountable.

Each program has identified a key strategic question, and a number of key scientific outputs and annual milestones.

**ANTARCTIC MARINE LIVING RESOURCES**

| What are the best management strategies to achieve ecological sustainability of Southern Ocean fisheries, while allowing for rational development of the economic potential of the Southern Ocean? | • Eight conservation measures adopted by CCAMLR  
• Identification guide for bycatch for the use of long-line fishers (Global initiative)  
• Automatic penguin monitoring system (CCAMLR Ecosystem Monitoring program) 11 years, 1.2m crossings  
• Emperor penguins - 2,000km covered in a 20 day feeding trip |
Can evidence of global climate change be deduced from long-term trends in temperature, winds and densities in the troposphere, stratosphere and mesosphere, and can 'space weather' prediction be improved through better understanding of high latitude, upper-atmosphere and near-Earth space processes?

- Long-term observational studies
- Antarctic circumpolar wave studies
- Installation of LIDAR - atmospheric temperature profile measured "Remote Observing" with automation at Mawson Station, AAT and Macquarie Island
- Physically realistic model developed (to explain MF radar observations) of atmospheric tides at 50-100 km altitude
- Solar flare radiation events at Earth modelled with increased accuracy
- Geoelectric field studies to determine the importance of thunderstorms in the global electric field circuit
- TIGER radar operational, communications and "Space Weather" prediction
**BIOLOGY**

*What are the main threats to the conservation of Antarctic biota; what are the effects on the biota of environmental modification from global climate change, and what is the role of the region’s biota in global biogeochemical cycles?*

- UV studies on Antarctic flora, and plankton
- Marine bacteria - low survival
- Viruses as abundant in SO as elsewhere - higher in sea-ice zone
- Snow algae and antioxidants
- Expansion of range of plant species in relation to glacial retreat
- Sea ice productivity higher than thought previously *in situ* observations
- Inverse correlation between SST in autumn preceding breeding season of fur seals on Macquarie Island and breeding success

**GEOSCIENCE**

*What geological and geophysical processes have shaped the Antarctic continent and surrounding ocean, and what has been their effect on the present and past Antarctic environment?*

- GPS data revealing that Antarctica is rotating around a south Atlantic pole
- Studies on vertical rebound of the Lambert Glacier bedrock
- Ice core analysis for late preglacial vegetation
- Study of deep crustal xenoliths
## GLACIOLOGY

**What are the roles of the Antarctic ice sheet and sea ice cover in ocean circulation, the freshwater budget and regional and global climate, and what were their roles in the past?**

- Understanding the annual extent of fast ice
- Calculation of velocity of Lambert Glacier, by SAR interferometry
- Calculation of mass balance of glacier, by SAR interferometry
- Retreat of Brown Glacier by 1.1 km in 54 years
- Mean temperature rise of Heard Island by 1° C in 54 years

## HUMAN IMPACTS

**How can past human impacts in Antarctica be ameliorated, and how can future impacts be minimised?**

- Studies on contaminated site remediation at Thala Valley, Casey Station.
- Preparatory studies for Wilkes, Casey Station
- Development of guidelines for approach to wildlife - accepted by tourist industry
- Development of techniques for using old photographs as source material for estimation of penguin/seabird population change
**OCEANOGRAPHY**

| What is the role of the Southern ocean in the global climate system, in the prediction of climate variability and change in the sustainability of Southern Ocean ecosystems? | • Program of mooring deployment, particularly at the face of the Amery Ice Shelf  
• Program of sediment trap deployment  
• Preparation for CLIVAR 2001-02  
• Preparation for Kerguelen Plateau/Western Boundary Current 2002-03 |

**ASTRONOMY**

| What are the processes by which stars and planetary systems form from dust clouds, and how does this formation process influence the subsequent evolution of the host galaxy? | • Testing of automatic astrophysical laboratory at South Pole. |

**HUMAN BIOLOGY AND MEDICINE**

| What changes occur to humans in Antarctica; how can human efficiency in the Antarctic be improved, and how can such knowledge aid the planning of human activities in other extreme environments? | • ANARE Health register  
• Studies on Antarctic immunology |
For the future, we look forward to:

- air transportation to and from Antarctica;
- enhanced efficiency of the program, both with respect to students and equipment;
- intra-continental opportunities for airborne science, eg aerogravity, aeromagnetism, other geophysical parameters; and
- opportunities to work at many remote localities.