Funding for Scientific Research in the Antarctic

How can we best achieve value for money?

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Method of Study

- Each student researched a specific area of scientific funding in Antarctica.
- A number of Antarctic researchers and managers were interviewed to assess the current issues associated with science in Antarctica.
- These interviews were video recorded and the transcripts are included.
- We collectively used this information to prepare this report.
- Throughout this report we make constant use of infomation contained within the interview transcripts provided in Appendix V.

Introduction

Research in Antarctica and the Southern Oceans is relevant to New Zealand for many reasons. Biological diversity, global significance and sovereignty are some of the key factors that shape the generation of funds for Antarctic science. The interdependence of funding agencies and organisations that form science support will be explained.

Funding for New Zealand science is in short supply. This report aims to address the issues that influence science funding in Antarctica and ultimately the output from research. In particularly, the issues to be discussed are the:

- drive to control the types of Antarctic research, and discuss whether the themes should be determined by the funding agencies or by scientific curiosity.
- difference between small group versus large group research teams.
- efficiency of younger versus older researchers.
- measurements of scientific success in the Antarctic context.

In 2005, Antarctica NZ [1] convened an international review panel to assess the science supported by Antarctica NZ over the past seven years. This report will describe the matters arising from this review and the outcome.

Antarctic Science

Scientific Committee on Antarctic Research

SCAR [2] is a committee of the ICSU[3] and is charged with the initiation, promotion and co-ordination of scientific research in Antarctica. SCAR has facilitated and coordinated research in Antarctica for the past 45 years and in doing so has become a model for international collaboration in science (details in Appendix I).

SCAR also provides international, independent scientific advice to the ATS[4]. As a signatory party to the ATS, New Zealand research in this area takes its direction from SCAR.

The NZ Government has a strategic statement covering New Zealand's presence in Antarctica. The statement says that New Zealand is committed to conservation of the intrinsic and wilderness values of Antarctica and the Southern Oceans, for the benefit of the world community and for present and future generations of New Zealanders (details in Appendix II).

The Royal Society of NZ was set up by Act of Parliament to act as a conduit between SCAR and New Zealand scientists.

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[1] |Antarctica New Zealand
[2] Scientific Committee on Antarctic Research
[3] International Council for Science
[4] Antarctic Treaty System

Funding Antarctic Scientific Research

Applying to undertake research in Antarctica is currently a two step process. Researchers have to write a proposal to Antarctica New Zealand to get logistical support to go to Antarctica and also apply separately for funding to one of the funding agencies.

There is a diverse source of funding for scientific research in Antarctica.

- The Marsden Fund administered by the Royal Society of New Zealand.
- The PGSF[5] administered by FRST[6] .
- Vote Education (through internal university grants).
- Biodiversity of the Ross Sea funding (BioRoss) administered through the Ministry of Fisheries.
- Antarctica New Zealand (funds the logistical support).

The Marsden Fund

This is a government provided fund (1994) disbursed by the Royal Society of NZ for ideas driven research (www.narsden.rsnz.org). The Marsden Fund's objectives are to:

- undertaken investigator-driven research
- enhance the research knowledge base in New Zealand
- contribute to the global advancement of knowledge
- broaden and deepen the research skill base in New Zealand

The Fund is competitive across New Zealand and not subject to priorities set up the government. There are two types of proposals:

- Standard proposals – research programs spanning a three year term.

- Fast Start proposals – for staff who hold a current position in a NZ university, CRI[7] and other research organization who are trying to establish independent research careers. They can apply for a maximum of $85,000 p.a. for up to 2 years. Applicants must have less than 7 years research experience since completing their Ph.D. It is intended that they be involved in their own research program and not part of a larger group. There is approximately an 8% success rate for applications. Over half the applicants are academics employed in NZ universities.

  In 2006, there were 78 proposals accepted and the pool of money allocated was $39.1m. There were 26 successful proposals from 210 Fast Start applications and 52 successes for the 722 Standard proposals.

[5] Public Good Science Fund
[6] Foundation for Research, Science and Technology
[7] Crown Research Institute

About 5% of the Fund is allocated to researchers with projects involving Antarctica.

The Public Good Science Fund

FRST administers the PGSF. Research areas are divided into portfolios. The ecosystem portfolio was completed in 2005 and the GLO[8] is being considered at present. It operates on a bulk funding principle. In the ecosystem round, money was ear marked specifically for Antarctic research but this has not happened in the global processes portfolio.

There are two parts to the process – negotiation, which occurs if there is already a history of research and funding, and competition. The fund competed for is well oversubscribed.

Applications are assessed by panels of experts in the following groupings:

- Biomedical sciences
- Cellular, molecular and physiological biology
- Ecology, evolution and behaviour
- Earth sciences and astronomy
- Physical sciences and engineering
- Mathematical and information sciences
- Social sciences
- Humanities

About 1% of the Fund is allocated to researchers with projects in Antarctica.

BioRoss Fund

The Ministry of Fisheries has a biodiversity programme in the Southern Ocean (Ministry of Fisheries Annual Report, 2005/2006). The Ministry funded two Antarctic projects in 2006:

1) A small purpose built yacht, the Tiama, sailed to the Balleny Islands to survey biodiversity in the shallows around the islands and seabird colonies on the islands. The trip was very successful with diver footage collects and a highlight was the discovery of a new penguin colony. This information will be used to assist in developing a proposal to establish a Marine Protected Area.

2) The Ministry also participated in a survey to the eastern Ross Sea, gathering data on seabird and mammal populations and plankton productivity. The use of cameras as a tool to survey Antarctic fish species was also assessed. Bottom samples were also collected around the Ballenys, continuing the work that had been started by the Tiama voyage and extending to greater depths.

[8] Global Processes Portfolio

3) Substantial progress has also been made in tooth fish stock assessment through the Antarctic working group and the development of a trophic model of the Ross Seas ecosystem. These are requirements for our governance of the Ross Sea Dependency and for our role at the CCAMLR[9].

The Ministry of Fisheries has a budget for research services which includes the Antarctic and deepwater species as shown in **Figure 1.**

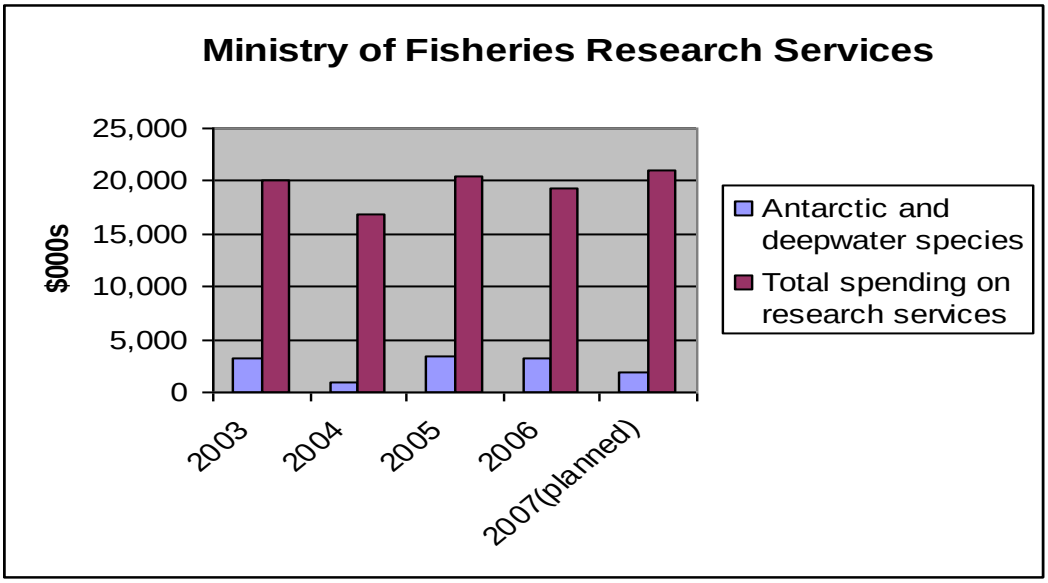

Figure 1: Ministry of Fisheries Research Services (Source: Ministry of Fisheries Annual Report 2005/2006)

Vote Education

There is research funding available from NZ universities and the University of Canterbury is widely known for its interest in Antarctica. This is evidenced by the operation of a separate Research Centre, Gateway Antarctica, which is responsible for being a focus for Antarctic researchers who operate out of their separate academic departments.

Money comes in from student fees, external research grants and there is also contestable funding for research based on ratings achieved with the PBRF[10].

Antarctica New Zealand

Antarctica NZ was established in 1996 and given the responsibilities of:

[9] Commission for the Conservation of Antarctica Marine Living Resources
[10] Performance Based Research Fund

- developing, managing and executing New Zealand's activities in Antarctica and the Southern Ocean.
- ensuring that quality science is carried out in the Antarctica.
- co-operating with other organisations both within and outside New Zealand that have similar objectives to Antarctica NZ.

It carries out these tasks by supporting quality science, providing sound logistical support and assisting the international collaboration so vital for the continuing success of New Zealand activities in Antarctica (details see Appendix III).

Amount of Funding

The following is a summary of the contributions from the major sources of funding for Antarctic research provided for the last four years.

Table 1: Funding for Antarctic Science 2002/2005

Funding ($m)	01/02	02/03	03/04	04/05
FRST	3.2	3.8	4.2	8.7
Vote Education	3.0	3.2	3.1	3.0
Ministry of Fisheries	0.4	0.4	4.3	0.4
Marsden	0.7	0.7	0.8	1.5
Total Science Funding	7.3	8.1	12.4	13.6
Antarctica NZ	6.9	7.9	8.7	10.0
Total Funding	14.2	16.0	21.1	23.6

Source: Report of the Review Committee 2005

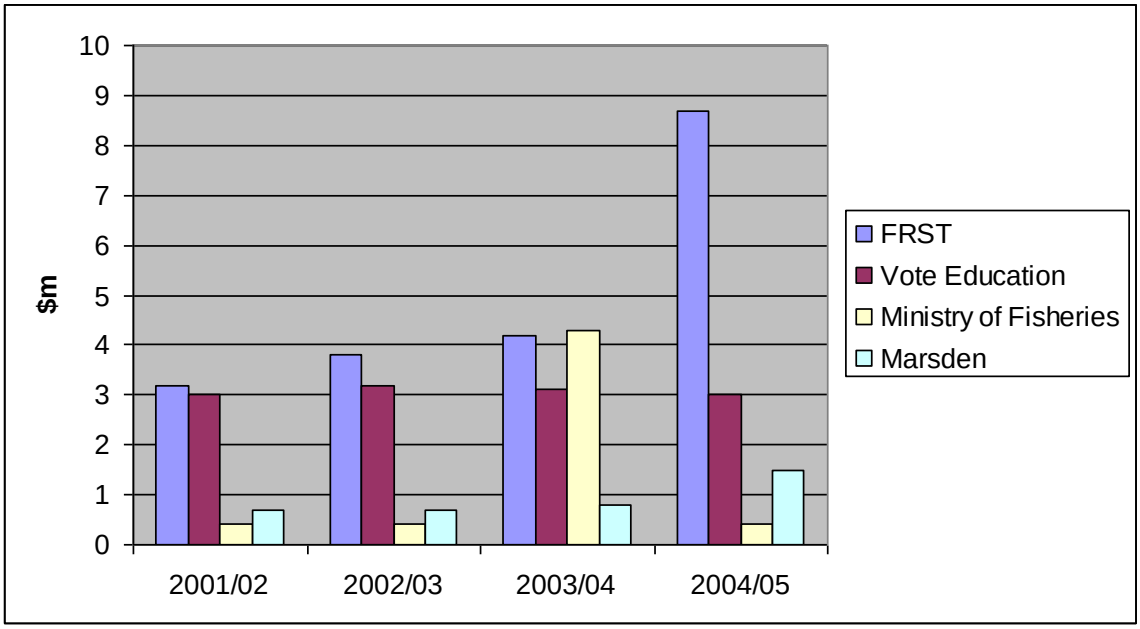

Figure 2: Funding for Antarctic Science (Source: Report of the Review Committee 2005)

The financial contribution from Antarctic NZ has increased over the four years to the level of $10m in 2005 but this rise has been necessary to cover the rising fuel and operational costs which come with Antarctic logistics.

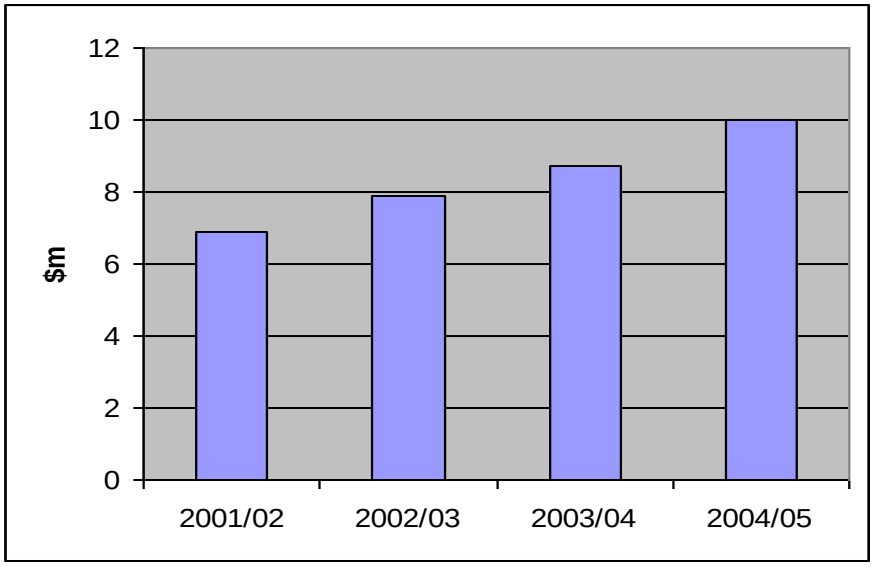

Figure 3: Logistical Funding by Antarctic NZ (Source: Report of the Review Committee 2005)

Current Situation with Funding

Clive Howard-Williams reminded us that National science funding in New Zealand is low, right at bottom of OECD[11] funding table for science funding along with Spain, Hungary and Portugal. The limited money available from the FRST and Marsden funds is greatly sought after. The amounts going towards funding scientific research in Antarctica is relatively small with the percentage from FRST funding being 1% and Marsden funding 5%. The variation between these percentages is due to differences in the criteria used by the Marsden Fund and FRST. The Marsden Fund is based on pure research which is more fundamental research that primarily answers the question why and explains how a system works (blue skies research) whereas FRST concentrates on the benefits of the research for New Zealand.

The Marsden Fund

The Marsden Fund represents a government investment in new fundamental knowledge through scholarly research (www.marsden.rsnz.org). The Fund was initiated to support research that was not

[11] Organisation for Economic Co-operation and Development

subject to the socio-economic criteria set for the PGSF. It sits at the discovery end of the New Zealand research spectrum and allows researchers to explore their own ideas.

The Marsden Fund does not discriminate against universities but university researchers interested in Antarctica have not been too successful. However it has provided a fast path for young researchers, like Victoria Metcalf. The Neutrino group from the University of Canterbury was also awarded a grant in 2006.

Marsden funding is fully costed and must include university salaries and all project costs. There can be many small hidden costs and procedures with Antarctic research, for example each member of the research party is required to have a full medical (which can cost $100) plus a series of blood tests. There is an extensive application procedure for permits to visit certain areas and to conduct specified activities.

The mechanism of having to include full costing is preferred by the universities as it generates income since the university salaries have already been budgeted for and can now be recovered from the Marsden Fund. Applying for a Marsden grant may typically include a request for $250,000 for marginal funding of $50,000.

The Public Good Science Fund

FRST is responsible for administering the pool of 'public good money' for New Zealand interest projects. It is intended for specific output driven research, research that is of direct benefit to New Zealand.

The allocation of funding depends on the politics and issues of interest for the government of the day. The MRST[12] identifies 'lead areas' for prioritisation and scientists should show connections into these to gain funding. Their three new initiatives are energy, new food products and new technologies, and potentially areas such as aquaculture and conservation of iconic species will be more important to MRST than Antarctica (Clive Howard-Williams, 2006).

To be accepted for FRST funding, research projects need to be designed to be relevant for New Zealand, or an issue linked to New Zealand. Subjects become trendy such as global warming but this is typical of science research not just in Antarctica, for example taxonomy became unfashionable and now biodiversity is popular. Fisheries is another topic that is hot at the moment and has been for the last 4-5 years. This can disadvantage researchers who are not in a 'hot area'. Yvonne Cook reminded us that ozone research is one example of a very important area of interest that developed from untargeted funding. It was originally a project that would not have been funded by FRST but has huge implications for New Zealand and the global community.

Brian Storey told us that Gateway Antarctica has come close to being successful with its proposals but there is not lot of money available and much of it is ear marked for CRIs. The situation has changed in last five years as originally universities could not apply. Then the universities were 'ring fenced' on how much money they could take out of FRST and in addition Antarctica work was 'ring fenced' to prevent too much being allocated. Now universities compete with everyone else but the

[12] Ministry of Research, Science and Technology

majority is ear marked for CRIs. The fund is well oversubscribed and Brian Storey stressed that it is increasingly important to form relationships with the end users of research information.

Dean Peterson from Antarctica NZ spoke about what he called one of the big problems with funding scientific research. The rules for funding research seem to change every year and he estimates that they have probably changed nine times in the last nine years. An example he quoted was that FRST has just gone to a policy called 'Pick Up the Pace' which guarantees blanket funding to CRIs. If doing research with NIWA or other CRIs, scientists are guaranteed 60-70% of their funding. There is only a small number of such projects (maybe 4 or 5) but their funding is a given.

Another example given of the changing nature of scientific funding was that FRST now has three different portfolios or application rounds. Nine years ago it had 17 different outputs and Antarctica was one of those outputs. A 'ring fence' was put around money for each of the different areas and Antarctica at that stage had about $2.5m. Over the years Antarctic science has asked to compete with the general science community and this has enabled them to grow significantly but there are no guarantees of future funding.

Brian Storey told us that the current round in the Global Processes Portfolio in which the investment is about $20m. this portfolio will predominantly be invested through negotiated processes leaving $2m a year for contest. The panel considering the proposals has received thirty concepts requesting a total of $12.3m per year for up to 6 years which represents an overbidding of 614% of the funds available. 90% of GLO is for negotiated funding with only 10% for open competition and it is for this 10% that the applications are overbid by 614%. Anyone including CRIs and universities can apply for contestable funds. The negotiated funding is not tagged for CRIs but it is realistic to expect that most of this money will go to the CRIs like \niwa as they are set up for longer term projects.

Sometimes the handling of money for the big projects is managed differently by FRST. Andrill funding came from the Foundation but the decision on how to fund Andrill was decided at an international meeting officiated by NSF. The decisions were made by a panel made up of science managers from Germany, Italy, United States and New Zealand. They accepted two of the six projects put forward by Andrill. FRST had no influence at this stage. The NZ science manager, Dean Peterson, then returned to New Zealand and told FRST that Antarctica NZ guaranteed the logistics funding and asked that they come up with the scientific money required, which they did.

BioRoss Fund

Several years ago, the government gave the Ministry of Fisheries funding for Ross biodiversity. Bill Davison did not view this fund as being open competition because it appears that the majority of the spending went to NIWA and most of the other applicants (university researchers) received standard rejection letters.

It appears that NIWA has the lion's share of Antarctica funding. This organisation is seen to be the main beneficiary of much of the research funding from the Ministry of Fisheries and they defend it aggressively. However, CRIs such as NIWA do rely on this money for their overheads and they lobby government opposing allocation of this funding to universities.

Vote Education

The University of Canterbury is the home of various Antarctic researchers who reveal that traditionally Canterbury has had very good funding compared to other New Zealand universities. Before 2000 there were separate research departments within the university with yearly research funding rounds organised by a central committee.

About three years ago the University of Canterbury was restructured into Colleges and contestable funding money was allocated to these Colleges. Gateway Antarctica used to compete separately in an annual university wide round but they are now under the umbrella of the College of Science. The College of Science planned to have a contestable proposal round each year but has yet to provide a funding round. This is in contrast to the College of Arts which, despite being faced with making staff cutbacks in 2006 still managed to run a funding round.

The College of Science wants researchers to go out and find their own funding. This is not easy as the large government funds such as Marsden and FRST, as well as bing well oversubscribed, use full cost recovery funding whereas university funding is marginal funding. This makes a significant difference in the amount of money that needs to be raised.

The PBRF money earned by individual researchers comes to their departments. There are four categories of research grading A, B, C and inactive. After deduction of overheads, the residual funds come through to the individual departments within which the researcher works. Spending is determined by the head of department and does not necessarily go to individual researchers with the PBRF ranking. It seems that a growing administrative layer within the new Colleges is absorbing a high proportion of the PBRF money. This is providing a conundrum - successful research leads to higher PBRFs and more funding but to achieve successful research requires funding.

Over the last few years, there has been little opportunity for funding of any research through the university, not just in Antarctica. The onus is on scientists to seek external funding and some of the researchers believe that research is about to hit a critical point when the current funds run out.

Antarctica New Zealand

Antarctica NZ was given $10m of government money in 2005, part of which was allocated to supporting science in Antarctica. Many of the people interviewed commented on the positive attitude Antarctic NZ has to facilitating research and researchers remarked that Antarctica NZ's work creates a lot of intangible flows which assists their research, logistics and international contacts. Antarctica NZ is also seen as being very sympathetic towards university scientists.

Victoria Metcalf made a point, also expressed by others, that what Antarctica NZ most wants to see is driven science that focuses on questions which enhance our understanding of Antarctica - not necessarily for commercial benefit but science that follows New Zealand's strategic intent strategy.

Funding in Other Countries

Funding for Antarctic research is carried out differently in other countries. Brian Storey told us that BAS[13] and the Australian Antarctic Program employ scientists on short term contracts. He noted that this approach is probably what Antarctica NZ would prefer to follow since they do not employ the scientists but just make the logistics available and this was part of reason for the science review. BAS heavily prescribes science programs unlike Antarctica NZ where the science strategy is so broad that it accommodates most proposals.

In the United Kingdom, the research funds are 'ring fenced' to support Antarctic research and 80% of the research funds are for government oganisations with some 20% available for open competition by university researchers .

Dean Peterson commented on the fact that American research funding through the NSF[14] has not changed sign significantly over the last twenty years. This can restrict the funding of new projects since funds get allocated to longer term projects. Researchers apply through the NSF for funding and their success rate is generally higher than in New Zealand. One in five proposals receives NSF funding and the decision is based on a researcher's publication record and this is similar to the Marsden policy. The NSF also reviews the previous publications to check the currency of the researcher.

Research in Antarctica and in the Ross Sea areas can be more difficult than other areas because of the logistical support required. Some of the funding bodies operate on a short timeframe which can disadvantage Antarctic researchers who need to have a logistics plan submitted well in advance of their proposed research.

Since New Zealand is a small country, with relatively few resources, there will never be enough funding to meet the requirements of the many worthy research proposals put forward.

Prescriptive versus Blue Sky Research

There is one undisputed truth concerning science in New Zealand, and that is limited funding. As a result, policy makers and funding agencies have to exercise a stringent selection process in order to achieve the best use of resources. As discussed earlier, target-based research has been well supported by FRST. Their comprehensive investment framework comprises eighteen distinct investment portfolios, grouped within five funds. One of the relevant funds for Antarctic science is the Environmental Research Fund. Under the umbrella of this fund, there are different portfolios from which Antarctic science can contest funds. Specific portfolios that have awarded funds to Antarctic research projects include Understanding and Adapting to Global Environmental Change (GLO) and Resilient, Functioning and Restored Natural Ecosystems (ECO). In 2004, the Institute of Geological & Nuclear Sciences Limited was awarded $486,800 within the GLO portfolio, to

[13] British Antarctic Survey
[14] National Science Funding

study Antarctic drivers of global change. The scientific work contributed to the climate change research effort, including understanding the effects of climate variability on biodiversity. It made a significant contribution to climate change and Antarctic themes. This illustrates the directive structure of the funding source FRST where portfolios of issues are set in order to achieve the required science.

Target-based research complements SCAR's framework, which has its focus on five Scientific Research Programs addressing major topical issues. Funding research that is in close alignment with SCAR's programs demonstrates a commitment to the global scientific community, and gives credibility to NZ's Antarctica stewardship.

International collaboration will become a common mode of practice as more countries recognise the dynamic aggregation of effort. In the CRP[15], a scientific and logistics agreement among six nations (Australia, Germany, Italy, New Zealand, United Kingdom and the United States) was made to undertake a drilling program of the ocean floor using a special platform placed on the coastal marine ice. Extending on this partnership approach, with a proven quality of output, the group was able to achieve funding for the Andrill project.

One of the conclusions of the ASRC[16] was that the target-based research in NZ's Antarctic science was of international standard. In fact, most scientists admit that no single nation can answer all the important questions of Antarctic science. Collaborations with universities and other centres of excellence around the world have formed internationally coordinated science activities. These include the WCRP[17], the IGBP[18], SCAR, the Convention of Biological Diversity and the IPY[19] 2007-2008.

Not only does FRST help New Zealand gain recognition in Antarctic science, but it provides an opportunity for local scientists to acquire experience in working with large consortiums. In any one season in Antarctica, there is a concentration of high calibre scientists and therefore FRST, being conscious of this standard, try to ensure that NZ researchers with equivalent expertise are selected. Target-based research becomes influenced in this way.

Having obtained funds, fixed-term projects can dominate the attention of science programs, thereby preventing new programs from entering. The Antarctic Sea Ice program is one such example. There may be other projects, like human influences in Antarctica that are being postponed for the duration of the Sea Ice programs. However, all science benefits human knowledge and longer term projects can produce a comprehensive database.

From a curiosity-driven perspective, a prescriptive mode of funding is not always satisfactory. Scientists argue that knowledge and understanding should evolve freely. Margaret Bradshaw commented that exploration in science is vital to inspire people. The Marsden Fund aims to satisfy this demand, but compared to the amount of over-subscription each year, funds for Antarctic research will remain highly competitive. On the surface, it would seem that Antarctic research in blue sky projects have to compete aggressively for funding, but in reality there are a number of programs being funded through PGSF which are considered pure science. Arguably, geological

[15] Cape Roberts Project
[16] Antarctic Science Review Committee
[17] World Climate Research Program
[18] International Geosphere-Biosphere Program
[19] International Polar Year

studies concerning tectonic plates in Antarctica may not seem to have immediate benefit to New Zealand. However, this is fundamental research that aims to understand the Earth and its systems, and NZ policy makers accept that. As Clive Howard-Williams stated "Antarctic funding manages to get a lot of support, even though it is not of immediate benefit to New Zealand".

Pure science also has a role in fostering stewardship in Antarctica. A PGSF funded program to Landcare Research NZ Limited in 2004, was a study on Antarctic soils. The objective was to increase fundamental knowledge and understanding of Antarctic soils, in order to improve environmental protection of the Ross Sea region of Antarctica. This illustrates a secondary benefit aspect of pure science in Antarctica. That is, by strengthening New Zealand's leadership role in environmental stewardship in the Ross Sea region of Antarctica, the outcome of pure science is to show our obligations under the Protocol on Environmental Protection to the Antarctic Treaty.

Antarctica NZ plays an active role in determining science programs. One of the emerging scientists, Victoria Metcalf of the University of Canterbury, has noticed that Antarctica NZ is adopting a prescriptive approach. When one looks at the goals and directions of Antarctica NZ, it is clear that they want to address global issues. Their focus is to enhance our understanding of Antarctica by producing high quality research, as identified in their Strategic Directions document. Securing contracts with projects such as Andrill and LGP, are examples of Antarctica NZ's credibility as a partner in Antarctic science. In order to participate in some of Antartica NZ's proposed projects, experienced scientists are submitting strong proposals for support. Indeed Dean Peterson commented that Antarctica NZ has become more scientifically rigorous than FRST.

Small versus Large Group of Researchers

Small group projects have the flexibility to change their work as the situation dictates. Working in the Antarctic environment poses many uncertainties therefore there is a distinct advantage for researchers to respond according to the situation. The importance of this is illustrated by Bill Davison's work which depends on fish availability. His versatility in adapting to a changing situation is a great example of small-group efficiency.

Sometimes, a small group project may have a better chance of obtaining funding because its relatively small budget makes it easier to 'slot in' to a larger logistical plan. An example of this is Wendy Lawson who had a successful proposal for a glaciology project which involved two scientists.
During the same funding round, another small research project of similar nature also received funding and the logistics were combined for the two projects.

The disadvantage of smaller group projects is the risk of being overlooked. However, this problem may not occur if there is a strong principle investigator with an excellent history of research. For example, Bill Davison's work in the physiology of Antarctic fish has always involved a small group of scientists, yet his research is both relevant and well-cited.

Another disadvantage with a small group project is it tends to be narrow focused. This is mostly caused by limited resources, not only in funds but in time. On the whole, there is still a place for very small, focused science in Antarctica according to Margaret Bradshaw.

Larger group programs are able to share resources, and this is highly advantageous in the context of Antarctica, where costs are high because of the remoteness of location. New Zealand's contribution of $5 million in the sediment drilling project Andrill which is a FRST collaborative program and thhis is a large group program drawing on the collective expertise of human resources from NZ and the world.

In terms of logistics, it may be easier for large projects to obtain the attention and therefore the support of Antarctica NZ Other scientists also pointed out that multidisciplinary projects are more likely to obtain funds from different sources and then combine them as required.

It is important to note that the high costs of support may not deter a large project from progressing since large projects are capable of addressing global issues. The prescriptive nature of projects, and the way that science is influenced by popularity.

An emerging trend is linking small groups under a larger umbrella, as illustrated by the LGP[20]. The LGP was instigated by the need to reduce costs and the sharing resources, such as helicopters. It has now expanded into a consortium in its own right, with the momentum to get the attention of funding agencies and logistics organisations.

Old Age and Cunning versus Youth and Enthusiasm

One of the more common dilemmas is whether we should be supporting fresh, new researchers such as Masters students and PhD researchers embarking on their maiden projects in Antarctica, or should we instead be focussing funding on the established projects of veteran Antarctic researchers.

There are definitely benefits associated with supporting both new and established researchers. Established Antarctic researchers are able to draw on previous experience of living and working in difficult Antarctic conditions while new, enthusiastic researchers often bring in new ideas and innovative techniques, leading to new frontiers in scientific research. However some people would argue that senior Antarctic researchers can lose their drive in subsequent years. They may be seen to contribute less to Antarctic science than they might have earlier in their career. They may have an expectation that they are secure in their funding for their research based on their past record. In terms of securing Antarctic science funding, the track record of the applicants also plays a large role in obtaining support and it helps if researchers have produced publications in respected journals. This presents a hurdle for novice researchers, as it is hard to get funding support if they don't have any experience in the field.

Established researchers also have an important role as mentors to pass their experience and knowledge on to new researchers in Antarctic science. Effective mentoring depends on a relationship between individuals, and this can be an issue for post-graduate students conducting standalone projects. Some research mentors choose new recruits based on their ability to handle life in Antarctica as well as their scientific skills. Other mentors are not so stringent in their selection

[20] Latitudinal Gradient Project

and find that their apprentices struggle under Antarctic conditions, which can further add to the perception that new researchers often produce poorer quality.

Another issue is ensuring inexperienced researchers are adequately prepared for their trip south. Earlier trips to the Antarctic always had several experienced participants who could provide support. There are now more researchers conducting projects with limited Antarctic experience and it is important that they are prepared before they depart. Although historically there was no formal mentoring scheme, there were people to help with training and there was also the Balmoral field camp for training skills in deep field science. There has now been a reduction in the ability of deep-field parties as new researchers are missing much of the background knowledge of how to live and work in these isolated camps. New researchers should be adequately primed before departure to make them more aware of some of the pitfalls of conducting science in Antarctica to improve their efficiency.

Large projects such as Andrill can be very successful and provide many opportunities for new researchers, but overly ambitious projects can struggle if just one or two vital components don't meet expectations. Problems arise when new researchers set their expectations too high or place too much reliance on sophisticated technology which can break down. The situation of too much technology can be a hindrance to new and experienced researchers alike as it is often difficult to repair equipment in the field and within the limited time scientists have available to them.

The NZ Antarctic research population is currently aging and more resources are needed for succession and capability planning in order to maintain an effective science program. For this reason, there is a need to take more young postgraduate students down to Antarctica as they are commonly the first members to be dropped from a research group if funding restrictions are imposed. The reason for this is that they are not seen as critical to the success of these projects unlike the principle investigators.

It seems that new researchers can have difficulty in gaining support to conduct Antarctic research. This is compounded by the fact that funding priority is given to existing projects or researchers with a good track record of publications, international links and research which is following key research initiatives. Unfortunately, for new researchers, they must first gain experience which can be difficult if they are not given mentoring advice from senior researchers or are dropped from research teams due to financial constraints.

Overall most people would agree that taking young people to Antarctica is vital to stimulate interest and passion in the continent and encourage a new generation of researchers. However it is also recognised that to do this, money has to be invested in training and mentoring these students to provide the best possible start.

Review

In 2005, Antarctica NZ commissioned a science review committee to assess the quality of science supported by Antarctica NZ from 1997-2004.
The review was designed to "*…create an overall view of New Zealand's Antarctic research capabilities and gaps*" and *"…help Antarctica New Zealand better understand where its priorities should be in supporting science in the future"*. (Report of the Review Committee 2005).

According to the review, the quality of New Zealand science being conducted in Antarctica is of a high standard, and lead the development of new technologies as a result of investigations in the Antarctic.

The findings of the review were based largely on an examination of scientific publications and presentations as well as looking at the direction of Antarctic and Southern Ocean research being conducted by New Zealand.

The science journal 'Nature' is viewed as one of the more prestigious publications for Antarctic science and was used as evidence in the review to highlight NZ science leadership in some areas, judged by the regularity of papers being published in this highly regarded journal.

Other concerns have been raised regarding the validity of peer-reviewed journal publications as the primary assessment of science for the Science Review. It is generally accepted that results and data need to be made available for interpretation and the conventional and most widely accepted way of doing this is through scientific publications. The problem for NZ science is that the peer review community is small and open to bias in response to unfavourable criticism on the work of reviewers. Unwarranted criticism of some scientific papers subjected to peer review can prevent research projects from receiving the acceptance that they deserve.

The application of an international review panel by Antarctica NZ was seen as a positive step by Yvonne Cook as much of the science is relevant internationally. The review was seen to address the quantity of publications but not necessarily the quality therefore highlighting the difficulty involved in ranking journals. It was noted by some of the interviewees that many of the papers listed in the review were published in one particular journal, which was considered not to be as rigorous as others in its peer review process. Another complicating factor is that a lot of Antarctic research is not necessarily new and exciting. Therefore the smaller, more specialist Antarctic journals play a significant role in the publication of more basic data before high level publications can be produced.

The review illustrated the relative performance of some researchers over the past five years and it appeared that some researchers, supported by Antarctica NZ, had published very little over that period of time. Others simply had not submitted the required information about publications in time for inclusion in the review.

The review stated that the ability of the review committee was compromised by a lack of information being provided prior to their meeting, contrary to the requirements of the Terms of Reference.

Recommendations

The review states that major international initiatives covering a number of disciplines, as well as small-scale “curiosity driven” research, are appropriate to support NZ’s science interests.

The current funding process was seen to be overly complicated and inefficient and it was suggested that this process of allocating funding could be improved. This would streamline the process that currently involves four separate funding routes and multiple committees as shown in Figure 4.

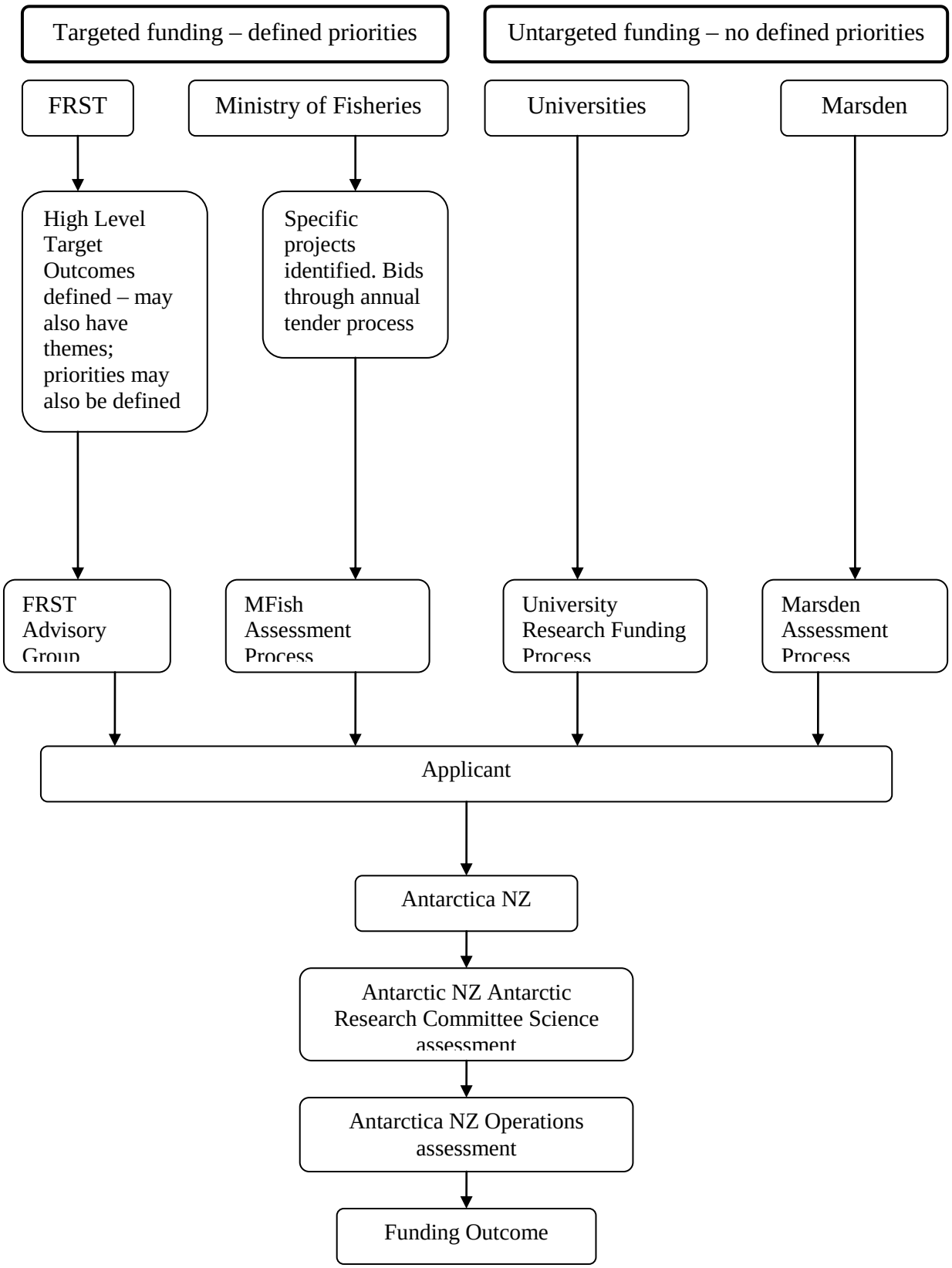

Fig 4. Funding process for New Zealand Antarctic Science (Source:Review Report 2005)

The review panel recommended the formation of a committee to be call the ASIC[21] to allow a co-operative approach between funding and logistic support partners as shown in Figure 5. This would establish a strategic review process for evaluating science proposals that New Zealand conducts in Antarctica. The ASIC should meet annually to evaluate research proposals and incorporate recommendations made by a proposal review subcommittee.

Having the ASIC to make decisions on research proposals based on advice from a Strategic Advisory Panel would provide a more focussed panel. This could satisfy government objectives and provide a one-stop pathway to funding for Antarctic research.

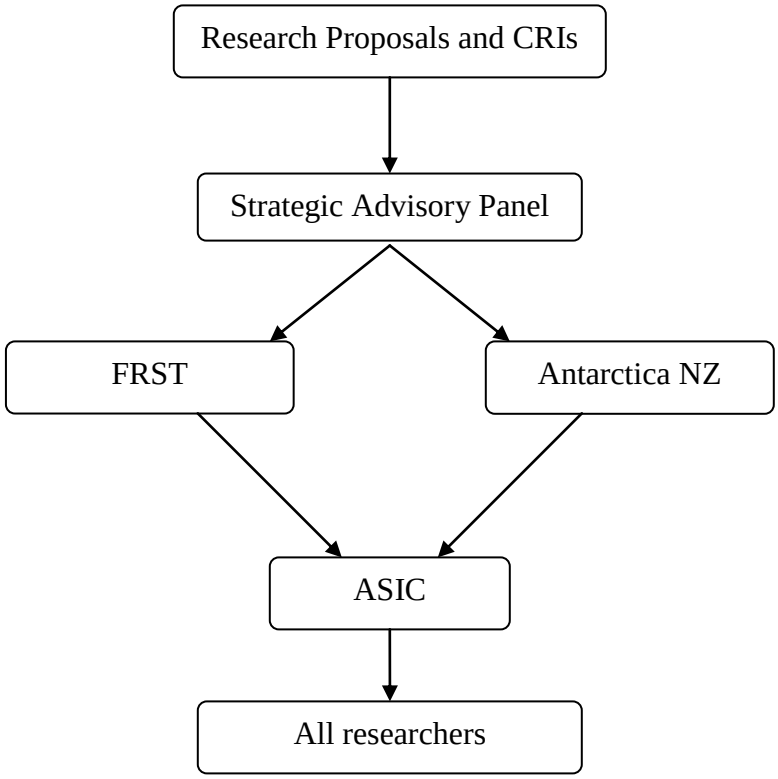

Figure 5: Proposed co-operative approach to funding and logistical support (Source: Dean Peterson pers. comm.)

Overall, the review was seen as a step in the right direction although it was conducted quickly and potentially without enough time to fully discuss and process the information, as there has been a lot of science activity in Antarctica over the last seven years.

[21] Antarctic Science Integrating Committee

Measuring the Quality of Research Performed in Antarctica

In assessing the quality of science supported by Antarctica NZ, the primary metric used was an assessment of the publications resulting from this scientific research. The measurement of science by publication is the established method of measuring science generally. During our interviewing of individuals associated with the NZ Antarctica science, we were particularly interested in their opinions on:

- opinions on the validity of using publications as the method to assess the quality of Antarctic science.
- the accuracy of the publication review process used in the report.
- alternative metrics which could and perhaps should, also be used to assess the science.
- the differences between small and large scale projects in the assessment of scientific output.

All of our interviewees agreed that publication record should form the primary basis for measuring science although there were many views on the accuracy and drawbacks of this system. The cost of conducting science in Antarctica is high and the importance of making data available for other researchers is clearly paramount. Yvonne Cook stressed the importance of making data accessible since interpretations of data can change as theories develop and are replaced. Consequently there is a high value in the data resulting from Antarctica research although this is not a direct measure of scientific output. Although this data is likely to be the subject of a publication by the original researcher, this may represent only a fraction of the data that has been collected and which could be of considerable value to other researchers in the future. Bryan Storey also highlighted the issue of researchers being very slow to publish their findings, citing the case of research performed in 1990 with no papers yet having been published from that work. The absence to publish should perhaps also be measured as an indicator for the quality of science performed in Antarctica. We also learnt that some researchers are not so interested in lodging data with central organizations such as Antarctica NZ which can clearly disadvantage other researchers and can also affect any review process on science output. Bill Davison also pointed out the importance of a publication record to university based researchers since this is the main input for PBRF performance and again Murray Munro said that promotion within the university system was largely based on research output in the form of publications.

The Peer Review Process

Within the interviews, there was considerable discussion on the process of peer review for publication. The subjective nature of peer review is a particular concern within Antarctic science which is a relatively specialised field where papers may be sent to colleagues who could have a vested interest in the outcome of the review process. This can be a particular problem in New Zealand where the science community is relatively small. There can be conflicts of interest in the review process (see reference 26) and some journals, such as ‘Nature’, have a conflicts of interest policy.

This issue is not constrained to the review process for scientific papers, during the interviews we did hear about similar problems with the review process for project proposals, especially in the context

of competition with CRIs with such funding organizations as the Ministry of Fisheries. Another interviewee with experience of the paper review process, both as an author and a reviewer, spoke of other issues such as sexism and nepotism interfering with the review process. Although it seems unlikely that these issues are widespread they do underline the importance of an effective appeals procedure within the review process, especially where the subject research community is relatively small.

Journals Used for Publication

The quality of the journal selected for publication is clearly important, Bryan Storey believes that NZ scientist should aspire to the top journals but is there a role for more specialised journals as well. Margaret Bradshaw thought that the 'New Zealand Journal of Geology of Geophysics' did have a useful role, despite being a small local journal, and was also used by international researchers. Clearly, researchers need to be encouraged to publish in the most relevant journal and care needs to be taken when trying to compare the relative values of publications in different journals. Any review process needs to take account of relative rankings and this has been one criticism of the report of the Review Committee where the top journal by publications was 'Terra Antarctica' with 180 whilst 'Nature' had five publications. However, this issue could be alleviated by using supplementary statistics such as citations to judge the relative values of papers although this does require some time to elapse for published papers to be valued by the wider community.

Factors Affecting Publication

There are also other issues which can determine the journals selected for the publication of scientific output. Margaret Bradshaw mentioned the publication costs levied by some journals which can be a problem for NZ scientists constrained by funding. The publication time can also be a factor, depending on the research, with some journals having a backlog of papers to publish. An issue for Antarctic scientists is in deciding whether to publish in a specialist journal or in an Antarctic journal. Many papers are published in 'Terra Antarctica' which although having a low scientific rating does allow many other researchers to view the work. However Dean Peterson raised the concern that scientists were publishing in 'Terra Antarctica' because it was cheap and quick with the aim of later producing a more substantial paper for a major journal which did not actually materialise.

There are certain areas of research, primarily of a more commercial nature, where the collected data is confidential. An example being fisheries research where generally the science is conducted separately by CRI[22] organisations such as NIWA[23]. The more obvious commercially biased scientific research is relatively easy to identify, and to separately fund, since the resulting data is not in the public domain. However there is increasing scientific research in areas which may become of commercial interest in the future and where the resulting outputs may also include intellectual property, such as patents, or information which could have a commercial value. Murray Munro and his group have conducted research on Antarctic samples where a patent was obtained on a derivative

[22] Crown Research Institute
[23] National Institute of Water and Atmospheric Research

product. In his view, government and private funding for scientific research do not combine well since there are different requirements and objectives as shown by the different expected outputs.

Other researchers have also mentioned the indirect outputs of scientific research, such as providing education and outreach information into the wider community. Margaret Bradshaw started her Antarctic career collecting samples for the Canterbury Museum and has provided talks and lectures based on her Antarctic research findings. Victoria Metcalf believes that outreach programs play an important part in the assessment of science by the wider community, she has been involved in eco-tourism and in encouraging interest in younger people as a result of her access to Antarctica for science research. Dean Peterson thought that key output indicators, apart from publications, could also include students mentored, education and outreach programs, essentially how the scientist is engaging with the 'real world'. Clive Howard-Williams believes that there are also other valuable outputs of science, although publications are the most important. He cited outputs which may actually be of greater value to the wider community such as how the research contributes towards the establishment of conservation matters. Although these outputs are more difficult to quantify, they could certainly be measured.

Size Does Matter

The differences between the assessment of science between small and large projects is important for Antarctic research. Clive Howard-Williams believes large projects are good in Antarctica where there can be good economies of scale, citing the US long term research in the Dry Valleys. After funding from the NSF to set up the infrastructure, individual scientists have been able to operate within this environment and have been very successful in terms of the number of papers published. In New Zealand, the LGP[24] is attempting to provide a similar umbrella for small researchers. In these large projects, which are really trying to achieve economies of scale for smaller research activities, then the measurement of output should be unchanged although the time taken for the papers to appear may be delayed as the infrastructure is established. On large, dedicated projects, such as Andrill or IceCube, then the difference is the scale of the science being attempted. In our interviews, we did hear criticism about the amount of resources taken by these large projects. Clearly there is intense debate within the science community about the relative value of these large projects. Consequently, the measurement of the output of these projects needs to be significantly higher with an expectation that they will publish in major journals on subjects of major international interest. The NSF takes a long term view with respect to some of these large projects considering that the eventual output could be at the level of a Nobel prize if they fulfill their full potential.

[24] Latitudinal Gradient Project

Conclusions

As result of our investigations, our conclusions on the funding of scientific research in Antarctica are as follows:

Target-driven objectives will continue to shape the funding allocation.

We thought that blue sky research should still be encouraged and this could be included as part of a larger target-based project.

It is important to promote collaboration at national and international levels, so that small research projects can be included within larger group programs.

Both young and experienced researchers offer invaluable insights to scientific research. This partnership is especially vital in a remote place like Antarctica, where young scientists explore new frontiers based on historical findings with experienced researchers.

In the discussion of how best to measure science output, the assessment of publications remains the most effective metric for review. The method of assessing publication performance could be improved by using techniques such as publication rankings and citation records.

As a science project develops there should be a corresponding progression in the standing of the publication selected.

It is acceptable that some research output is published in less specialised journals since they can form the foundation for future projects and need to receive a wider audience.

Systems should be set up to monitor the output of preliminary data and the follow-up of publications, in order to achieve a full record of science output. Perhaps, negative aspects should also be addressed such as the absence to publish after being supported to perform scientific work in Antarctica.

There should be continuous monitoring of project outcomes and feedback to central organisations such as Antarctica NZ.

Any issues associated with overly ambitious research projects need to be identified and mitigated during the initial assessment of proposals. In this way, the over-commitment of resources can be avoided and the possibility of failure to meet the objectives, when in the field, can be reduced.

In general, Antarctic science in New Zealand gets good value for money. NZ resources are very efficient at the project level although funding resources are limited and the prescription of funding to Antarctic science research remains a contentious issue.

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Appendix I: Scientific Committee on Antarctic Research (SCAR)

SCAR is a committee of the ICSU (International Council for Science) and is charged with the initiation, promotion and co-ordination of scientific research in Antarctica. SCAR was formed in 1958 and is an independent, interdisciplinary organization which currently has 31 member countries.

SCAR also provides international, independent scientific advice to the Antarctic Treaty system (ATS). As a signatory party to the ATS, New Zealand research in this area takes its direction from SCAR

Its mission is to

- facilitate and coordinate Antarctic research.
- identify emerging Antarctic issues that needs to be brought to the attention of policy makers.

To achieve its mission, SCAR aims to achieve 5 main objectives:

1 to initiate, develop and co-ordinate high quality international scientific research in the Ant region and the role of the Ant region in the earth system.
2 to provide objective and independent scientific advice to ATCM on issues affecting science and conservation affecting Antarctica.
3 To facilitate free and unrestricted access to ant scientific data and information.
5 Develop scientific capacity in its members (especially younger scientists).
6 To communicate scientific info about the Ant region to the public.

There are five research programs through much of SCAR science is coordinated (not funded):

- subglacial lake exploration
- Antarctica and the Global climate system
- Antarctic climate evolution
- evolution and biodiversity in the Antarctic
- inter-hemispheric conjugacy effects in solar-terrestrial and aeronomy research

Appendix II: 2002 Revised New Zealand Statement of Strategic Interest

New Zealand is committed to conservation of the intrinsic and wilderness values of Antarctica and the Southern Oceans, for the benefit of the world community and for present and future generations of New Zealanders. This will be reflected in active and responsible stewardship, under the Antarctic Treaty System, and promotes New Zealand's interests in:

i. National and international peace and security through a commitment to keeping Antarctica peaceful, nuclear free, and its environment protected;
ii. Continued influence in Antarctica governance through maintaining an effective role in the Antarctic Treaty System, and maintaining its long term interest, commitment to and credible presence in the Ross Dependency;
iii. Conserving, protecting and understanding the biodiversity of Antarctica and the Southern Ocean, in particular the biodiversity of the Ross Sea region, including the promotion, protection, and management of representative special areas, and enhancing biosecurity;
iv. Conservation and sustainable management of the marine living resources of the Southern Ocean, and in particular the Ross Sea, in accordance with CCAMLR and the Antarctica Environmental Protocol, and within this context supporting strong environmental standards and sustainable economic benefits;
v. Supporting and where appropriate leading, high quality Antarctic and Southern Ocean science that benefits from the unique research opportunities provided by Antarctica;
vi. Demonstrating and advocating for best practice in environmental stewardship and all other activities throughout Antarctica, and in particular the Ross Sea region;
vii. Ensuring all activity is undertaken in a manner consistent with Antarctica's status as a natural reserve devoted to peace and science.

Appendix III: Antarctic New Zealand

Science Supported by Antarctica New Zealand

The science supported by Antarctica New Zealand fits within three research themes. The three research themes have been further split into sub-themes with associated outcome, rationale and key questions. Scientific research from a wide variety of disciplines is supported within these themes, although it is recognised that much of the research is applicable to two or more themes. The three research themes are:

- Antarctic Physical Environments Research
- Southern Ocean Research
- Antarctic Ecosystems Research

Science Strategy

Antarctica and the surrounding Southern Ocean are very special places to humankind and the planet. The Antarctic Treaty System (ATS) was established to protect these special places. The ATS, established in 1959, has survived the cold war, mining concerns and nuclear build-up. Over this same timeframe, scientists have discovered the importance of the Antarctic and Southern Ocean as an indicator of the Earth's health, a driver of global processes, a place of unique ecosystems and a chronograph holding a wealth of paleoclimate data and geological information.

The strategy provides a basis for describing, managing and enhancing New Zealand science activities in Antarctica and the Southern Ocean, in particular the Ross Sea region, over the next five years (2004 – 2009). These activities are grouped into three interdisciplinary research themes that take into account the Revised New Zealand Statement of Strategic Interest, the Strategic Portfolio Outlines (SPOs) associated with Antarctic and Southern Ocean research, the growth and innovation strategy and the Ross Sea Region State of the Environment Report. Along with these documents, the Latitudinal Gradient Project (LGP) science plan, Andrill science plan and the Biodiversity of the Ross Sea (BioRoss) medium term plan, as established multinational initiatives, have been incorporated.

The science strategy *New Zealand Science in Antarctica and the Southern Ocean (2004 - 2009),* identifies three interdisciplinary research themes:

1. Antarctic Physical Environments Research
2. Southern Ocean Research
3. Antarctic Ecosystems Research

Antarctica New Zealand is also responsible for enhancing New Zealand scientific research, and providing sound environmental stewardship. In addition to supporting scientific research through logistics planning and scholarships, Antarctica New Zealand runs arts, media and education programs. These increase public awareness and appreciation of Antarctica and its conservation values.

Antarctica New Zealand is responsible for the year-round management of Scott Base. The Base provides services and accommodation for the many research parties and groups who visit Antarctica during the summer.
Responsible for logistical support.

By the end of 2006, the ARC reviewed 33 proposal for 2006/07 and 2007/08 and recommend to support 28 of them over the next two years. Each proposal is evaluated on

- scientific merit,
- feasibility of meeting the objects of the proposal and
- relevance to the Antarctic and Southern Ocean Science Strategy.

Science Role of Antarctica New Zealand

Antarctica New Zealand's role in science is to establish themes and priorities for New Zealand Antarctic science; encourage and facilitate the implementation of science projects that deliver on them; and present the outcomes and benefits of and advocate for Antarctic science.

A strategy for New Zealand Science in Antarctica and the Southern Ocean published in 2004 establishes themes and priorities for New Zealand Antarctic science. These are addressed by the science events and projects that Antarctica New Zealand supports.

A science support bidding round is held annually for those wishing to undertake research in Antarctica.

Workshops have been facilitated by Antarctica New Zealand to advocate and disseminate science research in Antarctica and three postgraduate scholarships are awarded annually

Large Science Projects

New Zealand is involved in a number of long term scientific projects in Antarctica with other member countries of the Antarctic Treaty.

Currently Antarctica New Zealand is project manager for the multinational Antarctic Drilling Project (Andrill) investigating climate change over time. This project builds upon the work of the Cape Roberts Project (CRP) which ran from 1996 to 2001.

The Latitudinal Gradient Project (LGP) is a framework for bringing together diverse multinational science groups in a collaborative manner to accumulate baseline ecological data along the Victoria Land coastline to help gain a better understanding of the possible effects of climate change.

The Ministry of Fisheries leads New Zealand's research into the Biodiversity of the Ross Sea (BioRoss), with input from Antarctica New Zealand.

The Census for Antarctic Marine Life (CAML) is a 5-year project that will focus the attention of the public on the ice-bound oceans of Antarctica during the International Polar Year (IPY) in 2007/08.

The International Polar Year (IPY) 2007-2008 will be an internationally coordinated campaign of research that hopes to initiate a new era in polar science.

Appendix IV: List of Interview Questions

Questions:

- How did your work evolve into Antarctic research?
- Where did you get funding for your first Antarctic project?
- How many funding agencies did you approach and how different were they in their selection criteria?
- In your research career, what is the ratio of successful proposals to rejected proposals?
- Was your project part of a larger group's research? Do you think that it is easier to procure funding if your project is part of a larger group's research? Why /why not?
- How difficult was it to draft the breakdown of logistical costs in your first project?
- How did you find information to draw up the proposal for funding? How did you estimate the cost of your project?
- Did you have to await approval from the funding agency before approaching Antarctica NZ for logistical support? Or will the funding agency approach the logistical support organisation to get cost-related information?
- As a novice researcher, was a mentoring scheme available to steer your development and progress?
- What is your opinion about taking a younger, inexperienced scientist into an established group project, as opposed to employing an older but experienced scientist?
- What do you personally think is a good yardstick to measure the success of a project? (e.g. journals, lectures, different types of educational media.)
- Currently, the findings / conclusions of most research projects, are submitted into peer-review journals for criticism. Success is assessed that way. Because the Antarctic region is so unique, do you think that projects related to it should have a different mode of assessment?
- How was the outcome of your project assessed, and do you think it was an appropriate method of judging your outcome? Do you feel that some other standards of assessment would be more accurate?
- Within Canterbury University, are there many funding opportunities for Antarctic projects? Does the outcome of Antarctic projects from previous years affect the availability of funds

for future years? If a scientist already holds university tenure, do you think that it increases the chance of getting funding for projects?

- How do New Zealand scientists apply for funding to do science outside the Ross Sea area?

- What is your personal opinion of the "Report of the Review Committee – Oct 2005", with respect to:
  a) the composition of the international panel,
  b) its recommendations.

- How are the funds divided between the different investigators within the research?

- Were there incidences when you feel that the area / topic of research were driven by economic demands, as opposed to genuine scientific curiosity? Why?

Appendix V: Interview Transcripts

Yvonne Cook (15 December 2006)

1) Always worked on projects where funding has been from within university system (small projects). Has just had to justify science behind project which then got slotted into a proposal. Antarctica NZ have fixed logistics cost based on number of days. Also research cost (salary, scholarship) for person(s) and materials. University or grant awarding institutions cost for researchers and all other costs, this is the research budget
2) Generally easier to bring someone new into Antarctic research as part of larger project (established researchers brings in post grads and PhDs). Her supervisor at Otago wanted people who could handle Antarctica as well as science, others not so fussy.
3) Peer review has good and bad points. Results need to be made available especially data and conventional way is peer review. Peer review community is small and they may not like their work criticized! Conferences are good, more informal but do not have such rigorous peer review process and feedback. Information being published on web which is good for access but has not been peer reviewed.
4) Important to reinterpret data and interpretations may change – especially important for Antarctica - don't want to go back to get data again!
5) Mentoring depends on relationship with individuals, seriously lacking in her case since her masters degree was standalone project.
6) Does not know too much about getting money for research from universities.
7) Funding depends on politics and issues of interest for government, etc, for example research designed to be relevant for NZ or climate control. Fisheries is hot at the moment (last 4-5 years). Can disadvantage researchers who are not in a hot area, ozone research is one example of things that can develop from untargeted funding.
8) Researching non Ross Sea areas can be more difficult because of logistics support, need other country's support with interest in that sector.
9) Thought international panel was good for science review since science is international, cannot comment on individuals, thought results were weak. Majority of papers published in one journal which is not very rigorous in review process. Conference presentations are usually easier than mainstream journals Experienced researched know how to present data at conferences, but may not have published in journals. Addressed quantity but not quality, how do you rank journals? A lot of Antarctica research is not necessarily cutting edge, some of it can be mundane and so we need these small specialist Antarctica journals before you can get to high level publications.
10) They said some NZ science had been done very well, but what about rest?
11) Recommendation to have one committee rather than split between logistics and science (BAS do logistics and science together) whereas Antarctica NZ is logistics only and so can be a bit lightweight on science.
12) NZ for a small country has a big investment in Scott Base (year round manning)
13) Multidisciplinary projects most likely to obtain funds from different sources and then to combine logistics costs.

Bill Davison (19 December 2006)

14) First trip in 1983, back around 21 times in Spring (fishing season).
15) No boat programme, all work has to be done off sea ice.
16) First trip funded by University of Auckland, then new to country but had background in fish. On first trip, all funding, etc had been organized by University of Auckland so just joined trip. Started organizing own trips in 1985 and this is a two part process, have to apply to Antarctica NZ for permission to go down and then for funding. In 1985 had Antarctic section for University Grants Committee, never had an application rejected but a proposal needs a lot of effort.
17) All his work has been independent, large projects are generally new. His research suits small projects and not multidisciplinary projects.
18) Lots of small hidden things in Antarctic research, eg medical, which need to be considered (talk to other researchers to find out).
19) Lot of funding bodies do not work very far out and so need to have logistics plan in to support proposed research., big lead in time to go down but need reasonable idea that research is going to be successful.
20) Auckland colleagues acted as mentors initially.
21) Pretty vital to have young researchers, this year seven people with two young researchers to bring on next generation.
22) Published journals probably only yardstick, PBRF performance based research fund mostly measured on publication success. Antarctic science has to get out in journals or in outreach programs (talks, continuing education, etc) but these tend not to be used in assessments – probably should be. Journals differ considerably in how easy it is to publish, have 'impact factor' Nature has 30-35 and one of his easier journals is less than 1 (based a lot on number of citations). Should really be looking at impact factors. Bill has about two manuscripts per week to review. Decent funding organization will look at quality as well as quantity on publications, need to have balance.
23) No opportunities for funding within University of Canterbury, about to hit critical point. Originally had University Grants Fund in 1980s, you had to provide own clothing, etc. In early 1990s this changed and then Antarctica NZ was established. FRST was formed but universities were excluded for Antarctic research and it was directed for CRIs. Universities were ring fenced on how much money they could take out of FRST ($10.5m) and Antarctica work was ring fenced to prevent it being creamed off. Contestable funding for research funding based off PBRF. Then colleges formed about 2-3 years ago, contestable funding money then allocated to colleges but college of science has yet to provide a funding round.
24) It is track record that matters (has 100 pubs and 2 books), have to play game and be in good journals.
25) Can go outside Ross Dependency with NZ funding (PhD worker on Springtails in Cape Byrd, he then went to S. Africa).
26) He has post doc student at moment on FRST funding who will soon be going to Boston using NZ funding.
27) He thought 2005 review was well conducted, fairly reasonably done in defined time frame. Had good, international team with fairly conservative conclusions.
28) Subjects become trendy, eg global warming, typical of science research not just Antarctica, eg taxonomy became unfashionable but now biodiversity is popular but skills are not so available,

29) Believes Antarctica NZ do good job with resources available to them, US much better equipped.
30) Has to ship lab to Scott Base which has disadvantages because lab is dependant on logistics, on US side they make facilities available and procure research equipment. Antarctica NZ could not afford to do this.
31) BAS are extreme and work like Australians, employ most of people that they want on short term contracts (probably where Antarctica NZ would like to be – don't employ scientists just make logistics available this was part of reason for science review).
32) BAS tend to dictate what science goes on, in case of ANZ their science strategy is so wide that most proposals can fit.
33) Italians program not good for comparison they forgot to put their budget in this year!
34) University funding now very tight, crunch point in couple of years when funds run out.
35) Funding becoming very difficult, if Antarctica NZ control funding could result in 'big brother' approach.
36) Government funds like Marsden and FRST are full cost recovery funding (everything has to be included such as salaries), university funding is marginal funding (just covers consumables) and huge difference in funding.
37) Applying for Marsden might be $250k for 50k marginal funding (university adds extra to salaries as well).
38) Colleges employing more administrators (middle managers) and where is money coming from?
39) PBRF money coming into university but just goes on keeping dept running.
40) Brian Mason research fund in natural sciences for marginal funding, very useful but university does not like trust funds like these now because they are independent
41) No funding from Ministry of Fisheries, government gave MoF money for Ross biodiversity a few years ago but spending was strange all the money went to NIWA, all other applicants had standard rejection letters.
42) Politics play huge part of Antarctic research.
43) NIWA boat gave no room for university researchers.
44) However open water marine biology is a major missing part of NZ work so NIWA boat useful.
45) Popular pastime to bash NIWA but they do good work.

Bryan Storey (19 December 2006)

46) Involved in Antarctic research since 1974, worked with BAS from 1974-1979. Since 2000 has had more of a management role with Gateway Antarctica.
47) Within university: In 2000 separate research departments with yearly research funding round organized by Central Committee. Now devolved to colleges, college of science has not had competitive research round yet and past money is running out but college of science will have deficit this year and next. College of science want researchers to go out and get funding, even college of art has had a funding round. Money comes in from student fees, PBRF ratings, external research grants. Were not competitive outside so got money from university, successful research lead to higher PBRFs – double edged sword. Canterbury traditionally a rich university prior to 2000. PRBF money comes into dept and spending is determined by head of department does not necessarily go to researchers based on PRBF

ranking and he believes this is right. FRST and Marsden funds are both highly competitive. Marsden is more blue sky, Antarctica researches have not been too successful, but fast path for young researchers like Wolfgang. However only Neutrino group have been successful within University of Canterbury,. Bryan and others have tried but not been successful. FRST is 'public good money' for NZ interest projects, Gateway Antarctica have come close but not lot of money available and much of it is ear marked for long term research providers like Crown Research Institutes. Situation has changed in last five years, originally universities could not apply then could apply and now about 80% is ear marked for CRIs. About 20% is available for competition and about 650% oversubscribed. Have to form relationships with end users of research information.

48) CRIs such as GNS, Land Care and NIWA address Antarctic issues
49) In NIWA researchers have to take annual leave to follow Antarctic research.
50) Also some money from Ministry of Fisheries but this all went to NIWA, people don't view it as open competition. However CRIs rely on this money for their employee's salaries and they lobby government saying universities should not receive this funding.
51) Other organization such as Global Environment Foundation for funding on glaciers in NZ, Chile and Antarctica. Gateway Antarctica through phase 1 and may be able to use this to leverage more money from NZ government if successful.
52) Thinks LGP is good to focus smaller projects but no funding associated with it.
53) Logistic support is major advantage but depends on research funding having been obtained.
54) Fully costed funding in Marsden (125%) does not discriminate against universities and non fully costed funding is not liked by CRIs. Fully costed funding is liked by universities as well because it generates income.
55) Review is natural process for government funded organization like Antarctica NZ. He believes report was over favourable , info gathered did not reflect true situation because not all researchers had submitted information to Antarctica NZ. Some researchers supported by Antarctica NZ have not produced enough papers over the years. Need to look at where papers are published as well as quantity.
56) Antartica NZ has a science strategy which on surface provides a framework, central committee attempted to align research into more coherent research on key issues for NZ and also to make sure it is adequately funded.
57) Need well funded program that meets NZ requirements.
58) In UK, money is 'ring fenced' to support Antarctic research, researchers are 80% govt employees with some 20% open competition for university researchers. In US, researchers apply through National Science Foundation for funding and their success rate is generally higher. Australians have mixed system with some government employed researchers.
59) Believes NZ has ad hoc approach and won't get anywhere without more central funding.
60) Review is step in right direction but nothing has happened yet!, has to be acted on. He will be asking why not at next general meeting!
61) Outcome of research is papers, need to aspire to top international journals.
62) Some researchers not so interested in lodging data with central organization like Antarctica NZ.
63) Citation indices is one method of assessing quality of research.
64) Research done in 1990 with no papers yet, no excuse for that!, believes researchers should be identified and future support withdrawn.
65) Believes that output of researcher needs to be reviewed at next proposal stage.
66) Antarctic data should be made available for everyone, open central meta-database available to everyone through Antarctica NZ.
67) Andrill very successful for a very large project and has brought in new researchers.

Margaret Bradshaw (20 December 2006)

68) First trip in 1975-6, collecting trip for Canterbury Museum, went down following year for research into Beacon Rocks. In those days easy to get funding through Antarctic Division DSIR, after research approved then they supported you in Antarctica. Funding base changed when Antarctic Division became Antarctica NZ. Now more difficult to get money from university. In old days had Ross Dependencies Research Committee with selection of people but has now changed, now much more peer review.
69) Margaret has had every project submitted accepted but may be different next time.
70) FRST changed rules and no longer supports independent researchers.
71) Thinks there is still a place for very small, focused science
72) Andrill doing interesting job but huge and soaks up a lot of money.
73) LGP is interesting project, she would like to go to Darwin area, gives opportunity for scientists to get into remoter areas without being part of larger team.
74) Lost ability for deep field parties, these were highly successful and now losing background knowledge of how to survive in these isolated camps.
75) Background support for logistics was good from Antarctica NZ for projects.
76) Place of work supported writing up of work afterwards (had grants from Trans Antarctic Association and other small groups).
77) No mentoring but had Balmoral field camp for training for deep field support (group mentoring).
78) Always people there to help but no formal mentoring.
79) All earlier trips had older experienced people but recent trips have researchers with no experience. Important to prime them before they go.
80) Papers produced, conferences and dissemination of information are very important. Can take a while for university researchers to write up and not as fast as Antarctica NZ would sometimes like.
81) Exploration side also important to inspire people
82) Science is based on papers produced and conferences.
83) Concerned about review because some of their papers were not included, does not believe that Antarctica NZ prompted researchers to make sure all their papers were listed.
84) Judging is done by reviewers of next project and approval for next project, does cost a lot to send researchers to Antarctica so most researchers will try and write up eventually.
85) Thinks peer review is best since researcher needs to be careful how proposal is viewed, but it needs enough people in review process. Not sure if they go overseas for peer review.
86) Not much opportunity for funding opportunities within university, Antarctica NZ were going to set up fund but has fallen through?
87) If university closes research funding then there will not be enough money.
88) Science now becoming more focused.
89) Scientists with university tenure only really have advantage for university funded projects unless they have international reputation. Tying in with overseas parties can help with funding from elsewhere. However she thinks that NZ should be supporting Antarctic research.
90) Older rock geology not tied into hot areas, like climate change, and so a concern for future maintaining skills.

91) Have not read review in depth, but unhappy about publications missed out.
92) Geology of Geophysics is local journal not viewed as very good locally but she thinks it is good and has international following.
93) Some of the international journals have page costs for publication which can add to research costs, can be a factor in where to publish.
94) Also consideration of how long it takes to publish, some journals can have quite a backlog.
95) Antarctic Science another good small journal, can be a problem where to publish – specialist or Antarctic journal?
96) She did 6 trips with Antarctic Window, got lots of specimens and gave many talks, good spin off for museum. Research was low priority at museum, more support at university.
97) Antarctica NZ have lost their library, where do they keep the list of papers presumably on a database?, some of their information not easy to open (problem with their database / system).
98) Has applied for FRST and got 4 years for NZ research, competed against CRI and lost out but understands the pressures on CRI as funding is required to keep salaries, etc.
99) Just rejected for Marsden, huge number get rejected and requires lot of work for proposals, they tend to fund long term and large projects, seems all wrong for small projects with relatively low budgets.
100) Small baseline research can lead to big discoveries so narrow focus can be a problem.
101) FRST is really funding agency for CRIs.
102) Lead in time of 2 years and circumstances can change.

Victoria Metcalf (20 December 2006)

103) Received scholarship for Antarctica trip looking at toothfish, research in Boston and ecotourism in Antarctica, now on FRST funded postdoc on Antarctica fish. Recently started a FRST funded post-doc research project in 2005 which covered salary plus $23000/year research costs
104) Mentored on post doc research by Bill Davidson although work is separate to his.
105) Small group of one and hence logistical support less of an issue. Advantage of a small project is that it is easier to 'slot-in' to a logistics pool, possible negatives are that they are sometimes overlooked May link to larger research project such as LGP in the future.
106) Very little money changes hands in the funding of research projects. Victoria has planned to receive a bill upon her return to NZ for $3000 living costs (at Scott Base).
107) FRST funding and Antarctica NZ logistics applications due concurrently Victoria was in the unusual scenario of knowing she had secured FRST funding before applying for logistics support, which may have helped her application with Antarctica NZ.
108) There is no requirement for Antarctic science grant recipients to pass on skills to train new researchers/train ambassadors. Victoria supports taking young people to the ice to stimulate their interest/passion in the continent and to provide new researchers. Outreach programmes play an important role in the assessment of science.
109) Peer review intrinsically biased subject to personal issues. There are major flaws in how the peer review process is conducted. Believes to be true of all journals.
110) The publication process begins much later after the data collection, especially for Biological Scientists because analysis can take months back in the lab.

111) At the moment there is little or no funding for research through the university, not just Antarctica. The onus is on scientists to seek external funding.
112) What Antarctica NZ most wants to see is driven science that focuses on questions to enhance our understanding of Antarctica - not necessarily for commercial benefit but science that follows NZs strategic intent strategy.
113) FRST has similar goals to Antarctica NZ.
114) In discussion with Ministry of Fisheries on future research.
115) NIWA has lion's share of Antarctic funding. Niwa is seen to be the main beneficiary of a lot of funding including M.Fish research funding and they defend it 'aggressively'.
116) Antarctica NZ is seen as being very sympathetic towards university scientists.
117) Victoria feels that as so little is known about many of the species she works with she has to do a lot of work covering the basic biology which could be a potential for M.Fish linkages/funding.
118) The process for scientists to bring back samples for further research in New Zealand is relatively simple providing you have the right MAF permits. Sanford (fishing company) collects toothfish samples for her. Fishing quantity decrease from 100% to 30% is financially viable amount of fish-taking but population crash in biological terms. Needs to be considered from an ecosystem perspective. Government perspective good fishing from toothfish industry and large income. NZ takes the largest tonnage of toothfish compared to any other countries. Rare type of fish from McMurdo. In shallow waters, most species have been identified.

Wendy Lawson (20 December 2006)

119) Has been to Antarctica 10 times; half of that involved research, and other half working as a member on Board of Antarctica NZ. First research project funded by University of Auckland & Antarctica NZ; cost break-down not necessary and full support was implicit. Small focus group; originally for two, but similar theme allowed joint effort of four people - collaborative effort.
120) Obtaining funds: Once you have gained Antarctica NZ approval, then the whole Antarctica NZ support-package is approved (guaranteed). Therefore their peer-review process has to be very thorough, in order to fund worthwhile projects.
121) As a larger research group, it may be easier to obtain the attention and therefore the support from Antarctica NZ.
122) In general the ability of researchers in obtaining positive funding support for other costs of their project depends on researcher's background and where the application is made to.
123) Some costs have been transferred from Antarctica NZ to researchers over the years, eg. clothing, support staff.
124) Difference between universities and CRIs in funding, eg funding for salaries is considered differently at different universities. Consider talking to CRIs researchers eg. Clive Howard-Williams (NIWA), Phil Lyver (Landcare, Lincoln).
125) Researchers make their own research budget and submit to funding agencies.
126) Believes NZ gets very good value for money at project level compared to almost any other nation, eg cost per paper. NZ resources very efficient at project level.
127) Funding is used frugally generally in NZ not just Antarctica.

128) Not enough glaciology in NZ.Antarctica funding but lack of capability in this area, not self interest. Huge potential to use remote sensing (analysis of satellite information) in NZ. Allows data access to places which are very expensive to reach.

129) Need ability to take more younger people down in research parties since they are more likely to be dropped if restrictions on funding (masters, PhD students) since they are not mission critical. NZ Antarctica research population is aging and need more resource for succession and capability planning.

130) Publications are standard metric for assessing science, valuable for ensuring other people know work. Paper published in Nature shown nepotism and sexism in peer review. Huge costs in peer review, labour intensive and flawed process but is valuable. Peer review in NZ can be a problem with a small community.

131) On proposals often have to suggest people so it is common to suggest favourable ones.

132) Only in last couple of years, funding system has changed and she regards as not fully resolved. Traditionally, Canterbury had very good funding compared to other NZ universities (more background sources of funding). Canterbury may have set aside more money for research.

133) Antarctica NZ has fairly 'can do' attitude on trying to facilitate research. Lot of intangible flows which help research, logistics and international contacts.

134) Focus on public good is fairly constant within science research in NZ.

135) Thought review was useful time to take stock for NZ and useful exercise.

136) Thinks fuel price will become the main threat to science research in Antarctica in next 5-10 years.

Dean Peterson (9 January 2007)

137) Science funding in Antarctica - percentage of FRST funding is 1% - FRST is specific output driven research – benefits to NZ – better understanding, etc; and proportion of Marsden funding is 5% which makes sense as blue skies research – primarily answering question why, how the system works, much more basic research.

138) Changes coming out of review – recommended an integrated science committee. Talking with FRST at the moment directly about this concept – all proposals go thru Strategic Advisory Panel (mostly science related); their advice is given to FRST and ANZ who meet again as an integrated committee to make decision (to do with meeting govt objectives and logistics; more focused govt panel – will have govt officials); new process will allow a one stop pathway to get scientific funding for Antarctic research.

139) University funding pretty hit and miss and what Dean would like to see happen is one Research Officer from each university head all requests from the university so the committee doesn't have to deal with a multitude of people; reduce people they need to talk to about funding; researchers who need science funding would channel requests thru Research officer who would then come to this panel. Researchers who already have their money (their $5,000 - $15,000 university grants or grants from Marsden) would be vetted by the university Research Officer
who would then apply on their behalf thru the strategic advisory panel.

140) The review process which led to the recommendation to form this integrated committee was a bit hit and miss and done in a hurry which produced a document which was not well crafted (sentences without verbs, etc). There were no surprises – mostly smoke and mirrors.

141) What has happened over the last few years is that things have completely flipped and the research proposals written for FRST have less science in them than the proposals written for Antarctic NZ. This is because our requirements are science related while theirs are output related. They are often more concerned with who they are collaborating with rather than the scientific methodology which is often not covered. Ant NZ has become more scientific rigorous than the Foundation – that is a major issue.

142) Together FRST and Ant NZ will put together this new structure; there will be a template to fill in. FRST has more bankers and investing people who are more interested in the outputs than the science – it is no longer science merit that is important, it is output. A lot of the science is being reviewed by people who don't know much about it.

143) A criticism of the review if that they did not have a complete list of all publications. Ant NZ had sent out a request to each PI and they either replied or didn't. The ranking of the journals was done thru the library process – no problem with that. One big issue was the Italian journal Terra Antarctica which does not peer review and therefore has a zero weighting. All of the reports from the Cape Roberts project (200-300) were published in that and therefore were not counted. This journal was used because of the Italian connection and was therefore cheap and also very quick. The idea was that later on the scientist put together a more substantive report and published in one of the more reputable journals but that did not happen.

144) Another criticism of the review was that the three days was not long enough to digest everything. Most of the information was provided ahead of time but only three days to discuss it and come up with the report. There has been a lot of things happening on the ice and this review covered 7 years.

145) Tried to keep a balance with presentations to the review committee between big and small projects. Bill Davidson came out as a real shiner because although he is small is small in terms of logistical and financial support he is actively producing. He has heaps of publications, lots of post graduate students and many collaborations.

146) Key performance indicators could be students such as Bill (but not all researchers are teachers); number of publications; education and outreach – how are you connecting with the real world.

147) They are going to try and do a review much more regularly. The new proposal process will actually carry out the function of a review. When a scientist puts his proposal forward he will have to show a good basis for the research he is proposing based on his past work. The number one thing to get a proposal through is to show a good track record. If you have a good track record and a hair-brained idea it is likely that you will still get thru rather than a poor record and a great idea. Unless you are part of an established group or have a mentor it is going to be difficult to break into.

148) There are a huge number of hurdles to jump through to do science in Antarctica – need someone to hold your hand. An example is the artists and writers group who get taken down for one season and get a bit overwhelmed – really need to go for two or more and so do scientists. New science groups are nearly always a disaster. They are either go down there with a ridiculous amount of technology and amount of sophistication and research goes out the window when the technology lets them down or too high expectations. Our example is down there now – the idea proposed sounds fantastic and on the basis of it gets funding for two years but too fantastic. Wants to cover seven sites in the two years and if anything goes wrong it is over. They had electrical problems which they couldn't fix but luckily when they got back to SB someone there could rewire it but it could easily have ruined the whole season.

149) When Dean first started he thought 25% of the support should go into new scientists but now knows that it would be an absolute disaster to have so much allocated to new projects. Work by lone post grad student or scholarship winner is generally always a disaster.

150) Dean is asked about the issue of the same old people going down each year and not publishing anything fresh. Science is an interesting area because if you go down the list of Nobel prize winners almost without exception, most of their cutting edge research as post grad students in the early years of their study and they are getting the prize now when they are 60 or 70. The period in which you are going to do your most significant research is a young scientist and after that just pushing papers around and hopefully mentoring students. The hard part for NZ is the next step. We have created a person like Victoria Metcalfe now how do we keep her without her being so over reviewed that she wants to leave the country.

151) Antarctic NZ put together the LGP structure because there were a whole lot of individual scientists doing there own thing and not talking to each other or relating their work to anything else. Took the opportunity with the LGP project to get them working at the same location and able to discuss their results in terms of a bigger picture, and that is a perfect example of how an organisation like ours can contribute scientifically having a big influence without being too strong on where it is going.

152) The original driver of LGP was to reduce costs but making more efficient use of resources like helicopters. It has actually worked out that why because scientists are smart because they say sure we want to be involved in LGP but we just have to finish our work over here therefore, so far, there has been no savings in costs. And this year LGP was supposed to go to Darwin – all the proposals were in but it had to be scrapped as not enough funds.

153) One of the big problems with funding scientific research is that the rules change every year. Probably changed nine times in the last nine years. FRST have just gone to this policy called "Pick Up the Pace" which guarantees blanket funding to CRIs. If doing research with NIWA or other CRI guaranteed 60-70% of funding. This will not go thru this new system. There are not a huge number of projects, maybe 4 or 5, but their funding is a given.

154) Andrill funding comes from FRST. The decision on how to fund Andrill was officiated and NSF and decisions made by an international panels made up of science

managers from Germany, Italy, US and NZ. They accepted two of the six projects put forward by Andrill. FRST had no influence at this stage. The NZ science manager then returned to NZ and told FRST that Ant NZ guaranteed the logistics funding – could they come up with the scientific money required.

155) Stability of scientific funding. FRST now has three different portfolios or application rounds. When Dean first started it had 17 different outputs and Antarctica was one of those outputs. A ring fence was put around money for each of the different areas and Antarctica at that stage had about $2.5m. Over the years Antarctic science has asked to compete with everyone else and this has enabled them to grow quite a bit but there are no guarantees with the funding now. NZ could not be more competitive. The current round now GLO has $2.5m to give out and currently the proposals total $24m.

156) Will the new structure solve some of the funding problems? It will certainly streamline things as now only one hoop instead to two for scientists. But we need to be careful about science direction – dangerous to get too powerful and what do the people making decisions know – e.g. what do I know about geology?? And other people like me? The way the strategy is written is that it is all encompassing so that it includes all important science. It gives some direction but allows anyone from any scientific area (including social sciences) to participate. We want to grow Ant science and not diminish it but because of this we don't get focus.

Clive Howard-Williams (10 January 2007)

157) Relatively little funding for research in NZ. Two ways of blue sky research funding; Marsden and small university research grants. Other way for funding is FRST if you can demonstrate 'public good'.

158) Public good science fund should be for immediate interest, Antarctic funding gets way with funding from here even though it is not of immediate interest.

159) Blue skies research gets a good run in Antarctica, but small amount of money is more of an issue.

160) Government surplus and interest in role of Antarctica in world weather/climate, interest in Southern oceans for fisheries mean that increased funding could be justified.

161) Science funding goes through MRST, Royal Society of NZ administer Marsden fund under contract to MRST.

162) Min Fish do more immediate research funding for fisheries (stock assessment and biological research directly related to fisheries productivity), more commercial focus and NIWA satisfy these requirements. Not open access information, no linkage with SCAR and this information has commercial confidentiality. Want to develop ecosystem model for the Ross Sea.

163) If you fill in form for public good research funding it helps if you international links (place for form on it).

164) Economies of scale very good for research and most spectacular successes are of this type is US long term research in Dry Valleys had funding from NSF to set up infrastructure

that all scientists need. Individual scientist apply for research to operate within this infrastructure. In terms of measured output (number of papers) has been very successful.

165) LGP has limited fund, good way to get small research teams working under umbrella.

166) Small amount of money to individual projects would be good but shouldn't be driver of main research activity. Marsden is good example since it is so competitive that if you get funding then very likely to get logistics support. Good way of getting individual researchers with small high quality projects into Antarctica.

167) Only one top level scientist within Antarctica New Zealand, FRST reviewers have expertise in wide areas of science but seldom in Antarctica. Need a better combination to review Antarctic Science. Would feel uncomfortable if Antarctica NZ had full control of Antarctica Science - 'tail wagging dog'. However they have to be involved

168) Some of world's best scientists are working down at McMurdo under NSF and so NZ scientists have to be of same calibre and selection process needs to ensure this.

169) The main point here is that I have no objection to visits by distinguished persons, senior Govt officials, etc if these result in a net benefit to our Antarctic operations. In fact such visits are necessary to maintain interest at high levels in Antarctica. I have recently had a discussion with Lou Sanson who assured me that no science was curtailed at Scott Base because of the 50th Anniversary celebrations so I will withdraw my earlier comment regarding my concern

170) Minister made commitment a few years ago that amount of Antarctic research funding would not reduce which set up "ring fence" for the quantum of Antarctic science funding.

171) Antarctica NZ receive Government funding allocation to support science and so have interest not to see science funding reduce.

172) NZ funding process changes all the time in early 1990s had to rebid every year for core funding as process was changing. Now the public good science fund grants are in the region of four to five years which provides more stability.

173) It is apparent that MRST does not see Antarctica as a priority area. Their three new initiatives are energy, new food products and new technologies and potentially areas such as aquaculture and conservation of iconic species will be more important to MRST than Antarctica.

174) The level of National science funding in NZ is low, well below average of OECD countries for gross expenditure on science funding as a proportion of GDP. { I have just looked at the OECD chart of our gross science expenditure and it is not quite at the level of Mexico but rather it is similar to Spain Hungary and Portugal }

175) Ministries identify 'lead areas' for prioritization, unless you can be tied into these then it is difficult to get funding.

176) One in five get through NSF funding and is based on publication record, similar with Marsden, also want to know publications in last five years to check currency. Does not know of better way.

177) He is manager of freshwater and coastal resources at NIWA, often benefit come through patents or commercial advantages, i.e. representation in courts on environmental matters, guidelines for ministry of environment. These are methods of showing immediate importance of science and nothing to do with papers.

178) How does research contribute to establishment of conservation matters? This would be good measure of science outside of publications. Provision of science on impact of human activity for CEP is also useful and justification of marine reserves in the Ross Sea. Formation of Dry Valley ASMA based on science is a direct output to assess quality of

science. Although publications must be number one, these are also one of significant importance.

179) Antarctic science is appraised through the publication record of the individual researchers and research teams. This is done regularly and is part of the process of evaluating the capability of researchers who apply for support.

180) Dept of Land and Survey responsible for charting oceans and NIWA have received funding from them for surveys. NZ used to run oceanographic program.

181) Will populate a ship with scientists if opportunity presents itself on a commercial survey.

Murray Munro (11 January 2007)

182) Murray hasn't been to Antarctica but wanted to get researchers down there, first people went down in 1989 although he had samples two years previously. All of funding was controlled through Canterprise (now a private company) who deal with patenting and marketing issues, mainly in science and engineering. Logistical support through Antarctica NZ with money from PharmaMar (a Spanish pharmaceutical company) and the University of Canterbury in 1990/91. Looking at grafting and rejection/acceptance issues.

183) Published work in 1995/96 and then patented later. Companies take risk in research but no control over work.

184) 1 patent came out of Antarctica work, published work and then obtained patent from a derivative compound.

185) Research involved diving in Antactica in about 25-30m of water with 20 min time limit. There had been no diving for 5-7 years beforehand due to an accident.

186) Science seems to get written up early by his department.

187) New researchers are good because they have different approaches and can bring new techniques into research.

188) He would like to have a look at the first 30-40 feet of the Andrill cores to look at microorganisms.

189) Antarctica NZ was not part of royalty sharing on the first trip but was on the second.

190) Government and private funding do not mix well, there are different requirements and objectives and he would not do it again.

191) Marsden funding is for more blue sky research; FRST is more favoured to the CRIs and quite controlled and long term, not good for university research.

192) University of Canterbury is well off for equipment but not manpower.

193) He thinks NZ is getting value for money with science spending.

194) University promotion is normally based on research output.