Submission on Te Ara Paerangi Future Pathways Green Paper

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SUMMARY

The new NZ research ecosystem should include strategic plans that involve transparent review processes drawing on both international and local expertise and experience. They should also take into account resources available and appropriate evidence of previous performance. Implementation plans should include mid-term and end-of-term reviews to provide for adjustments and preparation for the next strategic plan. Our views draw on our knowledge of the history of NZ's research in Antarctica and the Southern Ocean.

INTRODUCTION

In considering "how we best position New Zealand's research system for the future", the Future Pathways conversation is structured around six themes, all key areas of the research system as it is now. Our submission takes a longer perspective - reflecting on the change in research culture since the 1950s, when the Department of Scientific and Industrial Research (DSIR) and the Universities developed NZ's international reputation in many fields of science.

Since then the research "ecosystem" has undergone just one major restructuring, around 1991, with the creation of Crown Research Institutes and introduction of contestable funding to improve efficiency. However, it has become increasingly complex in recent years through a mix of developing technology and the growing need for solutions to growing health and environmental problems combined with the impact of natural hazards.

We will focus for examples on a small but internationally significant part of NZ's science sector – Antarctic and Southern Ocean research, but we know colleagues in other fields are seeing similar patterns in recent times. Our experience as part of the NZ research system began as graduate students in the 1960s when science was an adventure that followed the International Geophysical Year (IGY in 1957-58), the first crossing of the Antarctic by the Commonwealth Trans-Antarctic Expedition, the early mapping of the Transantarctic Mountains, and the first geophysical surveys between NZ and the Antarctic.

HISTORY 1957 TO 1991

NZ's Antarctic research during and following IGY has been analysed by Morten (2017), who sees two distinct phases: "1957 until 1991, when the Department of Industrial Research and the Universities were the key research organisations, and after 1991, when the publicly funded sector became more diverse". Funding decisions in the first phase were largely curiosity-driven, and collaboration with the US guaranteed by the Christchurch departure point for both Scott Base and McMurdo Station. This period also established NZ's leadership in major Antarctic initiatives of the day, the Ozone Hole, the BIOMASS project in the Southern Ocean leading to the CCAMLR convention, biology of Antarctic lakes and coasts, and drilling for climate history from the sea ice. By the end of 1982 NZ was the third most prolific producer of Antarctic research papers - 1484 in recognised journals (DSIR, 1983).

HISTORY SINCE 1991

Since 1991 and the shift in Government research from the DSIR to Crown Research Institutes, the focus has been on """coherent strategies and the outcomes sought with well-defined funding criteria and contests accepted as fair and transparent (Morten, 2017). However, the radical transition that brought this about (STAC, 1987) also changed the research culture leading to greater efficiency in the eyes of some, and increased bureaucracy in the eyes of others. Two organisations were established for this - the Ministry of Research, Science and Technology for developing policy, and the Foundation for Research, Science and Technology for its implementation through allocation of funding through competitive bidding. Innovative scientists worked with sympathetic managers making it work pretty well most of the time. However further

changes were to come as the Foundation and Ministry were merged in a Ministry of Science and Innovation in 2010, with that merging in 2012 into a much larger entity, the Ministry of Business, Innovation and Employment. While this led to added complexity and loss of corporate memory success stories continue.

In the 1991 changes, the DSIR's Ross Dependency Research Committee, and its responsibility for Antarctic research, was dealt with differently from NZ research by transferring Antarctic Division DSIR to the Ministry of Foreign Affairs and Trade (MFAT) to strengthen its dealings with Antarctic Treaty System and support the NZ/US relationship. Crucially it was considered that NZ's Antarctic interests would be best served by active and responsible stewardship for present and future generations (Morten, 2017). That led to the setting up of Antarctica New Zealand (AntNZ) with the 1996 NZ Antarctic Institute Act, with its responsibility for all NZ's Antarctic operations and its central principal focus 'to maintain and enhance the quality of NZ's Antarctic research".

AntNZ produced its first science strategy in 1998 (Peterson, 1999) with five broad themes linked to expected outcomes and criteria for prioritising proposals for the period 1999-2004. The chapter headings indicate the comprehensive nature of the document as a guide to the following six years of research: Global context; NZ context; Principles and Priorities; Science themes; the Future; Strategy implementation; and Appendices including Existing commitments in Antarctic Science Funding, and NZ's current logistic capability.

In 2005, a review panel comprising two Australian, one US and two NZ scientists assessed the NZ's Antarctic science from 1997 to 2004 (White, 2005). The Committee was tasked with:

1) Quality assessment of Antarctica NZ-supported research over the past 7 years, the fit to the NZ Antarctic Science Strategy document, and the 2004 Statement of Strategic Interests
2) Guidance on the whole Antarctic and Southern Ocean programme in relation to logistics and science funding.
3) Guidance on international cooperation through existing synergies and possible new partnerships.

It concluded "In addressing these questions the committee was immediately struck by the complexity of the funding process." On science quality the Panel observed "The NZ Antarctic science presented to the Review Committee indicated that excellent world quality work is being done in the program". They made a number of recommendations to ensure this continued, including the setting up of an Antarctic Science Integrating Committee as an over-arching guide, and a further review in 5 years. None of the recommendations were implemented.

Nevertheless, the 2000-2010 decade proved to be highly successful for NZ-led multinational projects (eg ANDRILL 2006-08, and the Latitudinal Gradients Project 2004-11), with publications rising and bumper years for biological sciences in 2006 and 2010.

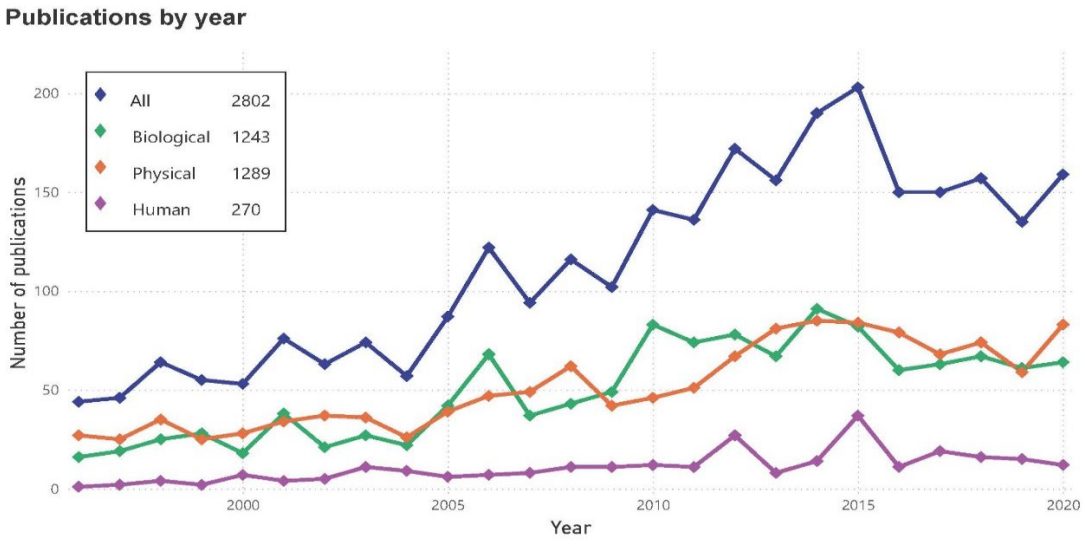

Fig. 1 Annual numbers of NZ-authored publications of all types from the Scopus database. Numbers in key are totals in database. Barrett, 2022.

THE LAST DECADE

In 2009 MFAT led the development of a decadal Antarctic and Southern Ocean strategy for 2010-2020 (MFAT, 2011), publishing an Antarctic and Southern Ocean Commitment statement in 2019 (MFAT 2019), and an updated 2021-2030 strategy last year (MFAT, 2021), but no expert review of the research was undertaken beforehand. Within the last decade the formation of the NZ Antarctic Research Institute (NZARI), a public-private partnership, pioneered new research between 2012 and 2018 that included a focus on the vulnerability of the Ross Ice Shelf. This has been taken up and expanded by a 7 year (2018-25) $49M MBIE Strategic Science Investment Fund award to Antarctica NZ, the Antarctic Science Platform (ASP, "to understand Antarctica's impact on the global earth system and New Zealand, and how this might change in a warming world." (website).

The ASP is unique in the history of the New Zealand Antarctic Programme in that while it is hosted by Antarctica NZ, it was developed by MBIE with leading NZ Antarctic scientists in collaboration with an international advisory panel. It has a strategy, an implementation plan in form of peer-reviewed proposals and a mid-term review process. In addition, it is aligned closely with the largest of three research programmes of the international Scientific Committee on Antarctic Research (SCAR-INSTANT). It has every prospect for success. The ASP involves around 35% of NZ's research spend, but what of the planning and coordination for the other 65%?

"A VERY COMPLEX ECOSYSTEM"

The ASP was launched in June 2019 at the annual Antarctic Science Conference, where the Prime Minister's Chief Science Advisor observed that "I'm an engaged scientist and it took me a while to figure out" the "very complex ecosystem" of Antarctic science. This led to an effort by the authors and colleagues under the aegis of the NZ Antarctic Society to map and explain NZ's Antarctic and Southern Ocean research system in a way that both scientists, managers, administrators and policy analysts could understand (Falconer and Barrett, 2021).

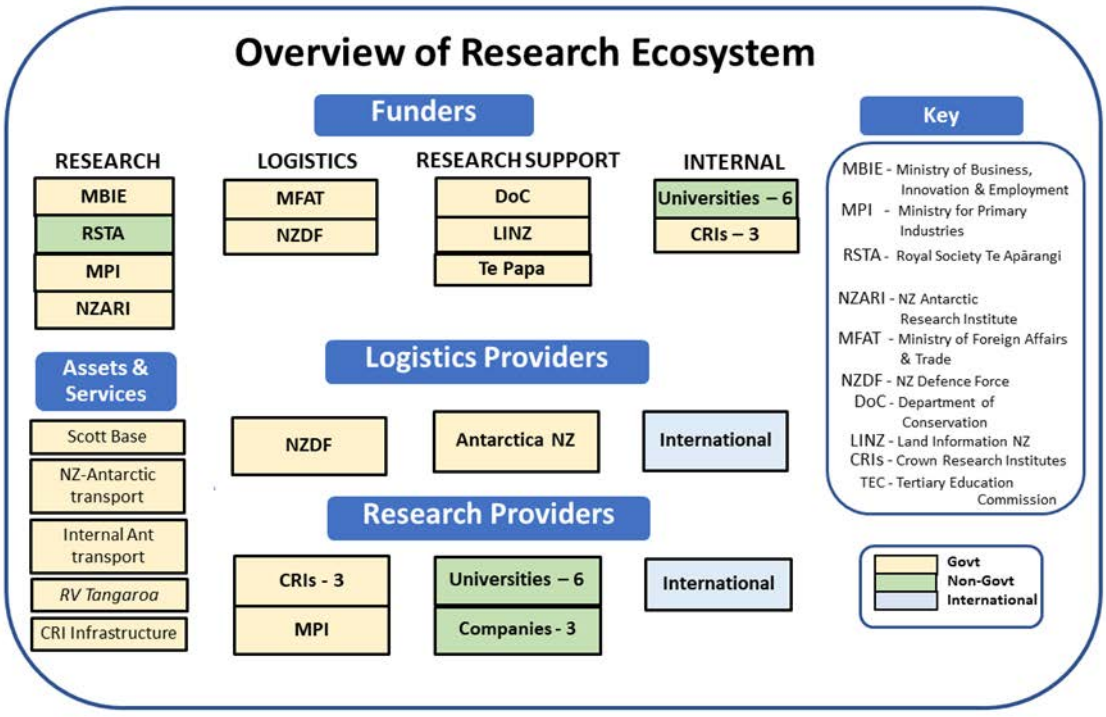

Fig. 2. Overview of New Zealand's Antarctic and Southern Ocean research ecosystem. Funders and research providers are shown in more detail in Figures 3 and 4 below. Note group colour coding in later figures. From Falconer and Barrett (2021).

Figure 2 from this report shows that even this small sector of the NZ science ecosystem was indeed very complex, and interestingly to those within the system as well as outside it. While recognising our data and analysis were necessarily limited we reached some conclusions, and reproduce two here that are relevant to virtually all NZ research sectors.

***Funding uncertainties**: Of the total research expenditure ($24.1M) 26% is sourced from highly competitive application processes across all NZ science with duration of awards from one to five years. Another 30% (now 40% with full ASP funding) is from MBIE's Strategic Science Investment Fund (SSIF) grants for two to seven years. SSIF grants have been negotiated from time to time in response to needs of the day with little long-term strategic oversight evident other than the recent ASP award.*

***Human capacity** People are as important as funding for achieving research. Information on the extent and depth of skill bases at organisation and project level would be valuable for strategic planning since skills, experience and leadership qualities take time to acquire.* [Funding for capacity development is important for all NZ research]

More detail is provided in Figures 3 and 4 with funding information provided to project level for the 2018/19 and 2019/20 financial years.

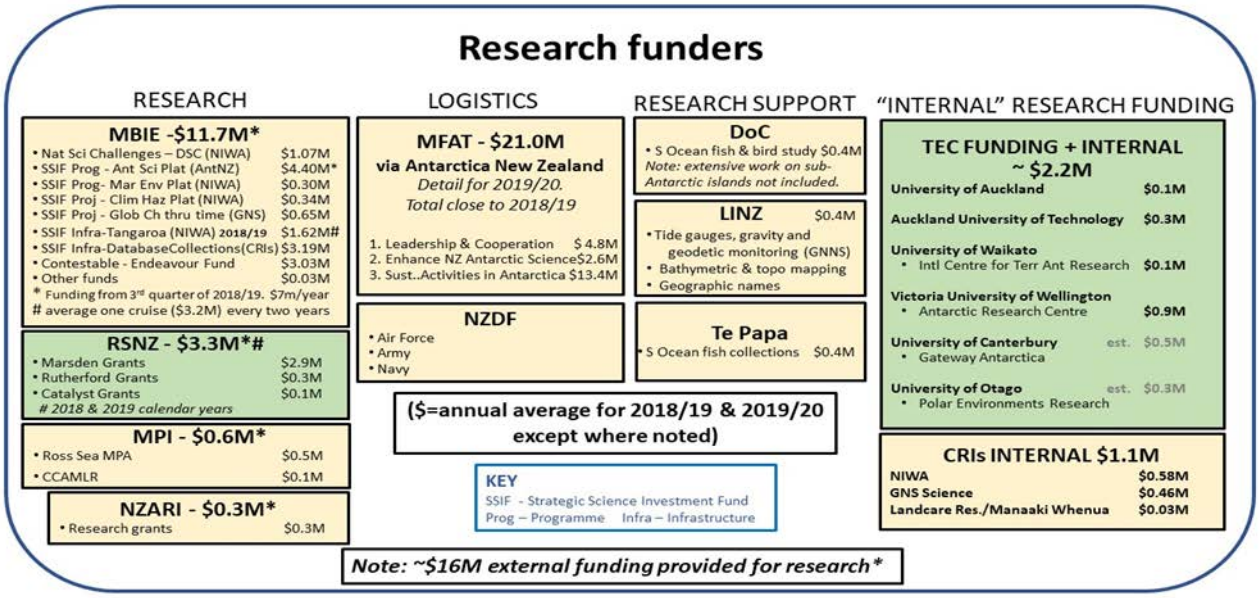

Fig. 3. Research funders for NZ's Antarctic and Southern Ocean research ecosystem with approximate sums for major funding categories. Project funding by MBIE and RSTA is shown in sections 3.5 and 3.6 of the report. From Falconer and Barrett (2021).

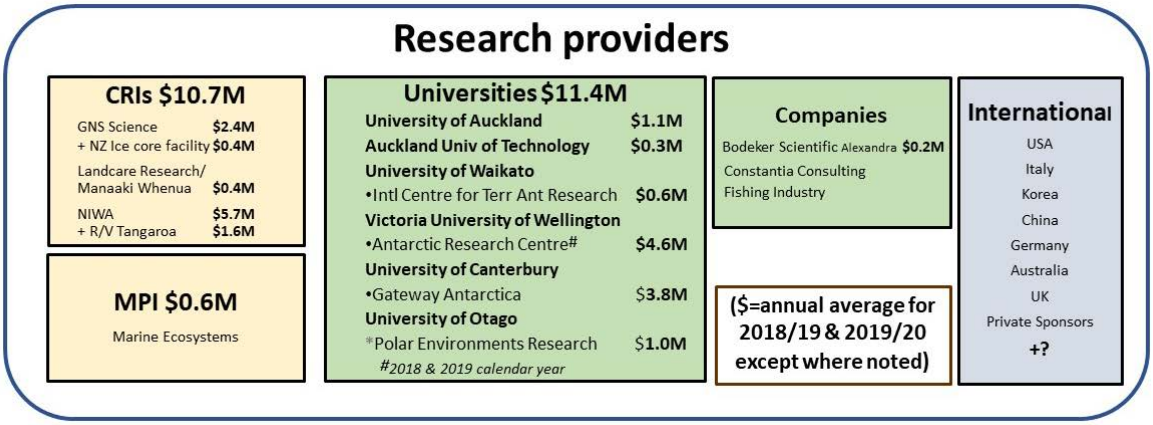

Fig. 4. Research providers for NZ's Antarctic and Southern Ocean research ecosystem with approximate sums for each. Examples with more detail on university and CRI funding are shown in section 3.8 and 3.9 of the report. From Falconer and Barrett (2021).

What isn't evident from these funding figures structured around institutions are the research communities that develop within and between institutions, which grow from the large and small research questions of the day. The ASP is a good example of this as the largest and most recent in the Antarctic community driven by a single focus on a melting ice sheet, but also because it is structured around four projects that each hosts a cluster of smaller specialist communities, along with a modelling hub, all of which contribute to that focus.

What older researchers can see from personal experience is the evolution of the many strands of research over decades that have given rise to the framework provided by the ASP for its now relevant focus. The scale and complexity of each framework in the NZ research community is likely to depend on the different problems requiring focus and the histories of the research communities that can address them. There will also be generic aspects identified in the six key questions. We leave those issues to the many other submissions

ASSESSING RESEARCH AND THE IMPORTANCE OF THE REVIEW PROCESS

A key issue in the history of Antarctic research in New Zealand has been the unwillingness of those responsible for its direction to arrange for reviews of previous research by panels of researchers with expertise and experience both local and from overseas. In the DSIR days the adventure-driven culture set its own high standard, but after 1991 public sector expenditure was to be justified by outputs generated, rather than inputs provided, and contestability was to be the governing principle. This led in time to a culture more focussed on funding, and a need for expert reviews to assess performance, along with objective data for performance benchmarks.

The first strategy review and implementation plan for 1998 to 2004 (Peterson, 1999) was exemplary, as was the review by a multi-national panel of experts that followed (White, 2005), as noted earlier. However, the recommendations were not adopted, in particular, the recommendation for five yearly reviews, and there has yet to be a review of the whole NZ Antarctic and Southern Ocean programme[1].

Despite this lack some idea of the health of NZ Antarctic and Southern Ocean research can be gauged from a review of bibliometric data from a database of 2802 NZ-authored publications on Antarctic and Southern Ocean research from 1996 to 2020 (Barrett, 2022). The key metrics used are the annual number of papers, reflecting "productivity", and the cumulative total of the previous six years of citations, reflecting "impact". Both are defined in this way by the AntNZ Statement of Intent (2013-16). We have used the global Scopus database as a source, based primarily on peer-reviewed publications, and do not take into account many useful documents from Government agencies, University theses and international Working and information papers (eg for Antarctic Treaty, SCAR and CCAMLR meetings). However, using Scopus allows us to compare our database metrics with those from other countries.

We know the use of bibliometrics is fraught in its crudeness and subject to biases, as Evans and others (2021) argue in their review on Excellence in Science. However, their concerns are mainly about its use for individual assessments, as a measure of excellence, and use by non-experts, and we agree. But we consider it interesting and useful to consider annual publication numbers and citations from NZ-authored Antarctic and Southern Ocean research over the last 25 years as a starting point for closer examination by an expert panel for assessing the strengths and weaknesses of NZ's research in this area. There will be an opportunity for this in the ASP mid-term review this year, as well as MFAT's mid-term review of its Aotearoa New Zealand Antarctic Research Directions and Priorities 2021-2030 (MFAT, 2021) no later than 2026.

This brief introduction to the database provides a view of trends in publication numbers in two science domains, Biological and Physical, roughly equal in numbers and around 90% of the database, and where citations are widely used as a measure of impact. Humanities represent just under 10%. Figure 1 shows the progressive though irregular rise in publications from 2004 to a peak at ~ 200 in 2015 followed by a drop to ~150 in the following 4 years. This drop suggests some difficulties with the programme and would seem to warrant examination by experts.

[1] A multi-national panel of experts conducted a mid-term review of NZARI (Kennicutt, 2015), then supporting less than ¼ of NZ's Antarctic research. The panel made 10 recommendations, but the substantive ones weren't adopted.

Citations as a metric are fraught in a number of ways, especially when used as a time series, for with any publication they can only increase with time, and almost all Antarctic publications do. However, the AntNZ metric, total citations from the previous six years (Fig. 2), is useful because it shows a trend through time that is measured fairly and consistently.

It's important though in considering a change in trend, for example, the peak for "All" at 2018 in Figure 5, to reflect on the timing of its cause. The metric is calculated from summing the rising annual citation numbers from publication year (2018) to py-5 (2013), the last two years having the roughly the same number of cites as the previous 4 (in fact a little over, being 57% for the last decade). Therefore, the peak is a consequence of a high point in numbers 4 years previously. Since it might take a couple of years after a funding award for research to be published and citations begin, that shifting from a rising to a falling trend might be a consequence of events 6 or more years earlier. Another feature worth expert consideration.

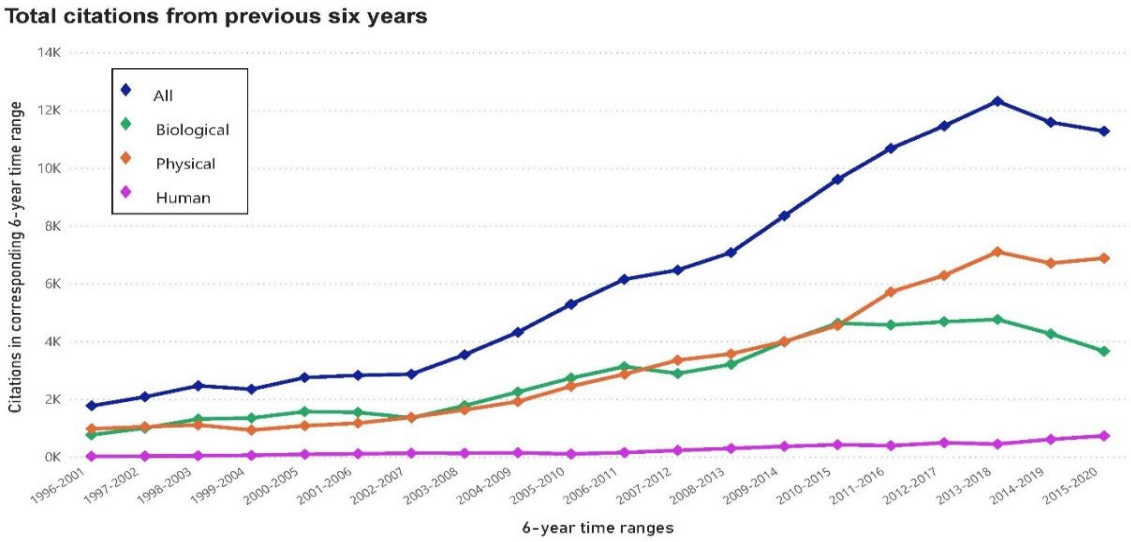

Fig 5. Total citations from the previous six years including the year of publication. A measure of overall impact through time, though reflecting responses to research ~6 years before the latest year in the range.

A final observation for the moment is the two citation trends for Biological and Physical sciences, trading places from 1996 to 2014, where Physical sciences continue to rise but Biological sciences decline. Other data indicate the research is generally still of a high international standard, but again worth attention.

A FINAL NOTE

We conclude with a plea for the new NZ research ecosystem to include strategic plans that involve transparent review processes to maintain their good health. They should involve both international and local expertise and experience, and take into account resources available and appropriate evidence of previous performance. It also seems prudent to develop strategies with implementation plans that include mid-term and end-of-term reviews to provide for adjustments and preparation for the next strategic plan.

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