New Zealand
Antarctic
Research Institute

ANNUAL REPORT

2015 – 2016

NZARI'S VISION & PURPOSE

OUR VISION
That new knowledge motivates humanity to act before the challenge of climate change is too great.

OUR MISSION
To build world-leading research teams positioned to address the questions of global significance.

To facilitate research that motivates communities, policy makers and world leaders to act.

OUR FOCUS
Antarctica and the Southern Ocean – the source of some of the greatest impacts of a changing climate

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LATEST FINDINGS

Headlines from research by NZARI and its collaborators since 2013

RATES OF ICE SHEET COLLAPSE
will be greater than those predicted by the Intergovernmental Panel on Climate Change.

ANTARCTIC WARMING LAGS BEHIND ARCTIC WARMING
due to the ozone hole – but rates of warming will increase as the ozone hole heals.

CLIMATE MODELS PREDICT
that Antarctic warming is consistently more than twice the global average.

CO_2 LEVELS OF 500PPM
in Earth's past resulted in mass loss from both West and East Antarctica equivalent to more than 20m of sea level rise.

MELTING ICE PATTERNS
will be driven by changing ocean conditions, changing atmospheric temperatures and internal limits on ice flow and melt.

SUPER-COOLED MELTWATER
from beneath ice shelves drives sea ice growth and extent.

WARMING AND ACIDIFYING WATER affect juvenile and adult stages of Antarctic marine invertebrates.

GENETIC DIVERSITY IS VITAL
to ensuring adaptability to changing atmospheric and sea water conditions.

ANTARCTIC TOOTH FISH
have not disappeared from McMurdo Sound as previously thought.

EVIDENCE OF SOUTHWARD SHIFT
of westerly wind belt around 5000 years ago – consistent with findings in South America.

New Zealand Antarctic Research Institute

NZARI'S POINTS OF DIFFERENCE

1

There are many elements that contribute to NZARI's success and distinguish the Institute from other polar science initiatives around the world. NZARI is led by scientists who maintain active research programmes in Antarctica and the Southern Ocean. This team is highly cognizant of current research findings and the future direction of research that is focused on change due to increasing levels of carbon dioxide in the atmosphere. This currency ensures that NZARI's scientific research programme is both highly relevant and cutting edge, and the scientists we support are at the forefront of discovery.

2

Although NZARI is an independent organisation, our relationship with Antarctica New Zealand enables NZARI-funded science to be logistically supported in some of the most challenging Antarctic environments. In other words, we work together to enable scientists to get to where they need to go to best answer the most pressing questions. NZARI is actively encouraging the formation of international collaborative programmes by breaking down institutional boundaries and establishing the powerful multidisciplinary teams needed to solve major scientific challenges.

3

NZARI is focused on answering key questions of global significance, and has taken a key role in initiatives to define these questions, and then map out the future direction and approach to answer them. NZARI is relatively small and virtual in nature, which provides freedom and nimbleness to focus on the questions that transcend national funding priorities and goals. We direct funds from New Zealand's research institutions into Antarctic and Southern Ocean research by requiring matched funds, which ensures that money raised by NZARI goes directly towards supporting research.

4

NZARI scientists are dedicated to achieving outcomes for humanity. We seek to predict the global implications of a warming planet on Antarctica and the Southern Ocean, and determine how this will affect the rest of the world. Our scientists are motivated to understand Antarctic and Southern Ocean ecosystems to better inform governments in the face of changing climate and resource pressures. NZARI recognises the importance of communicating science findings to policy makers and the public. We have a number of initiatives to assist scientists to communicate their findings and lift the level of understanding of key scientific principles by media, industry and stakeholders in order to establish critical direct pathways to policy.

CONTENTS

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CHAIR'S REPORT

The United Nations' climate change conference in Paris this year will be remembered principally for success in finally coalescing nations around a ceiling target of global temperature increase (however challenging that will be to achieve). An equally important outcome at Paris was universal acceptance that in many respects "the horse has bolted" and we now must devote as much investment in adapting to a warming world as we have in the past to mitigation.

NZARI is focused on determining how climate change is impacting Antarctica and the Southern Ocean in order to enable better predictions of how this will play out in the world's ocean and weather systems that sustain life on Earth. The Paris Agreement will ignite demand for this vital research, enabling planners and policy makers to design better infrastructure for future generations of people living by the sea – approximately 80% of the world's population.

Another primary purpose of NZARI is to stimulate investment in Antarctic science by our partners, the New Zealand Government, through our operating agreement with Antarctica New Zealand. Thus we were delighted when earlier this year Foreign Minister Murray McCully CNZM announced a significant increase in funding for Antarctica New Zealand's logistic support.

Evidence of the need for this funding boost was demonstrated last season when NZARI-funded science projects required scientists to travel to locations at the very limits of current logistics capacity. Antarctica New Zealand did an outstanding job of securing safe airlift and traverse logistics to deliver research teams to our projects at the Siple Coast of Ross Ice Shelf and Cape Adare at the confluence of Ross Sea and the

Southern Ocean, and ensured their safety in the field.

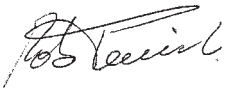
NZARI's unique business model of partnerships between global philanthropy and government agencies that can provide access to remote regions of Antarctica where science is most needed, continues to attract global interest. It has enabled us to move more quickly to support leading-edge science projects that otherwise may not have been funded. Our science is making a difference. A project partially funded by NZARI that included scientists from New Zealand, USA, Italy and Germany has revealed that Antarctica's massive land-based ice sheets are more vulnerable to increasing global temperatures than previously thought, with significant consequences to future sea level rise.

It is pleasing to see NZARI staff and supported researchers contribute to key policy discussions at an international level. Such involvement delivers on our strategic objectives by ensuring NZARI is facilitating environmental research that supports Antarctic management outcomes and communicating effectively to stakeholders on Antarctic and climate science issues. In May, Prof Wilson represented New Zealand at the Scientific Committee on Antarctic Research Integrated Science for the Subantarctic meeting in Punta Arenas, and staff continue to advise the Ministry of Foreign Affairs and Trade on our science findings, which has a pathway to policy through the Antarctic Treaty System.

On behalf of my fellow trustees I want to acknowledge the dedication of our small hard-working team led by Executive Director Prof Gary Wilson, his deputies Dr Vonda Cummings and Prof Craig Cary, and advisors Drs Rebecca McLeod and Fiona Shanhun. We are extremely grateful for the expertise and guidance provided by our International Science Panel and most appreciative of the ongoing support provided from Antarctica New Zealand, ably led by Peter Beggs, with contribution of expertise in communications, business support and logistics/ operations.

I also record our thanks to our key partners the Aotearoa Foundation, Air New Zealand and National Geographic Society.

Finally, my thanks to the trustees for their wise counsel and steady support during the year. This year we also celebrated Prof Mary O'Kane being made a companion of the Order of Australia.



Sir Rob Fenwick
Chair

Photo: Fiona Shanhun © Antarctica New Zealand Pictorial Collection

DIRECTOR'S REPORT

We are making excellent progress on implementing our strategic objectives, which is resulting in a wide-ranging, multifaceted and now well-established programme. NZARI's provision of consistent and reliable funding for innovative research, is having the desired effect of building capability in the research community, attracting new talent, and delivering high impact outcome-focused research. The attraction of new funds via partnerships with industry is a clear indication of confidence in NZARI's programme. Four years since the establishment of NZARI, we are now beginning to realise the outcomes of research supported in the early days. Publications emanating from these investments are delivering new knowledge and technology, which are directly influencing Antarctic policy.

In September, we signed an extension of our partnership with Air New Zealand. Air New Zealand's investment with NZARI is part of their sustainability programme, and will facilitate a three year programme of research focused on better understanding the resilience and adaptation of Antarctic ecosystems to a changing environment. This flagship research programme, will begin in the 2016/17 season, and will involve teams of New Zealand and international scientists conducting novel experiments in a range of environments across the Ross Dependency. The programme will deliver significant new knowledge and understanding that will guide management responses across the Ross Dependency.

Scientists that have been supported by NZARI continue to excel on the world stage, testament to the quality of our research programme and credit to opportunities that NZARI funds are helping to provide. NZARI continues to build this pool of scientists by initiatives such as sponsoring postgraduate

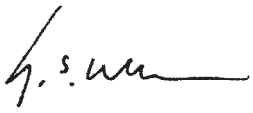
scholarships and supporting early career researchers.

In 2015/16, our partnership with National Geographic commenced with filming of science field teams over the field season and will soon deliver what promises to be an entertaining and informative portrayal of our Antarctic Research Programme to millions of people across the globe. Our researchers are being encouraged to tell their science stories in innovative ways, which is leading to some exciting collaborations and outputs. Our work with scientists, media, industry and policy makers at Winter School and the New Zealand Antarctic Science Conference is improving the quantity and quality of Antarctic science stories.

In March we supported eight new NZARI Type A projects, including one Postdoctoral Research Fellowship. Of the eight projects funded, five will be supported to conduct fieldwork in Antarctica, whilst the remainder make use of archived samples or remote technologies. The new projects include researchers from Landcare Research, the University of Canterbury, University of Otago, GNS Science, the Cawthron Institute and the University of Auckland, with collaborators from Australia, Belgium, South Korea, the United Kingdom, and the United States.

Last season we were excited to launch our new Ross Ice Shelf Programme, with joint support from the Ministry of Business Innovation and Employment and Marsden. Two teams conducted geophysical surveys on the ice shelf - one team worked at a site towards the middle of the ice shelf some three hundred kilometers from Scott Base and the other team at the Siple Coast, a thousand kilometers from Scott Base. We also established a field camp at Cape Adare, some eight hundred kilometers to the north of Scott Base, and conducted our first season of fieldwork in nearby Robertson Bay and at the Cape Adare Penguin Colony. Both of these programmes benefitted from collaborations and support from the United States, Italian and Korean Antarctic Programmes.

I would like to acknowledge the support and guidance of the Trustees/Board and congratulate our esteemed Chairman, Sir Rob Fenwick, on his knighthood.



Gary Wilson
Director

THREE YEARS OF PROGRESS

Since its inception in 2012, NZARI has changed the paradigm for Antarctic science by breaking down institutional barriers, attracting new talent, and accelerating research efforts in critical areas.

Photo: Gary Wilson © Antarctica New Zealand Pictorial Collection

STRATEGIC DIRECTION

In 2013 we launched seven strategic initiatives to address the major challenges facing Antarctica's future. These strategic initiatives were the product of a nationwide "Antarctic Futures" workshop that NZARI hosted. Over 80 scientists from across most New Zealand universities, several Crown Research Institutes and other independent research organisations participated in the workshop. The strategic initiatives, outlined below, guide our research plan development and bids for funding. We have made significant progress in focusing the Antarctic Science Programme on the most relevant and pressing areas of research.

Our primary interest is in reducing the uncertainties around Antarctica's future role in global sea level, climate and ecosystems to inform management and policy directions and decisions.

Boundary conditions in a high CO_2 world

Increasing levels of atmospheric CO_2 are warming the planet and driving change at the poles at a greater rate than the rest of the globe.

NZARI's goal – to determine at what levels and to what extent this will drive response in the Antarctic ice, ocean and biological systems.

Biological indicators of changing climate

Biological systems integrate across a wide range of environments and timescales. They also tend to be adapted to natural variability and therefore reflect longer-term trends in physical systems.

NZARI's goal – to establish a long term ecological research and monitoring programme to detect changes in ocean, atmosphere and biological systems.

The Ross Ice Shelf

At ~500,000 km^2, this is the largest of Antarctica's floating ice fringes and it represents an Achilles heel in the ice-ocean-climate system.

NZARI's goal – to determine what controls the rate of transfer of ice from Antarctica's ice sheets to the ice shelf and what controls the rate of melt to the underlying and surrounding ocean.

Climate prediction

The Antarctic polar vortex and surrounding westerly winds drive short timescale climate response in the Southern Hemisphere.

NZARI's goal – to connect key time-series of observations with new climate models in order to predict future climate change for Antarctic and the Southern Ocean.

Ocean connections

The Southern Ocean has three important roles in the ocean climate system – it conveys heat into the Antarctic, it insulates Antarctica, and it sequesters more than 40% of anthropogenic CO_2.

NZARI's goal – to detect changes in ocean condition that will have major implications for future ice loss, sea level rise and global CO_2 levels.

Marine ecosystem structure

In the Antarctic, the wider marine ecosystem is highly reliant on unique marine species. But, to date we have limited understanding of the relationship of the wider ecosystem to physical parameters and impacts.

NZARI's goal – to better understand Antarctic and Southern Ocean Marine ecosystems to improve stewardship through protection and monitoring.

The Subantarctic

The Subantarctic islands are positioned at the northern limit of the Southern Ocean. Their highly adapted iconic species provide a unique opportunity to measure Antarctica's changing impact on the rest of the world.

NZARI's goal – to establish a long term ecological research and monitoring programme to detect changes in ocean, atmosphere and biological systems.

THE RESEARCH PROGRAMME

NZARI has developed three funding streams to accelerate research and advance understanding of its strategic priorities:

1) Short term funding to develop ideas, solve key immediate questions, and develop scientific teams and approaches. We use a grass roots approach, encouraging scientists to develop their best ideas. Projects tend to employ a high risk – high gain angle with intent to shift the research agenda beyond traditional approaches. We offer up to $100,000 over a 1-2 year period and strive for an average 1:1 match from non-NZARI sources each year.

2) Longer-term funding to develop multidisciplinary teams and collaborative approaches to testing some of the bigger questions around our strategic themes. We offer up to $300,000 per year for 3 years and require a minimum 1:1 match from non-NZARI funds.

3) Funds to advance the uptake of NZARI's scientific progress through contributing to national and international discussions and policy development.

NZARI is committed to growing knowledge of how global system change will likely impact countries and communities, enabling them to plan and adapt on appropriate timescales. Trending news stories and recent high-profile publications with NZARI support over the past year provide a barometer for where NZARI's research is contributing to current global debate:

Melting ice and sea level rise – recent studies have shown that Intergovernmental Panel on Climate Change (IPCC) predictions for Antarctic ice sheet melting did not account for the role of melting ice shelves in controlling the loss of Antarctic ice mass. In fact, the vast ice shelves are more vulnerable than predicted, playing the cork-in-the-bottle role. Consequently, sea level rise may well occur sooner, at a faster rate and to a greater extent than previously acknowledged by IPCC. From its inception, NZARI has advocated greater research focus on the impact of warming ice shelves.

Anomalous sea ice growth – recent growth of Antarctic sea ice was an unpredicted response to warming. NZARI research explains this by demonstrating that sea ice is more responsive to production of cold water from beneath melting ice shelves and the cooling effect of the ozone hole than warming temperatures.

Role of increased CO_2 in Antarctica's changing climate – NZARI supported recently published work identifying past intervals of elevated atmospheric CO_2. These studies show that CO_2 levels of 500ppm resulted in mass loss from both West and East Antarctica equivalent to more than 20 m of sea level rise. Current predictions are that the planet will reach these levels again within the next 50 years, which compels us to learn more about the pathways that the globe may face as it continues to warm.

Threats to Antarctic biodiversity – NZARI has supported research on Antarctic top predators that has enabled several papers to be prepared for the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to provide scientific justification for a Marine Protected Area in the Ross Sea.

Changing Southern Ocean and climate conditions – NZARI research has demonstrated that westerly winds migrate southward with warming temperatures, with the potential to change the balance of natural CO_2 sequestration in the Southern Ocean.

Photo: Rebecca McLeod © Antarctica New Zealand Pictorial Collection

STAKEHOLDER ENGAGEMENT

It imperative that research findings are clearly communicated to the public and those with influence, to ensure that our science programme is making a valuable contribution to increasing understanding of the issues, improving future projections and motivating action. Progress in scientific publications, science meetings, clear pathways of communication to policy makers and public outreach are outlined below.

Publications 2013-2016

Boundary conditions in a high CO_2 world

Galeotti et al., 2016. Antarctic Ice Sheet variability across the Eocene-Oligocene boundary climate transition. *Science,* vol. 352, 76-80.

Golledge et al., 2015. The multi-millennial Antarctic commitment to future sea-level rise. *Nature,* vol. 526, 421-425.

Levy et al., 2016. Antarctic ice sheet sensitivity to atmospheric CO_2 variations in the early to mid-Miocene. *Proceedings of the National Academy of Sciences,* vol. 113, 3453-3458.

Patterson et al., 2014. Orbital forcing of the East Antarctic ice sheet during the Pliocene and Early Pleistocene. *Nature Geoscience*, vol. 7, 841-847.

Biological indicators of changing climate

Beet et al., 2015. Assessing the distribution and genetic diversity of Antarctic springtails (Collembola). *Genome,* vol. 58, 193-194.

Chown et al., 2015. The changing form of Antarctic biodiversity. *Nature,* vol. 522, 431-438.

Collins & Hogg, 2016. Temperature-related activity of *Gomphiocephalus hodgsoni* (Collembola) mitochondrial DNA (COI) haplotypes in Taylor Valley, Antarctica. *Polar Biology,* vol. 39, 379-389

Foo et al., 2016. Contributions of genetic and environmental variance in early development of the Antarctic sea urchin *Sterechinus neumayeri* in response to increased ocean temperature and acidification. *Marine Biology,* vol. 163, 130.

Lebrato et al., 2016. Benthic marine calcifiers coexist with $CaCO_3$-undersaturated seawater worldwide. *Global Biogeochemical Cycles,* in press.

The Ross Ice Shelf

Hiester et al., 2016. Topographically mediated ice stream subglacial drainage networks. *Journal of Geophysical Research,* vol. 121, 497-510.

Hulbe et al., 2016. Flow variability and ongoing margin shifts on Bindschadler and MacAyeal Ice Streams, West Antarctica. *Journal of Geophysical Research,* vol. 121, 283-293.

McKay et al., 2016. Antarctic marine ice-sheet retreat in the Ross Sea during the early Holocene. *Geology,* vol. 44, 7-10.

Price et al., 2015. Evaluation of CryoSat-2 derived sea-ice freeboard over fast ice in McMurdo Sound, Antarctica. *Journal of Glaciology,* vol. 61, 285-300.

Climate prediction

Coggins & McDonald, 2015. The influence of the Amundsen Sea Low on the winds in the Ross Sea and surroundings: Insights from a synoptic climatology. *Journal of Geophysical Research*, vol. 120, 2167-2189.

Coggins et al., 2014. Synoptic climatology of the Ross Ice Shelf and Ross Sea region of Antarctica: k-means clustering and validation. International *Journal of Climatology,* vol. 34, 2330-2348.

Harris et al., 2015. Past changes in the vertical distribution of ozone – Part 3: Analysis and interpretation of trends. *Atmospheric Chemistry and Physics,* vol. 15, 9965-9982.

Jolly et al., 2016. A validation of the Antarctic Mesoscale Prediction System using Self-Organizing Maps and high density observations from SNOWWEB, *Monthly Weather Review,* in press.

Parrish et al., 2014. Diurnal variations of stratospheric ozone measured by ground-based microwave remote sensing at the Mauna Loa NDACC site: Measurement validation and GEOSCCM model comparison. *Atmospheric Chemistry and Physics,* vol. 14, 7255-7272.

Tummon et al., 2015. Intercomparison of vertically resolved merged satellite ozone data sets: Interannual variability and long-term trends. *Atmospheric Chemistry and Physics,* vol. 15, 3021-3043.

Ocean connections

Crampton et al., 2016. Southern Ocean phytoplankton turnover in response to stepwise Antarctic cooling over the past 15 million years. *Proceedings of the National Academy of Sciences,* in press.

Cortese & Prebble, 2015. A radiolarian-based modern analogue dataset for palaeoenvironmental reconstructions in the southwest Pacific. *Marine Micropaleontology,* vol. 118, 34-39.

Marine ecosystem structure

Eisert, 2014. Killer whale studies, McMurdo Sound, Ross Sea, Antarctica, Jan-Feb 2014. *Journal of Cetacean Research and Management,* Paper SC-66a-SM-9.

Hanchet et al., 2015. The Antarctic toothfish (*Dissostichus mawsoni*): biology, ecology, and life history in the Ross Sea region. *Hydrobiologia,* vol. 761, 397–414.

Parker et al., 2016. Have toothfish returned to McMurdo Sound, Antarctica? *Antarctic Science,* vol. 28, 29-34.

The Subantarctic

Hinojosa et al., 2016. Trace metal cycling and $^{238}U/^{235}U$ in New Zealand's fjords: Implications for reconstructing global paleoredox conditions in organic-rich sediments. *Geochimica et Cosmochimica Acta,* vol. 179, 89-109.

Presenting Science Findings

NZARI has supported scientists to communicate the findings of their Antarctic- and Southern Ocean–focused research with a number of initiatives. In 2015, NZARI was the lead organiser of the New Zealand Antarctic Science Conference, which attracted 118 delegates from New Zealand and further afield. This will be a biennial event.

In alternate years, NZARI supports scientists to attend the Scientific Committee of Antarctic Research (SCAR) Open Science Conference. In 2016, NZARI awarded travel grants to 28 students, early career and established researchers to travel to Kuala Lumpur, Malaysia for this meeting.

Links To Policy

Science outcomes from NZARI's programme have fed directly into the following policy initiatives:

Forum	Finding / Contribution
Intergovernmental Panel on Climate Change	• Role of CO_2 in Antarctic ice melt • Controls on Antarctic sea ice extent • Links between ice melt and sea level rise • Future vulnerability of Antarctic ice shelves
Commission for the Conservation of Antarctic Marine Living Resources	• Antarctic toothfish still occur in McMurdo Sound • Toothfish predation by Weddell Seals • Increased Adélie penguin numbers
International Whaling Commission	• Type-C Killer Whales migrate between Antarctica and New Zealand
Scientific Committee on Antarctic Research	• Leadership of new action groups including "Antarctic Nearshore and Terrestrial Observing Systems" and "Integrated Science for the Subantarctic" • Science advisory committees of SCAR's two biology programmes • Contribution to Antarctic Horizon Scan and publications • Contribution to Council of Managers of National Antarctic Programmes roadmap for implementing the Horizon Scan
Antarctic Environments Portal	• Policy-ready articles on Antarctic Environment and Climate Change

Public Outreach

WINTER SCHOOL

NZARI hosted Winter Schools in 2015 and 2016. Winter School is designed to engage media personnel, policy analysts, educators and sponsors in order to provide a solid level of understanding about pressing issues for Antarctic ecosystems, and how Antarctic research is contributing to a broader understanding of climate change. Over a weekend, participants take part in a series of lectures, practical hands-on experiments and discussions. The programme for each Winter School is constructed around a central theme, and is presented by a panel of expert scientists and science communicators. Winter School is one of the initiatives NZARI is taking to improve understanding of Antarctic, Southern Ocean and climate science in order to promote the telling of science stories.

MEDIA TRAINING FOR SCIENTISTS

NZARI engaged the Science Media Centre to work with Antarctic and Southern Ocean research scientists to improve their science communication skills. At the 2015 New Zealand Antarctic Science Conference in Christchurch, researchers were supported to attend one-on-one sessions with the Science Media Centre. These sessions were fully utilised and there was excellent feedback from those involved.

NZARI PRESS RELEASES

NZARI has been able to profile its science programme over the past 3 years through a series of in depth articles in the New Zealand Herald and in the Air New Zealand KiaOra Magazine. We have also provided a number of interviews for New Zealand television and radio. Our most exciting opportunity will come with the soon to be released National Geographic Television series Continent 7: Antarctica, which will see NZARI science and scientists profiled in a series of shows that will reach audiences across the seven continents.

INVESTMENT IN INFRASTRUCTURE AND LOGISTIC SUPPORT

NZARI has had a significant influence on the growth and development of New Zealand's Antarctic Science Programme. Our emphasis is on going to where the scientists need to go to answer the big questions, rather than constraining efforts by what we think is possible. This philosophy, in combination with research funding and a call for increased collaboration, has resulted in a rapid change in the logistical demand placed on Antarctica New Zealand.

Antarctica New Zealand has responded by improving and upgrading the services to support science from Scott Base including the construction of the Hillary Field Center and investment and development of traverse capability to facilitate deep field science events.

HILLARY FIELD CENTRE

In response to the changing needs and focus of the Antarctic Science Programme, Antarctica New Zealand is investing in a $6.2 million upgrade of The Hillary Field Centre at Scott Base. The upgrade, which began in 2015 and will take 3 years to complete, will provide high-quality on-site science facilities that will extend the window for scientific analysis on the ice out to a full 12 months each year.

This project will add three new internal laboratories, mobile container laboratories including a "plug and play" docking facility, will double the field deployment preparation area, increase freezer space for holding field samples, a workstation area for up to 15 people, three additional meeting rooms and a breakout space. This development will provide additional capacity for specialised external laboratories and other facilities for effective science in Antarctica.

NZARI has been working closely with Antarctica New Zealand and

the Antarctic science community to ensure this redevelopment is fit for purpose and will support cutting edge research efforts in the region.

TRAVERSE CAPABILITY

Antarctica New Zealand has begun the process of developing traverse capability to transport equipment to the increasingly remote locations that scientists are needing to get to. In 2015-16, NZARI worked with Antarctica New Zealand engineering staff to design a traverse capability that will be capable of safely travelling ~100 km per day

The traverse capability will consist of three main functions:

- Route finding and proving capability PB100 with front-mounted ground penetrating radar for crevasse detection
- Two Traverse Pisten Bully 300 Polar vehicles with blades for route forming, one equipped with a Hiab crane and survival cabin and one potentially equipped with traverse team living cabin and ability to be fitted with a snow grooming tiller for runway preparation and maintenance
- Support infrastructure such as large fuel bladders, slippery sleds, rigging equipment such as tow bars and strops, fuel handling systems and a possibly a camp support module

BUDGET BID

NZARI supported Antarctica New Zealand in a bid to central Government for increased budget to support the growing demands of the Antarctic Field Programme. Largely due to NZARI initiatives, researchers are asking scientific questions that require work on larger multidisciplinary science programmes, which are often in more remote areas of Antarctica and require higher levels of logistical support from Antarctica New Zealand.

The bid was successful with Antarctica New Zealand receiving a $16.7 million funding boost over the next 4 years in the 2016 Budget. This is an acknowledgement from the Government of the increased logistical costs of supporting the science programme, and the Government's commitment to the New Zealand Antarctic Science Programme.

Antarctica New Zealand's annual government funding will increase by $3 million to $18 million from July 2016, with further increases in future years. This funding will sustain Antarctica New Zealand's provision of logistics support and related services, which is used to facilitate research undertaken within the Government's science priorities for Antarctica.

Photo: Rebecca McLeod © Antarctica New Zealand Pictorial Collection

NZARI'S PARTNERSHIPS FOR ANTARCTIC SCIENCE

NZARI works with a range of researchers and research providers, funders and supporters and Antarctica New Zealand to develop the best partnerships to address the most challenging scientific questions.

This year NZARI further developed the relationship with Air New Zealand, with an extension of the partnership for an additional three years. Air New Zealand's investment will support New Zealand Antarctic research initiatives through NZARI research programmes, and forms part of the airline's commitment to sustainability. The renewed commitment is facilitating a multi-year research programme based at Cape Adare that is focused on the resilience and likely response of Antarctic communities to a changing climate.

NZARI, in conjunction with Antarctica New Zealand, signed a three year partnership with National Geographic (USA).

The partnership includes significant funding to support important scientific research and an agreement to showcase the challenging work undertaken by our researchers and support staff through a global series for National Geographic Channel. The series will be broadcast in 171 countries and 45 languages, and will also include articles in National Geographic Magazine and multimedia content on the National Geographic web platforms.

The support of National Geographic recognises the global significance of NZARI's focus to understand the challenge facing future generations as the Antarctic responds to a warming climate, including melting ice, changing ocean circulation, and impacts on wildlife. National Geographic's financial contribution is being used to support the Ross Ice Shelf Research Programme, which will help us understand just how vulnerable Antarctica and its floating ice fringe is to changes in the world's ocean and climate.

ATTRACTING FUNDS TO SUPPORT RESEARCH

	2013-14	2014-15	2015-16
Aotearoa Foundation via Julian Robertson Foundation, USA ($5m over 5 years)	$1,000,000	$1,000,000	$1,000,000
NZ Government (logistics support)	$1,135,333	$1,042,800	$2,194,455
NZ Government (NZ / Korea Antarctic partnership)	–	$75,000	$150,000
Air New Zealand ($1m over 4 years)	$200,000	$200,000	$250,000
National Geographic Society USA ($1m over 3 years)	–	–	$385,000
NZ Universities	$531,266	$717,983	$671,263
NZ Crown Research Institutes	$320,000	$219,000	$248,722
International Science Partners	$182,920	$302,017	$71,657
Total*	$3,369,519	$3,556,800	$4,971,097

* Dollar values as per funding support contracts to NZARI from Sponsors, in-kind funding as agreed in research contracts with NZ Universities and Crown Research Institutes (including their international science partners) and the value of logistics support provided by Antarctica New Zealand for those projects including field support.

2015/2016 ACHIEVEMENTS

The 2015/16 season was a busy time for NZARI with six new Type A projects undertaking fieldwork and two projects returning for a second season to collect instruments and data relating to the past year of measurement. The projects involved a range of activities from ice and sediment coring to an assessment of human impacts on the Ross Sea Region. NZARI initiated a pilot study at Cape Adare in order to assess the appropriateness of this remote area as a site for long term monitoring of a changing climate and biome. This included an assessment of environmental impacts of the activity and feasibility of maintaining a long term camp. This project is included in the collaboration with the Korean Polar Research Institute.

NZARI is now making good progress against its strategic initiatives. New publications are making a significant advance on our understanding of the vulnerability of Antarctic ice and ecosystems and policy agencies such as the Intergovernmental Panel on Climate Change are moving to incorporate these new findings into their future climate predictions.

In July, NZARI co-sponsored the Antarctic Science Conference, with the theme “Antarctica: A Changing Environment”. NZARI’s second Winter School was held on Great Barrier Island in May, and focused on “Antarctic ecosystems in a changing world”.

NZARI sponsored a total of three postgraduate scholarships in the 2016 Antarctica New Zealand Postgraduate Research Scholarship Programme. These included:

- New Zealand Antarctic Research Institute Doctoral Scholarship: Alena Malyarenko, University of Otago/NIWA, PhD - “Interannual ocean variability in the Ross Sea”
- New Zealand Antarctic Research Institute Masters Scholarship: Rebecca Parker, University of Otago, MSc - “Sea ice and diatom primary production in the Ross Sea, Antarctica: the response to post-glacial warming”
- New Zealand Antarctic Research Institute Prize: Marcus Arnold, University of Canterbury, MSc - “Surface mass balance of the Ross Ice Shelf: Dating snow layers from radar by using stable isotope analysis”

RESEARCH HIGHLIGHTS: 2015 TYPE A PROJECTS

Investigating Antarctic ice sheet response to past anomalous Southern Ocean warming

Dr Catherine Beltran, University of Otago; Dr Christian Ohneiser, University of Otago; Dr Christina Riesselman, University of Otago; Dr Kimberly Hageman, University of Otago; Dr Nicholas Golledge, Victoria University of Wellington

Sectors of the Antarctic Ice Sheets (AIS) are predicted to destabilize in the coming centuries because of Southern Ocean warming and increased advection of warm water beneath the ice shelves. The future of the AIS is of real concern due to its role in global sea level. However, our ability to predict precisely its behaviour is limited, in large part because the dynamic links between the AIS and the Southern Ocean is still not fully deciphered and the critical ocean temperature that will initiate significant ice volume loss has not been clearly identified.

Studying geological records of past extreme warm events during which the oceans warmed and the ice retreated can provide those crucial missing information. Our work is to investigate the ice-ocean interactions during one of the last great super-interglacial period, which occurred 1 million years ago. We selected marine sediments from Southern Ocean high latitudes and around Antarctica and used molecular thermometry to reconstruct the surface ocean temperatures. Our data indicate that when the West AIS retreated 1 million years ago, the Southern Ocean was up to 5°C warmer than today.

We will now use ice sheet and climate model computer simulations together with the paleoenvironmental reconstructions to identify ocean temperature thresholds, which triggered Antarctic ice retreat and how the AIS responded to changing ocean temperatures.

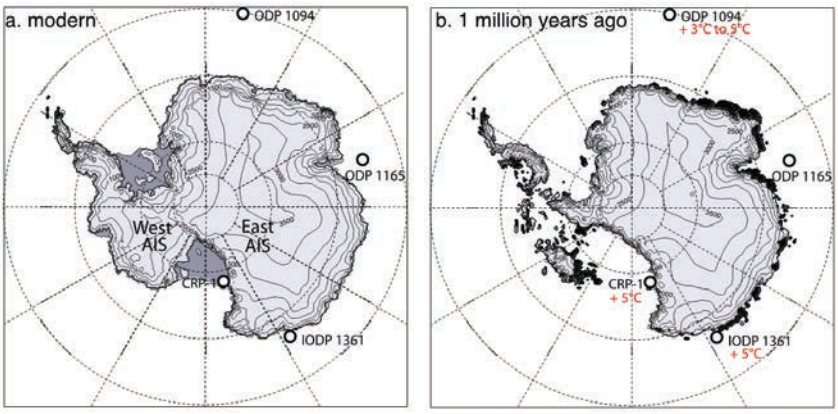


Figure: Locations of the oceanic sites chosen for this study. a. indicates the modern extent of the AIS and of the main ice shelves (darker grey) and b. shows the modelled Antarctic ice sheet retreat 1 million year ago in response to the Southern Ocean surface warming (Numbers indicated in red represent the maximum summer sea surface temperature warming).

K011 team in the field with their drones. Left to right: Rebecca Jarvis, Len Gillman, Richie Hunter, Ashray Doshi, Barbara Bollard-Breen (Event leader). (Fleet Left to right, top row: Fox 3, Fox 2. Bottom row: sWing 3, X8P 2, sWing 2)

Interfacing human impact assessment and social valuation of climate sensitive landforms in the Ross Sea Region

Dr Barbara Bollard Breen, Auckland University of Technology; Professor Mark Orams, Auckland University of Technology; Professor Steve Pointing, Auckland University of Technology; Dr Neil Gilbert, Constantia Consulting Ltd.; Dr Peyman Zawar-Reza, University of Canterbury

Conservation outcomes in the Ross Sea Region are limited by resources for monitoring past and cumulative effects of humans on vulnerable ecosystems. This research has provided high resolution spatial maps obtained from unmanned aerial systems (UAS). We conducted UAS surveys within critical habitats found in three Antarctic Special Protected Areas (ASPAs) to identify the presence, and scale, of human induced impacts. Each selected location had historic campsites and walking tracks. Locations were selected to minimise any potential disturbance to wildlife. We compared survey area estimates with other methods and made recommendations for future surveys and applications to other areas.

Antarctic influences on New Zealand climate during the Antarctic Cold Reversal

Associate Professor Andrew Mackintosh, Victoria University of Wellington; Dr Brian Anderson, Victoria University of Wellington; Dr Andrew Lorrey, NIWA; Professor Joerg Schaefer, Lamont-Doherty Earth Observatory, USA; Dr Kevin Norton, Victoria University of Wellington; Dr Helen Bostock, NIWA; Dr Joel Pedro, Centre for Ice and Climate, Denmark

In April 2015 a team of 4 scientists from Victoria University of Wellington spent a week in the Southern Alps mapping glacial landforms and collecting samples that will help understand past climatic connections between Antarctica and New Zealand. The team, led by PI Andrew Mackintosh and NZARI-supported post doc Shaun Eaves, aim to improve understanding of the Antarctic Cold Reversal (ACR) – a c. 2000 yr interval of relatively cold climatic conditions in the Southern Hemisphere, which occurred 14,000 to 13,000 years ago. Southern cooling during the ACR occurred against a background of sustained natural increases in global mean temperature and atmospheric carbon dioxide, however the cause of this event remains uncertain.

Mountain glaciers are highly sensitive to climate change, therefore geological records of past glacier fluctuations provide useful insight into past climate variability. The team are applying a geological dating technique, known as cosmogenic surface exposure dating, to determine the timing of past glacier advances in the Spenser Mountains, New Zealand. Preliminary findings show that glaciers in this region advanced during the Antarctic Cold Reversal, in broad synchrony with Antarctic cooling recording in ice cores. Combining this new chronological information with computer modelling, the team will provide new estimates of the timing and magnitude of climate change in New Zealand during the Antarctic Cold Reversal.

Top: The study site in the Spenser Mountains. Our dating target is the sequence of moraines that are clearly visible. Photo: Brian Anderson.

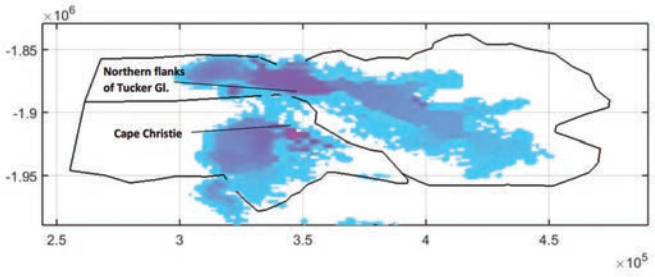
Bottom: Kevin Norton and Andrew Mackintosh sampling glacially-transported boulders for 10Be analyses. Photos: Shaun Eaves

Constraining Antarctica's contribution to past global sea level rise in Northern Victoria Land and the western Ross Sea

Dr Kevin Norton, Victoria University of Wellington; Associate Professor Andrew Mackintosh, Victoria University of Wellington; Dr Nicholas Golledge, Victoria University of Wellington; Dr Cliff Atkins, Victoria University of Wellington; Dr Greg Balco, Berkeley Geochronology Centre, USA; Dr Stewart Jamieson, Durham University, UK; Professor Mike Bentley, Durham University, UK

An Antarctic source for Meltwater Pulse 1a (MWP1a) – an abrupt rise in global sea level of ~20 metres approximately 15,000 years ago – still proves elusive. In our project, we seek to test whether a previously expanded ice sheet in Northern Victoria Land (NVL) and the western Ross Sea contributed to MWP1a. The project combines geochemical exposure dating (using rare atoms produced at Earth's surface by cosmic rays) and computer modelling of NVL glaciers in order to reconstruct the evolution of ice in this region. The first year of the project was dedicated to developing a model of Tucker Glacier in order to determine its sensitivity to climate forcings and physical feedbacks. The model allows us to target areas of the glacier that likely experienced the largest changes in ice thickness for exposure dating.

A 4-person field party will conduct the field work in November. We will spend 3-4 weeks in Northern Victoria Land, focused on collecting cobbles and bedrock samples in elevation transects. Geochemical analysis of these rocks will generate a high-resolution chronology of past ice thickness change at Tucker Glacier and surrounding area. By combining these measured ages with the glacier modelling, we will be able to provide exceptional insight into the past evolution of NVL glaciers and their role (or lack thereof) in MWP1a.



Effect of ice buttressing on the modelled ice thickness of the Tucker and surrounding glaciers (blue to purple, low to high ice thickness change). If the Ross Ice Shelf is grounded north of Tucker Glacier, we expect to see evidence of much thicker ice recorded in our elevation transects.

Sampling bedrock for exposure dating on Mt Gran, Antarctica. Elevation transects of these bedrock and the surrounding cobble samples allow us to build age-elevation profiles to determine ice surface lowering rates through time.

Reconstructing the history of the Ross Ice Shelf since the Last Glacial Maximum

Dr Christian Ohneiser, University of Otago; Dr Christina Riesselman, University of Otago; Dr James Channell, University of Florida, USA; Dr Nicholas Golledge, Victoria University of Wellington; Dr Richard Levy, GNS Science; Dr Rob McKay, Victoria University of Wellington; Dr Brad Rosenheim, University of South Florida, USA; Dr Ho Il Yoon, Korean Polar Research Institute, South Korea; Miss Rebecca Parker, University of Otago

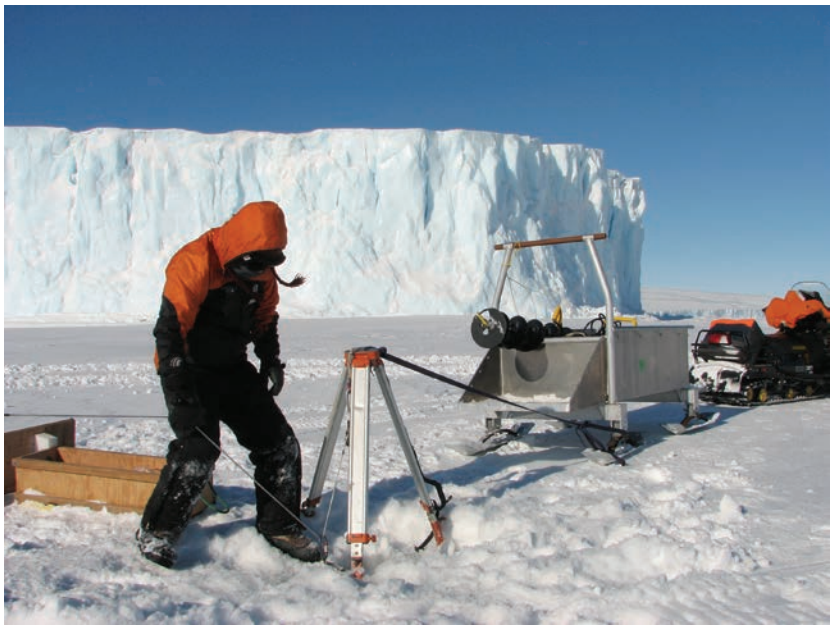
Model simulations indicate that rising ocean temperatures will destabilise the West Antarctic Ice Sheet (WAIS) in the coming centuries. The Ross Ice Shelf protects the WAIS from the warming ocean but little is known about its history, which complicates predictions of future behaviour. During the last ice age the Ross Ice Shelf was larger and grounded - it was a part of the Antarctic ice sheet and extended further north than it does today. At the end of the ice age, as the world warmed, the ice sheet retreated and, in the Ross Sea, thinned until it began to float and became an Ice Shelf. However, we still have a poor understanding on when and how quickly the Ross Ice Shelf retreated at the eastern edge. The aim of our project is to reconstruct the Ross Ice Shelf history since the last ice age from 17 seafloor sediment cores, which will reveal whether the ice sheet was larger and ground, when it retreated and lifted off and finally when and how quickly the ice shelf reached its modern position. Ultimately we will create a map, which outlines the retreat and transition of the large ice sheet to an ice shelf and use this map to test computer models of past change in order to improve forecast simulations.

RV Araon in the Ross Sea. Photo: Korean Polar Research Institute

Supercooled ice shelf cavity water and the influence on sea ice growth

Associate Professor Craig Stevens, NIWA; Associate Professor Patricia Langhorne, University of Otago

Despite rising global temperatures and clearly declining sea ice in the Arctic, Antarctic sea ice coverage is increasing. In our work we are trying to understand how melting ice shelves might serve to create more, but different, ice. We do this by setting up an ice camp on sea ice right by the outlet of a giant ice shelf cavity (The Ross/McMurdo) – the idea being the water from the melting ice shelf cavity should travel past our camp. Then we measure the ocean and ice properties as they develop. A big challenge for us is that the ocean is so cold it is actually colder than its freezing-point, but still liquid. This causes ice to rapidly accumulate on any instruments. Internationally, the majority of the work on this topic is model-based. But models need data and mechanics. We now have a decade of experimental data and are helping change the view on the effects of ice shelves. Key results include (i) observations of ice crystals growing in situ in the ocean, (ii) quantification of the effect this has on the under-ice roughness which is a key parameter in modelling ice melt and (iii) real-time delivery of sea ice temperatures. In addition we embedded an artist in our most recent NZARI-supported event as we are developing work around collaboration, communication and education - as well as generating high impact science communication.



Deploying oceanographic instrumentation through the sea ice. Photo: Brett Grant

Artistic interpretations of platelet ice. Photos: Gabby O'Connor

NEW RESEARCH PROJECTS

In February, NZARI announced its support for a fourth round of "Type A" research projects that focus on the challenges of warming in Antarctica, with large foci on the resilience of life in the extreme environments of Antarctica and the ability of organisms to adapt to changing environments, and improved predictive capabilities of the behaviour of the Antarctic Ice Sheet.

The eight projects were chosen from 21 applications that underwent peer review through a process involving 56 expert reviewers, under the guidance and supervision of the International Science Panel. Four of the projects are being provided logistical field support by Antarctica New Zealand for the 2016/17 season, with the remainder using either archived samples and data and/or remote sensing technology to address their science objectives.

The new research projects will support scientists from four Universities, two Crown Research Institutes and one private research institute in New Zealand, attracting $1.27 million in co-funding from these institutions. The projects will facilitate new research collaborations with scientists from Australia, Belgium, South Korea, the United Kingdom, and the United States.

For the first time, one of the projects was reserved to support a postdoctoral research fellow, in recognition of the importance of tangible career pathways for emerging scientists. The successful candidate will move to New Zealand from Belgium for the tenure of the fellowship and will work to determine the distributions of Antarctic brittle stars in Antarctic and warmer waters.

Several of the proposals will focus on developing new methods and techniques to study marine mammals and birds (including whales and penguins) and the challenges of changing Southern Ocean conditions on their life cycles, habitats and distributions. One project is taking advantage of the imminent winter science opportunities by examining biological processes over winter in the McMurdo Dry Valleys.

Both of the projects with a physical science approach will work to improve understanding of the behaviour of the Antarctic Ice Sheet, both presently and in the past, in order to improve the accuracy of predictive climate models.

Photo: Stephen Dawson © Antarctica New Zealand Pictorial Collection

ABSTRACTS OF NEW RESEARCH PROJECTS

Sentinels of the Southern Ocean: measuring nutritional condition of right whales using remotely piloted multi-rotor aircraft

Professor Stephen Dawson, University of Otago

To measure how environmental change affects recovering whale populations, we need a way to measure nutritional condition, essentially, body shape. Right whales store energy as blubber. Hence their condition reflects food availability in the Southern Ocean, and must affect breeding and population recovery. Aerial photography allows measurement of whale size and shape, but at high cost. New drone technology offers a practical and inexpensive solution. We have adapted small multicopters (four and six rotor) to carry calibrated cameras, and will use these to measure the condition of right whales breeding at New Zealand's Auckland Islands.

Shining a light in the darkness: Winter science in the McMurdo Dry Valleys

Professor Ian Hawes, University of Canterbury; Dr Susie Wood, Cawthron Institute

Despite decades of intensive research in Antarctica's Dry Valleys, little is known about how these unique ecosystems function in winter. During winter many parts of the Dry Valleys freeze and are presumed inactive, but others retain liquid water and microbial processes are ongoing. Over winter instrumentation can describe some summer-winter changes, but physical access is required to sample biological communities and measure processes. This project will provide insight and allow us to determine how winter dynamics of carbon, nutrients and dissolved gases influence the structure and functioning of Antarctic ecosystems in order to better understand and predict responses to change.

Transgenerational Plasticity (TGP) in polar invertebrates as a mechanism of adapting to a warmer more acidic coastal Antarctic

Associate Professor Miles Lamare, University of Otago; Associate Professor Mary Sewell, University of Auckland; Associate Professor Bruno Danis, Universite Libre de Bruxelles; Dr Antonio Aguera Garcia, Universite Libre de Bruxelles

Antarctic coastal seas will warm and acidify over the coming decades, and understanding the capacity of polar marine species to adapt to change is vital to predict the future of Antarctic marine ecosystems. Transgenerational plasticity, TGP (where offspring responses to warming reflect parental experiences and hence their ability to persist under climate change) is one mechanism for adaptation, yet there is limited understanding of this key process for polar species. Here, we will quantify TGP in a sea star *Odontaster validus*, an important predator of the coastal Antarctic, to understand if polar species have the capacity to rapidly adapt in the face of climate change.

Mercury contamination in Adélie and emperor penguins in the Ross Sea: latitudinal, temporal, sexual, age and inter-specific differences

Dr Phil Lyver (Landcare Research)

The oceans of the southern hemisphere, in particular the Southern Ocean, are considered the least contaminated marine ecosystems on earth. However, a changing climate combined with increased emissions of heavy metals from rapidly growing economies in Asia, Africa and South America raises the threat of long-range atmospheric transport and deposition of mercury in the Antarctic. To understand the risk of mercury exposure for top predators in the Ross Sea, we will assess the differences in spatial, temporal, sexual, age and inter-specific concentrations of mercury in Adélie *(Pygoscelis adeliae)* and emperor penguins *(Aptenodytes forsteri)* in relation to their respective positions in the food web.

Past Antarctic ice sheet characteristics and stability deduced from lava—ice interactions at Mason Spur, Mount Morning volcano, McMurdo Sound, during mid-Late Miocene climatic warmth

Dr Adam Martin (GNS Science)

Antarctica abounds in volcanoes and ice, and exciting new research is showing that when the two interact, the resulting rock forms can record the unique environment at that time. Through interpretation of lava—ice interaction forms, scientists can deduce past thicknesses and variations in thermal regime (a measure of stability) of Antarctica's ice sheet. In particular, evidence obtained at Mason Spur volcano will provide uniquely valuable information for the mid Miocene Climatic Optimum, when atmospheric CO_2 levels were comparable to modern day. This information is vital for validating models of climate and sea level changes that will affect New Zealand.

Photo: Fiona Shanhun © Antarctica New Zealand Pictorial Collection

Testing predicted tolerances of Antarctic non-marine biota across all trophic levels

Dr Phil Novis (Landcare Research)

Predictions of how organisms will respond to changing climate often presumes their current distributions are to some extent defined by their basic life functions. However, we have little evidence of a significant relationship between life function adaptions of Antarctic microbes and their distribution across Antarctic environments. Using high throughput environmental sequencing of frozen legacy samples originating from across the Ross Sea Region, we will characterise distributions of biota along environmental gradients, and compare them with tolerances determined with laboratory cultures. Our proposal involves New Zealand, US and Korean researchers, and is relevant to the new SCAR programs ANTOS, AntEco, and AnT-ERA.

Past and future deformation of the Ross Ice Shelf

Professor David Prior, University of Otago; Professor Christina Hulbe, University of Otago

The response of the Antarctic ice sheet to global warming will have a big impact on global sea level, ocean circulation and climate. The internal temperature of the ice and the alignment of ice crystals are key controls on the rate of ice flow towards the ocean. We will send sound waves through the ice to a string of sensors in a borehole in the Ross Ice Shelf to map patterns of temperature and crystal alignment. These data will allow us to make much better predictions of how the Antarctic ice sheet will respond to global warming.

POSTDOCTORAL RESEARCH AWARD

Out of Antarctica: implications of extensive gene flow and multiple reproductive modes on the resilience of a Southern Ocean brittle star

Dr Quentin Jossart (University of Auckland)

This project will verify the generalisation of the "out of Antarctica" event (fauna originating from Antarctica that has then migrated to sub-Antarctic and temperate areas) in the brittle star *Astrotoma agassizii.* Using both morphological and genetic approaches, we will measure the past and present dispersal patterns occurring among Antarctica and warmer waters. This information is primordial in order to evaluate the capacity of this species to respond to environmental change.

Photo Rebecca McLeod © Antarctica New Zealand Pictorial Collection

NEW ZEALAND ANTARCTIC SCIENCE CONFERENCE

The Antarctic Science Conference was held in the first week of July, with the theme "Antarctica: A Changing Environment". The conference was cosponsored by NZARI and Antarctica New Zealand and hosted by the University of Canterbury. The conference provided an opportunity for presenters to showcase recent findings, build multidisciplinary links with other researchers and contribute to developing the future direction of our Antarctic Research Programme. There were 120 participants including students, early career and established researchers, and representatives from government and non-governmental organisations.

WINTER SCHOOL

NZARI's second Winter School was held on Great Barrier Island in May, and focused on "Antarctic ecosystems in a changing world". Participants, including representatives from media, education, industry and policy, took part in a series of lectures, practical hands-on experiments and discussions over two days. These sessions resulted in improved understanding of Antarctic and climate science in order to promote the telling of science stories. Winter School is one of the initiatives NZARI is taking to improve the communication of topical Antarctic and Southern Oceans research to the wider community.

Photo: Damian Christie © Antarctica New Zealand Pictorial Collection

Photo: Bob Dagg © Antarctica New Zealand Pictorial Collection

NZARI'S STRUCTURE, GOVERNANCE AND MANAGEMENT

Established as a charitable trust on 5 March 2012, NZARI is incorporated under the Charitable Trusts Act 1957 (NZ) and registered as a charitable entity under the Charities Act 2005 (NZ).

The Board of Trustees has appointed a Director whose role includes directing the implementation of research, ensuring delivery of science outputs and developing partnerships with organisations to deliver outcomes and support and encourage new Antarctic scientists.

The Board of Trustees has also appointed an International Science Panel (ISP) whose role includes peer reviewing the NZARI science programme to ensure it meets international best practice, and carrying out triennial reviews of the effectiveness and outcomes of the NZARI science programme.

OBJECTIVES

The purpose of NZARI is to operate as a virtual, multi-disciplinary research institute dedicated to Antarctic and Southern Ocean research including, without limitation, through:

1. Delivering world-class strategic science relevant to understanding Antarctica's influence on the global climate system, and the global climate system's influence on Antarctica;

2. Communicating effectively to the public, stakeholders, and policymakers on Antarctic and related environmental and climate change issues;

3. Facilitating applied environmental research that directly supports Antarctic environmental management outcomes and policy development;

4. Attracting new, and support existing, capability in Antarctic research and developing the next generation of Antarctic researchers and educators;

5. Enhancing international relationships and partnerships with research organisations and Antarctic programmes.

BOARD OF TRUSTEES

SIR ROB FENWICK KNZM, HON.D NAT RES (LINC) (Chair)
Founding chairman Rob Fenwick has a 20 year connection with Antarctica in a variety of governance roles for the New Zealand Government and associated organisations. An experienced businessman and company director he chairs the New Zealand National Science Challenge – Sustainable Seas and is a director of the New Zealand National Museum – Te Papa Tongarewa. He is an inductee of NZ Business Hall of Fame and was knighted for services to business and conservation. In 2005 the New Zealand Geographic Society named the Fenwick Ice Piedmont in the Ross Sea for his work in Antarctica.

PROFESSOR STEVEN CHOWN (appointed Jan 2016)
Professor Chown is the Head of the School of Biological Sciences at Monash University in Australia. He has worked on Antarctic terrestrial and marine ecosystems and their constituent species for the past 25 years. Much of his research has been taken up in conservation policy in the region. In 2009, Professor Chown was awarded the first Martha T Muse Prize for Science and Policy in Antarctica, and in 2014 he received the SCAR Medal for Excellence in Antarctic Research.

PHILLIP MELCHIOR
Phillip Melchior had an extensive career in journalism, both press and television, in New Zealand. He occupied senior management positions with Reuters in Asia before moving to London as global managing director for Reuters Media from 1996 to 2001. Since his retirement in 2002, Mr Melchior held governance roles with a number of international media companies in addition to chairman of Land Search and Rescue NZ (2007-2014) and director of Antarctica New Zealand (2011 – present).

PROFESSOR MARY O'KANE AC

Professor Mary O'Kane is the New South Wales Chief Scientist & Engineer and also a company director and Executive Chairman of Mary O'Kane & Associates Pty Ltd, a Sydney-based company that advises governments, universities and the private sector on innovation, research, education and development. She is also Chair of the Board of the Institute of Marine and Antarctic Studies at the University of Tasmania, Chair of the Development Gateway based in Washington and the Development Gateway International based in Brussels, Chair of the Cooperative Research Centre for Spatial Information, and a Director of Business Events Sydney, National ICT Australia Ltd, and the Capital Markets Cooperative Research Centre. Mary was Vice-Chancellor of the University of Adelaide from 1996 to 2001.

PROFESSOR MAHLON CHUCK KENNICUTT II

Chuck Kennicutt is Professor Emeritus of Oceanography at Texas A&M University. He was a member of the U.S. Department of State delegation to the Antarctic Treaty from 2002-2007, US Delegate to the Scientific Committee on Antarctic Research (SCAR) from 2003-2012 and ex officio member of the U.S. Polar Research Board from 1998-2014. He served as a Vice President (2004-2008) and President of SCAR (2008-2012) and led the first SCAR Antarctic and Southern Ocean Science Horizon Scan in 2014. Professor Kennicutt was named a National Associate of the U.S. National Academy of Sciences for life, awarded the Antarctic Service Medal of the U.S. Antarctic Program and a geographic feature was officially named Kennicutt Point in 2006.

SIR DAVID SKEGG KNZM, OBE, FRSNZ

Professor Sir David Skegg is one of New Zealand's most distinguished scientists and is recognised internationally for his work in epidemiology. He was knighted in 2009 for services to medicine. Sir David was the President of the Royal Society of New Zealand from 2012-2015. After graduating from Otago and Oxford universities, he was a lecturer in epidemiology at the University of Oxford. In 1980, he returned to New Zealand to take up the Chair of Preventive and Social Medicine at Otago. From 2004 to 2011 he was the Vice-Chancellor of the University. Sir David is a former Chair of the Health Research Council, the Public Health Commission, and the Universities New Zealand Research Committee. He was the foundation Chair of the New Zealand Science Board, and currently chairs a research committee for the World Health Organisation in Geneva.

NZARI STAFF

DIRECTOR

PROFESSOR GARY WILSON

A Professor of Marine Science at the University of Otago, Gary has participated in over 35 expeditions to the Antarctic and Subantarctic, and attracted more than $20 million in research grants, resulting in 100 scientific papers in peer-reviewed journals. Gary's influence on internationally collaborative Antarctic research was acknowledged with a Sir Peter Blake Leadership Award in 2006. He has held the Byrd Fellowship at the Ohio State University and the Blaustein Visiting Professorship at Stanford University.

DEPUTY DIRECTORS

PROFESSOR CRAIG CARY

A microbial ecologist turned molecular geneticist and a Professor in Biological Sciences at the University of Waikato, Craig's research is focussed on microbial life in extreme environments. He has participated in 29 deep-sea expeditions to hydrothermal vents, and 12 seasons in Antarctica to study microbial life. He chairs the Antarctic Nearshore and Terrestrial Observing Systems (ANTOS) SCAR Action Group. Craig's work is highly published and is directly influencing management of human impacts in Antarctica.

DR VONDA CUMMINGS

A marine ecologist at the National Institute of Water and Atmospheric Research (NIWA) in Wellington, Vonda has participated in and led a diverse range of projects focused on marine ecosystem structure and function in New Zealand and Antarctica. She is a principal investigator of two SCAR programmes, and was part of the New Zealand-led Latitudinal Gradient Project. Vonda has authored more than 80 research papers in scientific journals, actively pursues pathways to policy at international fora and leads multiple SCAR Action Groups.

SCIENCE PROGRAMME ADVISORS

DR FIONA SHANHUN

Fiona's expertise as a soil scientist has taken her to Antarctica many times with both the New Zealand and Australian Antarctic programmes. She has worked on soil CO_2 dynamics in the McMurdo Dry Valleys, and focused on understanding biological and non-biological processes associated with CO_2 fluxes from soils. Fiona draws on her field experience and scientific knowledge to ensure science logistics are fit for purpose. She is a SCAR Fellow.

DR REBECCA MCLEOD

Recognised for her dual talents in research and science communication, Rebecca is a previous MacDiarmid New Zealand Young Scientist. She has published extensively on the use chemical approaches for determining energy flux in marine food webs. Rebecca has experience in the academic and commercial sectors and has conducted ecological research in the Antarctic and Subantarctic. Rebecca was appointed as a Fiordland Marine Guardian in 2012 by the Minister for the Environment, and now chairs the board.

INTERNATIONAL SCIENCE PANEL

The International Science Panel (ISP) peer-reviews the science strategy and programme to ensure that it represents international best practice and advises on multi-disciplinary and international opportunities.

PROFESSOR MAHLON CHUCK KENNICUTT II (CHAIR)

Professor Kennicutt is the US Delegate to and former President of, the Scientific Committee on Antarctic Research (SCAR). He is the principal investigator of a highly successful long-term environmental monitoring programme in McMurdo Sound in Antarctica.

PROFESSOR PETER BARRETT*

Professor Barrett is professor emeritus of Geology at Victoria University of Wellington where he is a founding member of the Climate Change Research Institute. He has received numerous awards in recognition of his Antarctic research including the Marsden Medal by the New Zealand Association of Scientists (2004) the SCAR President's Medal for Outstanding Achievement in Antarctic Science (2006) and the New Zealand Antarctic Medal (2010).

PROFESSOR STEVEN CHOWN*

Professor Chown is the Head of the School of Biological Sciences at Monash University in Australia. He has worked on Antarctic terrestrial and marine ecosystems and their constituent species for the past 25 years. Much of his research has been taken up in conservation policy in the region. In 2009, Professor Chown was awarded the first Martha T Muse Prize for Science and Policy in Antarctica, and in 2014 he received the SCAR Medal for Excellence in Antarctic Research.

DR JANE FRANCIS

Professor Francis is the Director of the British Antarctic Survey. She was a Professor of Palaeoclimatology and Dean of the Faculty of Environment at the University of Leeds, UK. She is Chair of the UK National Committee for Antarctic Research and recipient of a UK Polar Medal. Her principal research interests include palaeoclimatology and palaeobotany. Professor Francis' work focused on understanding past climate change during both greenhouse and icehouse periods in the geological past, in both the Arctic and Antarctica.

DR YEADONG KIM

Dr Yeadong Kim is the President of the Korean Polar Research Institute (KOPRI) and was a principal research scientist in geophysics at KOPRI. He was the project manager for the construction of the Korean Antarctic station, Jang Bogo, which opened in February 2014 at Terra Nova Bay. Dr Kim was the president of the Korean Geophysical Society from 2004 to 2007 and is a current SCAR Vice President.

PROFESSOR W. BERRY LYONS

Professor Lyons is currently the Director of the School of Earth Sciences at the Ohio State University, and former Director of the Byrd Polar Research Center. He is a Fellow of the Geological Society of America, American Association for the Advancement of Science and American Geophysical Union. Professor Lyons was the lead investigator (and is still an active member) of the McMurdo Dry Valleys Long Term Ecological Research program funded by the National Science Foundation.

DR OLAV ORHEIM*

Dr Orheim was Director of the Norwegian Polar Institute for more than a decade and subsequently Executive Secretary for the International Polar Year Secretariat. He was the Vice President of SCAR, chaired many meetings within the Antarctic Treaty system and was the first Chair of the Committee for Environmental Protection. He has more than 80 publications covering glacier mass balance and climate, ice dynamics, remote sensing, and politics of the polar-regions. In 2007 he was knighted under the Royal Norwegian Order of St Olav.

DR STEVE RINTOUL

Dr Rintoul is a Commonwealth Scientific and Industrial Research Organisation (CSIRO) Fellow at the CSIRO Marine and Atmospheric Research facility in Hobart, and leader of the Oceans program at the Antarctic Climate and Ecosystems Cooperative Research Centre. He is a recipient of the Australian Antarctic Medal and internationally recognised as a leading authority on the circulation of the Southern Ocean and how it affects global climate systems. Dr Rintoul was awarded the 2012 Martha T Muse prize for Science and Policy in Antarctica and is a Fellow of the Australian Academy of Science.

PROFESSOR DIANA WALL

Professor Wall is the director of the School of Global Environmental Sustainability, a University Distinguished Professor of Biology and Senior Scientist at the Natural Resource Ecology Laboratory at Colorado State University. She is the recipient of the 2012 SCAR President's Medal for Excellence in Antarctic Research and the 2013 Tyler Prize for Environmental Achievement. Her research interests include how soil biodiversity contributes to healthy, productive soils, and the consequences of human activities on soil sustainability.

*Professor Peter Barrett, Professor Steven Chown and Dr Olav Orheim completed their term in 2016

TRUSTEES' STATEMENT OF RESPONSIBILITY

The Board of Trustees of the New Zealand Antarctic Research Institute are pleased to present the annual report for the New Zealand Antarctic Research Institute for the year ended 30 June 2016.

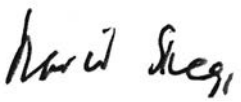
The Performance Report incorporating the Statement of Service Performance and financial statements have been prepared in accordance with the statement of accounting policies on page 44 and comply with the charity's Trust Deed.

The Board of Trustees accept responsibility for:

- The preparation of the Performance Report and for the judgements used in them; and
- Establishing and maintaining a system of internal controls designed to provide reasonable assurance as to the integrity and reliability of financial and non-financial reporting.

In the opinion of the Board of Trustees, the annual Performance Report for the year ended 30 June 2016 fairly reflects the financial position, operations and cash flows of the New Zealand Antarctic Research Institute.

Sir Rob Fenwick
KNZM
Chair
14 December 2016



Sir David Skegg
KNZM, OBE, FRSNZ
Trustee
14 December 2016

PERFORMANCE REPORT

FOR THE YEAR ENDED 30 JUNE 2016

ENTITY INFORMATION
FOR THE YEAR ENDED 30 JUNE 2016

Legal Name of Entity
New Zealand Antarctic Research Institute ("NZARI")

Type of Entity and Legal Basis
NZARI is a charitable trust incorporated under the Charitable Trust Act 1957 and is registered as a charitable entity under the Charities Act 2005.

Registration Number with DIA Charities
CC47860

Entity's Purpose or Mission:
NZARI partners with research agencies to develop a global understanding of Antarctica's impacts and vulnerability in a changing climate. The entity's vision is to inform industry, government and community alike so that plans can be made for impacts of these changes and, where possible, mitigate them. Its operations are governed by the entity's Trust Deed.

Entity Structure
Trust Structure
The entity is governed by a Board of Trustees comprising six members and a director. The members of the governing body are as follows:

- Sir Rob Fenwick (Chair)
- Mr Phillip Melchior (Acting Chair July 2015)
- Professor Mahlon Kennicutt II
- Professor Mary O'Kane
- Sir David Skegg
- Professor Steven Chown (29 Jan 2016 – 6 Sept 2016)
- Professor Gary Wilson (Director)

Key Strategic Objectives
The operation of NZARI as a virtual, multi-disciplinary research institute dedicated to Antarctic and Southern Ocean research, including without limitation through:

(i) delivering research on Antarctica's terrestrial and marine ecosystems;

(ii) delivering research on Antarctica's cryosphere, atmosphere and lithosphere;

(iii) providing new knowledge of the impact of global change on Antarctica and Antarctica's impact on global change;

(iv) increasing understanding of Southern Ocean physical processes;

(v) facilitating applied environmental research that supports Antarctic environmental management outcomes;

(vi) communicating effectively to the public and stakeholders on Antarctic and related environmental and climate science issues;

(vii) attracting new, and supporting existing, capability in Antarctic research, and developing ongoing research and education and Antarctic-related matters; and

(viii) enhancing international relationship and partnerships with research organisations and Antarctic programmes.

Main Sources of the Entity's Cash and Resources
NZARI's primary source of funding is through the receipt of grants and donations.

Additional sources of funding include:

- Donated goods and services
- Interest income

Main Methods Used by the Entity to Raise Funds
Funding for NZARI is sought from organisations and individuals concerned with global scale connections to Antarctica and the consequences of its changing environment.

Entity's Reliance on Volunteers and Donated Goods or Services
Donated goods and services are provided by Antarctica New Zealand to NZARI for its operating activities.

STATEMENT OF SERVICE PERFORMANCE
FOR THE YEAR ENDED 30 JUNE 2016

NZARI Outcomes

- Scientific Understanding – particularly the vulnerability of Antarctica's ice sheets, environments and ecosystems to a warming globe and the impacts of changes in Antarctica on New Zealand and the wider globe through rising sea levels, changing ocean currents, climate and ecosystems.
- Communication – of the changing Antarctic environment, and the potential impacts on the Southern Ocean, New Zealand and the wider world particularly in the support of management approaches and policy development.
- Training – of the next generation of Antarctic Researchers to underpin an intergenerational understanding and response to change.
- International Collaboration – to develop a global response through joint ventures in Scientific Research.

NZARI Outputs in 2015/2016

Output Performance Measure	Performance Standards		
	2015/2016 Actual	**2015/2016 Target**	**2014/2015 Actual**
New frontiers grants to support Scientific Discovery	8	6	6
Scientific Publications in International Peer Reviewed Journals	21	*	11
Support stakeholder (media, industry, educators, communicators, government department) participation at annual Winter School (participants)	20	15	15
Grants to support International Action Groups (SCAR)	3	3	0
Grants for early career scientists	2	1	1
Graduate Student Scholarships	3	1	0
Support Scientists to present findings at Antarctic Conference (attendees)	118	100	N/A
Support new international collaborations (Countries)	5	*	5
Support International Joint Ventures	1	1	1

NZARI staff have presented findings and talks to a wide range of New Zealand audiences, including government programmes, leadership conferences, Schools and University contributions, and University of the 3rd age.

A large amount of donated time and cofunding has meant NZARI have been able to support more output than budgeted particularly with respect to Research Grants and Scholarships.

*Target not set for 2016

STATEMENT OF ACCOUNTING POLICIES

Reporting entity

The New Zealand Antarctic Research Institute (NZARI) was established as a charitable trust on 5 March 2012 for the purpose of operating as a virtual, multi-disciplinary research institute dedicated to Antarctic and Southern Ocean research. NZARI is incorporated under the Charitable Trusts Act 1957 and registered as a charitable entity under the Charities Act 2005.

Statement of compliance

The Performance Report of NZARI has been prepared in accordance with Public Benefit Entity Simple Format Reporting – Accrual (Not-for-Profit) (PBE SFR – A (NFP)).

NZARI qualifies for PBE SFR-A (NFP) on the basis that it does not have public accountability and has total annual expenses of equal or less than $2,000,000 for the last two annual reporting periods.

This is the first year of its adoption in light of the requirements of the Charities Act 2005. NZARI previously applied New Zealand generally accepted accounting practice (NZ GAAP). These have now been restated to PBE SFR-A (NFP).

There were no adjustments on transition, except for a reclassification adjustment to comparatives for Cash Equivalents to Investments (refer Note 3 & Note 5).

Basis of preparation

The Performance Report has been prepared on a historical basis and uses the accrual basis of accounting. It is also prepared under the assumption that NZARI will continue to operate as a going concern in the foreseeable future.

This Report is presented in New Zealand dollars unless otherwise stated. The functional currency of NZARI is New Zealand dollars.

The Performance Report is for the year ended 30 June 2016 and was approved by the Board of Trustees on 17 October 2016.

Significant accounting policies

The following significant accounting policies have been adopted in preparation and presentation of the financial statements:

a) Revenue

Grants and donations

Grants and donations are the primary source of NZARI's revenue and are restricted for the purposes of meeting its objectives as specified in the Trust Deed. Grants and donations are recognised as revenue in the Statement of Financial Performance when they become receivable, unless NZARI has an obligation to repay the grant or donation if the requirements of the grant or donation are not fulfilled. A liability is recognised to the extent that such conditions are unfulfilled at the end of the period.

Interest income

Interest is recognised as revenue in the Statement of Financial Performance as it accrues, using the effective interest rate method.

b) Donated goods and services

Where goods or services are acquired by NZARI for nil or nominal consideration, the fair value of the goods or services is recognised as revenue in the Statement of Financial Performance.

Where the goods or services are utilised in the operations of NZARI, the fair value of the goods or services is recognised as expense in the Statement of Financial Performance as if NZARI had paid for them directly.

Donated services are not recognised where they cannot be reliably measured.

c) Cash and cash equivalents

Cash and cash equivalents include deposits held at call with banks and other short term, highly liquid investments, with original maturities of three months or less.

d) Receivables

Receivables are recognised in the Statement of Financial Position at their nominal value which is considered a reasonable approximation of their fair value due to their short term nature.

e) Investments

Bank term deposits

Investments in bank term deposits are initially measured at the amount invested. After initial recognition, investments in bank deposits are measured at amortised cost using the effective interest method, less any provision for impairment.

f) Accounts payable and accruals

Creditors and other payables are recognised in the Statement of Financial Position at their nominal value which

STATEMENT OF ACCOUNTING POLICIES

is considered a reasonable approximation of their fair value due to their short term nature.

g) Goods and services tax (GST)
NZARI is registered for GST purposes. All items in the financial statements are stated exclusive of GST except for receivables and payables, which are stated on a GST inclusive basis. Where GST is not recoverable as input tax then it is recognised as part of the related asset or expense.

The net amount of GST recoverable from, or payable to, the Inland Revenue is included as part of receivables or payables in the Statement of Financial Position.

The net GST paid to, or received from the Inland Revenue, including the GST relating to investing and financing activities, is classified as an operating cash flow in the statement of cash flows.

Commitments and contingencies are disclosed exclusive of GST.

h) Income Tax
NZARI is registered as a charitable entity and is exempt from income tax.

i) Financial assets and liabilities
NZARI is party to financial instruments as part of its normal operations. These financial instruments include bank accounts, interest receivable and accounts payable and are shown in the Statement of Financial Position. Income and expenses arising from these financial instruments are recognised in the Statement of Financial Performance. Bank account deposits are short term, highly liquid and held with high quality financial institutions. Receivables and payables are short term in nature.

j) Foreign currency
Foreign currency transactions are converted into local currency at the exchange rate on the date of transaction

k) Judgements, estimates and assumptions
The preparation of financial statements in conformity with PBE SFR-A (NFP) requires judgements, estimates and assumptions that affect the application of policies and reported amounts of assets and liabilities, income and expenses. The estimates and associated assumptions are based on historical experience and various other factors that are believed to be reasonable in the circumstances. Actual results may differ from these estimates.

l) Comparatives
When presentation or classification of items in the financial statements is amended or accounting policies are changed voluntarily, comparative figures are restated to ensure consistency with the current period unless it is impracticable to do so.

m) Changes in accounting policies
Other than the adoption of PBE SFR-A (NFP) and reclassification adjustment to comparatives for Cash Equivalents to Investments, there have been no changes in accounting policies. They have been applied on a consistent basis with those of the previous period.

STATEMENT OF FINANCIAL PERFORMANCE
FOR THE YEAR ENDED 30 JUNE 2016

	Note	2016 NZ$	2015 NZ$
Revenue			
Interest income		34,189	23,513
Grants and donations		1,788,597	1,300,000
Donated goods and services	1	273,645	193,481
Total revenue		2,096,430	1,516,994
Expenditure			
Personnel costs		467,763	342,202
Operating expenses	2	1,448,411	837,208
Total expenditure		1,916,174	1,179,410
Net operating surplus		**180,256**	**337,584**

The accompanying notes form part of these financial statements.

STATEMENT OF CHANGES IN EQUITY
FOR THE YEAR ENDED 30 JUNE 2016

	Note	2016 NZ$	2015 NZ$
Trustees' equity balance at beginning of year		881,939	544,355
Net Operating Surplus		180,256	337,584
Trustees' equity balance at end of year		**1,062,195**	**881,939**

The accompanying notes form part of these financial statements.

STATEMENT OF FINANCIAL POSITION
AS AT 30 JUNE 2016

	Note	2016 NZ$	2015 NZ$	1 July 2014 NZ$
Trustees equity		**1,062,195**	**881,939**	**544,355**
Represented by:				
Current assets				
Cash and cash equivalents	3	805,553	520,273	1,087,886
Debtors and other receivables	4	599,831	686,464	25,653
Investments	5	200,000	300,000	—
Total assets		1,605,384	1,506,737	1,113,539
Current liabilities				
Creditors and other payables	6	543,189	624,798	569,184
Total liabilities		543,189	624,798	569,184
Net assets		**1,062,195**	**881,939**	**544,355**

The accompanying notes form part of these financial statements.

STATEMENT OF CASH FLOWS
AS AT 30 JUNE 2016

	Note	2016 NZ$	2015 NZ$
Cash flows from operating activities			
Cash was provided from:			
Grants from Aotearoa Foundation		1,000,000	500,000
Grants from Air New Zealand		300,000	150,000
Grants from National Geographic Society		388,597	—
Grants from Ministry of Business, Innovation & Employment		150,000	75,000
Other grants and donations		—	25,000
Interest received		32,388	27,600
Total receipts		1,870,985	777,600
Cash was applied to:			
Payments to grant recipients		(1,089,874)	(694,112)
Payments to suppliers		(262,979)	(153,248)
Payments to employees		(256,853)	(188,751)
Goods and services tax (net)		(75,999)	(9,102)
Total payments		(1,685,705)	(1,045,213)
Net cash from operating activities		185,280	(267,613)
Cash flows from investing and financing activities			
Cash was provided from:			
Maturity of investments		100,000	—
Cash was applied to:			
Acquisition of investments		—	(300,000)
Net cash from investing and financing activities		100,000	(300,000)
Net increase/(decrease) in cash and cash equivalents		285,280	(567,613)
Cash and cash equivalents at the beginning of the year		520,273	1,087,886
Cash and cash equivalents at the end of the year	3	**805,553**	**520,273**

The accompanying notes form part of these financial statements.

1. Donated goods and services

Donated services totalling $273,645 (2015 - $193,481) have been provided by Antarctica New Zealand.

2. Operating expenses

	Note	2016 NZ$	2015 NZ$
Remuneration of auditor (audit fees)		3,500	3,475
Trustees' remuneration	9	37,514	34,125
Research grants		1,156,922	601,762
Science development functions		33,013	42,896
Director's travel		110,447	79,067
Trustees' travel		27,195	11,852
Other operating expenses		79,820	64,031
Total operating expenses		**1,448,411**	**837,208**

3. Cash and cash equivalents

	2016 NZ$	2015 NZ$	1 July 2014 NZ$
Cash at bank	455,553	520,273	587,886
Cash equivalents - term deposits	350,000	—	500,000
Total cash and cash equivalents	**805,553**	**520,273**	**1,087,886**

The carrying value of short term deposits with maturity dates of three months or less approximates their fair value. The weighted average effective interest rate for term deposits is 3.10% (2015 - nil, 2014 - 3.75%).

4. Debtors and other receivables

	2016 NZ$	2015 NZ$	1 July 2014 NZ$
Debtors and other receivables	597,494	685,928	21,030
Term deposit interest	2,336	536	4,623
Total debtors and other receivables	**599,831**	**686,464**	**25,653**

5. Investments

	2016 NZ$	2015 NZ$	1 July 2014 NZ$
Current portion of term deposits	200,000	300,000	—
Total debtors and other receivables	**200,000**	**300,000**	**—**

The carrying value of current portion term deposits with maturity dates less than 12 months approximates their fair value. The weighted average effective interest rate for term deposits is 3.07% (2015 - 4.08%, 2014 - nil).

6. Creditors and other payables

	2016 NZ$	2015 NZ$	1 July 2014 NZ$
Creditors	71,333	374,596	67,195
Accrued expenses	471,856	250,202	501,989
Total creditors and other payables	**543,189**	**624,798**	**569,184**

7. Post balance date events

No post balance day events have come to the attention of NZARI that are of a material nature as to require adjustment of the amounts contained in the financial statements or separate note disclosure.

8. Related party transactions and key management personnel

There were no related party transactions between NZARI and its Trustees or any other party.

Key management personnel compensation	2016 NZ$	2015 NZ$
Trustees' fees	37,514	34,125
Director's salary	175,000	175,000
Total key management personnel compensation	**212,514**	**209,125**

Key management personnel are the Members of the Board of Trustees and the Director.

9. Trustees' remuneration

Members of the Board of Trustees earned the following fees during the year

	2016 NZ$	2015 NZ$
Sir Rob Fenwick (Chair)	11,500	8,000
Mr Phillip Melchior (Acting Chair July 2015)	6,500	8,000
Professor Mahlon Kennicutt II	6,014	6,000
Professor Mary O'Kane	6,000	6,125
Sir David Skegg	6,000	6,000
Professor Steven Chown (Apr-Jun 2016)	1,500	—
Total Trustees' remuneration	**37,514**	**34,125**

No Trustees received compensation or other benefits in relation to cessation (2015 – nil).

10. Contingent assets and liabilities and commitments

NZARI entered into a signed agreement with Aotearoa Foundation on 7 October 2011 in which the Foundation agreed to grant a total of $5,180,000 to NZARI over 5 years to support NZARI's establishment and operation. The grant is subject to the satisfactory achievement of agreed milestones and receipt of six-monthly reports. At 30 June 2016, $1,500,000 (2015 - $2,500,000) is yet to be received subject to achievement of these milestones.

There are no contingent liabilities, nor are there any commitments as at 30 June 2016 (2015 - nil).

NOTES TO THE PERFORMANCE REPORT
FOR THE YEAR ENDED 30 JUNE 2016

11. Breach of Trust Deed

Clause 23 of the First Schedule of the Trust Deed, requires that the financial statements of the Trust for each financial year are audited within 4 months, after the end of the financial year. Whilst the audit was completed in October 2016, due to science commitments of NZARI key personnel in Antarctica during October/November 2016, the audited financial statements were adopted on 14 December 2016.

Independent Auditor's Report

To the readers of the New Zealand Antarctic Research Institute's financial statements and statement of service performance for the year ended 30 June 2016

The Auditor-General has agreed to be the auditor of the New Zealand Antarctic Research Institute's (the Institute) pursuant to section 19 of the Public Audit Act 2001. The Auditor-General has appointed me, John Mackey, using the staff and resources of Audit New Zealand, to carry out the audit of the financial statements and statement of service performance of the Institute on her behalf.

Opinion on the financial statements and the statement of service performance

We have audited:

- The financial statements of the Institute on pages 42, and 44 to 51, that comprise the statement of financial position as at 30 June 2016, the entity information, the statement of financial performance, statement of changes in equity and statement of cash flows for the year ended on that date and the notes to the financial statements that include accounting policies and other explanatory information.
- The statement of service performance of the Institute on page 43.

In our opinion:

- The financial statements of the Institute:
    - present fairly, in all material respects:
        - its financial position as at 30 June 2016; and
        - its financial performance and cash flows for the year then ended; and
    - comply with generally accepted accounting practice in New Zealand in accordance with the Public Benefit Entity Simple Format Reporting (Accrual) Not For Profit Standard.
- The statement of service performance of the Institute:
    - presents fairly, in all material respects, the Institute's performance for the year ended 30 June 2016; and
    - complies with generally accepted accounting practice in New Zealand in accordance with the Public Benefit Entity Simple Format Reporting - Accrual (Not-For-Profit) Standard.

Our audit was completed on 14 December 2016. This is the date at which our opinion is expressed.

The basis of our opinion is explained below. In addition, we outline the responsibilities of the Trustees and our responsibilities, and explain our independence.

Basis of opinion

We carried out our audit in accordance with the Auditor-General's Auditing Standards, which incorporate the International Standards on Auditing (New Zealand). Those standards require that we comply with ethical requirements and plan and carry out our audit to obtain reasonable assurance about whether the financial statements and the statement of service performance are free from material misstatement.

Material misstatements are differences or omissions of amounts and disclosures that, in our judgement, are likely to influence readers' overall understanding of the financial statements and the statement of service

performance. If we had found material misstatements that were not corrected, we would have referred to them in our opinion.

An audit involves carrying out procedures to obtain audit evidence about the amounts and disclosures in the financial statements and the statement of service performance. The procedures selected depend on our judgement, including our assessment of risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, we consider internal control relevant to the preparation of the Institute's financial statements and the statement of service performance in order to design audit procedures that are appropriate in the circumstances but not for the purpose of expressing an opinion on the effectiveness of the Institute's internal control.

An audit also involves evaluating:

- the appropriateness of accounting policies used and whether they have been consistently applied;
- the reasonableness of the significant accounting estimates and judgements made by the Trustees;
- the adequacy of the disclosures in the financial statements; and
- the overall presentation of the financial statements and statement of service performance.

We did not examine every transaction, nor do we guarantee complete accuracy of the financial statements and the statement of service performance. Also, we did not evaluate the security and controls over the electronic publication of the financial statements and the statement of service performance.

We believe we have obtained sufficient and appropriate audit evidence to provide a basis for our audit opinion.

Responsibilities of the Trustees

The Trustees are responsible for the preparation and fair presentation of financial statements and the statement of service performance for the Institute that comply with generally accepted accounting practice in New Zealand.

The Trustees' responsibilities arise from clause 22 of the Trust Deed of the Institute.

The Trustees are also responsible for such internal control as they determine is necessary to enable the preparation of financial statements and the statement of service performance that are free from material misstatement, whether due to fraud or error. The Trustees are also responsible for the publication of the financial statements and the statement of service performance, whether in printed or electronic form.

Responsibilities of the Auditor

The Auditor-General has agreed to be the auditor of the Institute pursuant to section 19 of the Public Audit Act 2001 and accordingly, under section 15 of that Act we are responsible for expressing an independent opinion on the financial statements and the statement of service performance and reporting that opinion to you based on our audit.

Independence

When carrying out the audit, we followed the independence requirements of the Auditor-General, which incorporate the independence requirements of the External Reporting Board.

Other than the audit, we have no relationship with or interests in the Institute.

John Mackey
Audit New Zealand
On behalf of the Auditor-General
Christchurch, New Zealand

DIRECTORY

Trustees
Sir Rob Fenwick KNZM (Chair)

Professor Steven Chown (appointed Jan 2016)

Mr Phillip Melchior

Professor Mahlon C Kennicutt II

Professor Mary O'Kane AC

Sir David Skegg KNZM, OBE, FRSNZ

Director
Professor Gary Wilson

Deputy Directors
Professor Craig Cary
Dr Vonda Cummings

Science Advisors
Dr Fiona Shanhun
Dr Rebecca McLeod

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Audit New Zealand

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Bankers
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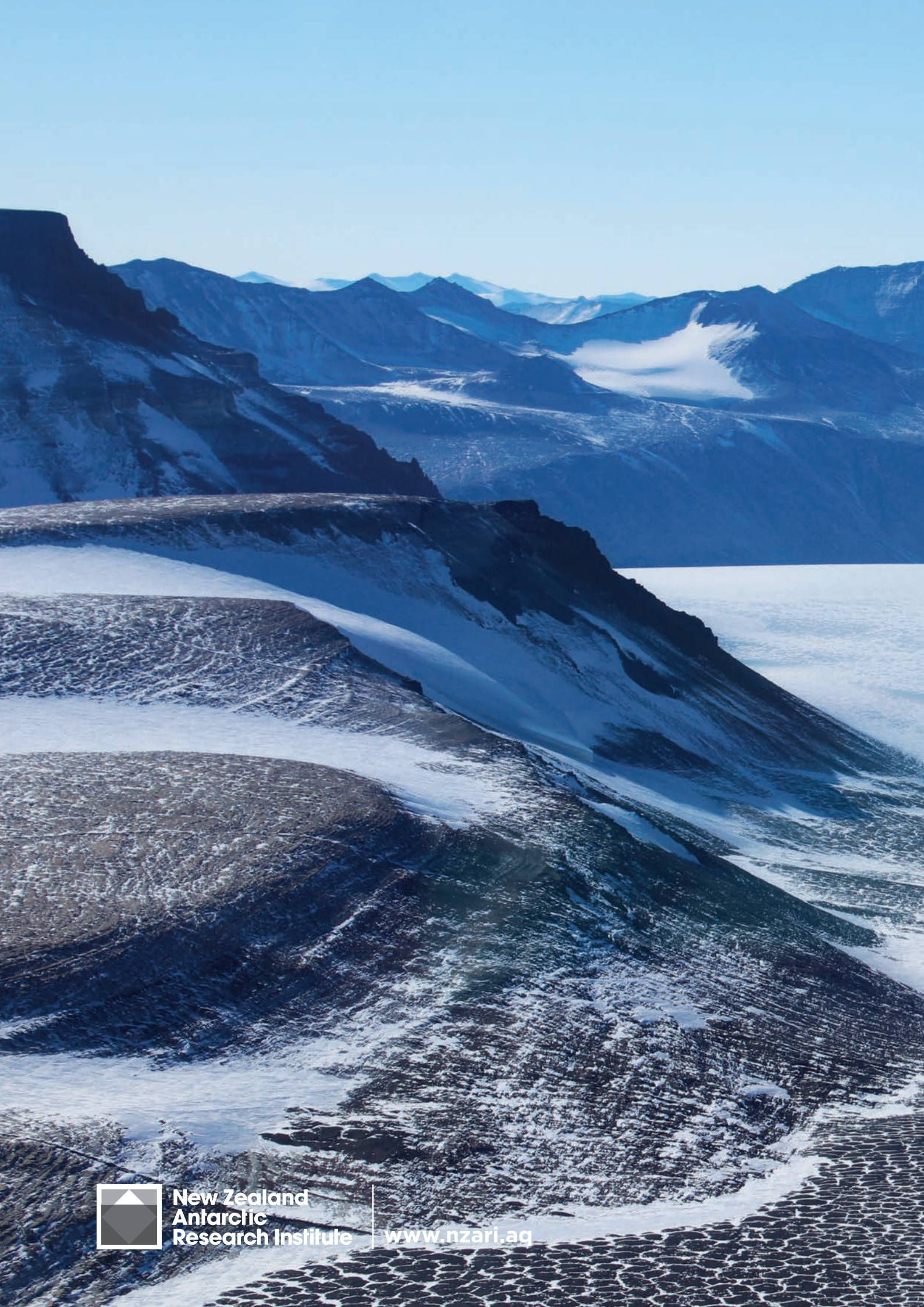
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