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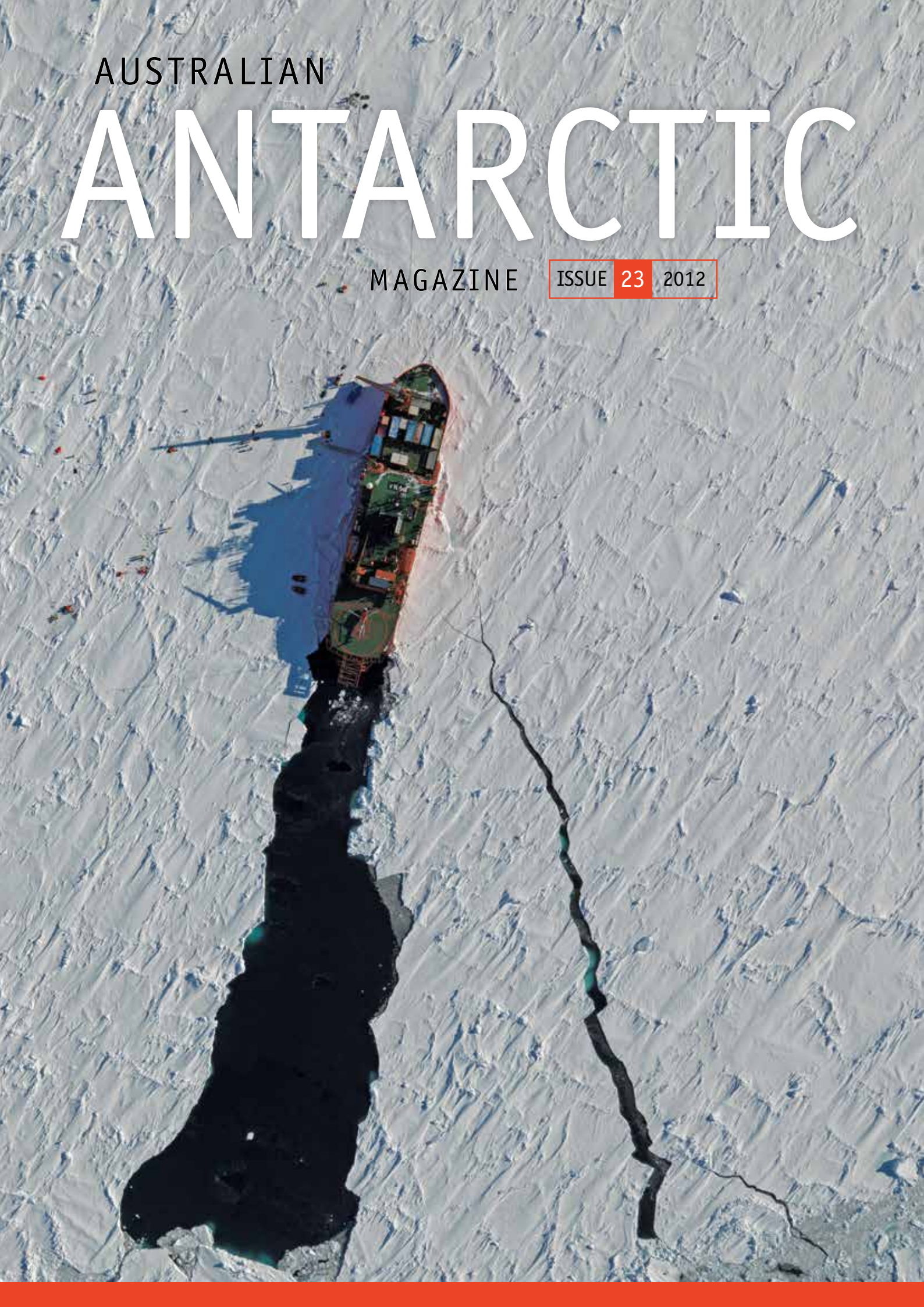

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The Australian Antarctic Division, a Division of the Department for Sustainability, Environment, Water, Population and Communities, leads Australia's Antarctic program and seeks to advance Australia's Antarctic interests in pursuit of its vision of having 'Antarctica valued, protected and understood'. It does this by managing Australian government activity in Antarctica, providing transport and logistic support to Australia's Antarctic research program, maintaining four permanent Australian research stations, and conducting scientific research programs both on land and in the Southern Ocean.

Australia's four Antarctic goals are:

- To maintain the Antarctic Treaty System and enhance Australia's influence in it;
- To protect the Antarctic environment;
- To understand the role of Antarctica in the global climate system; and
- To undertake scientific work of practical, economic and national significance.

Australian Antarctic Magazine seeks to inform the Australian and international Antarctic community about the activities of the Australian Antarctic program. Opinions expressed in *Australian Antarctic Magazine* do not necessarily represent the position of the Australian Government.

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ABOUT THE COVER

This issue's cover features an aerial image of the *Aurora Australis* at an 'ice station' in East Antarctica during the second Sea Ice Physics and Ecosystem eXperiment (SIPEX-II), which ran between September and November this year. A range of instruments, including a high resolution digital camera, were mounted on a 'Squirrel' helicopter and used to measure sea ice and snow cover thickness (see story on page 5). The image was supplied courtesy of Dr Jan Lieser and the Aerial Imaging Group.

CHARTING THE SEAS OF SCIENCE

DAN COSTA

Dr Nick Gales (left) anaesthetises a crabeater seal in Antarctica while biologists attach a satellite tag.

When he's not at the bow of an inflatable rubber boat in the rolling, grey Southern Ocean, firing satellite tags into the blubber of the world's largest marine mammal, you might find Dr Nick Gales island hopping around southern Australia studying sea lions, engaging in international whaling issues, surfing a break off the Tasmanian coast or plying the Tasman Sea in a yacht.

The Australian Antarctic Division's new Chief Scientist certainly leads an adventurous life. But in a 30 year career devoted to marine mammal issues – from the tropics to the Antarctic, at local and international scales – two things have remained constant; his love of the sea and his desire to see good science inform good policy and management.

As Chief Scientist, Nick has an exciting opportunity to apply skills honed while working across the interfaces of industry, science, government and conservation, to a broader remit. While some aspects of his work in the marine mammal realm will continue, Nick must now add Antarctic climate, marine ecosystem and terrestrial science to his list of priorities. He also has a large group of scientists within and outside the Antarctic Division to look out for, and the funding, administrative and communication tasks that come with the job.

But as you might expect from someone experienced in negotiating a better deal for whales through the International Whaling Commission, or working with fisheries and tourism operators to protect sea lion or dolphin populations, Nick is taking it all in his stride.

'Whether it's seabird bycatch mitigation or collaborating on ice drilling projects that deliver into the climate science domain, or understanding the importance of studying different parts of the atmosphere, it's not that different to what I've already done in terms of working within government to ensure that science is delivered into policy and management,' Nick says.

'I'm lucky to be coming into this job at a time when we're starting a new science strategic plan that defines the importance of translating science into policy and management outcomes, because that's what I enjoy and that's how I've spent most of my career.'

Nick began his career as a veterinarian, working briefly in a mixed animal practice after university, before a position arose at a new marine mammal park in Western Australia. Here he was responsible for the care of bottlenose dolphins, Australian sea lions, New Zealand fur seals, little blue penguins, fish, rays and sharks. But he was more interested in research than captive animals, so when a job came up at the Australian Antarctic Division, he jumped at it.

'My interest in Antarctica was piqued by a university lecturer who had spent time there and I had seen a presentation about an expedition to Heard Island in 1983, which added to my determination to get there. So I applied for a wintering expeditioner position and spent two and a half years working as a biologist on elephant seals and penguins, spending some months on Heard Island and the winter of 1986 at Davis station,' Nick says.

1

ROBB CLIFTON

3

NICOLA HODGINS

1. Dr Nick Gales (left) monitors a fur seal on Heard Island in 2003 with Dr Simon Goldsworthy (centre) and Dr Ruth Casper, while a range of tracking tags are attached.

2. Dr Nick Gales (right) and Dr Rochelle Constantine during a break from satellite tagging humpback whales in the Southern Ocean in 2009.

3. Nick indulges his passion for surfing, in the Maldives.

4. Dr Nick Gales (in wetsuit and beanie, left of the whale) provides veterinary assistance during the successful rescue of false killer whales at a mass stranding event in Western Australia in 1988.

2

SIMON CHILDERHOUSE

After a brief stint back in Western Australia during which he completed a PhD on Australian sea lions, Nick was offered a job with the New Zealand Department of Conservation, running their marine mammal program and dealing with a particularly gnarly issue.

'Their endemic sea lion was interacting with fisheries and there was a front page newspaper fight, with the fishing industry saying the conservation organisations were going to close them down and the conservation organisations saying the sea lions were going to become extinct, and the government sitting somewhere in the middle,' Nick says.

With his wife, young son and three-week old daughter, Nick sailed their yacht across the top end of Australia, down to Coffs Harbour and across the Tasman to the windy New Zealand capital of Wellington, where they spent the next four and a half years.

'The sea lion issue taught me a lot,' Nick says.

'It was my job to assemble a team, work out what the scale of the problem was, understand more about the biology of the sea lions, and work with industry to reduce the sea lion bycatch down to limits that still allowed the population to increase. It was my first real taste of taking science directly into a management forum and seeing management outcomes happen as a result of the science; and it worked really well. We got industry to modify their gear, we closed the fishery early on three separate seasons, and we brought the bycatch down.'

By this time Nick was entrenched in the marine mammal science community and was collaborating with scientists on projects that provided both academic and management outcomes. When he returned to Western Australia he spent three years running the state government marine mammal program, working on a spectrum of marine mammal issues, such as strandings, boat strikes and bycatch, relating to dugongs, dolphins, seals and whales.

In 1999 Nick was approached by the Australian Antarctic Division to do an independent assessment of the hot iron branding of elephant seals on Macquarie Island. This controversial issue had hit the media and gained the attention of the Federal Environment Minister. Nick reviewed the program, assessed the seals on the island, spoke to the scientists and the people concerned about the work, and delivered a report that contributed to the ultimate decision to cancel the branding program.

'It was a challenging job because it was such a polarised debate,' he says.

But it was really just the start of Nick's involvement in polarised issues. He subsequently moved into a permanent job with the Australian Antarctic Division, developing a marine mammal program in the Southern Ocean. The research focussed on the interaction of marine mammals with the krill fishery and fed into models used to inform the Convention for the Conservation of Antarctic Marine Living Resources. Nick was asked to contribute to the development of a similar science delivery model for the International Whaling Commission (IWC).

'I started going to the IWC Scientific Committee meetings, and we put a structure in place that

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PHOTOGRAPHER UNKNOWN

ensured science contributed directly to, and developed a strong conservation agenda for, the Commission,' Nick says.

While Japanese so-called scientific whaling tends to dominate media coverage of whale conservation, Nick says the IWC deals effectively with a range of other conservation issues, including aboriginal and subsistence whaling, bycatch, ship strikes, the effects of noise, and the role of whales in ecosystems.

Recently the IWC reviewed its future, with a major focus on negotiating the differences between countries that want to end the moratorium on commercial whaling (established in 1987), and countries that never want to see commercial whaling again.

'Australia's position is that there is no place in the modern world for commercial whaling. Some countries aligned with us, but there was a lot of pressure to allow some limited commercial whaling to proceed,' Nick says.

'That negotiation was incredibly difficult and in the end we didn't land a solution to the impasse. But the moratorium remains intact.'

Australia is now in the International Court in the Hague over the issue. At the same time two major whale science initiatives began. The first was the development of conservation management plans where multiple countries work together to manage non-whaling threats to whales in their region. The second was large, regional research partnerships, such as the Southern Ocean Research Partnership (the first of these collaborations is between Australia and, currently, nine other countries), where countries pool resources to conduct prioritised and strategic research.

'This year saw a real shift in the business of the IWC, with a whole range of important conservation and research outcomes being reported and discussed,' Nick says.

'So even though we didn't resolve the irreconcilable difference on whaling, these initiatives are a core part of the IWC now. It's a different organisation now in that it has a substantively advanced conservation agenda and a lot of that was principally driven by Australia.'

Closer to home, Nick was instrumental in establishing the Australian Marine Mammal Centre in 2006, within the Australian Antarctic Division. The Centre acts as a central point for researchers in the Australasian region to seek funding and to collaborate on marine mammal research that answers the questions government needs to inform policy. Through the Centre a wide range of applied research is funded around Australia, including work developing genetic and tagging techniques to acquire information about the diet, age, population structure and migration patterns of marine mammals. A range of regional projects have also been funded in places such as Thailand, Fiji, Pakistan and Papua New Guinea, to address conservation issues there and to build the capacity of the regions to continue the research.

Nick's experiences will set him up well for the challenges that no doubt lie ahead. He is philosophical about the realities that frustrate solutions to complex conservation and other global problems.

'Decisions are made by governments on the basis of science and a whole range of other things to do with politics, economics and society. These other major influences may trump science as a priority – just look at the climate debate – and you need to understand that science is just part of the process,' he says.

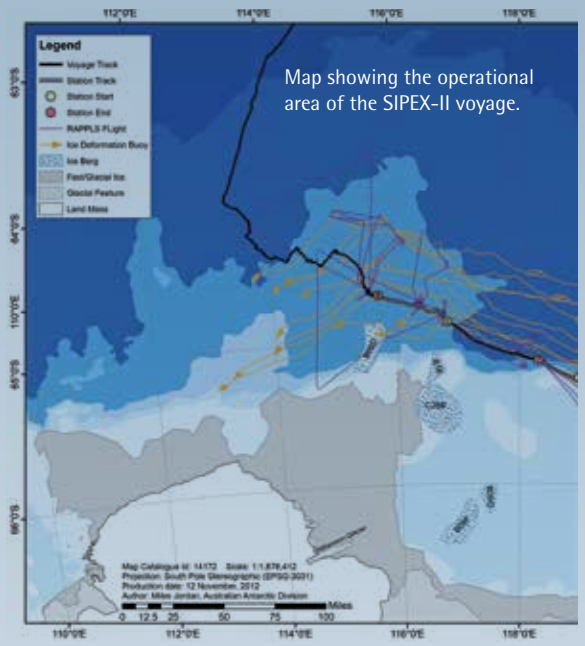
'But, as scientists, we have a critically important responsibility to influence and affect government decisions by delivering and clearly communicating the relevant science to ensure that policy is well informed.'

Nick is excited about this next stage of his career and delivering a science plan that he had a role in developing. Like the previous science strategy, this 10 year strategic plan is focussed on good science, but it's also heavily weighted towards government priorities and delivering science to end users.

And while he won't be messing about in boats in the name of scientific research quite so much, Nick will still find opportunities to indulge his passion for surfing. He is also building his retirement plan – an aluminium yacht that he and his wife plan to sail around the world.

WENDY PYPER
Australian Antarctic Division

ANTARCTIC SCIENCE IN THE SPRING SEA ICE ZONE



Map showing the operational area of the SIPEX-II voyage.

The advance and retreat of sea ice is one of the largest physical and biological phenomena on earth, which drives biological process and is highly vulnerable to changing climate. We know little about these important global processes but for eight weeks, between September and November this year, I travelled with international experts in polar sea ice, snow, algae and krill research to learn more about these phenomena in the spring-time sea ice zone in East Antarctica.

The occasion of the voyage was the second Sea Ice Physics and Ecosystem eXperiment (SIPEX-II); the first such voyage was conducted in 2007 as part of the International Polar Year.

The research voyage brought together some 50 scientists from 9 countries – Australia, United States, Germany, France, New Zealand, Switzerland, Japan, Belgium and Canada. It also brought together a suite of high-tech research tools to study snow, sea ice and the associated biology from all angles – from the air, on the ice floes and beneath the ice.

The main aim of SIPEX-II was to estimate snow cover and sea ice thickness and distribution in East Antarctica at small (via ice floe measurements) and regional (via airborne ice surveys) scales, and to better understand the importance of sea ice for the growth and distribution of sea ice algae and Antarctic krill. This information will help scientists assess the likely impacts of climate change on the physical and biological elements of the East Antarctic sea ice zone.

The following stories provide an insight into some of the research. For more stories read the SIPEX-II blog at http://www.antarctica.gov.au/about-antarctica/history/exploration-and-expeditions/modern-expeditions/diaries-and-stories/spotlight-on-the-sea-ice.

WENDY PYPER
Australian Antarctic Division

1 Scientists participating in the second Sea Ice Physics and Ecosystem eXperiment (SIPEX-II) between September and November this year, measured Antarctic sea ice thickness, snow cover and biology from all angles.

BRETT FREE

2. The Antarctic aerial survey team. Kneeling at front L-R: helicopter engineer Tyson Griffin and marine glaciologist Dr Jan L. Lieser. Back L-R: electronics engineer Kym Newbery, pilot Leigh Hornsby, radar engineer Peter Jansen, pilot Dougie Gray, and engineer Mark Lucas.

3. An aerial photograph taken with the high resolution digital camera in the helicopter, showing part of a survey area or 'transect' to the left of the ship, and scientists working on the ice.

Sea ice sky-lab

It's difficult to become a member of the Golden Blade Club. But as marine glaciologist Dr Jan Lieser tends to spend more time in a helicopter than on the ship, he was a natural fit for this exclusive (yet unofficial) group.

Dr Lieser, from the Antarctic Climate and Ecosystems Cooperative Research Centre, led a small team working to obtain aerial measurements of sea ice and snow cover thickness in East Antarctica during the recent Sea Ice Physics and Ecosystem eXperiment (SIPEX-II).

These measurements will be used to validate and calibrate measurements from the European Space Agency satellite, Cryosat-II. Currently, satellites provide good information about the area covered by sea ice, but satellite-borne instruments that can measure the thickness of sea ice and its snow cover are a recent addition. Once the accuracy of these instruments is confirmed, they will provide a large-scale view of the total volume of sea ice in Antarctica.

'The thickness of sea ice is regarded amongst climate scientists as one of the crucial indicators of change,' Dr Lieser says.

'When we know how the thickness of sea ice cover is changing over time, we can estimate the influence of global climate change on the Antarctic environment.'

Changes in sea ice thickness will affect the formation of cold, salty Antarctic Bottom Water that drives ocean currents around the world, and the organisms that depend on the ice for habitat and food, from phytoplankton and krill, to whales.

Dr Lieser took aerial measurements of sea ice and snow cover thickness using a range of high-tech instruments mounted in a 'Squirrel' helicopter nick-named the 'flying toolbox'. The instrument hardware was purchased off the shelf and then wired and integrated with custom software by the Australian Antarctic Division science technical support group and the project team. After many hours of testing and refinement the final result almost doubled the value of the helicopter.

The flying toolbox included a high resolution digital camera for aerial photographs, which gives scientists a measure of the area covered by sea ice and the type of ice – whether it is smooth or rough. A 'pyrometer' measured the surface temperature of the snow, ice and ocean, which will help calibrate temperature measurements from space. The pyrometer is good for classifying ice types as thin ice is warmer than thick ice.

The helicopter also carried a scanning laser system (or 'LiDAR'), used in combination with a snow radar to measure the amount of snow and sea ice floating above the ocean surface (known as 'freeboard' or surface elevation). As snow pushes sea ice beneath the ocean surface, scientists need to measure snow thickness to work out how much ice is under the water – something that can't be determined from space. The LiDAR and radar also provide information on how rough or smooth the snow cover is, which influences what we see on satellite images.

The helicopter also incorporated an inertial navigation and global positioning system to pinpoint the attitude and location of the helicopter in space. The data collected by this system are essential for assigning aerial measurements to locations on the sea ice.

Last but not least, the helicopter carried a microwave radiometer provided by Japanese colleagues, which gives an estimate of the two dimensional area covered by sea ice. These measurements are again used to calibrate satellite data.

To capture all this information the helicopter flew in a triangular pattern over 60x60x60 nautical mile survey areas, which took about 2.5 hours per survey. Each survey included the study area of scientists working on the ground (a 100–200 m transect of snow and ice parameters), so that related on-ground measurements can be used to test the accuracy of those made from the air. The airborne survey thus acts as an intermediate layer between the highly detailed ground measurements and coarse resolution satellite measurements.

Dr Lieser will now spend many months collating and interpreting all the data. The aerial measurements and photographs, in combination with on-ground and under-ice measurements, will allow scientists to produce high resolution, three-dimensional images of the sea ice.

WENDY PYPER
Australian Antarctic Division

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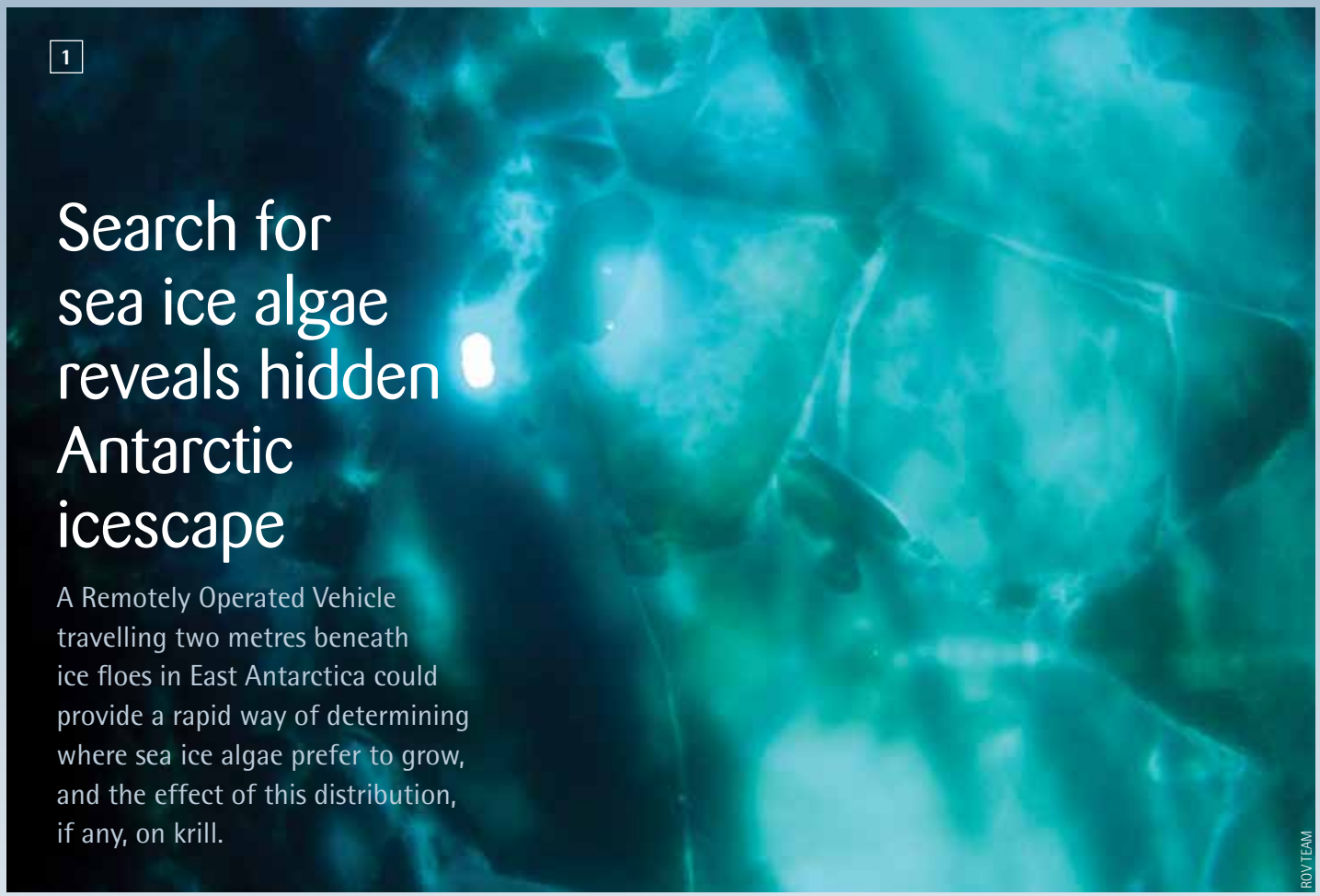


ROV TEAM

Search for sea ice algae reveals hidden Antarctic icescape

A Remotely Operated Vehicle travelling two metres beneath ice floes in East Antarctica could provide a rapid way of determining where sea ice algae prefer to grow, and the effect of this distribution, if any, on krill.

The Remotely Operated Vehicle or ROV, which is tethered to the surface by a 400 metre-long cable, played a key role in the recent Sea Ice Physics and Ecosystem eXperiment-II (SIPEX-II) voyage.

Voyage Chief Scientist, Dr Klaus Meiners, from the Australian Antarctic Division and the Antarctic Climate and Ecosystems Cooperative Research Centre, said the main job of the ROV was to measure the amount and distribution of sea ice algae under the ice using a smart light sensor called a 'hyperspectral radiometer'.

'This instrument measures the different wavelengths of sunlight penetrating the ice, some of which are absorbed by sea ice algae for photosynthesis,' Dr Meiners says.

2

WENDY PYPER

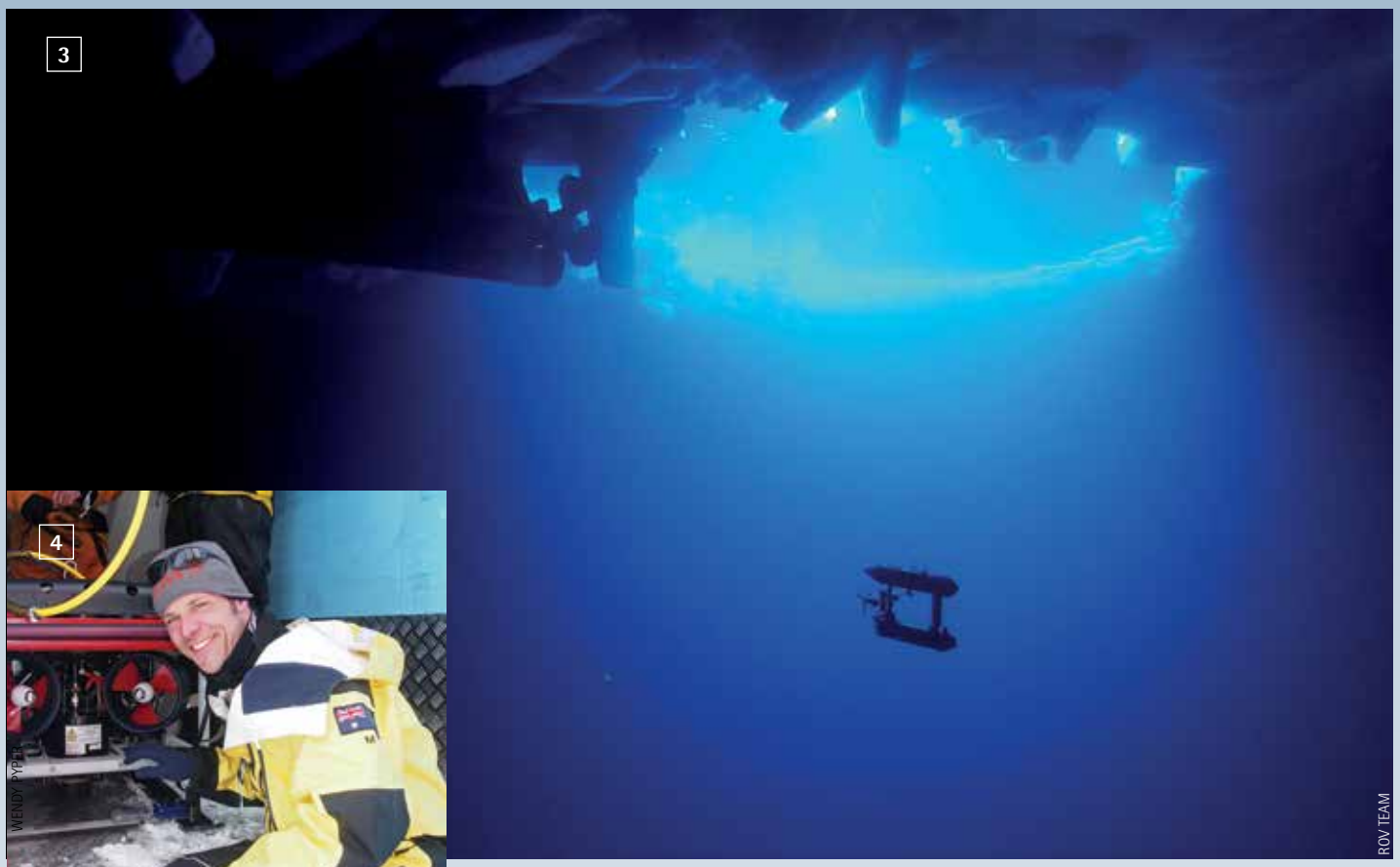
'By measuring the reduction in the blue and green wavelengths of light beneath the ice, we can estimate how much algae there is.'

Sea ice algae live within and attached to the bottom of the sea ice and are an essential food source for Antarctic krill, which in turn provide food for larger animals such as penguins, seals and whales. Climate models predict that sea ice in Antarctica will have declined by 25% in extent and 35% in volume at the end of the century. So understanding the distribution of sea ice algae now, and the effect of sea ice thickness and snow thickness on its biomass, will enable more accurate assessments of the impact of climate change on this keystone species and the rest of the Antarctic marine ecosystem.

'The traditional method of studying sea ice algae is to take ice cores and then measure the photosynthetic pigment used by algae – chlorophyll – as a proxy for how much algae there is,' Dr Meiners says.

'But since the 1980s about 1500 sea ice cores have been taken around Antarctica, each with a diameter of only 10 cm. So that's less than a football field of data in an area that extends to 18 million km^2 in winter.

'The hyperspectral radiometer on the ROV can take a measurement every 10 seconds, so in a



1. The ROV's view under the ice as light streams through the ROV hole at the surface.
2. The Remotely Operated Vehicle being readied for deployment under the Antarctic sea ice.
3. A view of the Autonomous Underwater Vehicle taken by the ROV. The hyperspectral radiometer data from each vehicle will contribute to a map of sea ice algae biomass.
4. Voyage Chief Scientist, Dr Klaus Meiners, with the ROV.

single day we can collect more information than everyone has collected in 30 years.'

The SIPEX-II voyage was the first opportunity for the Australian Antarctic program to use the ROV in the harsh Antarctic environment. The vehicle was instrumented with various sensors and tested months before departure by the Antarctic Division's Science Technical Support team and the instrument workshop. A big part of the voyage was then dedicated to getting the vehicle, its navigation system, and associated procedures around deploying it under the ice, right.

The team had to first drill a suitable hole in the ice using an industrial sized drill bit on a back-hoe, before winching the 80 kg ROV into the hole. Engineers then used a joystick to operate the vehicle, from a heated container next to the hole, and monitored its progress via a link to four high definition stereo vision cameras installed on the ROV.

'It was amazing how rugged the subsurface of the ice was. It looked pretty wild, like a badly eroded mountain range. We had a lot of snags under icicles which was pretty stressful, but the ROV has a little grabber which we used to pull the tether free,' Dr Meiners says.

'We saw a lot of beautiful jellyfish and Antarctic krill, as well as patchy areas of algae, but we need to analyse our images and link our hyperspectral data to surface measurements to get a proper estimate of the amount of sea ice algae.'

As well as hyperspectral data the ROV was also able to collect information on sea ice thickness using a sonar and pressure sensor.

'The pressure sensor tells us how deep we are and the sonar gives us the distance from the ROV to the subsurface. The difference between these measurements gives us an estimate of the ice thickness,' Dr Meiners says.

This thickness data will be compared with similar measurements made from a deeper-diving Autonomous Underwater Vehicle or AUV, which operated at about 20 m below the ice (see story page 8).

'The ROV project links with many other projects on the voyage operating underneath, on and above the ice,' Dr Meiners said.

'As well as the AUV work, we will link with measurements of snow thickness collected by laser scanners on the ice surface and from a helicopter. When we link this data together we'll get a three-dimensional map of the ice. Using this we'll be able to see whether sea ice algae distribution correlates with ice thickness and if this affects krill distribution as well.'

The ROV and other teams will spend the coming months linking their different data sets to build the ice thickness and algae biomass distribution maps.

'These are big questions that you can't answer on one voyage, but you understand more each time,' Dr Meiners says.

'We've proven that the ROV, the AUV, and other technologies work in Antarctica, and these technologies will allow us to improve the speed and scale at which we can collect data in the future.'

WENDY PYPER
Australian Antarctic Division

Twenty metres under the sea ice

Twenty metres beneath the ocean surface, a submersible robot is hard at work mapping the Antarctic sea-ice floe under our feet.

Its efforts will contribute to the first complete three-dimensional measurements of Antarctic ice floes, and inform the validation and calibration of satellite measurements that aim to provide ongoing large-scale assessment of sea ice thickness in East Antarctica.

The untethered robot, known as an Autonomous Underwater Vehicle or AUV, is part of an exciting new collaboration between Dr Guy Williams of the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC), and the Deep Submergence Laboratory at the Woods Hole Oceanographic Institution (WHOI) in the United States.

The dual-hulled AUV travels at 30 cm per second in a 'lawnmower' grid pattern at a constant depth of about 20 m under the ice. It measures the three-dimensional 'topography' or shape of the base of an ice floe using an on-board instrument called a multi-beam sonar. The sonar works by sending out a swath of 'pings' and measuring the amount of time it takes for the sound to bounce back.

'The AUV is a huge step forward in our observational capability of how we measure sea ice thickness,' Dr Williams says.

'In the past we took drill line measurements or observed the ice thickness as we moved through it on the ship.'

Woods Hole AUV engineer, Dr Clay Kunz, says the AUV is from a line of 'seabed class' vehicles that are normally used to map the sea floor.

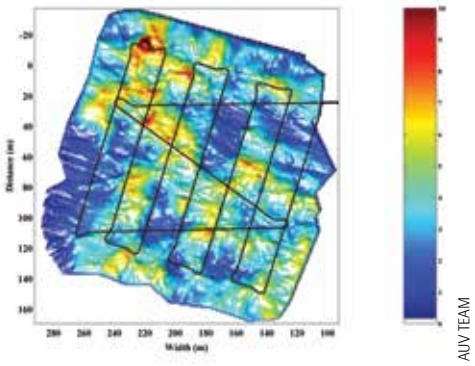
'For this Antarctic mission we've mounted all the navigation and scientific instruments on top of the vehicle so that they can measure the topography of the underside of the sea ice instead,' Dr Kunz says.

Data is stored in an onboard computer and then converted into a three-dimensional map at the end of each survey.

'The under-ice surface is very complex and dynamic and we need to measure this shape to be able to assess how much ice there is,' Dr Williams says.

'When we combine our 3-D view of the underside of the sea ice with surface measurements that we'll get from other instruments, we'll have a full 3-D map of the entire ice floe.'

WENDY PYPER



AUV TEAM

1. The AUV team. Front (L-R): Peter Kimball (WHOI), Polly Alexander (Australian Maritime College and CSIRO), Rowan Frost (Australian Maritime College). Back (L-R): Clay Kunz (WHOI), Guy Williams (ACE CRC).

2. A preliminary 3-D map produced from multibeam sonar data collected by the AUV under an ice floe on 4 October 2012. The map shows a typical 'lawnmower' grid of about 150 x 150 m and the depth bar on the left shows deeper ice in red (up to about 10 m below the surface) and shallower ice in blue.

This AUV work contributed to one of the major goals of the recent Sea Ice Physics and Ecosystem eXperiment-II (SIPEX-II) voyage – to obtain floe-scale and aerial measurements of sea ice thickness and snow cover, which can be used to validate and calibrate satellite measurements that provide a large-scale view of the amount of sea ice in East Antarctica.

Measuring life from light

The AUV also contributed to a key goal of the Remotely Operated Vehicle (ROV) project (see story page 6), which aims to measure sea ice algal biomass – the amount of microscopic plants living within and attached to the sea ice floes.

Both the AUV and the ROV are instrumented with specific light sensors called radiometers, which measure the amount of light penetrating the water column through the snow and ice above. Some of the light, in particular blue and green wavelengths, is absorbed by the photosynthetic pigments of the sea ice algae. As the light penetrates the water, phytoplankton (free-floating microscopic plants) absorb more. Thus, measurements of the reduction in blue and green wavelengths of light as they move through the ice and water column can be used to estimate how biologically active the sea ice is.

The results from the AUV's radiometer will be compared to the biological patterns observed by the ROV, to see if the patterns can be detected at the operational depth range of the AUV (the AUV operates at about 20 m below the ice while the ROV operates at about 2 m). If successful, this could see AUVs conducting bio-optical surveys over much larger spatial scales on subsequent voyages.

As ice is predicted to thin in the future, these measurements could allow scientists to predict the resulting changes in the biomass of ice algae. As algae provide food for krill and zooplankton, scientists will also be able to determine the likely flow-on effects up the food chain.

WENDY PYPER
Australian Antarctic Division

1. Dr Patti Virtue from the Institute of Marine and Antarctic Studies in Hobart checks krill involved in a growth rate experiment on the ship.

2. Australian Antarctic Division krill aquarium manager Rob King, catching krill in the Antarctic sea ice zone using a fish pump.

Pumping krill into research

An international team of scientists has pulled out the 'big guns' in experimental krill pumping technology to capture live specimens of the tiny and elusive larval and juvenile stages of this important crustacean in the East Antarctic sea ice zone.

Australian Antarctic Division krill aquarium manager, Mr Rob King, caught larval and juvenile krill in open water leads in the sea ice, using a high volume water pumping system off the side of the icebreaker, *Aurora Australis*, during the recent Sea Ice Physics and Ecosystem eXperiment-II (SIPEX-II).

The pump, designed originally for salmon by Aqua Life Products in Idaho, US, uses a large, insulated pipe to suck some 400 litres of water per minute into a filter system housed in the ship's oceanographic instrument room. The captured krill are then gently hosed into a holding tank for transport to the ship's laboratories.

'The pump is much gentler on krill than the traditional method of catching them in zooplankton nets,' Mr King says.

'Better than 95% of the krill that came through the pump were in good condition and survived. This is the first time we've tried using a fish pump in Antarctica and it's an approach we're exploring as an experimental technique. It seems to work well but we're still to determine whether it's efficient enough to deploy on a regular basis.'

The krill were collected by Australian and German scientists onboard, who are studying their metabolism, growth rate and diet, and the sea ice habitat they live in, to learn more about how these early life stages survive the winter.

'Most krill research has been conducted on adult krill during the Antarctic summer and only a few studies have focused on the larval stages during winter – mainly from the Atlantic sector of the Southern Ocean,' says krill biologist Dr Patti Virtue, from the Institute of Marine and Antarctic Studies.

'We think krill larvae depend on the winter sea ice algae for food. If climate change alters the thickness, extent and duration of Antarctic sea ice, as it is predicted to, this could affect the survival of krill larvae, with flow-on effects to the adult population, and higher organisms that rely on krill for food.'

Krill have 11 larval stages before they become juveniles and then sexually mature adults. The final larval stage caught on the voyage was about 9 mm in size and looked much like a juvenile (25 mm) or adult.

As well as the heavy duty krill pump, Dr Bettina Meyer and Dr Ulrich Freier from the Alfred Wegener Institute for Polar and Marine Research in Germany (see story page 10) used a smaller sled-based pump on sea ice floes, to capture krill from directly under the ice.

Dr Meyer's previous research in West Antarctica has shown that larval krill prefer the relatively favourable living conditions provided by rafted sea ice – where large pieces of ice push up over each other, forming pockets or icy caverns protected from strong ocean currents. Within these pockets of calmer water, sea ice algae associated with the underside of the ice provide an important food source for the developing krill.

'I want to compare the habitat we've observed in West Antarctica with what we find in East Antarctica, to see whether the larvae prefer an over-rafted refuge containing a developed sea ice algae community,' Dr Meyer said.

'In West Antarctica the krill population has shown a strong decline over the last 30 years and we think it has something to do with the survival of larvae over winter.

'Climate change is already having an impact there, with sea ice formation starting much later, when the algal blooms have finished. So there is less algae around to be incorporated into the sea ice and less light to stimulate production.'

WENDY PYPER
Australian Antarctic Division

1. Dr Bettina Meyer and Dr Ulrich Freier collecting krill from under the ice using a sled-based pump (MASMA) in Antarctica during the recent SIPEX-II.

2. A juvenile krill caught during SIPEX-II.

Rhythm of Antarctic life

'Clock genes' that regulate the daily and seasonal internal rhythms of krill are the target of new research by Antarctic scientists seeking a better understanding of what makes these important crustaceans tick.

Australian Antarctic Division krill biologist, Dr So Kawaguchi, and molecular biologist, Dr Simon Jarman, are part of an international collaboration searching for genes that control how krill respond to changing day length and other environmental cues, such as sea ice extent and ocean temperature.

The study is based on decades of research on the circadian rhythms of the fruit fly (*Drosophila*) by collaborating scientists at the University of Padova in Italy.

'There are about a dozen key genes in fruit flies that regulate their daily and seasonal biorhythms, and we're trying to identify the equivalent genes in krill,' Dr Jarman says.

'Insects and crustaceans share similar systems but we'll also be looking for other genes that interact with these clock genes or that are specific to krill. It's likely that an organism like krill, which has evolved in the changeable Antarctic environment, will have extra genes that also contribute to regulating their biorhythms.'

The research is expected to provide clues to how krill will fare in a changing environment. Krill have 11 larval developmental stages before they become juveniles and, finally, adults. These developmental stages need to be timed to make the most of the food (sea ice algae) that's on offer.

'When winter ends and there's spring growth of algae, if the krill aren't developing at the right time, then they could starve, or miss out on critical feeding opportunities as other organisms eat the algae before them,' Dr Jarman says.

This could happen if a disconnect forms between changing day length (from complete darkness in winter to all-day sunlight in summer) and sea ice conditions that may be affected by a warming ocean and changing wind patterns.

'If krill have evolved a physiology or behaviour that changes with day length rather than sea ice conditions, and changing sea ice conditions lead to earlier or later algal blooms, then there could be a desynchronisation of food availability and larval development, or adult breeding,' Dr Jarman says.

The research team has formed the Helmholtz Virtual Institute for 'Polar Time', centred on the Alfred-Wegener Institute of Polar and Marine Research* in Germany and led by krill physiologist Dr Bettina Meyer.

During the recent Sea Ice Physics and Ecosystem eXperiment (SIPEX-II) Dr Meyer and her colleague Dr Ulrich Freier collected live larval and juvenile Antarctic krill for the Polar Time project. They will now look to see if, or how strongly, the clock genes are expressed in the cells of late-stage larval krill and juveniles, compared to adults.

'From previous investigations we know that the clock gene machinery is active in adult krill, but it has not yet been observed in the larvae stages. We don't know in which of the developmental stages the genes become active. So we need to collect krill at different life stages to identify when the transition occurs,' Dr Meyer says.

'With the animals collected on the SIPEX-II voyage we'll also be able to compare clock gene expression in krill during spring – a time of year when the day length increases daily – to those we've already collected during autumn, summer and mid-winter.'

Gene expression will be assessed by measuring the amount of clock-gene-specific mRNA (messenger ribonucleic acid) in krill cells.

3. Dr Ulrich Freier processing freshly caught krill for RNA analysis, onboard the *Aurora Australis*.

4. Dr Bettina Meyer (left) and Dr Ulrich Freier from the Alfred Wegener Institute of Polar and Marine Science onboard the *Aurora Australis* in October 2012.

This molecule is the direct result of genes (DNA) being switched on in response to various triggers. Immediately after capture on the SIPEX-II voyage the krill were prepared by Dr Freier for RNA extraction. The extraction process will be completed by Dr Freier and Dr Jarman back at the Australian Antarctic Division.

This work will provide a baseline against which to compare future experiments on captive krill in the Australian Antarctic Division's krill aquarium.

'We have the only facility in the world where we can conduct experiments on captive krill under simulated Antarctic conditions,' Dr Jarman says.

'We'll set up light regimes similar to those that wild krill experience, but we'll also set up different light regimes to look at the effect on clock gene expression.'

The research team also includes ecosystem modellers, who will combine gene expression data with sea ice and other environmental data to see how changes in sea ice extent, day length, algal growth and the internal biorhythm of krill, interact.

'This work is fundamental biology, so we don't know necessarily where it will end up. It will have links into sustainable fisheries policy, but it will also turn up things that have not been thought of yet,' Dr Jarman says.

*The Helmholtz Virtual Institute partners are the Australian Antarctic Division, Alfred-Wegener Institute, University of Padova, the University of Oldenburg and the Charité Berlin.

WENDY PYPER
Australian Antarctic Division

A brave new world as Macquarie Island moves towards recovery

MICHAH VISOIU

TASMANIA PARKS AND WILDLIFE SERVICE

1. This 30 year exclosure plot near Sandy Bay provides a graphic contrast between the lush native vegetation inside the fence and the 'lawn' of exotic *Poa* grass outside.
2. The hunting effort continues year round in the search for any surviving rabbits.

More than one year after aerial baiting to rid Macquarie Island of its destructive rabbits, rats and mice, there are encouraging signs that the eradication effort has been successful.

The seven year program began in 2007 with the aim of restoring the island's biodiversity to a natural balance, free of the impacts of introduced species. Pest eradication project teams around the world have been watching the project on the sub-Antarctic, World Heritage-listed Macquarie Island, with interest.

It is the world's largest eradication project for three species at one time and the logistical challenges of undertaking the project 1500 km from Tasmania, accessible only by ship, has added immense complexity to the undertaking.

Keith Springer, the Macquarie Island Pest Eradication Project manager for the Tasmania Parks and Wildlife Service is cautiously optimistic about the removal of both rabbits and rodents and the recovery of the island's habitats.

'Following the completion of aerial baiting in July 2011, the hunting phase began with the objective of removing the small number of rabbits that were expected to survive the baiting. A total of 13 rabbits were found and killed, with the last rabbit killed in November 2011,' Mr Springer said.

'I'm confident that rabbit numbers are now extremely low, and we estimate that there may be fewer than five remaining on the island. The last rabbits killed were a doe and kittens, but the father of that litter has not been located, and rabbits responsible for grazing damage in a couple of areas have also not been located and dispatched.'

The focus for the current eradication team is clear – to locate and dispatch any remaining rabbits that found the bait unappetising and survived. The island is divided into six hunting blocks, with dog handlers and hunters tackling one block for a four-week period. Their search patterns are recorded on GPS units and since August 2011 they have clocked up an incredible 33 412 km as they search every accessible nook and cranny of the 12 785 hectare island's varied terrain.

The going will invariably get tougher for the hunters with each month that passes with no further sign or rabbit kills. Physically, travel is more gruelling as the vegetation recovers and becomes denser and increasingly wetter, as it retains more of the atmosphere's moisture in its leaf mass. Spotting rabbit disturbance is also more difficult as the ground cover increases. The psychological challenge increases too with each month that passes with no sign of rabbits.

The news is also encouraging in regard to the rodents, but Mr Springer is reluctant to claim success at this early stage.

3. Recovering *Pleurophyllum hookeri* at Sandy Bay.

4. Hunters and their dogs search for rodents. The dogs have no interest in penguins, testament to their high level of training.

'I am pleased by the lack of rodent sign and I'm pretty confident the rats are gone because we know they take the bait well and we spread enough bait for all the target animals to access some. But mice eradications have failed on much, much smaller islands. We don't fully understand the reasons for this, but there is a pattern that when rats are present, the success rate of mouse eradication decreases,' he said.

As a precautionary measure, baiting continues at huts and station buildings and the island's coastal caves. Rodent detection dogs will be part of the hunting team that arrives in February 2013. These dogs will help the team to confirm that the eradication of rodents has been successful. A two year interval after baiting allows any surviving remnants time to breed up to detectable levels, before eradication success is declared.

With the removal of rabbits, rats and mice, the island's vegetation, insect and bird life are showing signs of recovery. Recently, visitors to the island have observed areas of dense spider webs in recovering vegetation, shimmering with moisture droplets. It's a sight not previously recorded on Macquarie Island and is testimony to the rapid recovery of spider populations in the absence of mice predation.

Populations of some bird species are slowly increasing, with the island's burrowing petrels being the main beneficiaries. In particular, blue petrels, previously restricted to breeding on offshore rock stacks due to rat predation, have begun to breed again on the main island. Likewise, grey petrels have shown increased breeding success and have fledged greater numbers of chicks; both positive indicators even in these early days. In the first breeding season since baiting finished, Antarctic terns are now breeding on the island's cobblestone beaches in far greater numbers than previously, when they were restricted to less accessible rock stacks.

Botanists too are watching the recovery process with interest and hope. Senior ecologist with the Tasmania Department of Primary Industries, Parks, Water and Environment, Dr Jennie Whinam, is among those who have seen the island at its worst and are now keenly documenting the recovery.

Department scientists started monitoring Macquarie Island's vegetation in the 1980s. Their exclosure plots and photo-monitoring sites have provided graphic visual evidence of just how badly the island was degraded under the pressure of a rabbit population estimated at more than 100 000. It was a landscape-scale catastrophe that saw increased incidence of landslips resulting from the island's denudation and subsequent erosion.

'The island had changed to a very simple island. It was a much less exciting and complex mosaic of landscapes and vegetation. The specialness of it had gone with the loss of iconic species such as the unique megaherbs, the Macquarie Island cabbage (*Stilbocarpa polaris*) and silver-leaf daisy (*Pleurophyllum hookeri*)', Dr Whinam said.

Dr Whinam is heartened to see the island may once again be worthy of its nickname, 'The Green Sponge'. But she also warns that as the island regains its ecological equilibrium, there will be winners and losers.

'In five years' time the island will look significantly different from today. It will have a lot more green, a lot more colour in general. What I can't predict is how long it will take to become stable. There's a big difference between initial recovery with the grazing pressure taken off, and I expect that will be fast and lush, but it's likely to be 20 years before we can start talking about what the new equilibrium is like,' Dr Whinam said.

'In this new world, there will be winners and losers. The sleeper is what will happen with the weeds. There are three weed species on the island and we're expecting some of them to increase initially and then hopefully decrease as the native species re-establish. There may also have been new arrivals of weeds that have gone unnoticed simply because it's been so hard to identify plants that were so heavily grazed.'

Coupled with the joy of the island's vegetation recovery is caution. Reports from other island eradication projects indicate that even in the same archipelago, different plant species have responded quite differently to the removal of pest species.

'Their message is that we should expect the unexpected,' Dr Whinam said.

Whatever changes occur, if in another few years the eradication is deemed to have been successful, it will set a new benchmark in island eradications for its size, multiple species, remoteness and challenging environment.

LIZ WREN

Manager Media and Communications, Tasmania Parks and Wildlife Service

Listening to the blues

Antarctic scientists have tracked and located more than 50 blue whales using acoustic technology to eavesdrop on the animals' resonant song.

By using sound rather than sight to initially detect the whales, the scientists greatly improved the likelihood of finding and counting whales in the vast Southern Ocean, saving enormous amounts of searching effort and expensive ship time.

To test the technology the team, led by Australian Antarctic Division marine biologist Dr Mike Double, deployed 131 'directional sonobouys' in northern Bass Strait in January and March 2012.

'Previous methods of estimating blue whale abundance by sightings surveys from ships, allowed us to visually detect a whale from up to 10 km away in good weather, but acoustic methods can allow you to detect them perhaps as much as several hundred kilometres away, and in rough weather,' Dr Double says.

'We wanted to answer questions such as how far away can we detect whales using the sonobuoys, how far away can the vessel pick up the VHF signal from the sonobuoys, do whales sing long enough for us to find them, and can we track the whales at night?'

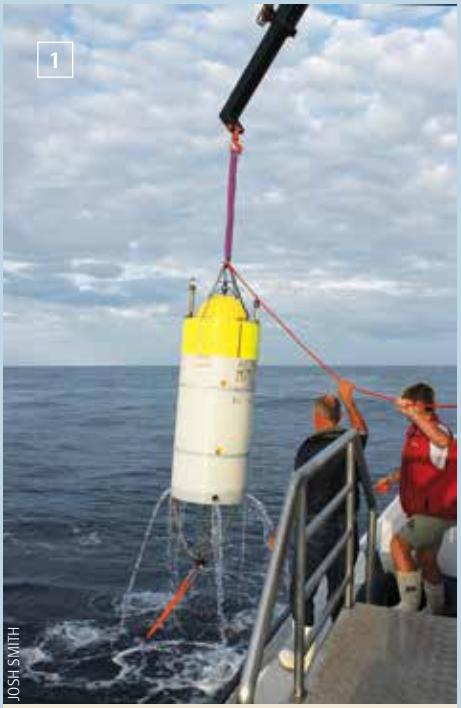
In the first of the two three-week voyages the sonobuoys were deployed as needed in a 500 km study area south of Portland, Victoria. Australian Antarctic Division acoustician, Dr Brian Miller, said the first 10 sonobuoys detected nothing but ship and wave noise, as they traversed an area apparently devoid of blue whales. But it wasn't long after the ship moved to another region that the team struck gold.

'We heard our first blue whale singing at 2 am and tracked the ship towards the sound through to 6 am, when the whale stopped singing,' Dr Miller says.

The team estimated that the ship had approached the singing whale to within about two kilometres. At day-break the observer team then visually detected the animal and directed the ship to approach the whale during several surfacing bouts, before it surfaced some 50 m from the vessel, allowing them to take photographs for individual identification.

The team continued this process of deploying sonobuoys to triangulate the location of singing whales and get within range to make visual sightings, with good success.

'With a team of five dedicated acousticians we are able to monitor for whales 24 hours a day, every day. This continuous acoustic coverage ensured that the ship was almost always moving towards whales, so as to maximise the number of encounters,' Dr Miller says.

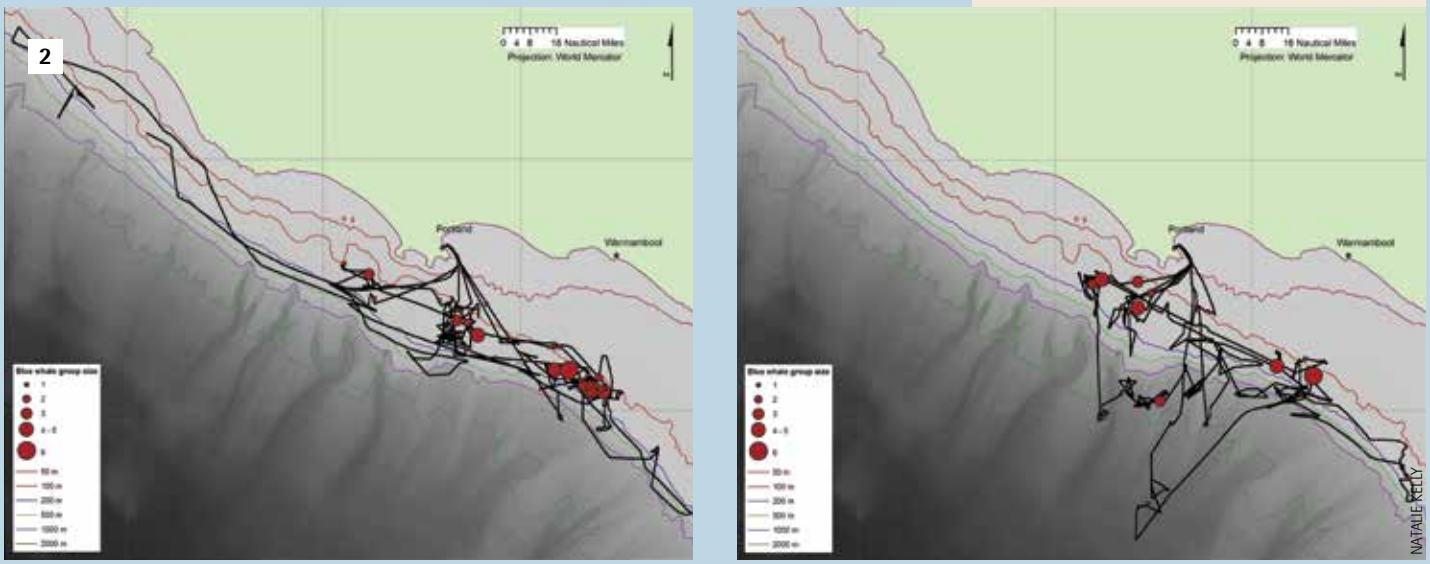


1. Scientists retrieve the prototype moored acoustic recorder, which may be used for 15 month deployments in the Southern Ocean in the future.

2. These maps show the number of blue whales sighted (red circles) and the ship's track (black line) during the January (left) and March (right) voyages off the coast of Victoria. The contour lines show different depths.

JANUARY

MARCH



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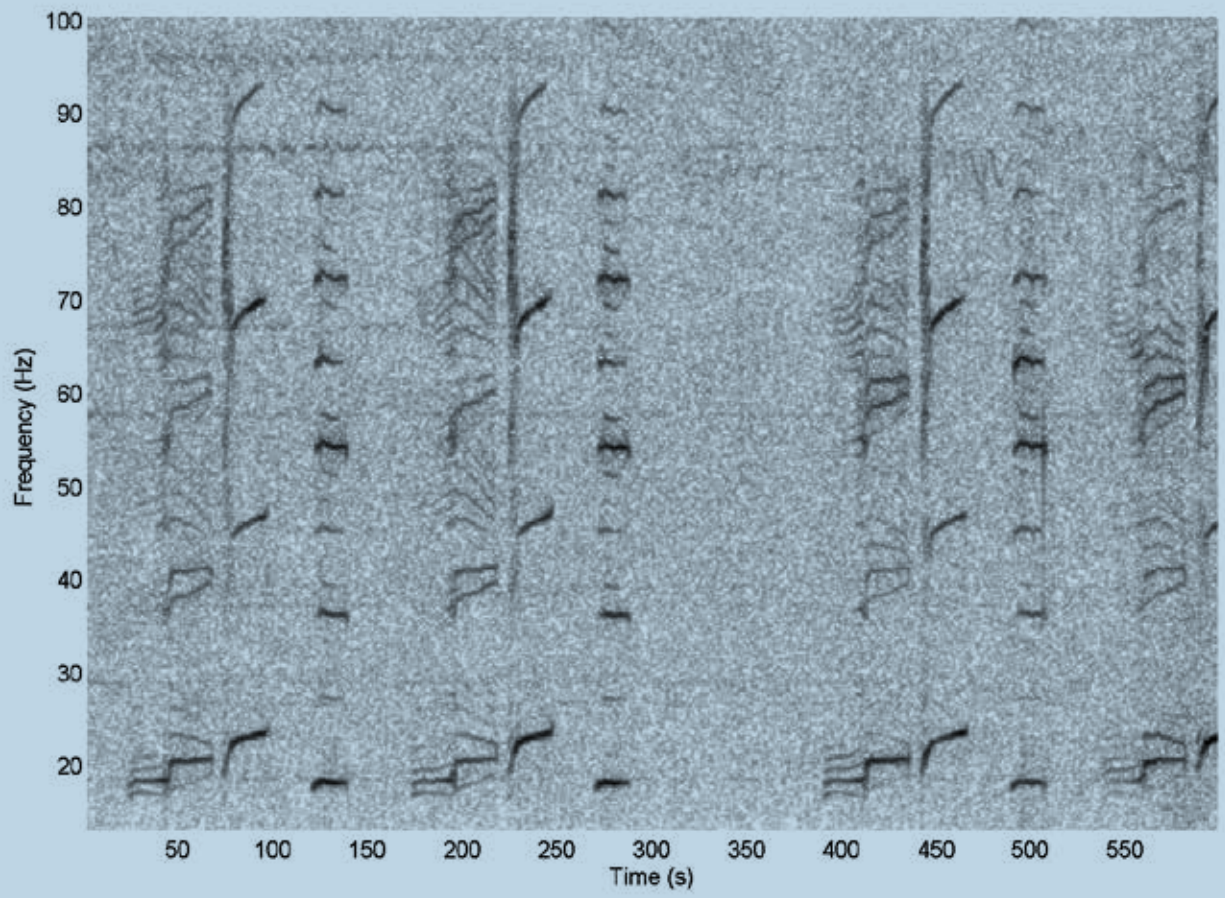


BRIAN MILLER

4

DAVID DONNELLY

3. A visual representation of blue whale song, detected by sonobuoys at frequencies between 20 and 90 Hz, showing a pattern of three repeated units, which can be sung over many hours.

4. Scientists deploy a directional sonobuoy.

'During both voyages, 32 vocalising blue whales were pursued using acoustic tracking and of these we sighted 29 groups of one or more whales – a 90 per cent success rate.

'We monitored more than 500 hours of audio in real time, yielding over 20 000 blue whales calls, and our tracking enabled 70 blue whale sightings on the first voyage and 34 on the second.'

Dr Miller says that over the continental shelf, distances to acoustically tracked whales were typically less than 20 km. However, in the deeper waters further offshore, the team successfully tracked whales over distances greater than 60 km.

'These long-distance, deep-water tracks are very important as they are most similar to the conditions we expect to encounter when tracking blue whales in the Southern Ocean around Antarctica,' Dr Miller says.

The team also trialled a prototype of a moored acoustic recorder, which remained anchored to the sea floor (at about 800 m depth) for three days. The mooring, developed and built at the Australian Antarctic Division, successfully recorded whale song during this time and, in the future, could be used for longer-term deployments of up to 15 months.

The acoustic technology and methodology will now be used on blue whales in Antarctic waters in February 2013, during the inaugural voyage of the Antarctic Blue Whale Project. This flagship project of the Southern Ocean Research Partnership aims to estimate the abundance of blue whales in the Southern Ocean, 50 years after whalers killed some 350 000 individuals, as well as examine their distribution, population structure and migration routes.

'This pilot study has given us confidence that the sonobuoys will help us to find rare blue whales in Antarctica,' Dr Double says.

WENDY PYPER
Australian Antarctic Division

1

Bugs, soils and rocks in the Prince Charles Mountains

ADRIAN CORVINO

FIONA SHANHUN

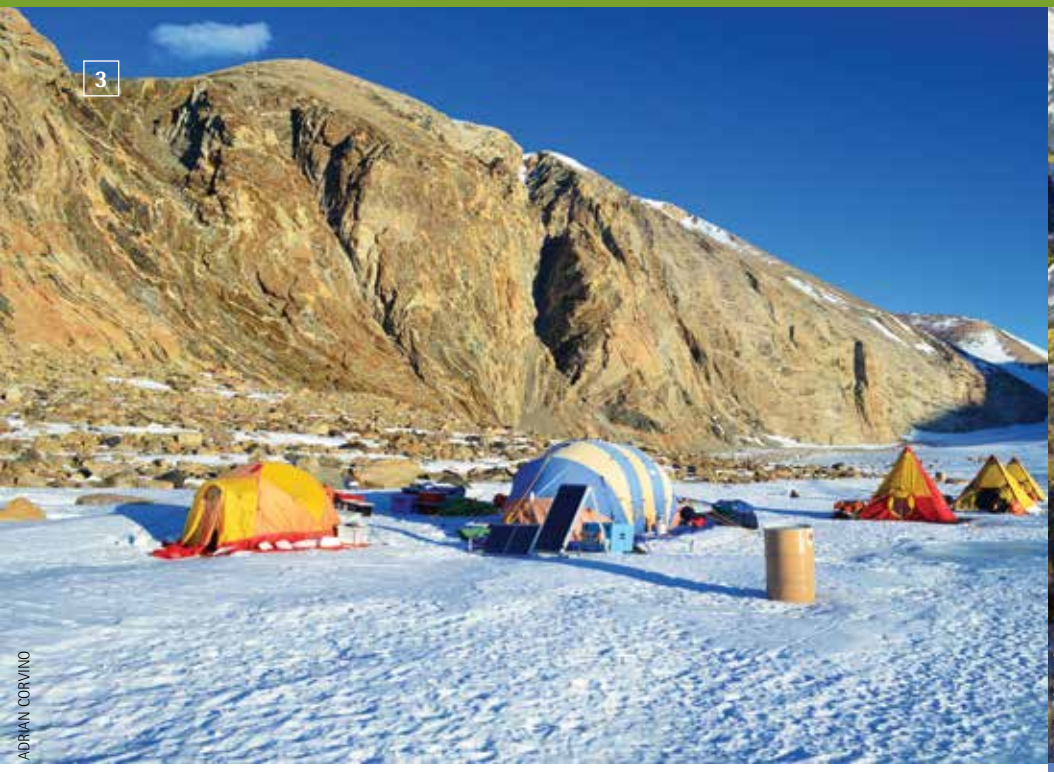
1. The South Australia Museum team at Mount Menzies. From left to right: Nick Morgan, Josh Scarrow, Paul Czechowski, Fiona Shanhun and Adrian Corvino.
2. Geologist Adrian Corvino aspirates mites from beneath a rock.

The Prince Charles Mountains are the largest chain of rocky outcrops in Australia's Antarctic Territory and extend from near the coast to over 600 km inland. At first glance, they do not appear to harbor much plant and animal life, though rare mosses, lichens, mites and tardigrades have been documented from a few locations. From a biological perspective, the Prince Charles Mountains are among the least known places of Antarctica, and there has been little study on the natural processes driving biodiversity in this region, until now.

During the 2011–12 field season our six-person research team set out on a three-month campaign to explore the biodiversity and to address fundamental biogeographic questions about life-forms eking out their existence in the mountains. We wanted to find out what types of creatures exist, and to understand the ecological, evolutionary and geological processes influencing their distribution and genetic diversity. Some of the controlling factors we considered were water and sunlight availability, temperature, soil chemistry, rock type and mineralogy, landscape age, altitude, slope angle and aspect, and latitude. Examination of these features benefited from our multidisciplinary team made up of a biologist, bacteriologist, geologist, soil scientist, geomorphologist and field training officer.

Our fieldwork focused on three primary sites: Mount Menzies in the deep south; a dry valley in the Mawson Escarpment; and Lake Terrasovje in the far north. These sites were selected because of their distinctive geomorphic and geologic features, and to provide broad geographic and environmental coverage across the mountains. To guide the biological surveys, each site was subdivided into a hundred or so polygons, or sample 'tiles', outlining as many potential habitats and landscape variations as possible. This was done using standard GIS tools and reviewing aerial and satellite images, together with topographic and geologic maps provided by the Australian Antarctic Data Centre.

The sampling strategy and methodology essentially followed that of the New Zealand Terrestrial Antarctic Biocomplexity Survey, which has been successfully underway in the McMurdo Dry Valleys since 2008. At each sampling site, geomorphic observations accompanied a visual inspection of lichens, mosses, algae and invertebrates. Air and soil temperatures



3. Campsite on the Turk Glacier, Mawson Escarpment.
4. Close up of moss *Coscinodon lawianus* growing on ground saturated with water sourced from a glacier melt stream, North Mawson Escarpment. The mossy area is home to extensive mite colonies and other micro-invertebrates living in the soil.
5. Biologist Paul Czechowski doing preliminary analyses on soil samples in the tent.

were recorded, and soil samples were taken. The soils were collected in two bags, one for geochemical work, the other for sorting out micro-invertebrates, and a small fraction was analysed back at camp to determine bacterial activity. Several types of mites found lurking amongst the moss tufts or on the underside of loose stones were captured by sucking them into vials using an aspirator. Diurnal variations in soil temperature were recorded by a series of 'iButton' thermometers which were laid out across the sampling area and left to log data for the duration of the field stay.

Our sampling activities were conducted on foot out of base camps established for weeks at a time at each of the primary sites. Each day, the group was split into teams trekking up to 15 km over moraine boulders, scree and snow, and carrying 10 to 15 kg of gear and samples per person. We experienced challenging conditions at Mount Menzies, where temperatures were regularly between -10 and -20°C, and plummeted to nearly -30°C when the mountains cast their shadows in the evening. After facing such cold temperatures, shifting camps from Mount Menzies to the Mawson Escarpment felt like moving to a tropical paradise; we gained an extra 10 degrees of warmth by dropping 1000 m in altitude (without any significant change in latitude). The discovery of other signs of visible life enjoying the warmer climate, including mites, quickly followed.

Our work was supported by a Twin Otter aircraft, which ferried people and equipment from Davis station and between camp sites. Helicopters were also available to the project for several days at a time, and were used for exploratory 'hit-and-run' sampling of many of the surrounding nunataks including Corry, Crohn, Cumpston and Fisher massifs, as well as mounts Kirkby, Loewe, Woinarski, Meredith, Lanyon and Stinear, Reinbolt Hills, and others.

Overall, more than 275 soil samples were collected from individual sites, with many of them supplemented by mites and botanical specimens. The follow-up work will involve genetic analyses and classification of the soil micro-invertebrates, and could unearth several new species. Examination of the species distributions in conjunction with the large volumes of related field data will then help address questions such as: How related are the organisms to those found elsewhere in Antarctica? What are the linkages, if any, between genetic diversity and the recent (Cenozoic) geologic evolution of the mountains? Are refugial sites present, where organisms have persisted in isolation and evolved to new species over time? What is the relative importance of changes in local climate and other abiotic factors such as landscape age and soil chemistry for influencing the distribution of plants and organisms in Antarctica?

A considerably vast and varied amount of useful fieldwork was accomplished, which for such a small team may perhaps be best attributed to their enthusiasm and the interdisciplinary approach. The success of the project would not have been possible without the planning, operations and logistic support from staff and fellow expeditioners of the Australian Antarctic program.

ADRIAN CORVINO[1], FIONA SHANHUN[1,2], PAUL CZECHOWSKI[1,3], JOSH SCARROW[1,4], TESSA WILLIAMS[1,5] and MARK STEVENS[1,3]

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2 Lincoln University, Christchurch, New Zealand
3 The University of Adelaide, Adelaide, Australia
4 The University of Waikato, Hamilton, New Zealand
5 University of Canterbury, Christchurch, New Zealand

ANTARCTIC BOTTOM WATER DISAPPEARING

New research by teams of Australian and US scientists has revealed a massive reduction in the amount of Antarctic Bottom Water found off the coast of Antarctica.

Comparing detailed measurements taken during the Australian Antarctic program's 2012 Southern Ocean marine science voyage, to historical data dating back to 1970, scientists estimate there has been as much as a 60% reduction in the volume of Antarctic Bottom Water – the cold dense water that drives global ocean currents.

In an intensive 25-day observing program in January this year, temperature and salinity samples were collected at 77 sites between Antarctica and Fremantle (Western Australia). Such ship transects provide the only means to detect changes in the deep ocean.

The new measurements suggest the densest waters in the world ocean are gradually disappearing and being replaced by less dense waters. These measurements concur with a recent study by US-based researchers which showed that Antarctic Bottom Water is contracting over much of the global ocean. The ocean profiles also show that the dense water formed around Antarctica has become less saline since 1970.

'It's a clear signal to us that the oceans are responding rapidly to variations in climate in polar regions,' Voyage Leader and voyage Chief Scientist, Dr Steve Rintoul, said.

'The sinking of dense water around Antarctica is part of a global pattern of ocean currents that has a strong influence on climate, so evidence that these waters are changing is important.'

Dr Rintoul, an oceanographer with the CSIRO and the Antarctic Climate and Ecosystems Cooperative Research Centre, led the scientific voyage from Hobart, south to Commonwealth Bay, before turning west along the Antarctic coast and returning to Fremantle. The ship visited Commonwealth Bay as part of a celebration of the centenary of Sir Douglas Mawson's Australasian Antarctic Expedition. Dr Rintoul's team had the opportunity to repeat oceanographic measurements made by Mawson's team 100 years ago, obtaining one of the few century-long records obtained anywhere in the ocean.

'Our measurements collected in 2012 are quite different to those collected by Mawson in 1912,' Dr Rintoul said.

'The water is cooler now than it was then, indicating a change in ocean currents that may be related to a reduction in the amount of dense water formed near Antarctica – as less dense water is exported, less warm water flows into the region to replace it.

'When we speak of global warming, we really mean ocean warming: more than 90% of the extra heat energy stored by the earth over the last 50 years has gone into warming up the ocean.

'The Southern Ocean is particularly important because it stores more heat and carbon dioxide released by human activities than any other region, and so helps to slow the rate of climate change. A key goal of our work is to determine if the Southern Ocean will continue to play this role in the future.'

The causes of the observed changes in the Southern Ocean are not yet fully understood. Changes in winds, sea ice, precipitation, or melt of floating glacial ice around the edge of Antarctica, may be responsible. Data collected on the latest voyage will help unravel this mystery.

A major challenge is the lack of observations at high latitude, where much of the ocean is covered by sea ice in winter. During the voyage, scientists deployed nine drifting profilers, called Argo floats, which will transmit profiles of temperature and salinity every 10 days for the next five years.

'The Argo floats have revolutionised our ability to measure the ocean, particularly in winter when ship observations are very rare,' Dr Rintoul said.

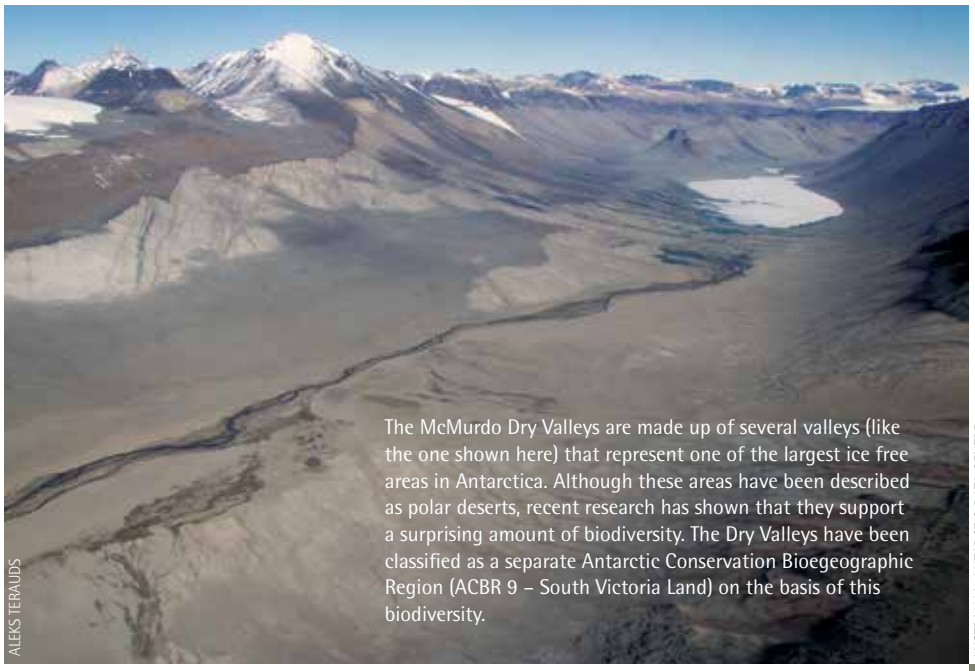
'On this voyage we deployed a new kind of float designed to survive encounters with the sea ice. These floats will allow us to see how dense water forms in winter for the first time.'

NISHA HARRIS
Australian Antarctic Division

1. Dr Steve Rintoul (front right) and other scientists take samples collected by the CTD (conductivity, temperature and depth) instrument.
2. Voyage Leader and voyage Chief Scientist Dr Steve Rintoul says there has been a massive reduction in the amount of Antarctic Bottom Water found off the coast of Antarctica.

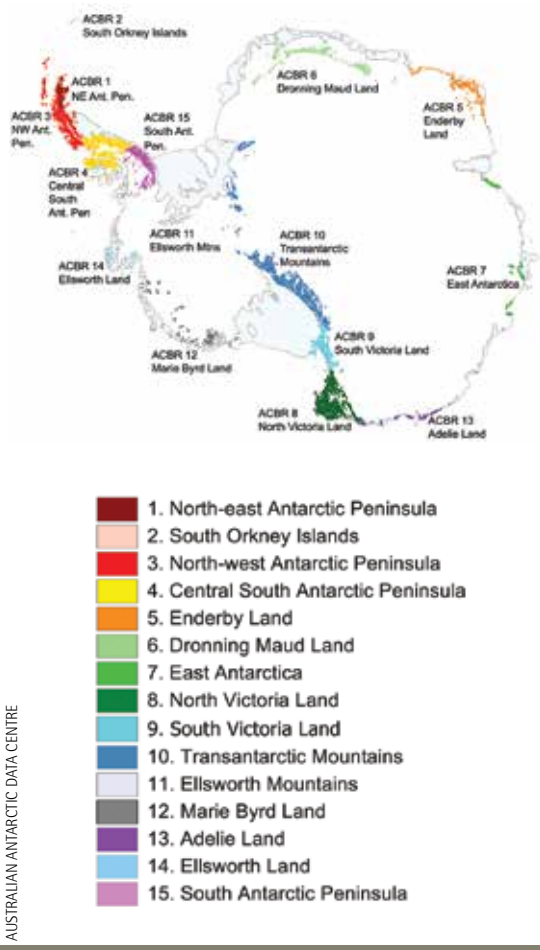
Antarctic bioregions enhance conservation planning

New research into the biogeography of Antarctica has identified 15 distinct regions on the continent and near-shore islands, which will assist future conservation planning.



ALEKS TERAUDS

The McMurdo Dry Valleys are made up of several valleys (like the one shown here) that represent one of the largest ice free areas in Antarctica. Although these areas have been described as polar deserts, recent research has shown that they support a surprising amount of biodiversity. The Dry Valleys have been classified as a separate Antarctic Conservation Bioegeographic Region (ACBR 9 – South Victoria Land) on the basis of this biodiversity.



AUSTRALIAN ANTARCTIC DATA CENTRE

The Antarctic Conservation Biogeographic Regions analysis was a collaborative effort between scientists from Australia, South Africa, New Zealand and the United Kingdom. The location of the 15 bioregions is illustrated on this map.

The study, published in the journal *Diversity and Distributions* in June, examined the geography, geology, climate, flora and fauna of the ice-free areas of Antarctica and indentified 15 biologically distinct 'Antarctic Conservation Biogeographic Regions' (ACBRs).

Australian Antarctic Division terrestrial biologist and lead author Dr Aleks Terauds, says the study was the first continent-wide assessment of the biogeography of Antarctica using all the available biodiversity data.

'In 2008 the Antarctic Treaty Consultative Meeting adopted an Environmental Domains of Antarctica analysis developed by New Zealand, which classified Antarctica into 21 regions based on the physical environment, including climate, ice cover and geology,' Dr Terauds says.

'However, the Environmental Domains of Antarctica contain no biological information, so our study developed them further by incorporating biodiversity data.'

This data included more than 38 800 records of microbes, invertebrates and plants in the ice-free areas of the Antarctic continent, Antarctic Peninsula and close-lying islands. Expert consultation also provided a consensus view for the location of biogeographic regions.

'Our analysis revealed a complex ecosystem that can be divided into 15 very distinct and potentially delicate biogeographic regions, which are characterized by different climates, landscapes and species,' Dr Terauds says.

This new perspective will improve conservation planning for Antarctica. The Antarctic Treaty System currently has a conservation framework for assigning Antarctic Specially Protected Areas, based on the Environmental Domains of Antarctica, which protects features independent of biological considerations. The study authors recommend that the new biogeographic regions be used to identify new protected areas and to manage the risk of transferring species between locations in Antarctica.

'Several distinct bioregions identified in the ACBRs are not fully represented in the current Antarctic Specially Protected Area network,' Dr Terauds says.

'Each of the ACBRs should be managed as distinct areas of conservation significance and consideration should be given to representing them by at least one, but preferably more protected areas.'

'Biosecurity measures between these ACBRs should also be developed to prevent biotic homogenization in the region.'

This is especially critical in an era of climate change and increasing human pressure on the ice-free areas of Antarctica.

'With about 40 000 people visiting Antarctica over a summer, as tourists, scientists or station support personnel, there's the potential for more species to be accidently transferred to and within Antarctica,' Dr Terauds says.

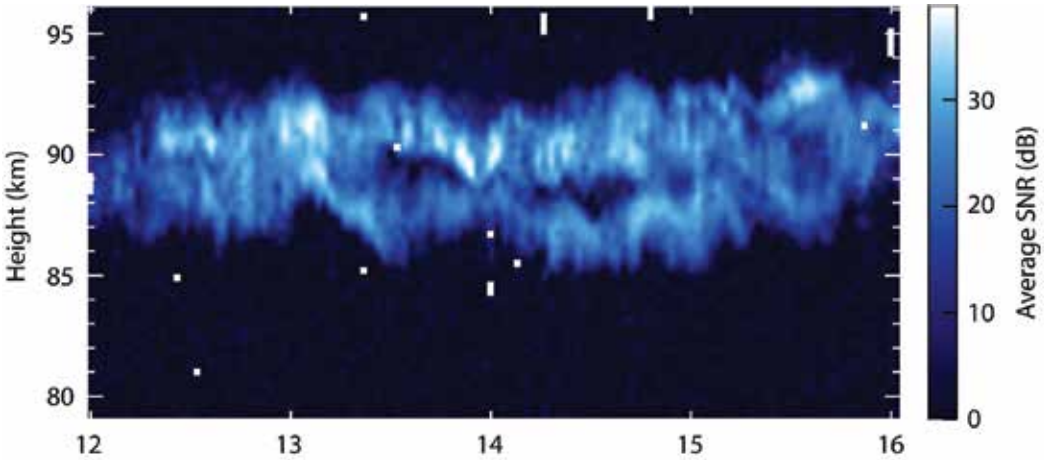
'While quarantine procedures are already in place for inter-continental travel, such as cleaning clothing and equipment before arriving in Antarctica, there are fewer biosecurity measures for intra-continental movement.

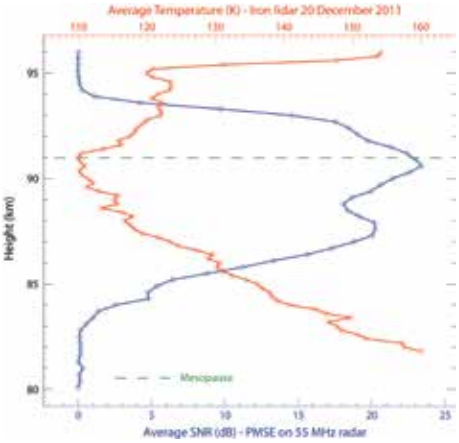
'The Antarctic Conservation Biogeographic Regions should be used in biosecurity planning to manage the risk of species, including species native to Antarctica, being transferred from one biogeographic zone to another.'

NISHA HARRIS and WENDY PYPER
Australian Antarctic Division

Antarctic ice clouds

Instruments measuring atmospheric processes and temperatures in the Antarctic atmosphere, some 80 to 100 km above the Earth's surface, have recorded some of the lowest temperatures and the highest charged ice clouds ever observed in the Earth's atmosphere.





Above: High altitude sub-visual charged ice clouds (PMSE) detected by the Australian 55 MHz atmospheric radar at Davis on 20 December 2011.

Left: A height profile plot showing mesosphere temperatures (red) reach a record low temperature of 110 Kelvin at the mesopause (green) together with PMSE (blue) which peak in strength (decibels) for temperatures less than ~140 Kelvin.

IMAGES: RAY MORRIS & DANNY RATCLIFFE

The measurements were made at Davis station between November 2010 and November 2012 using an iron resonance 'lidar' (light detection and ranging) instrument from the Leibniz-Institute of Atmospheric Physics in Germany, and the Australian Antarctic Division's atmospheric radar.

The iron resonance lidar can operate in daylight and measures, amongst other things, vertical winds and temperatures in the iron layer (approximately 80-100 km), as well as 'noctilucent' (night-shining) clouds. Noctilucent clouds appear in the summer mesosphere, near 84 km, and are visible at sub-polar latitudes when the sun sets 6 to 16 degrees below the horizon.

Noctilucent clouds, together with sub-visual Polar Mesosphere Summer Echoes (PMSE) – which are radar echoes related to charged ice-particles – can be used to detect climate change, as they are very sensitive to temperature changes. Noctilucent clouds and PMSE have been observed for more than 100 years and 30 years, respectively, in the Arctic, and since the early 1960s and 2000s, respectively, in the Antarctic. In the Arctic, these ice clouds are occurring more frequently and over a greater area than in the past, and this change is hypothesised to be linked to climate change.

To learn more about the processes involved in ice-particle cloud formation and dynamics we monitored the mesosphere over two summers with the iron lidar and radar operating at 55 MHz. The iron lidar achieved over 2700 hours of operation, providing the largest, nearly continuous mesosphere temperature record in Antarctica.

Measurements near the summer solstice (21 December) revealed extremely low temperatures, sometimes below -160°C at 90 to 98 km altitude; possibly the lowest temperature ever observed in the Earth's atmosphere, and at unexpectedly high altitudes. The radar also recorded low intensity charged ice clouds up to 94 km, which are among the highest ever recorded. Initial published results show that the Antarctic mesopause altitude changes throughout the summer season by several kilometres, which is significantly different from the Arctic. Temperatures at Davis near 86 km are similar to the northern hemisphere, but they are much colder at Davis at higher altitudes.

We found that the thermal structure around the mesopause above Davis is closely related to the general wind circulation in the stratosphere (10–50 km) and the break-down of the polar vortex (an annual stratosphere wind system that circulates around Antarctica from winter to early summer). Both the strength of the polar vortex wind flow and the timing of its annual break-down are linked to atmospheric wave activity in the southern hemisphere, which is also important for the Antarctic ozone hole.

In contrast to theoretical expectations, we occasionally find the mesopause region to be significantly higher and colder than it is in the northern hemisphere. We also find large thermal atmospheric tides in the summer months at Davis, with amplitudes of up to 6–7 degrees Kelvin, which is much larger than expected from models. These thermal atmospheric tides result from the daily variation of solar radiation heating the Earth's atmosphere. Current models predict that tides are basically absent at high altitudes in the polar summer.

Middle atmosphere processes may affect weather in the troposphere (0–10 km) and possibly long-term climate; therefore climate simulations are improved by incorporating these processes. The expansion of international weather and climate models to higher altitudes requires us to understand whole-of-atmosphere dynamics. The findings from this Australian–German collaboration will be incorporated in the Kühlungsborn Mechanistic general Circulation Model to better understand the role of mesospheric ice particles for the physics of the middle atmosphere. Australian and German scientists are currently working to explain our new and unexpected observations, which will impact our basic understanding of this part of Earth's atmosphere.

RAY MORRIS[1] and FRANZ-JOSEF LUBKEN[2]

1 Australian Antarctic Division
2 Director, Leibniz Institute of Atmospheric Physics

Federal Environment Minister, the Hon Tony Burke, opens the 35th Antarctic Treaty Consultative Meeting.

RICHARD JUPE

RICHARD JUPE

Heads of Delegations gather in front of the giant floor map of Antarctica. The map reminded delegates that the centre of attention should be on the actions to govern the region and protect its special environment.

Minister's Opening Address

Following is an excerpt from the speech given by Federal Environment Minister, the Hon Tony Burke, on the opening of the 35th Antarctic Treaty Consultative Meeting.

"... we celebrate today the 35th meeting of one of the most successful and significant Treaty organisations on our planet.

A Treaty that has dedicated that there will be one part of the world that is dedicated to wilderness, one part of the world that is dedicated to the environment, to science, to knowledge and to peaceful cooperation.

This group around this table has achieved what has not been achieved through many attempts throughout the course of human history. And the science and knowledge and the purposes of the Treaty have come under challenge at different times; no challenge more so than when decisions were so close to being made, some 20 years ago, to allow mining and exploration for minerals and resources in the Antarctic.

The Madrid protocol which followed from that, with a prohibition being placed on the mineral exploitation of the Antarctic, was in no small way led by, obviously Madrid, by the Spanish nation with the role that they had, and by Michel Rocard, and by our own Bob Hawke, who are both present in Hobart today, and I salute both of you and say you are both heroes of the Antarctic.

We know so much about our own world, about our environment because of the way the Antarctic has been preserved."

Australia hosts Antarctic Treaty meeting

In June 2012 it was Australia's turn to host the 35th Antarctic Treaty Consultative Meeting (ATCM), the annual assembly of the peak body providing for governance of the Antarctic Treaty area.

It is a rare privilege for an Antarctic Treaty Party to host the meeting. We hosted the very first Treaty meeting in 1961 and the 12th in 1983; both in Canberra. This year the meeting went to Hobart, home of the Australian Antarctic program and many other Antarctic organisations.

The venue was the Grand Chancellor Hotel, adjacent to Hobart's waterfront and in view of the Antarctic vessels *Aurora Australis* and *l'Astrolabe*, underscoring to delegates that they were meeting in Australia's 'Antarctic capital'. Well over 300 people participated. They were welcomed by the Hon Tony Burke, MP, Minister responsible for Australia's Antarctic program, who said in his opening speech that this is 'one of the most successful and significant Treaty organisations on our planet' (see side bar).

The 2012 meeting was the first time that the ATCM had been squeezed into eight working days instead of the usual 10. Two main meeting rooms were provided – the larger one for the Plenary, the Committee for Environmental Protection and the Tourism Working Group. The second room was set up for the Legal and Institutional Working Group and the working group on considering science and operational matters. Other rooms were provided to allow for 'contact groups' to meet and discuss issues informally.

The meeting rooms became a diplomatic conference centre, with country name plates and interpreters' booths. The flags of the 28 consultative parties provided a reminder that people from across the world were coming together, and a giant floor map of Antarctica reminded delegations that the centre of attention should be on the actions to govern the region and protect its special environment. By meeting's end the Parties had adopted 26 Measures, Resolutions and Decisions on a wide range of issues.

As hosts, we introduced some new technologies to improve efficiency and enhance the delegate experience. Carbon emissions were fully offset and the successful promotion of electronic access to the meeting documents reduced the paper demand by 43% from the previous ATCM.

RICHARD JUPE

Hobart's Grand Chancellor Hotel, with a view to the waterfront, was the setting for the 35th Antarctic Treaty Consultative Meeting in June.

But it wasn't all work, with delegates being treated to a reception hosted by the Governor of Tasmania and a wharf-side barbecue and tour of the *Aurora Australis*. Another reception was hosted by the Tasmanian Premier Lara Giddings, at MONA (Museum of Old and New Art) – a private museum and art gallery – accompanied by fine Tasmanian wine and food.

Detailed planning for the meeting began in 2010 with the allocation of funding in the Federal budget. Subsequently, 35 staff were engaged from the Department of Foreign Affairs and Trade, the Australian Antarctic Division and the Tasmanian Government. Host Country Secretariat staff covered the Registration and Information Desk, the preparation of meeting reports, printing, public relations and other technical services. All worked in close cooperation with the staff of the Antarctic Treaty Secretariat who came from Buenos Aires, Argentina. On top of this were the 23 translators and interpreters. Additional support came from many Antarctic Division staff, the Tasmanian Government, and staff of the Commission for the Conservation of Antarctic Marine Living Resources, who are well skilled in running similar meetings.

While hosting the ATCM in Australia brought considerable benefits to Hobart, its primary function was to facilitate good outcomes for the Antarctic Treaty system by providing an environment for consultation, cooperation and consensus – hallmarks of the Treaty system.

The Heads of the Delegations were given a copy of a book celebrating 50 years of Australian influence in the Antarctic Treaty system. The successful conclusion of the Hobart ATCM is another chapter in that story. As one member of the Host Country Secretariat team observed afterwards, this was a 'once in a lifetime opportunity' – indeed it was, and not just for the individuals involved. Another generation will pass before Australia again has the opportunity to host the meeting of Antarctica's primary governance forum.

ANDREW JACKSON
Head, Host Country Secretariat

Dr Tony Fleming (left), Director of the Australian Antarctic Division, and Dr Qu Tanzhou, Director of the Chinese Arctic and Antarctic Administration, sign a Memorandum of Understanding at the Antarctic Treaty Consultative Meeting in June 2012.

AAD

Strengthening Antarctic links

The links between the Australian, Chinese, Russian and French national Antarctic programs were strengthened in June 2012 during the 35th Antarctic Treaty Consultative Meeting held in Hobart.

Director of the Australian Antarctic Division, Dr Tony Fleming, signed a Memorandum of Understanding between the Australian Antarctic Division and the Chinese Arctic and Antarctic Administration, which was represented by its Director Dr Qu Tanzhou. Dr Fleming also signed a Schedule of Action on Antarctic Cooperation with his Russian Arctic and Antarctic Research Institute counterpart, Mr Valery Lukin.

The signing of an updated Memorandum of Agreement between the Australian Antarctic Division and the French Polar Institute Paul-Emile Victor (IPEV), updates an earlier agreement adopted in 2001 and reaffirms the close relationship between both programs. Dr Yves Frenot, Director of the IPEV, signed on behalf of the French program.

The agreements reflect the ongoing close cooperation between Russia, China, France and Australia in Antarctic logistics and environmental protection. They also facilitate further Antarctic science collaboration in areas including glaciology, ice-core science, oceanography, and studies of ice shelves.

Cooperative spirit steers Antarctic meeting

One of the features of the Antarctic Treaty Consultative Meeting (ATCM) is that decisions are taken by consensus. All the 28 Consultative Parties – the original signatories to the Antarctic Treaty – as well as those with active Antarctic science programs, work to agree on the decisions and actions that help govern and protect Antarctica as a natural reserve devoted to peace and science. This results in a truly cooperative and harmonious approach to managing the Antarctic region.

1 RICHARD JUPE

At the 35th ATCM in Hobart, decisions ranged from the 'big picture' discussions of encouraging participation in Antarctic agreements, through to practical matters of cooperation, and how the Parties organise their work. The ATCM released a communiqué at the conclusion of the meeting, summarising the key outcomes of the meeting (see http://atcm35.antarctica.gov.au/communique).

Since the last ATCM, Malaysia and Pakistan have become Parties to the Treaty - making a total of 50 Parties.

A commitment to environmental protection

Australia, France and Spain were instrumental in the decision to establish the Protocol on Environmental Protection to the Antarctic Treaty (in 1991). The Protocol provides comprehensive protection for Antarctica, prohibits mining, and established the Committee for Environmental Protection. Some of those Parties to the Treaty that do not have active Antarctic programs have not yet signed up to the Protocol, so at the 34th ATCM in 2011, Australia, France and Spain proposed a coordinated diplomatic push to encourage them to do so. This year, we reported that five states so far had decided to take this step. The importance of this work was reinforced by the Hon. Bob Hawke AC (who was Prime Minister of Australia when the decision was taken to pursue the Protocol), and the Hon Michel Rocard AC, former Prime Minister of France. The ATCM agreed on further diplomatic representations to continue this effort.

Globally significant science

Under its regular agenda, the ATCM considers scientific cooperation and major scientific activities. Russia reported on its achievement in accessing sub-glacial Lake Vostok, and the United Kingdom outlined its plans to research sub-glacial Lake Ellsworth. New science capabilities are coming on line, with India reporting on the completion of its new research station 'Bharati' (in the Larsemann Hills region of East Antarctica), while the Republic of Korea tabled its final environmental assessment for Jang Bogo research station in the Ross Sea region.

Well managed tourism

The ATCM welcomed a report from the Committee for Environmental Protection on what is known about the environmental impacts of commercial tourism activity (see page 25), and agreed with its recommendations to improve data collection and site monitoring to support tourism management decisions.

The Treaty Parties also took steps relating to two small but specialised activity sectors. Guidelines were adopted to raise awareness of the requirements for Antarctic activities among those planning yacht visits, and to give specific advice to help ensure that yacht visits are safe and environmentally sensitive. Expeditions on the continent – land (or ice) based activities – also have particular characteristics, and guidelines were agreed to assist Parties in assessing proposals for these activities.

The Parties adopted site-specific guidelines for three additional sites where tourism occurs. Existing guidelines for Aitcho Island in the Peninsula Region were also revised. Site specific guidelines are now in place for the most heavily used sites, and for those that are particularly sensitive.


2 RICHARD JUPE

1. Attending the Antarctic Treaty Consultative Meeting in Hobart were (L-R): Former Prime Minister The Hon Bob Hawke (AC), Minister for the Environment The Hon Tony Burke, ATCM 35 Chair Mr Richard Rowe, and Australian Antarctic Division Director Dr Tony Fleming.
2. Antarctic Treaty Consultative Meeting delegates worked together to address a range of Antarctic issues in Hobart this year.

Understanding and responding to climate change effects

ATCM delegates continue to work on the implications of climate change in the Antarctic context – one of the region's most pressing concerns. A key priority for Antarctic Treaty Parties is conveying information about Antarctica and Antarctic science to the international forums that deal with climate change issues. Australia led the discussion about how the Antarctic Treaty Parties can do this most effectively.

A strategic approach to work

The Meeting supported the proposal by Australia, Belgium, and many other Parties, to develop a work plan for addressing priority issues at meetings. Australia and Belgium will continue to lead this work, with Belgium hosting a workshop immediately prior to the next ATCM in Brussels. Next year's meeting will also see a focus on search and rescue issues, with a workshop on enhancing cooperation and coordination for incident response in the Antarctic region.

PHIL TRACEY
Senior Policy Officer,
Australian Antarctic Division

Continent-wide studies support Antarctic environmental protection

For several years the Committee for Environmental Protection (CEP) has focussed on the main environmental challenges facing Antarctica, under the auspices of the Madrid Protocol and its goal of maintaining Antarctica as a natural reserve devoted to peace and science.

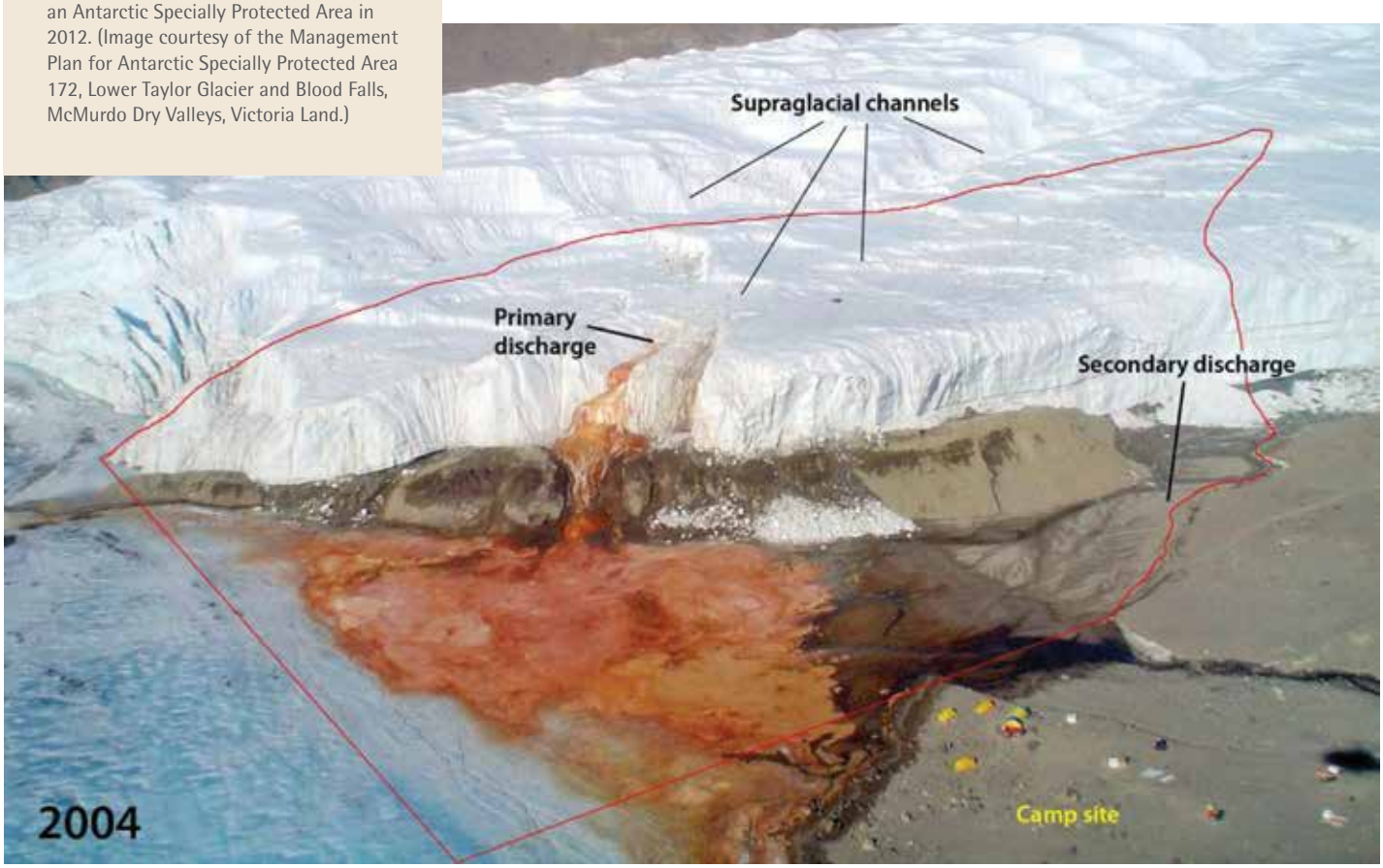
At the 35th Antarctic Treaty Consultative Meeting (ATCM) in Hobart this year, the Committee's deliberations on several of these challenges were informed by recent continent-wide studies into the state of the Antarctic environment and the effects of human activities.

Area protection

Recently published scientific research led by the Australian Antarctic Division identified 15 biologically distinct ice-free areas on the Antarctic continent and close-lying islands [see page 19]. The CEP and ATCM endorsed a proposal by Australia, New Zealand and the Scientific Committee on Antarctic Research (SCAR) to use these 'Antarctic Conservation Biogeographic Regions' to guide further development of the Antarctic protected areas system, and to identify protected areas that would be representative of major terrestrial ecosystems.

Non-native species

As Antarctica's climate warms, the human-assisted introduction of non-native species to Antarctica is an increasing concern. The Australian-led Aliens in Antarctica project (part of the International Polar Year, 2007–09) produced a continent-wide assessment of the risk of non-native species establishment, both in the present day and with predicted climate warming. The assessment will provide an essential resource for the CEP's work to develop mitigation and surveillance strategies for inclusion in its Non-Native Species Manual. The CEP also agreed that the Antarctic Conservation Biogeographic Regions provide a basis for actions to prevent species being inadvertently transported between locations in Antarctica.



An aerial view of the terminus of the Taylor Glacier in 2004, with Blood Falls at the centre. The area was designated an Antarctic Specially Protected Area in 2012. (Image courtesy of the Management Plan for Antarctic Specially Protected Area 172, Lower Taylor Glacier and Blood Falls, McMurdo Dry Valleys, Victoria Land.)

REBECCA MCWATTERS

A Clean-Up Manual will provide guidance on remediating contaminated sites in Antarctica. One technique includes the use of 'biopiles', seen here under a protective covering in the snow at Casey station, which utilise naturally occurring soil microbes to clean up fuel spills.

Tourism

In 2009 Australia joined with New Zealand and France to investigate how Antarctic tourism activities interact with the environment, with a view to better informing management practices; resulting in a CEP Tourism Study. Among other things the study presented: an overview of the status, trends and characteristics of Antarctic tourism; an assessment of the potential impacts associated with Antarctic tourism; a review of sites visited by tourists; and a review of published literature on the impacts of tourism. The study concluded that that there are few known instances of environmental impacts specific to Antarctic tourism. It recommended a number of actions to develop a more systematic approach to monitoring for possible future impacts.

Clean-up

Today, all activities in Antarctica must be planned and conducted to minimise environmental impacts, including removing waste and other materials from Antarctica, but there remains a legacy of damage from an earlier period when environmental standards were less stringent. This includes waste disposal sites on land and abandoned facilities. The Environmental Protocol requires these sites to be cleaned up, provided that doing so does not cause greater environmental harm.

The CEP supported a proposal by Australia and the United Kingdom to develop a Clean-Up Manual, containing practical guidance and resources. This draft Clean-Up Manual will be refined for adoption at the CEP meeting in Belgium in May 2013. The Australian Antarctic Division will provide guidance on a range of relevant aspects, including in situ remediation techniques, and Antarctic-specific environmental quality standards.

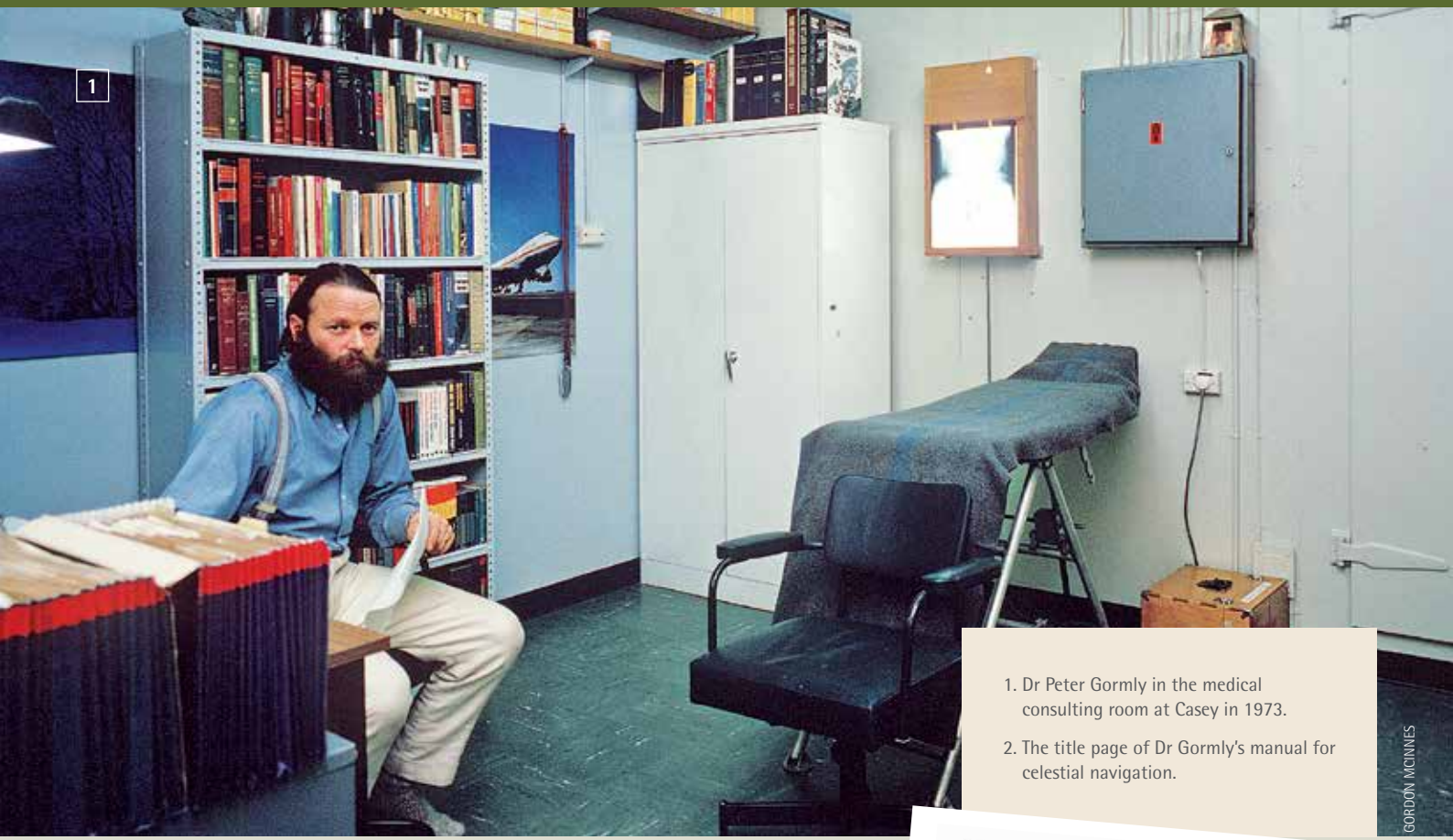
Other meeting highlights

Among other achievements the Committee:

- agreed to three new site-specific guidelines to promote safe and environmentally responsible tourist visits;
- designated a new protected area to safeguard the unique microbial community at Blood Falls in the McMurdo Dry Valleys;
- supported the concept of an online 'portal' of information on Antarctic environments, for decision-makers, scientists and the public;
- supported work to test the suitability of a system, currently being used in the Arctic, to identify ecosystems that are likely to be resilient to climate change;
- encouraged the further development of remote sensing techniques to support environmental monitoring, including to assess the environmental implications of climate change;
- supported work to develop practical guidance for protecting wilderness values.

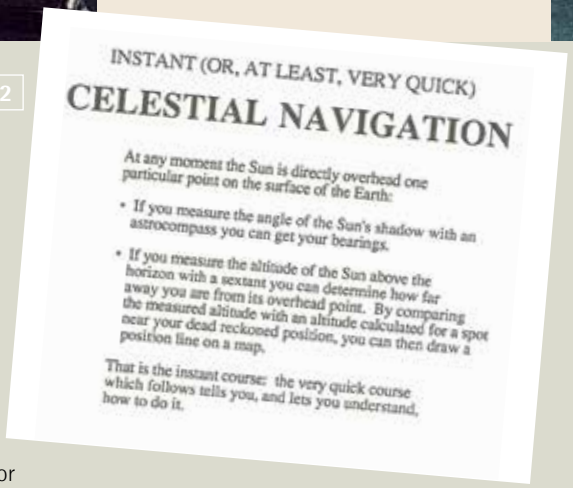
On a personal note, it was as great pleasure to welcome CEP colleagues to Hobart. It was also my fourth and final meeting as CEP Vice-Chair, which has been a very interesting and rewarding role.

EWAN McIVOR
Senior Environmental Policy Adviser, Australian Antarctic Division



1. Dr Peter Gormly in the medical consulting room at Casey in 1973.
2. The title page of Dr Gormly's manual for celestial navigation.

GORDON MCINNES



INSTANT (OR, AT LEAST, VERY QUICK)

CELESTIAL NAVIGATION

At any moment the Sun is directly overhead one particular point on the surface of the Earth:

- If you measure the angle of the Sun's shadow with an astrocompass you can get your bearings.
- If you measure the altitude of the Sun above the horizon with a sextant you can determine how far away you are from its overhead point. By comparing the measured altitude with an altitude calculated for a spot near your dead reckoned position, you can then draw a position line on a map.

That is the instant course: the very quick course which follows tells you, and lets you understand, how to do it.

VALE: Peter James Gormly
AAM, FRCS, 1937–2012

Born and educated in New Zealand, Peter Gormly remained a staunch and proud New Zealander to the end, even though he spent the majority of his life outside of his native country. One might speculate on whether this influenced such an able, educated and cultured individual to become a complex, unconventional, and memorable character.

After graduating in 1962 from the Dunedin School of Medicine at the University of Otago, Peter practised in Christchurch before travelling to the UK in 1965. Here he worked at St Thomas' Hospital London, at Uxbridge, Inverness and the Outer Hebrides, and with P&O Lines as Ship's Surgeon. He gained his surgical FRCS (Fellowship of the Royal College of Surgeons) in 1970.

In May 1972 the Australian Antarctic Division received a letter from a surgeon's wife in Inverness seeking a wintering position in Antarctica for her husband. This was considered a most unconventional application at the time but it was vintage Dr Gormly. Sir Vivian Fuchs, Director of the British Antarctic Survey, interviewed on behalf of the Antarctic Division and Peter commenced duties on 8 December, wintering at Casey in 1973. During winter he researched megadosage vitamin C, which was written up during 1974 and published in 1977.

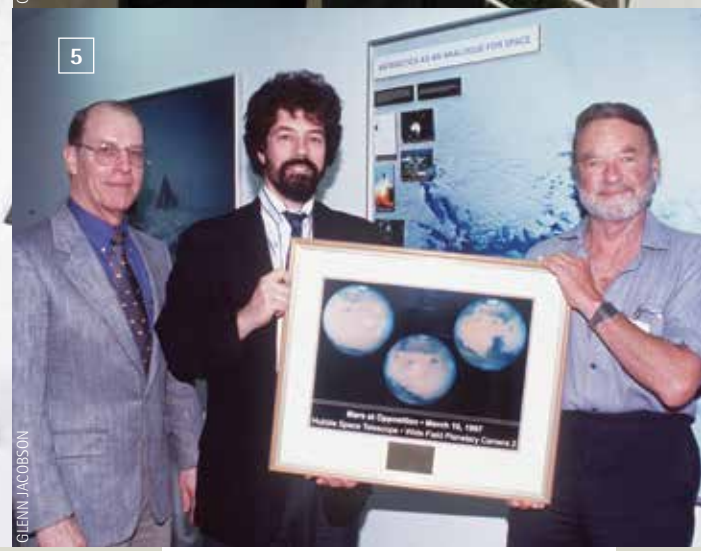
In early 1975 Peter joined Canberra Hospital as an Orthopaedic Registrar and in 1976 he held the same position at the Royal Adelaide Hospital.

Wintering again at Mawson in 1977, Peter performed further research on vitamin C and nail growth, and was especially proud of his operation on the husky 'Deefa' to remove a piece of webbing from the stomach. A photo of the operation and the piece of webbing are displayed in the medical area at Kingston to this day. Peter accompanied the summer Enderby Land Survey and following his return in March 1978 stayed on to write up his research and to produce a pocket *ANARE First Aid Manual*. Prior to this time rudimentary resuscitation notes and St John Ambulance First Aid Manuals were used. Peter was not convinced of the need for a manual but agreed to try.

It was fortuitous that Peter stayed on, as the only permanent Antarctic Division Head Office doctor was studying at the University of Cambridge for a year from September 1978, and the doctor chosen to act withdrew at short notice. Peter eagerly accepted the temporary appointment and became permanent in November 1978. He became the deputy following his colleague's return in September 1979, thus giving Polar Medicine a much needed increase in Head Office staff.


3
STEVEN BROWN


4
GLENN JACOBSON


5
GLENN JACOBSON

October saw the release of the *ANARE First Aid Manual* (30 pages) without Peter's name on it. The Second Edition of 54 pages appeared in September 1980, with his name on it and a foreword by John Masterton, who had been Medical Officer on the British North Greenland Expedition 1952–54, acknowledging Peter's efforts with 'he has done his job with skill and thankfully brevity'. Over nearly 30 years, seven editions were published, the last in 2008 of 106 pages, but still small enough to carry in the pocket in the field. The value of such a pocket manual for use in isolation has been recognized by many Antarctic medical groups and by NASA, and is a tribute to its author.

The review of pre-departure medical assessments of staff was largely performed by Dr Gormly and he created a valuable resource of epidemiological research data on pre-existing conditions and their effects on health during expeditions. Between the summers of 1978–79 and 1995–96 Peter was Medical Officer on no less than 20 voyages. He performed an appendicectomy on his last voyage.

While conducting much of the pre-departure training for both doctors and lay staff, he was renowned for his unforgettable sessions at the Bernacchi Lake Augusta Training Facility, and given the affectionate title of 'Dr Death'. He found time to train staff in celestial navigation and wrote a manual *Instant (or, at least, very quick) Celestial Navigation*. The award of an Australian Antarctic Medal on Midwinter's Day 1991 was due recognition for his efforts and proudly accepted by him. He retired in 2007.

Dr Gormly's contribution to ANARE and the Australian Antarctic program was recognized by the large number of Antarctic Division staff and ex-expeditioners who joined his family at a celebration of his life on what would have been his 75th birthday.

DESMOND LUGG[1] and JEFF AYTON[2]

[1] Head Polar Medicine, AAD 1968–2001
[2] Chief Medical Officer, AAD 2002 – present

3. Dr Peter Gormly (right) explaining human adaption to cold weather experiments to Prime Minister Malcolm Fraser (left) and Chief Scientist Pat Quilty (centre) during the opening of the Australian Antarctic Division's Kingston headquarters in 1981.
4. Australian Antarctic Division Chief Medical Officer Dr Jeff Ayton (left), and Dr Peter Gormly, at the launch of the seventh edition of the *First Aid Manual* in 2008.
5. Dr Duane Pierson, Director of Microbiology at NASA JSC (left), and Dr Marc Shepanek of the Office of the Chief Health & Medical Officer at NASA HQ, present a picture of the Mars north polar cap to Dr Peter Gormly (right) in 1998. The picture was in appreciation of Dr Gormly's efforts in collaborative research between the Antarctic Division and NASA.

Glimpses of a bygone era

1. Portrait of (L to R): Captain G.H. Wilkins, MC & bar; John King Davis, Lt. RNR; and Major Eric Webb, DSO MC, magnetic observer AAE 1911-14. (MC – Military Cross, RNR – Royal Naval Reserve, DSO – Distinguished Service Order).

The former Head of Polar Medicine at the Australian Antarctic Division, Dr Desmond Lugg, has fond memories of meeting some of the men from the Heroic Era of Antarctic exploration.

Saturday 15th March, 2013, marks the centenary of the return of the *SY Aurora* to Hobart carrying Sir Douglas Mawson's Australasian Antarctic Expedition 1911–14 (AAE) Western Base party and the majority of those who had spent the first wintering year at the Main Base at Cape Denison. During 2012, a plethora of celebrations, meetings, dinners, books (including diaries), medallions and stamps, have celebrated the expedition, each adding to the legacy of this significant event in the history of Australia's involvement in Antarctica. Personally, I am privileged to have been able to celebrate by remembering members of the AAE who entered and influenced my Antarctic life.

As a young Adelaide schoolboy with a great interest in Antarctica, I made a holiday expedition to the University of Adelaide when I heard that memorabilia of the AAE was there. Challenged at the entrance to the Geology Department by a balding man of immense stature, I stated my aims. He spent several hours showing me clothing, sleds and equipment and answering my many questions. In my naivety I did not know who the man was but told my father he was a 'kind professor'; Mawson himself.

After graduation from the same university 50 years ago, and being selected to winter with the Australian National Antarctic Research Expeditions (ANARE), I moved to Melbourne and met John King Davis, Captain of the *SY Aurora*. Upon return from Antarctica, many pleasant hours were spent with him discussing the changes between the AAE and ANARE, and his numerous Antarctic voyages. A bachelor living in a boarding house, he was always kind, generous with his time, and most informative of the expeditions he had been involved in, as well as the Heroic Age in general. He belied his Antarctic nickname of 'Gloomy'. It was a sad day when he died in 1967 at the age of 83.

As Leader of the January 1974 ANARE voyage to Casey, which visited Dumont D'Urville Station en route, I took the opportunity to visit Cape Denison, site of the AAE Main Base. Dr Phillip Law had led the last Australian visit there in 1962. Publicity about the visit resulted in contact with Eric Webb, who wintered at the Main Base, Morton Moyes from the Western Base party, who wintered on the Shackleton Ice Shelf, Lady Mawson, and numerous relatives of those who had served on AAE. In the months preceding her death in May 1974, Lady Mawson was most interested in the current state of the Main Base site.

A decade of correspondence followed and I had numerous meetings in the UK and Australia with Webb, and in Sydney with Moyes. A period in late 1977 has lasting

2. Davis in the grounds of the St Kilda Road boarding home where he spent his final years.

3. Captain John King Davis in retirement in Melbourne, 1965. Des Lugg spent 'many pleasant hours' discussing Davis's Antarctic experiences.

4. Eric Webb (1889-1984) speaking at the Australian Antarctic Division on 13 December 1977, aged 88. Eric was Chief Magnetician accompanying the Southern Sledging Party during the AAE.

memories. Webb flew to Australia to travel on a Qantas overflight of his old base. While he was in Melbourne a number of significant events took place. Jennie Boddington of the National Gallery of Victoria had organised an exhibition of Hurley and Ponting Antarctic Photographs 1910–1916, and I took Webb for a preview. As he had been close to Hurley on the AAE he took great delight in seeing the photographs, especially those that Hurley had composed of several images. Webb called them 'fakes' as the men could not have reached the positions in the photographs, but with great enthusiasm he described Hurley's technical brilliance in performing such tasks with glass photographic plates.

On visiting the Antarctic Division on December 13th, Webb agreed to my (Acting Director) request that he address the staff. The small conference room was quickly adorned with AAE photographs and memorabilia and an animated Webb held court for several hours, much to the interest and delight of staff. An ABC television interview was made at short notice for primetime viewing and it received wide public acclaim. A meeting for the first time between Webb and Dick Richards, a member of Shackleton's ill-fated Ross Sea Party who were rescued by Davis, is particularly poignant. For hours I sat in silence as these two Antarctic veterans discussed and questioned each other on their respective expeditions.

Photographic records remain, but on only one occasion did I request a recording. Webb, then an old man but as sharp as ever, was staying with my family in Cambridge, UK. After making a visit to Scott Polar Research Institute, Webb, the last survivor of the Main Base party, agreed to talk about the expedition and make comments on each of its members. He was left in a room on his own to make the recording. A completed tape was given to me. Some weeks later after he had returned to his home, a typed transcript arrived; such was his meticulous attention to detail. His final comment – 'For myself, the AAE was much the greatest character builder of my life and a most agreeable one' – is one expressed to this day by many going to Antarctica. Webb died at 94 and Moyes died at 95. I represented the Antarctic Division at Moyes' funeral service at St Andrews Church, Roseville in 1981, but was not able to attend Webb's funeral in England in 1984.

The centenary of the AAE causes one to reflect on chance meetings and enduring friendships with some of the veterans of AAE, and the influence they had on my Antarctic career and life; one that bears no comparison with the lives of these great Antarctic pioneers but was made easier by their endeavours.

DESMOND LUGG
Australian Antarctic Division
1962-64, 1968-2001

Shipwreck, loss and reunion in the Antarctic

In 1981, each member of the West German's expedition to Northern Victoria Land, Antarctica, was issued with a Swiss Army knife. A feature engraved on the knife was the name of the expedition, Ganovex II – the second German Antarctic Northern Victoria Land Expedition. The 25 expedition members were drawn from the German Geological Survey (BGR – Bundesanstalt für Geowissenschaften und Rohstoffe) and different German universities, and included me – an Australian geologist – and a fellow exchange scientist, New Zealand geophysicist Tim Stern.

1. Professor Chris Wilson using the knife on a Specialist Group of Tectonics and Structural Geology field trip at Cape Liptrap, Victoria, in February 2012.

2. The Ganovex knife returned to Chris.

3. The radio operator Werner Thonhausen of the *Gotland II* at the entrance of his emergency tent at Birthday Ridge. Werner is still updating his radio log-book and surrounded by the only possessions that he could salvage from the ship after its sinking in December 1981.

Unfortunately the expedition suffered several embarrassing setbacks, with its ice-strengthened research vessel, *Gotland II*, spending four frustrating weeks negotiating very thick pack ice on the voyage to Cape Adare. The first geological party, which included me and my new Swiss Army knife, was flown from the ship to Birthday Ridge in Yule Bay, to set up a field camp on 11 December. Subsequent inclement weather restricted flying conditions and at the same time the *Gotland II* began taking water, after being subjected to incredible pressure from moving pack ice. The ship was evacuated and eventually sank on the 18th December 1981.

This meant an end to the expedition, as little food, aviation fuel, scientific equipment and personal belongings could be rescued.

My pocket knife survived the sinking and was my constant companion in the field, until I lost it in December 1991 while conducting geological fieldwork somewhere in the southern region of the Vestfold Hills.

It was not until 2006 that a knife in near perfect condition, except for a seized blade that soon came free after cleaning, was found by a young Australian National University Research Fellow, Dan Zwartz, while setting up a permanent remote GPS installation on the Mule Peninsula, Vestfold Hills. Dan wondered who the original owner could have been, as the knife was engraved with 'Ganovex II' and 'BGR Hannover am Südpol'.

It was only after Dan moved to the Antarctic Research Centre at Victoria University of Wellington that the origin of the knife fell into place. Tim Stern, now a Professor of Geophysics at the university, filled him in on the ill-fated Ganovex II expedition and its members. They soon realised there could only be one person who would have been the original owner. This was confirmed after Dan contacted Detlef Damaske of the BGR, another member of the ill-fated expedition, and Dan was able to return the knife to me at Monash University in December 2011.

The knife, which is still in pristine condition, will remain a cherished friend after experiencing such a chequered 30-year history. It certainly reflects the quality of the Swiss knife after constant use by two geologists and being exposed to 15 years of Antarctic weather conditions.

CHRIS WILSON
School of Geosciences, Monash University

The first woman in Antarctica

1. Ingrid Christensen (left) and Mathilde Wegger, the first identified women to have seen Antarctica, on a voyage in 1931. Photo courtesy of Sandefjord Whaling Museum.
2. Jesse with 'Stay' at Bandits Hut near Davis.

Author Jesse Blackadder travelled to Antarctica on an Australian Antarctic Arts Fellowship to research her novel about the first woman to reach Antarctica.

I am standing on a rocky hill on a sunny spring day in Antarctica. It's minus four degrees with hardly any breeze – most unusual for the planet's windiest continent, and ice and snow stretch to the horizon in every direction. I am waving a 70-year-old Australian Red Ensign flag that I've unearthed from a rock cairn, and my companion is a life-sized fibreglass Guide Dog called "Stay". It's one of the more surreal moments of my Australian Antarctic Arts Fellowship, researching a novel about the first women to reach Antarctica, but it typifies several things about the extraordinary continent: history is truly alive in the moment when you are there, it helps to have an eccentric obsession if you want to visit, and if there's something you want to find again – a ship, a flag, a vehicle – it's a good idea to make sure it's red.

These are the opening words of an essay called 'The first woman and the last dog in Antarctica', which I wrote after returning from a voyage south with the Australian Antarctic Division, in November 2011. The essay explored the obsession that took me to Antarctica - tracking down the first woman to reach the continent in order to write a novel about her. The story was bigger than I first imagined, expanding to cover whales, ice, the Wall Street Crash, undiscovered lands, ancient rocks, contraception and margarine. Not to mention Seeing Eye Dogs.

I first saw a picture of Ingrid Christensen and Mathilde Wegger in the Mitchell Library in Sydney. From an old black and white photograph of two women on the deck of a ship bound for the ice, Ingrid Christensen gazed out at me, as if daring me to find out more. The photo was taken in 1931, four years before the first woman is thought to have landed on Antarctica.

Ingrid Christensen Land is the name of the region where Davis station is located. But try Googling her name and you'll find virtually nothing about Ingrid herself. As Antarctic researcher Elizabeth Chipman commented, when writing *Women on the Ice* back in the 1980s, the history of women in the far south is 'patchy'. In fact, women were actively excluded from the continent. One of the earliest examples of this was when Dr Marie Stopes (at the time a leading palaeobotanist) applied to go on Scott's *Terra Nova* expedition to look for the fossilised patterns of *Glossopteris indicia* leaf veins, to prove that Antarctica had once been part of the ancient supercontinent of Gondwana. In spite of her international standing, Scott declined to take her.

Women continued applying to expeditions through the heroic era (including to Mawson, Scott and Shackleton) and the mechanical era, with the extraordinary number of 1300 women applying to the proposed British Antarctic Expedition in 1937. None were accepted, and the fact of these applications has been largely forgotten.

Similarly, little was written about 38-year-old mother of six, Ingrid Christensen, and her four journeys to Antarctica in the 1930s, and even less about her female companions. It took longer than I expected to unearth her story. Almost as long as it took me to win the Arts Fellowship. I applied three times before getting the nod, and had a few nerve-racking hitches with the medical, so it was with great excitement that I finally boarded the *Aurora Australis* in October 2011 and set out for Davis Station.

I wasn't sure what I expected to find in Antarctica. By that stage I'd been researching Ingrid for a couple of years, and I'd already written a third of my novel based on her travels.

3. Jesse at Caroline Mikkelsen's landing site on Tryne Island.

4. Jesse takes a helicopter ride over Davis.

I had also been to the Antarctic Peninsula the year before. What would be different about travelling to Ingrid Christensen Land? As it turned out, just about everything.

The Arts Fellowship provided me with a round trip and I'm sure I'm not the only Arts Fellow who dreamt of going AWOL and spending a season on the ice. However the six-week voyage turned out to be perfect for my research. When Ingrid travelled to Antarctica four times during the 1930s, she went on the resupply vessel for her husband's deep sea whaling fleet. Their point of departure was Cape Town and they travelled with fuel, food and supplies for the four factory ships and fleet of catchers working in East Antarctica. The voyage took about six weeks. Sound familiar? Not unlike today's station resupply voyages.

I had many of the jigsaw pieces of my research assembled. But it wasn't till I was in Antarctica that I realised being there wasn't about writing better descriptions of ice. (Possibly the opposite is true – although my descriptions of seasickness now have the ring of authenticity.) It was about comprehending the story of these women's journeys in the physical landscape in which they took place.

Once the ship arrived at Davis station the Antarctic Division turned on the red carpet treatment, sending me out on a three day escorted field trip to explore the surrounds of the station, including the flagpole marking Caroline Mikkelsen's landing place. Caroline is widely believed to be the first woman on Antarctica. But work by polar researcher Ian Norman and his colleagues, published in *Polar Record* in 1998 and 2002, suggested otherwise. And it was there, on a rocky hillside in the middle of an Adélie penguin rookery, with Caroline's flagpole standing tantalisingly out of reach in the nesting area, the jigsaw pieces came together.

On the way home in the *Aurora Australis*, I set myself up in a laboratory and wrote like a demon. As on the way down, writing proved a great antidote to seasickness and I hope it infused my novel with the real experience of a voyage to Antarctica. I have since finished the book, which is called *Chasing the light*.

I came back from the fellowship with an unexpected gift. I spent three days with 'Stay' (a fibreglass Guide Dog) on our field trip, and it seemed fitting that a female Guide Dog accompanied me as I followed the nearly invisible traces of the first women to reach Antarctica. However Stay wasn't content to play second fiddle, and wanted to star in her own book, so I have also written a children's novel about the last dog in Antarctica, featuring Stay.

JESSE BLACKADDER

Jesse's novel about Ingrid Christensen, *Chasing the light*, will be published in February 2013 by Harper Collins and *Stay: the last dog in Antarctica*, a novel for children 8-11, will be published by ABC Books in July 2013. Jesse won the 2012 Guy Morrison Prize for Literary Journalism for her essay 'The first woman and the last dog in Antarctica'. Her feature on early women travellers to Antarctica will appear in *Australian Geographic* in March 2013.

ANTARCTIC MEDAL AWARDS

Four people were awarded the Antarctic Medal this year for outstanding service to the Australian Antarctic program

Oceanographer Dr Steve Rintoul, medical practitioner Dr James Doube, and the late meteorologist Dr Neil Adams, each received an Antarctic Medal, while seabird ecologist Dr Graham Robertson received a clasp to the Antarctic Medal.


CSIRO


AAD

Dr Steve Rintoul

Oceanographer, Dr Steve Rintoul, received his award for leadership and his outstanding contribution to science and Australia's Antarctic program. He has undertaken 15 marine science voyages, 12 as Chief Scientist, and has spent more than 13 months in the Southern Ocean.

His major research focus has been to develop a new concept of the dynamics of the Southern Ocean in which three-dimensional ocean circulation, such as eddy fluxes, wind forcing and topographic interactions, are intimately linked.

'Dr Rintoul's work has shown that deep Antarctic water is becoming fresher and warmer at a much higher rate than previously thought – an observation of crucial importance for future climate predictions,' Federal Environment Minister Tony Burke said.

This year Dr Rintoul was also awarded the prestigious Martha T. Muse Prize for Science and Policy in Antarctica (http://www.museprize.org/news.html) – a prize awarded to an individual who has demonstrated potential for sustained and significant contributions that will enhance the understanding and/or preservation of Antarctica.

In 2005 Dr Rintoul was the inaugural winner of the Georg Wüst medal by the German Society of Marine Research. He was elected a Fellow of the Academy of Science in 2006 and appointed a CSIRO Fellow in 2007 – CSIRO's highest accolade for science excellence. He is a program leader at the Antarctic Climate and Ecosystems Cooperative Research Centre and co-Chair of the new Southern Ocean Observing System, on behalf of the Scientific Committee on Antarctic Research. Much of his work feeds into the Intergovernmental Panel on Climate Change reports, the latest of which will be published in 2013.

Dr James Doube

Medical practitioner Dr James Doube received his Antarctic Medal for outstanding service to Antarctic expeditions to Macquarie Island between 2006 and 2012.

Dr Doube commenced his service with the Australian Antarctic Division as a registrar and completed his Fellowship of the Australian College of Rural and Remote Medicine with advanced skills in General Practice Surgery.

As well as his medical responsibilities, Dr Doube took the role of Field Training Officer and led Search and Rescue teams on Macquarie Island. He was extensively involved in boat operations, commanding both inflatable craft and amphibious LARCs, all of which require enhanced ability in the Macquarie Island environment. He also contributed substantially to seal, seabird and botanical research, in which his former qualifications in biology proved valuable.

Dr Doube also made a significant contribution to the success of the Macquarie Island Pest Eradication Program. This ranged from conducting bait trials and developing methods using thermal imaging equipment to count rabbit populations, to planning and operational strategy, and developing emergency response capacity in the challenging environment.

'Dr Doube is a multi-skilled expeditioner whose enthusiasm and abilities embraced all aspects of ship and station life and he substantially contributed, both as an individual and team member, to the success of each voyage and expedition in which he was involved,' Federal Environment Minister Tony Burke said.

'As well as his skills in generalist medicine, expedition medicine, public health and occupational medicine, he has honed his skills in biology and science, communications, media, search and rescue and field support. Dr Doube is an inspiration to other doctors practicing remote medicine.'

Dr Neil Adams

The late Dr Neil Adams received a posthumous Antarctic Medal for the development of the science of Antarctic meteorology. His exceptional abilities as a forecaster contributed immensely to the achievement of Australia's Antarctic scientific programs for three decades.

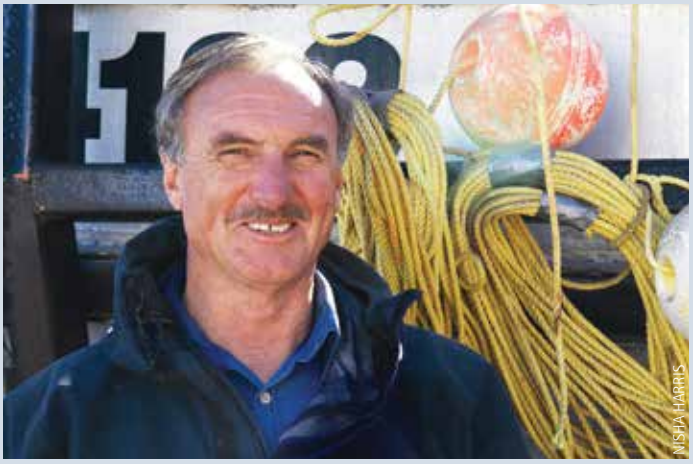
Dr Adams was the Manager of the Bureau of Meteorology's Antarctic Meteorological Section, based in Tasmania, and he spent three decades supporting Australia's Antarctic program, including three summers and one winter in Antarctica. He was responsible for the development and implementation of polar research and services, as well as the operational use of polar observations.

Federal Environment Minister Tony Burke said the observation and forecasting infrastructure which underpins the Bureau's Antarctic forecasting service is testimony to Dr Adams' work.

'The polar Numerical Weather Prediction (NWP) suite; the observational data and NWP model output viewing system; the Australian Antarctic Division's aviation-based Automatic Weather Station network; and the Bureau's satellite facilities in Antarctica: these have all greatly benefited from his insightful contributions and hands-on input,' Mr Burke said.

Dr Adams made, and his Antarctic meteorological team continue to make, an enormous impact on the work of the Australian Antarctic Division. Dr Adams was the lynchpin of the familiar relationship between the Division and the Bureau of Meteorology, which is crucial to the operations of the Antarctic Division. The Bureau's forecasts support the Division's station, traverse, shipping, flights and deep field activities, while contributing to the safety of personnel and infrastructure.

Dr Adams passed away in March 2012.



Dr Graham Robertson

Dr Robertson received his first Antarctic Medal in 1989 for his contribution to the scientific knowledge of emperor penguins. The previous year he had spent much of the winter living in a remote field hut studying the emperor penguins at Auster Rookery, near Mawson. In the summer of 1988–89 he spent a further three months in the field studying the Taylor Glacier emperor penguin rookery.

Dr Robertson's second medal recognises his research on ways to reduce seabird bycatch in longline fisheries, including developing an underwater bait setting machine.

Since 1989 Dr Robertson has spent several years conducting research related to seabird bycatch in fisheries controlled by the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). This work includes:

Research to understand the 'mechanics' of setting and hauling fishing lines (for example, the effects of prop wash and turbulence, how weighted lines behave under water, and measuring line sink rates), as well as studying how different fishers behave and the consequences of both the mechanical and the human factors on fishing practices.

Designing, developing and testing innovative mitigation measures to reduce seabird bycatch.

Developing observation protocols for fisheries observers to gather data on fishing practices and gears, and the impacts on seabirds.

Federal Environment Minister Tony Burke said Dr Robertson is an influential force in domestic and international scientific forums, including CCAMLR.

'He has the rare ability to work collaboratively with a wide variety of people from different cultures and has successfully bridged the gap between, science, conservation and industry to help reduce the number of seabirds dying on our oceans,' Mr Burke said.

CORPORATE COMMUNICATIONS
Australian Antarctic Division


RICHARD JUPE

Australian Antarctic Division Director Tony Fleming presents Prince Charles (left) with a photograph, taken by Nick Morgan, of the Prince Charles Mountains, while Antarctic Division Chief Scientist Nick Gales (centre) and ice core scientist Tessa Vance look on.

Royal visit

His Royal Highness The Prince of Wales learned more about Australia's Antarctic science program and Tasmania's role as an Antarctic research hub during a visit to Hobart in November.

The Prince and Her Royal Highness the Duchess of Cornwall were in Tasmania as part of a week-long Australian leg of the Queen's Diamond Jubilee tour.

Scientists from the Australian Antarctic Division, Antarctic Climate and Ecosystems Cooperative Research Centre, the Institute of Marine and Antarctic Studies, the Commission for the Conservation of Antarctic Marine Living Resources and CSIRO spoke about Australia's current Antarctic and Southern Ocean climate research and ecosystems management.

To commemorate his visit the Prince was presented with a framed photograph of the Prince Charles Mountains in East Antarctica, taken by Nick Morgan.

East Antarctic Marine Protected Areas

A Special Meeting of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and its Science Committee has been scheduled for mid-2013 to progress the establishment in Antarctica of one of the world's largest networks of Marine Protected Areas (MPAs).

Australia, France and the European Union jointly proposed to the 25 Member Commission the establishment of a network of seven MPAs in the East Antarctic region with a total area of 1.9 million square kilometres.

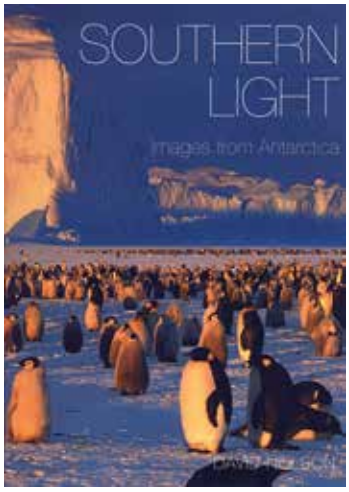
The Head of the Australian delegation to CCAMLR and the Director of the Australian Antarctic Division, Dr Tony Fleming, said despite strong advocacy by Australia and other MPA proponents at the annual CCAMLR meeting in Hobart in November, a few CCAMLR members wanted more time to consider the proposal.

'CCAMLR committed itself to adopting a representative system of MPAs by 2012 in accordance with the goal set by World Summit on Sustainable Development, but members were unable to reach agreement at the annual meeting,' Dr Fleming said.

'However, it is encouraging that members have committed to holding a Special Meeting in Germany in 2013 to press forward with consideration of the proposals. It's only the second time CCAMLR has held a Special Meeting of this type and we remain optimistic about the prospects for the MPAs.'

Also at the annual meeting, CCAMLR adopted a compliance evaluation procedure for fishing vessels operating in the CCAMLR area. This procedure provides a formal mechanism for assessing fishing vessel compliance with CCAMLR's Conservation Measures.

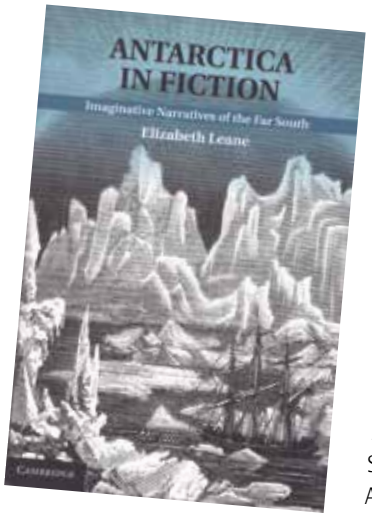
'This is a great outcome and the culmination of years of work by Australia and other nations to strengthen the compliance framework for vessels that fish in waters covered by the CCAMLR Convention. It is an important addition to the suite of measures CCAMLR has in place to manage fishing operations in Antarctic waters,' Dr Fleming said.



Southern Light: Images from Antarctica

Melbourne photographer David Neilson travelled to Antarctica with the Australian Antarctic Division in 1990 and 2004, through the Humanities and Australian Antarctic Arts Fellowship programs, respectively. These fellowships enabled him to spend two summers based at Mawson station, taking photographs of the wildlife around the coast, at the Auster emperor penguin colony, the Framnes Mountains, the Prince Charles Mountains and the Vestfold Hills near Davis station. Photographs from these two trips are included in his new book *Southern Light: Images from Antarctica*. As well as East Antarctica, the book includes photos from a trip to the Ross Sea area and from three sailing trips to South Georgia and the Antarctic Peninsula. There are 130 colour images, 100 black and white images reproduced in duotone, five maps of the regions photographed, and essays on climate change and protecting the Antarctic environment. The stunning 306 page coffee table book is available from Snowgum Press (http://www.snowgumpress.com.au/) and local bookshops.

Antarctica in Fiction

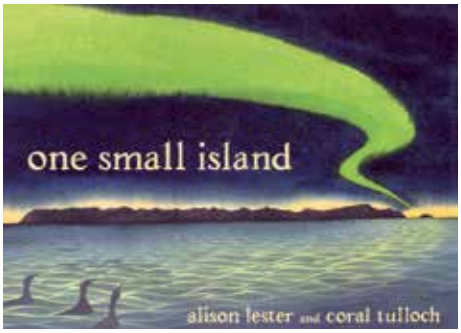


Antarctica has inspired a rich body of writing over the past 300 years, including from novelists such as Edgar Allan Poe and Jules Verne, from the Mills and Boon romance stables, and from writers of espionage thrillers and horror-fantasies. Elizabeth Leane, a senior lecturer in English literature at the University of Tasmania and a former Australian Antarctic Arts Fellow, has written a comprehensive analysis of these literary responses to Antarctica in *Antarctica in Fiction: Imaginative Narratives of the Far South*. Her book maps Antarctica as a space of the imagination and argues that only by engaging with this space, as well as the physical continent, can we understand current attitudes towards Antarctica. The 250 page book contains notes to each chapter and an extensive bibliography of Antarctic literature. It is available from Cambridge University Press http://www.cambridge.org/aus/catalogue/catalogue.asp?isbn=9781107020825.

An Awfully Beautiful Place

Former Australian Antarctic Arts Fellow Stephen Eastaugh, this year held exhibitions of his work in Hobart, Melbourne and China. *An Awfully Beautiful Place: The Antarctic Art of Stephen Eastaugh*, spanned 10 years of Stephen's work in and about Antarctica. Stephen spent 18 months on the ice, including a year at Mawson station (2009) and a summer at Davis (2002–03), and has made nine voyages across the Southern Ocean. His finished works are rendered in acrylic, cotton, linen, wool, thread and bandage, and include massive landscape-based wall hangings, cartographic pattern works and tiny 'Travailogue'pieces. For more information about Stephen and his art visit http://www.stepheneastaugh.com.au/.

Detail: Nunatack studies 2 (Antarctica), 2009. Acrylic, thread, linen, 40x40 cm. Stephen Eastaugh.



Literature awards for One Small Island

Former Australian Antarctic Arts Fellows, Alison Lester and Coral Tulloch, have won a swag of awards for their non-fiction picture book about Macquarie Island. *One Small Island* tells the story of the natural and human history of the island and is illustrated with Alison's landscape paintings and Coral's detailed artwork and calligraphy (*Australian Antarctic Magazine* 21: 35, 2011). The book won the 2012 Wilderness Society's Environment Award for Children's Literature, the Children's Book Council of Australia Information Book of the year (2012) and was a 'Notable Book' in the picture book section of the Children's Book Council awards. The book has been re-printed and includes a post script updating readers on the success of the pest eradication program on the island.

Queen's Birthday Honours

Former Australian Antarctic Division Director Lyn Maddock received a Member of the Order of Australia (AM) in the General Division in this year's Queen's Birthday Honours List. Lyn received her award 'For service to public administration, particularly in the area of Australia's Antarctic operations, to the development of natural resources and environmental protection strategies, and to scientific research'.

Station Leaders 2013

The Antarctic and Macquarie Island Station Leaders for 2013 have been selected. Bill De Bruyn returns to Davis for the summer, while Jason Ahrens will take over for the winter. Allan Cooney will be based at Casey and Graham Cook returns to Mawson. Mark Gasson will winter on Macquarie Island. For more information about our Station Leaders visit the Antarctic Division website at http://www.antarctica.gov.au/media/news/2012/2012-13-antarctic-station-leaders.


RICK VAN DEN ENDEN

FREEZE FRAME

Aaron Spurr first summered at Mawson station in 1996-97 and then at Davis in 2009-10. He has also participated in the Australian Antarctic program as Deputy Voyage Leader on three voyages, and as the Australian Antarctic Division's Senior Gear Officer on many marine science voyages.

This photo was taken late in the day against the setting sun during the Sea Ice Physics and Ecosystem eXperiment-II (SIPEX-II) voyage this year. Silhouettes of people have always intrigued me and working on the sea ice adds an extra dimension. To me, this photo of Ernesto Trujillo-Gomez carrying part of the radiometer mast back to the ship, captures the essence of sea ice research, as many hours of manual work is needed to obtain the data.

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